AQA A-LEVEL · 7402

BIOLOGY



MARK SCHEME

3.2.3 TRANSPORT ACROSS CELL MEMBRANES

SCORE	PERCENTAGE
/826	%

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Q1.

(a) (a monomer is a smaller / repeating) unit / molecule from which larger molecules / polymers are made;

Reject atoms / elements / 'building blocks' for units / molecules

Ignore examples

1

(b) **Similarity**

1. Both contain galactose / a glycosidic bond;

Ignore references to hydrolysis and / or condensation

Difference

2. Lactulose contains fructose, whereas lactose contains glucose;

Ignore alpha / beta prefix for glucose

Difference must be stated, not implied

2

(c) 1. (Lactulose) lowers the water potential of faeces / intestine / contents of the intestine;

Accept Ψ for water potential

2. Water retained / enters (due to osmosis) **and** softens the faeces;

Accept descriptions of soft faeces, eg faeces is less dry / less hard

2

(d) (-) 84.1(%);;

Accept (-) 84.15(%)

Allow 1 mark for

84

OR

$$\frac{2.82 \times 10^{-7} - 4.47 \times 10^{-8}}{2.82 \times 10^{-7}}$$

OR

$$\frac{2.37 \times 10^{-7}}{2.82 \times 10^{-7}}$$

2

[7]

Q2.

(a) 1. (Movement) down a gradient / from high concentration to low concentration;

Ignore along / across gradient

Reject movement from gradient to gradient

2. Passive / not active processes;
OR
Do not use energy **from** respiration / **from** ATP / **from** metabolism;

OR
Use energy **from** the solution;
Reject do not use energy unqualified

2

(b) 1. Movement through carrier proteins;
OR
Facilitated diffusion;
Between A and B
Accept MP1 in either section
Ignore co-transport / active transport
Accept channel proteins

2. Rate of uptake proportional to (external) concentration;
Between C and D
Accept description of proportional

3. All channel / carrier proteins in use / saturated / limiting;
Accept used up
Accept transport proteins

3

(c) 1. Rate of uptake is proportional / does not level off (so diffusion occurring);
Accept as one increases the other increases

2. (Lipid-soluble molecules) diffuse through / are soluble in phospholipid (bilayer);

2

[7]

Q3.

(a) 1. The (individual) chromosomes are visible because they have condensed;
Both parts of each answer are required – evidence and explanation.
For 'they' accept 'chromosomes/chromatin/DNA'
Accept 'tightly coiled' or 'short and thick' for condensed but do not accept 'contracted'.
Ignore references to nucleus/nucleolus/nuclear membrane.

2. (Each) chromosome is made up of two chromatids because DNA has replicated;
Both parts of each answer are required – evidence and explanation.
Accept 'sister chromatids' for 'two chromatids'.
Ignore references to nucleus/nucleolus/nuclear membrane.

3. The chromosomes are not arranged in homologous pairs, which they would be if it was meiosis;
Both parts of each answer are required – evidence and explanation.
Accept not meiosis because bivalents/chiasmata/crossing over not seen.
Ignore references to nucleus/nucleolus/nuclear membrane.

2 max

(b) Automarked q – ✔ prophase

1

(c) 1. Water moves into the cells/cytoplasm by <u>osmosis</u>;

Reject water moving into chromosomes/nucleus.

2. Cell/cytoplasm gets bigger;

Accept idea of cell/cytoplasm has greater volume/swells/expands.

Ignore references to pressure changes, turgidity and chromosomes being more dilute.

Ignore references to changing water/fluid contents of the cell.

Allow ECF for 'nucleus expands' but not for 'chromosomes expand'.

2

(d) Differences in base sequences

OR

Differences in histones/interaction with histones

OR

Differences in condensation/(super)coiling;

Answer must be in context of differences in arrangement of chromosomes not just related to the properties of the stain.

Accept spec section 8 ideas e.g. different methylation/acetylation

Accept different genes

Reject different alleles

1

(e) (Two chromosomes that) carry the same gene<u>s</u>;

Reject 'same alleles'

Accept 'same loci' (plural) or 'gene<u>s</u> for the same characteristics'

1

(f) (Prokaryotic DNA) is

1. Circular (as opposed to linear);

2. Not associated with proteins/histones ;

3. Only one molecule/piece of DNA
OR
present as plasmids;

Max 1 if prokaryotic DNA only found as plasmids OR if prokaryotic DNA is single stranded.

Ignore references to nucleus, exons, introns or length of DNA. Do not credit converse statements.

Ignore descriptions of eukaryotic DNA alone.

2 max

[9]

Q4.

(a) 1. Method to ensure all cut surfaces of the eight cubes are exposed to the sucrose solution;

Credit valid method descriptions to fulfil mp1, 2 and 3 (no explanation is required).

2. Method of controlling temperature;

Accept 'at room temperature' for method

3. Method of drying cubes before measuring;

4. Measure mass of cubes at stated time intervals;

Accept time intervals between every 5 minutes with maximum of every 40 minutes.

Accept 'weigh the cubes at stated time intervals'

3 max

(b) Yes or No (no mark)

Calculation of rate per mm^2 for both sets of data, accept answers in the range
1.6×10^{-5} to 1.8×10^{-5} **and**
1.5×10^{-5} to 1.6×10^{-5};;; Both correct = 3

One correct = 2

Neither correct – look below for max 2

Allow 1 mark for calculation of surface area of two (sets of) cubes 7350 (mm^2) and 14700 (mm^2)

Allow 1 mark for calculation of both rates of osmosis shown in first 40 minutes – between 0.12 and 0.13 **and** between 0.22 and 0.23

If surface area and/or rate of osmosis is incorrect then, allow 1 mark for (their) calculated rate divided by (their) calculated surface area

Accept answers not given in standard form or to any number of significant figures ≥2sf as long as rounding correct.

3 max

[6]

Q5.

(a) Diffusion

Automarker

1

(b) 1. **Droplets** increase surface areas (for lipase / enzyme action);
2. (So) faster hydrolysis / digestion (of triglycerides / lipids);
3. **Micelles** carry fatty acids and glycerol / monoglycerides to / through membrane / to (intestinal epithelial) cell;

1. Context is important

1. Reject micelles increase surface area

2. Ignore 'breakdown'

3. Ignore 'small enough'

3. Accept description of membrane

3. Reject any movement through membrane proteins

3

(c) 1. Golgi (apparatus);
2. Modifies / processes triglycerides;
3. Combines triglycerides with proteins;
4. Packaged for release / exocytosis
OR
Forms vesicles;

Ignore 'processes and packages' unqualified

2. Reject synthesises triglycerides

3. Accept 'forms / are lipoproteins'

4

[8]

Q6.

(a) Accept any three suitable properties e.g.:
- Is a metabolite
- Is a solvent
- Has a (relatively) **high** heat capacity
- Has a (relatively) **large** latent heat of vaporisation / evaporation
- Has cohesion / hydrogen bonds between molecules;

No explanations are needed

However do not accept 'polar' unqualified

3 max

(b) Dilution series;

Accept serial dilution

1

(c) 1. Axes correct way round with linear scales;
2. Axes labelled with mol dm^{-3} and ratio without units;
3. Correct values correctly plotted and suitable curve drawn;

3. Accept point to point or smooth curve but no extrapolation

***NFP** – 3. Graph starts just below 1.4 and finishes just above 0.7 and looks right.*

3

(d) 1. (0.8 mol dm^{-3} sucrose) solution has a more negative / lower water potential than potato (cytoplasm);
OR
potato (cytoplasm) has a less negative / higher water potential than (0.8 mol dm^{-3} sucrose) solution;
2. (therefore) water moves out (of potato) into the (sucrose) solution by osmosis (so cells decrease in mass);

1. Accept sucrose solution is hypertonic / potato cytoplasm is hypotonic

*2. Accept water moves **down** a water potential gradient*

2

[9]

Q7.

(a) 1. (If) too much water the concentration of pigment (in solution) will be lower / solution will appear lighter / more light passes through (than expected);
OR
(If) too little water the concentration of pigment (in solution) will be greater / solution will appear darker / less light passes through (than expected);
2. So results (from different temperatures) are comparable;
1. Ignore reference to too much water so red pigment / solution too weak to measure

2

(b) (Take) reading**s** (during the experiment) using a (digital) thermometer / temperature sensor;

1

(c) Point-to-point line drawn between co-ordinates (with a ruler);
OR
Smooth s-shaped line of best fit;
Reject any extrapolations below 20 °C or above 80 °C
Any line should look smooth (not 'sketchy')

1

(d) 1. Damage to (cell surface) membrane;
2. (membrane) proteins denature;
3. Increased fluidity / damage to the phospholipid bilayer;

2 max

[6]

Q8.

(a) 1. Polysaccharide of α-glucose;
OR
polymer of α-glucose;
2. (Joined by) glycosidic bonds
OR
Branched structure;

2

(b) 1. Hydrolysed (to glucose);
2. Glucose used in respiration;
1. Ignore 'Broken down'
2. 'Energy produced' disqualifies mp2

2

(c) 1. Membrane folded **so** increased / large surface area;
OR
Membrane has increased / large surface area **for** (fast) diffusion / facilitated diffusion / active transport / co-transport;
2. Large number of protein channels / carriers (in membrane) **for** facilitated diffusion;
3. Large number of protein carriers (in membrane) **for** active transport;
4. Large number of protein (channels / carriers in membrane) **for** co-transport;

1. Accept 'microvilli to increase surface area'

1. Reject reference to villi.

Note feature and function required for each marking point and reference to large / many / more.

List rule applies.

2 max

(d) 3.3×10^{-5} **OR** 3.28×10^{-5} **OR** 3.281×10^{-5};
1 mark for
Evidence of 128 (cells)
Correct numerical calculation but not in standard form gains 1 mark
(0.00003281 **OR** 0.0000328 **OR** 0.000033);

Accept any number of significant figures as long as rounding correct (3.28125×10^{-5} scores 2 marks)

2

[8]

Q9.

(a) 1. Co-transport;
2. Uses (hydrolysis of) ATP;
3. Sodium ion and proton bind to the protein;
4. Protein changes shape (to move sodium ion and / or proton across the membrane);

3. Accept 'Na^+ and H^+ bind to protein' but do not allow incorrect chemical symbols

3 max

(b) 1. Tenapanor / (Group)B / drug causes a <u>significant</u> increase;
OR
There is a <u>significant</u> difference with Tenapanor / drug / between **A** and **B**;
2. There is a less than 0.05 <u>probability</u> that the difference is due to <u>chance</u>;
3. (More salt in gut) reduces water potential in gut (contents);
4. (so) less water absorbed out of gut (contents) by <u>osmosis</u>
OR
Less water absorbed into cells by <u>osmosis</u>
OR
Water moves into the gut (contents) by <u>osmosis</u>.
OR
(so) water moves out of cells by <u>osmosis</u>.

1. and 2. Reject references to 'results' being significant / due to chance once only.

2. Do not credit suggestion that probability is 0.05% or 5.

*2. Accept 'There is a greater than 0.95 / 95% probability that any difference between observed and expected is **not** due to chance'*

4

(c) 1. (Higher salt) results in low<u>er</u> water potential of tissue fluid;
2. (So) less <u>water</u> returns to capillary by osmosis (at venule end);
OR
3. (Higher salt) results in high<u>er</u> blood pressure / volume;
4. (So) more fluid pushed / forced out (at arteriole end) of capillary;

For 'salt' accept 'sodium ions'.

Do not allow mix and match of points from different alternative pairs

3. *Accept higher hydrostatic pressure.*

2

[9]

Q10.

(a) 1. Concentration of mineral ion/named mineral ion in soil;
2. Soil pH;
3. Temperature;
4. Light intensity / wavelength / duration;
5. Distance between seeds / plants;
6. Volume of water given;
7. CO_2 concentration;
8. Humidity;

1 and 2. Allow 'growing solution' for 'soil'.

2. *pH alone is insufficient.*

3. *Allow 'colour of light'*

Reject 'amount' for mps 1, 4, 6 and 7.

Ignore O_2 concentration

Three correct = 2 marks

Two correct = 1 mark

One or none correct = 0 marks

2 max

(b) 1. 2,4-D causes an increase in release of ions from wild oat cells **and** 2,4-D does not affect / has little effect on the release of ions from wheat cells;
2. (For wheat) Difference is less than LSD / 7 **so** difference is not significant;
OR
(For wild oats) Difference is more than LSD / 10 **so** difference is significant;
3. Loss of ions from cells (likely to) lead to cell / plant death/damage;
OR
Disruption of cell membrane (likely to) lead to cell / plant death / damage;
4. No evidence here about death of plants as a result of this ion loss;
5. No evidence here of other ecological/environmental impact;

1. *Accept reference to 'concentration of ions in water' or 'disruption of the cell membranes' in place of 'release of ions'*

1. *Accept 'difference in release of ions from wild oats is 25 **and** difference in release of ions from wheat is 1'*

2. *Accept '(For wheat) difference is less than LSD **so** greater than 5% probability that difference is due to chance'*

OR

*'(For oats) difference is more than LSD **so** less than 5% probability that difference is due to chance'*

5. *Accept 'development of resistance'*

4 max

(c) 1. (Maintain temperature) so that the rate of diffusion (of ions out of cells)

remains constant
OR
(Maintain temperature) so no change in fluidity of phospholipids / kinetic energy of phospholipids;
OR
(Maintain temperature) so no change in shape / structure / denaturation of membrane proteins;

2. (Shaking) So all surfaces of the leaf discs are exposed (to water) / so all submerged;
OR
To maintain diffusion / concentration gradient (for ions out of leaf discs);

1. Ignore references to rate of enzyme catalysed reactions

2. Accept 'so that leaf discs do not stick together'

2

[8]

Q11.

(a) 1. (Nerve impulse / depolarisation of membrane) causes Ca^{2+} channel (proteins) to open;
2. Ca^{2+} enter by (facilitated) diffusion;
3. Causes (synaptic) vesicles to fuse with (presynaptic) membrane;

Accept single reference to ions to cover 1 and 2

Penalise once for no reference to ions

1. Reject carrier proteins

3. Reject ref to release of vesicles

3. Ignore vesicles bind to membrane (but accept merge with)

3

(b) 1. Myosin head attaches to actin **and** bends / performs powerstroke;
2. (This) pulls mitochondria past / along the actin;
3. Other / next myosin head attaches to actin (and bends / performs powerstroke);

1. Accept change shape / change angle

2. Ignore pulls actin along

2. Ignore refs to cytoskeleon

Accept plural or singular statements

2 max

(c) 1. (Mitochondria) supply (additional) ATP / energy;
2. To move vesicles / for active transport of ions / for myosin to move past actin
OR
Re-synthesis / reabsorption of neurotransmitter / named neurotransmitter;

1. Reject produces energy

2. Ignore ref. to ATP for opening calcium ion channels/making vesicles fuse with membrane

2

[7]

Q12.

(a) Correct answer 23.55 – 24 two marks;
For one mark
5.9
OR
94.2;

2

(b) 1. Method for measuring area;
e.g. draw round (each) leaf on graph paper and count squares;
2. Of both sides of (each) leaf;
3. Divide rate (of water loss / uptake from potometer) by (total) surface area (of leaves);

3

(c) Plant has roots
OR
xylem cells very narrow;

Ignore references to air bubbles / mass flow / photosynthesis

Accept xylem damaged when cut

1

(d) 1. Both small / similar size (so fit channel);
2. Have a similar shape (so bind to / fit channel);

1. Accept same height and width

Ignore refs to polar / non-polar

2. Accept Aquaporin complementary to oxygen(s)

2

(e) 1. Single-stranded RNA (has base sequence) complementary to PIP1 mRNA;
2. Binds to mRNA (of PIP1) / leads to destruction of mRNA;
3. Prevents / reduces translation (of PIP1);
4. Reduces photosynthesis/named process that uses water;

3. Less made is insufficient

3 max

(f) Not all of mRNA bound to single-stranded RNA / there is more mRNA than interfering RNA
OR
Not all mRNA destroyed / disabled;

Accept mutations in transgene,

Accept not all cells with transgenes

1

(g) 1. Loss of PIP reduces water **and** carbon dioxide movement;
2. Differences significant because SDs don't overlap
OR
Need stats test to see whether significant differences (or not);
3. Greater (proportional) effect on carbon dioxide transport;
4. Not all movement through PIP;

1. Accept converse for wild type

2. Reject references to results significant or not significant

2. Accept error bars for SDs

3 max

[15]

Q13.

(a) 1. Sodium ions actively transported from ileum cell to blood;

2. Maintains / forms diffusion gradient for sodium to enter cells from gut (and with it, glucose);

3. Glucose enters by facilitated diffusion with sodium ions;

3

(b)

Biochemical test	Liquid from beaker	Liquid inside Visking tubing
Biuret reagent		✔
I_2/KI		✔ or blank
Benedict's	✔	✔

1 mark for each correct row

3

(c) 1. Biuret: protein molecules too large to pass through tubing;
Neutral: enzyme molecules

2. Iodine in potassium iodide solution: starch molecules too large to pass through tubing;
If no tick in 04.2, allow no starch hydrolysed

3. Benedict's: starch hydrolysed to maltose, which is able to pass through tubing.
Reject: glucose

3

[9]

Q14.

(a) 1. Polar molecule;

2. Acts as a (universal) solvent;

OR

3. (Universal) solvent;

4. (Metabolic) reactions occur faster in solution;

OR

5. Reactive;

6. Takes place in hydrolysis / condensation / named reaction;
Polar molecule so acts as (universal) solvent so (metabolic reactions are faster = 3 marks

4

(b) Name of ion;

Correct function within cell;

Ions other than sodium in specification are H^+, Fe^{2+} and PO_4^{3-} but accept any correct ion (other than sodium) plus relevant function = 2.

Allow ion to be named in words but not as element, e.g, iron ion but not iron.

2

(c) 1. Comparison: both move down concentration gradient;

2. Comparison: both move through (protein) channels in membrane;

Accept aquaporins (for water) and ion channels

3. Contrast: ions can move against a concentration gradient by active transport

3

[9]

Q15.

(a) 1. Between 0 and 0.1 calcium (ions) cannot enter by facilitated diffusion
OR
No diffusion gradient for entry into the cell.

2. Between 0.1 and 0.3 calcium (ions) enter by facilitated diffusion;

3. As calcium (ions) enter without oxygen
OR
Oxygen is not required for facilitated diffusion;

4. Between 0 and 0.1 calcium (ions) enter by active transport;

5. Movement is against the concentration gradient;

6. As calcium (ions) only enter in presence of oxygen / oxygen is required for active transport.

Accept 'they' refers to calcium ions

5 max

(b) (She could have used) boiled (and cooled) water
OR
Layer of oil in top of solution;

1

[6]

Q16.

(a) Binary fission;

Reject mitosis

1

(b) 1. Keep lid on Petri dish
OR
Open lid of Petri dish as little as possible.

2. To prevent unwanted bacteria contaminating the dish.
OR
L. monocytogenes may be dangerous / may get out.

OR

3. Wear gloves
OR
Wear mask
OR
Wash hands;

4. To prevent contamination from bacteria on hands / mouth
OR
Prevent spread of bacteria outside the lab;

OR

5. Use sterile pipette
OR
Flame the loop
OR
Flame the neck of the container of the culture;

6. To maintain a pure culture of bacteria

4 max

(c) Cinnamon;

1

(d) 1. Thyme is the most effective / best (at 4 °C);

2. Clove and cinnamon same effectiveness at 4 °C as 35 °C (so suitable);

3. Bay and nutmeg are less effective at 4 °C than 35 °C (so unsuitable).

3

(e) Less kinetic energy
OR
Less movement of oil molecules / of phospholipid molecules

1 max

[10]

Q17.

(a) Electron microscope has higher resolution (than optical microscope).

1

(b) Cytoplasm of red blood cell filled with haemoglobin.

1

(c) 1. Membrane has phospholipid bilayer;

2. Stain binds to phosphate / glycerol;

3. On inside <u>and</u> outside of membrane.
Accept phospholipid head / protein

3

(d) 1. Carrier / channel protein;

2. (Protein) specific / complementary to substance;

3. Substance moves down concentration gradient;

Allow down electrochemical gradient

Reject 'along' concentration gradient

3

[8]

Q18.

(a) 1. (Overall) outward pressure of 3.2 kPa;
2. Forces small molecules out of capillary.

2

(b) Loss of water / loss of fluid / friction (against capillary lining).

1

(c) 1. High blood pressure = high hydrostatic pressure;
2. Increases outward pressure from (arterial) end of capillary / reduces inward pressure at (venule) end of capillary;
3. (So) more tissue fluid formed / less tissue fluid is reabsorbed.

Allow lymph system not able to drain tissues fast enough

3

(d) 1. Water has left the capillary;
2. Proteins (in blood) too large to leave capillary;
3. Increasing / giving higher concentration of blood proteins (and thus wp).

3

[9]

Q19.

(a) 1. Dissolve in alcohol, then add water;
2. White emulsion shows presence of lipid.

2

(b) Glycerol.

1

(c) Ester.

1

(d) **Y** (no mark)
Contains double bond between (adjacent) carbon atoms in hydrocarbon chain.

1

(e) 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
2. Multiply answer by 100.

2

(f) Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape;

Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining shape.

1

(g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein.

2 max

[10]

Q20.

(a) Calculations made (from raw data) / raw data would have recorded initial and final masses.

1

(b) Add 4.5 cm^3 of (1.0 mol dm^{-3}) solution to 25.5 cm^3 (distilled) water.

If incorrect, allow 1 mark for solution to water in a proportion of 0.15:0.85

2

(c) 1. Water potential of solution is less than / more negative than that of potato tissue;

Allow Ψ as equivalent to water potential

2. Tissue loses water by osmosis.

2

(d) 1. Plot a graph with concentration on the *x*-axis and percentage change in mass on the *y*-axis;
2. Find concentration where curve crosses the *x*-axis / where percentage change is zero;
3. Use (another) resource to find water potential of sucrose concentration (where curve crosses *x*-axis).

3

[8]

Q21.

(a) 0.22;

1

(b) 1. Uptake in flask **G** much greater than in flask **F**;
2. Showing use of ATP in flask **G**;
3. Sodium ion concentration in flask **G** falls to zero;
4. Showing uptake against a concentration gradient.

4

(c) 1. (Uptake of sodium ions occurring by) facilitated diffusion;
2. Equilibrium reached / sodium ion concentrations in solution and in cells the same.

2

[7]

Q22.

(a) 1. Water potential becomes lower / becomes more negative (as sugar enters phloem);
2. Water enters phloem by osmosis;
3. Increased volume (of water) causes increased pressure.

3

(b) 1. Rate of photosynthesis related to rate of sucrose production;
2. Rate of translocation higher when sucrose concentration is higher.

2

(c) 1. Rate of translocation does not fall to zero / translocation still occurs after 120 minutes;

2. But sucrose no longer able to enter cytoplasm of phloem cells.

2

[7]

Q23.

(a) 1. Trachea and bronchi and bronchioles;
2. Down pressure gradient;
3. Down diffusion gradient;
4. Across alveolar epithelium.

Capillary wall neutral

5. Across capillary endothelium / epithelium.

4 max

(b) (About) 80.0%.

1

(c) 1. (Group **B** because) breathe out as quickly as healthy / have similar FEV to group **A**;
2. So bronchioles not affected;
3. FVC reduced / total volume breathed out reduced.

*Allow this marking point for group **C***

3

[8]

Q24.

(a) 1. Facilitated diffusion involves channel or carrier proteins whereas active transport only involves carrier proteins;
2. Facilitated diffusion does not use ATP / is passive whereas active transport uses ATP;
3. Facilitated diffusion takes place down a concentration gradient whereas active transport can occur against a concentration gradient.

Since 'contrast', both sides of the differences needed

3

(b) 3.3:1.

Correct answer = 2 marks

If incorrect, allow 1 mark for 470–360 / 60 for rate in second hour

2

(c) 1. Group **A** – initial uptake slower because by diffusion (only);
2. Group **A** – levels off because same concentrations inside cells and outside cells / reached equilibrium;
3. Group **B** – uptake faster because by diffusion plus active transport;
4. Group **B** fails to level off because uptake against gradient / no equilibrium to be reached;
5. Group **B** – rate slows because few / fewer chloride ions in external solution / respiratory substrate used up.

4 max

[9]

Q25.

(a) 1. (Because) same water potential (as valve);

2. (So) prevents loss or gain of water by osmosis / down water potential gradient;

Loss or gain and method of loss or gain must both be in the answer

3. (So) cells / tissues in the valves aren't damaged;

2 max

(b) 1. Kills / stops growth of bacteria that could cause infection / disease (in patient);

2. Kills / stops growth of bacteria that could damage the valve;

'Kill / stop growth of bacteria' is insufficient without further explanation.

1 max

(c) (After surgery) valve closes fully / correctly / works so preventing blood flowing back into the heart;

OR

(After surgery) valve closes fully / correctly / works so preventing blood flowing out of the artery;

Do not credit the converse here

1

(d) 1. (For maximum) mean decreases, to within the normal range;

2. (For minimum) mean increases to within normal range;

3. No overlap in the (means ±) standard deviation for <u>minimum</u> pressure so there is a real difference;

Ignore references to the differences in maximum pressure

Accept idea of significant difference for 'real difference'

4. Includes wide range of ages of patients;

3 max

(e) 1. Standard deviation shows that some of the patients will be outside normal pressure range (after surgery);

Accept this as a general statement or in relation to maximum or minimum pressures

2. Small group;

3. Short follow up times;

4. No comparison with other treatments;

2 max

(f) Don't know the range;

1

[10]

Q26.

(a) 1. In phospholipid, one fatty acid replaced by a phosphate;

Ignore references to saturated and unsaturated

Accept Pi/PO_4^{3-} / (P)

Reject P/Phosphorus

Accept annotated diagrams

1

(b) 1. Add ethanol, then add water;

Reject ethanal/ethonal

Accept 'Alcohol/named alcohol'

2. White (emulsion shows lipid);

Accept milky – Ignore 'cloudy'

Sequence must be correct

If heated then DQ point 1

Reject precipitate

2

(c) Saturated single/no double bonds (between carbons)
OR
Unsaturated has (at least one) double bond (between carbons);

Accept hydrocarbon chain/R group for 'between carbons' for either

Accept Sat = max number of H atoms bound

'It' refers to saturated

1

(d) 1. (Fat substitute) is a different/wrong shape/not complementary;
OR
Bond between glycerol/fatty acid and propylene glycol different (to that between glycerol and fatty acid)/no ester bond;

2. Unable to fit/bind to (active site of) lipase/no ES complex formed;

If wrong bond name given (e.g. peptide/glycosidic), then penalise once

2

(e) It is hydrophilic/is polar/is too large/is too big;

Ignore 'Is not lipid soluble'

1

[7]

Q27.

(a)

Transport through a channel protein | Q |

1

Transport of small, non-polar molecules | P |

1

Transport of glucose with sodium ions | S |

1

(b) 1. (Y is) an enzyme/has active site/forms ES complex;

Accept catalyst

2. That makes cellulose/attaches substrate to cellulose/joins β glucose;

OR

3. Makes cellulose/forms glycosidic bonds;
4. From β glucose;

Mark in pairs (1&2 or 3&4)

2

(c) Cell wall forms outside cell-surface membrane/has cellulose on it (on the outside);

1

(d) (Tick in box next to) Hydrogen;

1

[7]

Q28.

(a) Dipeptidase/s;

Accept: membrane bound dipeptidase/s.

1

(b) 1. Endopeptidases hydrolyse internal (peptide bonds)

OR

Exopeptidases remove amino acids/hydrolyse (bonds) at end(s);

Accept: break for hydrolyse.

Accept: endopeptidases break (proteins) into shorter chains.

2. More ends or increase in surface area (for exopeptidases);

2

(c) 1. No/less ATP produced

OR

No active transport;

2. Sodium (ions) not moved (into/out of cell);

Accept: sodium (ions) increase in cell.

Accept: sodium (ions) cannot diffuse into cell.

3. No diffusion gradient for sodium (to move into cell with amino acid)

OR

No concentration gradient for sodium (to move into cell with amino acid);

Accept: converse for all three points.

Note: no active transport of sodium (ions) equals 2 marks.

3

[6]

Q29.

(a) (Simple) diffusion;

Reject: facilitated diffusion.

1

(b) 1. Thin/small **so** short diffusion pathway;

Reject: thin membrane/wall/cells.

2. Flat/long/small/thin **so** large surface area to volume ratio/surface area : volume;

Accept: small volume to surface area ratio.

2

(c) 1. High/50% saturation (with oxygen) below (pO_2 of) 0.2 kPa;

*Accept: fully saturated **or** above 50% saturation below 0.2kPa.*

Accept: any number between 0.08 and 0.2 kPa

2. (Oxygen) for respiration;

2

(d) 1. Water potential higher in worm
OR
Lower water potential in seawater;

Accept: correct reference to water potential gradient if direction of water movement is given.

Accept: ψ for water potential.

2. Water leaves by osmosis (and worm dies);

Reject: worm/cells burst.

2

[7]

Q30.

(a) 1. Na^+ ions leave epithelial cell and enter blood;

Penalise for Na without ions once.

2. (Transport out is by) active transport / pump / via carrier protein using ATP;

Reject channel protein

3. So, Na^+ conc. in cell is lower than in lumen (of gut);

Maintains diffusion gradient for Na^+ from lumen/into cells;

4. Sodium/Na^+ ions enter by facilitated diffusion;

Accept diffusion/from high to low concentration through a symport/cotransport protein

5. Glucose absorbed with Na^+ ions against their concentration/diffusion gradient / glucose absorbed down an electrochemical gradient;

Accept glucose absorbed with sodium ions by indirect active transport

5

(b) 1. Chloride ions water soluble/charged/polar;

Penalise chloride molecules only once

Ignore ref to size

Accept not lipid soluble

2. Cannot cross (lipid) bilayer (of membrane);
3. Chloride ions transported by facilitated diffusion OR diffusion involving channel/carrier protein;
4. Oxygen not charged/non-polar;

Accept oxygen lipid soluble

5. (Oxygen) soluble in/can diffuse across (lipid) bilayer;

5

[10]

Q31.

(a) 1. (Releases) toxins;
2. Kills cells / tissues.

2. Accept any reference to cell / tissue damage

Ignore infecting / invading cells

2

(b) 1. Water potential in (bacterial) cells higher (than in honey) / water potential in honey lower (than in bacterial cells);

Q candidates must express themselves clearly

1. Must be comparative e.g. high WP in cell and low WP in honey

2. Water leaves bacteria / cells by osmosis;
3. (Loss of water) stops (metabolic) reactions.

3. Needs a reason why lack of water kills the cell

3

[5]

Q32.

(a) Regulator protein.

Accept regulator protein antigen

Reject regulator protein receptor

Ignore regular protein

1

(b) 1. Lipid soluble / hydrophobic
2. Enters through (phospholipid) bilayer

OR

3. (Protein part of) LDL attaches to receptor
4. Goes through carrier / channel protein.

4. Accept by facilitated diffusion or active transport

4. Reject active transport through channel protein

2

(c) Any **two** from:

1. (Monoclonal antibody) has a specific tertiary structure / variable region / is complementary to regulator protein

Do not award MP1 if reference to active site.

2. Binds to / forms complex with (regulator protein)

"It" refers to monoclonal antibody in MP1 and MP2

3. (So regulator protein) would not fit / bind to the receptor / is not

complementary to receptor

3. Reject receptor on LDL

2 max

(d) 1. Injection with salt solution

1. Accept inject placebo in salt solution

2. Otherwise treated the same.

2

[7]

Q33.

(a) 1. (No grease)
means stomata are open
OR
allows normal CO_2 uptake;

Allow 'gas exchange' for CO_2 uptake.

'As a control' is insufficient on its own.

2. (Grease on lower surface)
seals stomata
OR
stops CO_2 uptake through stomata
OR
to find CO_2 uptake through stomata
OR
shows CO_2 uptake through cuticle / upper surface;

3. (Grease on both surfaces) shows sealing is effective
OR
stops all CO_2 uptake.

3

(b) (i) 1. (Mean rate of) carbon dioxide uptake was constant *and* fell after the light turned off;

Ignore absence of arbitrary units in both marking points.

Both ideas needed for mark.

Accept 'stayed at 4.5' as equivalent to 'was constant'.

2. Uptake fell from 4.5 to 0 / uptake started to fall at 60 minutes and reached lowest at 80 minutes / uptake fell over period of 20 minutes;

One correct use of figures required.

Accept fell to nothing / no uptake for 0.

2

(ii) 1. (Because) water is lost through stomata;
2. (Closure) prevents / reduces water loss;
3. Maintain water content of cells.

This marking point rewards an understanding of reducing water loss e.g. reduce wilting, maintain turgor, and is not related to photosynthesis.

2 max

(c) (i) (Carbon dioxide uptake) through the upper surface of the leaf / through cuticle.

1

(ii) 1. No use of carbon dioxide in photosynthesis (in the dark);
2. No diffusion gradient (maintained) for carbon dioxide into leaf / there is now a diffusion gradient for carbon dioxide out of leaf (due to respiration).

2

[10]

Q34.

(a) 1. Bilayer;

Accept double layer
Accept drawing which shows bilayer

2. Hydrophobic / fatty acid / lipid (tails) to inside;

3. Polar / phosphate group / hydrophilic (head) to outside;

2. & 3. need labels
2. & 3. accept water loving or hating

2 max

(b) (i) 1. (Rough endoplasmic reticulum has) ribosomes;
accept "contains / stores"

2. To make protein (which an enzyme is);
Accept amino acids joined together / (poly)peptide
Reject makes amino acids
Ignore glycoprotein

2

(ii) (Golgi apparatus) modifies (protein)

OR

packages / put into (Golgi) vesicles

OR

transport to cell surface / vacuole;
Accept protein has sugar added
Reject protein synthesis
Accept lysosome formation

1

[5]

Q35.

(a) Variable that is changed;
Reject 'the variable that changes'.

1

(b) 1. Idea of a confounding variable;

2. (So) genetically similar;

2. Do not accept 'genetically identical / same DNA'.

3. (So) have similar salt tolerance / response to salt water / response to watering treatment;

4. (So) have similar yield / mass of seeds;

Do not accept 'amount / number of seeds' or 'growth rate'.

2 max

(c) Mitosis;

Ignore cell division

1

(d) 1. Irrigation with sea water / **C** / **D** increased yield compared with no irrigation / **A**;

For 'yield' accept 'mass of seed' throughout.

2. Yield was lower when irrigated with sea water / **C** / **D** compared with fresh water / **B**;

Only penalise once for use of 'amount / number of seeds'.

3. Yield was lower when watered with sea water throughout growth and seed formation / **C** than when watered with sea water just at seed formation / **D**;

Accept use of figures from table.

'It' refers to watering with seawater / mixture.

2 max

(e) 1. Irrigation with sea water / **C** / **D** increases concentration of salt in soil;

Ignore reference to standard deviation / quality of the data.

2. Lower water potential in the soil linked to reduced uptake of water;

3. Salt concentration in the soil might / might not increase in the future;

Mark point 3 includes the principle for mark point 1 so mp3 gains 2 marks (for mp1 and mp3)

4. Might decrease plant growth / yield in the future;

5. Less food / fewer seeds for future planting;

Mp 3 and 4. Allow 'further' for the idea of 'in the future'.

3 max

[9]

Q36.

(a) 1. (Curve for) dog falls rapidly at the start but (curve for) sheep falls slowly at first;

*Do **not** allow curve for dog falls more steeply (since from 0.5% NaCl fall in sheep is just as steep as fall in dog)*

2. Sheep doesn't fall rapidly until 0.5 (but dog falls rapidly from 0);

3. (Trend shows that) for any concentration of sodium chloride haemolysis

is lower in the dog;

The idea of a trend is required. Statement of individual values alone is insufficient, eg 'at 0.2, 34% in dog and 98% in sheep' is insufficient

Accept dog reaches 0 at lower concentration of sodium chloride than for sheep / dog reaches 0 at 0.38% compared to 0.84 % in sheep;

2 max

(b) 74 to 76;

Accept a value within this range

1

(c) 1. (Red) colour is due to haemoglobin;

Note: a correct response to marking point 2 also scores marking point 1

2. The more haemoglobin released the more red the solution;

Need idea of haemoglobin release before giving credit

2

(d) 1. (Use of 0.9%) will not cause haemolysis in any (of the mammals);

Full credit requires statement of marking point 1 and any approach from marking point 2

2. (So) will not kill any of the animals;

or

Only need to use / store / buy one concentration of sodium chloride solution / cheaper to have one concentration of sodium chloride solution / can buy in bulk;

or

Anyone can give it / no need to find out what concentration any animal requires;

Different approaches available for this marking point

2 max

[7]

Q37.

(a) Answer of 9.09 / 9.1;; = 2 marks

Calculation of the difference in mean time (2) divided by original time (22); = 1 mark

Ignore number of decimal places as long as they are correct

2

(b) (Yes)

Can mix and match yes or no approach, all 5 responses are available

(No)

1. Faster running time after sports drink;

   'Faster running time in group Q' is insufficient but accept 'faster running time in group Q in Race 2'

2. Mean times given **so** there will be variation in the group;

3. No standard deviations to know the spread of the data (about the mean) / whether they overlap;

   Accept 'no stats analysis'

4. Improvement in running time only small in both groups / both groups improved in Race 2;

5. Did not drink the same volumes;

3 max

(c) 1. Age;

2. Gender / sex;

3. Ethnicity;

4. Food / fluid intake before the race;

   Any fluid / food is included here eg coffee, alcohol

5. Amount of sleep / rest / exercise before the race;

6. Reference to one named health factor eg diabetic or non-diabetic, smoker or non-smoker;

   Reference to medication is included here

3 max

(d) 1. Sodium ions and glucose absorbed by co-transport;

   Only penalise omission of 'ions' once in marking points 1, 3, 4 and 5

2. (Co-transport) via carrier / channel protein;

   Accept via symport

   Only reward reference to carrier / channel proteins in the context of co-transport

3. Sodium ions removed (from epithelial cell) by active transport into blood;

4. Maintains low concentration of sodium ions (in epithelial cell) / maintains sodium ion concentration gradient (between small intestine and epithelial cell);

   Principle: marking points 3, 5, and 6 require consideration of 'what moves', 'where it moves to' and 'how it moves' to achieve credit

5. Sodium ions enter epithelial cells by facilitated diffusion taking glucose with them (from small intestine);

   Reference to diffuse / diffusion for movement is required. Accept facilitated diffusion

6. Glucose moved by <u>facilitated diffusion</u> into blood (from epithelial cells);

4 max

[12]

Q38.

1. (Drink) contains carbohydrates / sugars **so** High GI / (drink) contains carbohydrates / sugars **so** raises blood glucose concentration quickly;

   Each alternative requires both aspects for credit

   The second alternative requires a reference to speed eg 'quickly' or 'immediately'

2. Contains salt so glucose more rapidly absorbed;

3. Increases glucose to muscles for respiration;

4. More / faster respiration so more / faster energy release;

   Reject reference to energy production

   Accept more ATP produced

[3]

Q39.

(a) 1. **A**: phospholipid (layer);

   1. Reject hydrophobic / hydrophilic phospholipid

2. **B**: pore / channel / pump / carrier / transmembrane / intrinsic / transport <u>protein</u>;

   2. Ignore unqualified reference to protein

2

(b) (i) Condensation (reaction);

1

(ii) Organelle named; Function in protein production / secretion;

Function must be for organelle named

Incorrect organelle = 0

eg

1. Golgi (apparatus);

   1. Accept smooth endoplasmic reticulum

2. Package / process proteins;

OR

3. Rough endoplasmic reticulum / ribosomes;

   3. Accept alternative correct functions of rough endoplasmic reticulum. ER / RER is insufficient

   3. Accept folding polypeptide / protein

4. Make polypeptide / protein / forming peptide bonds;

OR

5. Mitochondria;

6. Release of energy / make ATP;
6. Reject produce / make energy
6. Accept produce energy in the form of ATP

OR

7. Vesicles;

8. Secretion / transport of protein;

2

[5]

Q40.

(a) 1. To allow comparison;

2. Because different number of cells in samples / different times for incubation / numbers become easier to manipulate;

2

(b) 203.7(%);;
Allow 1 mark for 21.8 / 10.7
Allow 1 mark for correct answer (203.74) but not correctly to 1 dp
204 = 1 mark

2

(c) (i) 1. (At every concentration) uptake is faster at 37°C / at higher temperature;

2. Due to faster respiration / ATP production;

2

(ii) 1. Uptake at 37°C only small increase / levelling off / almost constant as carrier proteins full;
Accept 'no (significant) change'
Ignore use of numbers

2. Concentration of imatinib is not the limiting factor;

2

[8]

Q41.

(a) (i) Substance that causes an immune response / production of antibodies;
Ignore foreign / non-self

1

(ii) 1. Not lipid soluble;

2. Too large (to diffuse through the membrane);

3. Antigens do not have the complementary shape / cannot bind to receptor / channel / carrier proteins (in membranes of other

epithelial cells);

2 max

(b) 1. (Vaccine contains) antigen / attenuated / dead pathogen;

1. Reject if in context of injection of vaccine

2. T-cells activate B-cells;

3. B-cells divide / form clone / undergo mitosis;

4. Plasma cells produce antibodies;

5. Memory cells produced meaning more antibodies / antibodies produced faster in secondary response / on reinfection;

5

[8]

Q42.

21 – 25	Extended abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16 – 20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.
11 – 15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one

		irrelevant topic.
6 – 10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1 – 5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	**Definition**
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. ‘Several’ here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the

	specification. Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at A-level standard.

Please note that to obtain full credit, students must use information to show **the importance of different types of cells and how they are involved in many different functions**.

Topics

1.M	Membrane function as selectively permeable barrier
1.T	Transport mechanisms across membranes
1.CT	Absorption and co-transport of sodium ions and glucose
2.P	Photosynthesis, chloroplast, thylakoids
2.R	Respiration, mitochondrion and cristae.
2.Ps	Protein secretion, RER, SER and Golgi
3.A	Surface receptors / antigen and immune response
3.CD	Cell division
3.B	Vertical and horizontal transmission − membranes and bacteria
3.Pc	Pacinian corpuscle

4.Tr	Tropisms − movement of IAA
4.N	Nerve impulses / action potentials
4.S	Synaptic transmission
4.Mc	Muscle contraction, calcium ion movement / storage
4.H	Hormones - eg Blood glucose regulation − insulin and glucagon
4.O	Osmosis, including water movement in plants

Examiners are free to select other letters if they wish

The emphasis in answers should be on the involvement of membranes in processes, not just the processes themselves

Breadth, one mark for use of an example from each of the following approaches:

1. Membranes − basic functions

2. Organelle membranes

3. Cell surface membranes

4. Processes − eg protein secretion, synaptic transmission, cell division

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q43.

FOR

1. (If the husband smokes) there's a greater risk of dying from lung cancer / emphysema / cervical cancer;

2. The more the husband smokes, the greater the risk of dying from lung cancer / emphysema;

3. Suitable use of figures from the table to illustrate answer;

AGAINST

4. Little difference in risk of dying of stomach / heart disease;

5. Other factor (than husband smoking) / named factor might cause death;

6. Only one sample / further studies needed;

4 max

[4]

Q44.

By osmosis (no mark)

No mark awarded for naming terms e.g. osmosis, facilitated diffusion, active transport, co-transport etc.

1. From a high water potential to a low water potential / down a water potential gradient;

2. Through aquaporins / water channels;

QWC ignore large / small WP

By facilitated diffusion (no mark)

QWC ignore reference to high / low concentrations of water or high / low concentration of solution

3. Channel / carrier protein;

4. Down concentration gradient;

By active transport (no mark)

QWC ignore ' along' concentration gradients

5. Carrier protein / protein pumps;

6. Against concentration gradient;

7. Using ATP / energy (from respiration);

Co-transport subsumed into mark scheme for active transport and facilitated diffusion

By phagocytosis / endocytosis (no mark)

Can award MP2, 3, 5 for 3 marks with no context given

8. Engulfing by cell surface membrane to form vesicle / vacuole;

Ignore lipid diffusion as in stem of question

By exocytosis / role of Golgi vesicles (no mark)

9. Fusion of vesicle with cell surface membrane;

5 max

[5]

Q45.

(a) (i) Made of (different) tissues / more than one tissue;

1

(ii) 1. (Muscle) contracts;

Assume that 'they' or 'it' = muscle

2. (Arteriole) narrows / constricts / reduces size of lumen / vessel / vasoconstriction;

Ignore: references to pressure

***Q** Correct context for muscle contracts, vessel constricts*

2

(b) (i) Short diffusion distance / pathway;

Accept: thin diffusion pathway

1

(ii) (More) time for exchange / diffusion (of substances);

Accept: example of more time for specific substance to be exchanged

1

(c) 1. Water potential (in capillary) not as low / is higher / less negative / water potential gradient is reduced;

Accept: 'blood or plasma' instead of 'capillary'

2. Less / no water removed (into capillary);

Accept converse: water remains in the tissue

3. By osmosis (into capillary);

***Q** Marking points 2. and 3. must be in the context of movement into the capillary*

Neutral: reference to more tissue fluid being formed as in the question stem

Neutral: reference to lymphatic drainage

3

[8]

Q46.

(a) 1. Cell wall not formed / production inhibited;

*1. **Q** Accept: weakened cell wall, but do not accept 'cell wall is broken down'*

2. Lower water potential in bacterium;

2. Accept: converse

2. Must be clear that the lower water potential is in the bacterium

3. Water enters and causes lysis / expansion / pressure;

2 max

(b) Human cells lack enzyme (**B**) / have a different enzyme / produce different fatty acids / use different substrates;

Neutral: 'human cells do not have cell walls' as out of context

1

(c) 1. Change in base sequence (of DNA / gene) leading to change in amino acid sequence / primary structure (of enzyme);

1. Accept: different amino acids coded for

1. Reject: different amino acids produced

2. Change in hydrogen / ionic / disulphide bonds leading to change in the tertiary structure / active site (of enzyme);

2. Neutral: alters 3D structure / 3D shape

3. Substrate not complementary / cannot bind (to enzyme / active site) / no enzyme-substrate complexes form;

3

[6]

Q47.

(a) 1. Flatten / moves down;

1. Ignore: additional information about rib movements

2. (Diaphragm muscle) contracts;

2

(b) 1. Diaphragm contracts / moves down / flattens;

Ignore refs to rib movement

2. Increases volume (of thorax) and decrease in pressure;

2. Accept pressure lower than atmospheric pressure

3. Air moves from high to lower pressure / down pressure gradient;

3. Reject: by diffusion

3

(c) 1. Diffusion;

Accept down diffusion gradient

2. Across (alveoli) epithelium / (capillary) endothelium;

2. Accept: capillary epithelium / squamous cell

2 max

[7]

Q48.

(a) 2 marks for correct answer 0.2

Accept concentration ÷ time

1 mark for 6 / 30;

2

(b) 1. (Uptake) decreases / slower, then no further uptake / uptake stops;

2. (Decreases) to 20 - 22 / no uptake after 20 / 22 minutes;

Accept: (only) 1.6 (arbitrary units) absorbed / (only) drops to 8.4

Is for correct use of data from graph

2

(c) 1. Stops / reduces / inhibits respiration;

Accept: inhibits respiratory enzymes

2. No / less energy released / ATP produced;

Ignore: less energy produced / made

3. (ATP / energy needed) for active transport;

Accept ref to Na^+ pump / description of active transport

Ignore consequences of less Na^+ in cell

3

[7]

Q49.

(a) 1. Add Benedict's;
Hydrolyse with acid negates mp1

2. Heat;
Accept warm, but not an unqualified reference to water bath

3. Red / orange / yellow / green (shows reducing sugar present);
Accept brown

3

(b) (i) 1. Starch hydrolysed / broken down / glucose / maltose produced;
Neutral: Sugar produced

2. Lower water potential;

3. Water enters by osmosis;

3

(ii) Only 2 pHs studied / more pHs need to be tested;
Accept: different amylase may have a different optimum pH

1

[7]

Q50.

(a) Hydrolysis (reaction);
Accept phonetic spelling

1

(b) 1. Too big / wrong shape;
Wrong charge - neutral
Accept insoluble

2. To fit / bind / pass through (membrane / into cell / through carrier / channel protein);

3. Carrier / channel protein;
Accept carrier / channel protein not present

3

(c) Foreign / (act as) antigen / non-self;
Reject foreign cells

1

(d) 1. Dose to be given;
Accept: interaction with other drugs

2. No (serious) side effects;

3. How effective;

4. Cost of drug;

2 max

[7]

Q51.

(a) (i) Diffusion;

Ignore references to structures, membrane components etc

Allow simple diffusion

Reject facilitated diffusion

1

(ii) 1. (Thin / flat body) so short distance for diffusion / short diffusion pathway;

Ignore references to membrane, wall, body surface

2. (Thin / flat body so) large surface area to volume ratio;

'It' refers to flatworm's body

2

(b) (i) A group of tissues;

Ignore references to function Group = more than one

1

(ii) 1. (Carbon dioxide enters) via stomata;

Reject stroma

2. (Stomata opened by) guard cells;

3. Diffuses through air spaces;

Allow concentration gradient. Reject along gradient unless direction made clear

4. Down diffusion gradient;

3 max

[7]

Q52.

(a) (i) 1. Increases (surface) area / inside surface exposed / more cells exposed / shorter distance for water to move;

2. Producing water loss;

Accept better answers, such as diffusion or osmosis relating to water loss.

2

(ii) 1. Sucrose solution / water / liquid (on the slices) would add to the mass / weight of the slices;

2. Would vary;

Ignore references to reliability

2

(b) This is initial mass / the time is too short for water to have left / the time is too short for osmosis / have not been treated;

1

(c) 1. Percentage loss in mass increases with time;

2. Texture decreases then levels out;

Only credit answers that refer to decreasing <u>and</u> levelling out.

3. (Texture levels out) after first 2 hours;

3

(d) 1. Plot graph of percentage loss in mass against time;

2. Draw curve (of best fit);

Although curve is the technical term accept references to line etc

3. Extrapolate / record when no further change in mass / record when curve flattens out;

3

[11]

Q53.

(a) (i) 1. Allows results to be compared;

2. Because initial masses may have been different;

2

(ii) 1. Quantitative measure (of cooking);

2. Ensures all cooked to same extent as not all turkey pieces same shape / thickness;

2 Emphasis here must be on being cooked to the same extent. Do not accept reference to all being cooked.

2

(iii) 1. (Yes) Loss of water results in loss in mass;

2. (No) Loss of other substances / other substances being burnt;

No marks should be given for "Yes" or "No"

2

(b) 1. Water potential in brine lower than in cells / meat;

Accept water potential more negative or converse answers

2. Water would move out of the meat / water does not move out of the meat;

2

[8]

Q54.

(a) (i) 1. <u>Water potential</u> same (inside and outside) / no <u>water potential</u> gradient;

Accept symbol Ψ or abbreviation WP as alternatives to water potential.

2. <u>Water</u> does not enter / leave spores;

3. By osmosis / prevents osmotic damage;
Answer must refer to osmosis.

2 max

(ii) Prevents growth (before ready) / stops growth of (other) microorganisms / slows enzyme action / prevents enzymes being denatured;

1

(b) 1. Nitrogen / N / sulfur / S;

2. Catalase is a protein / catalase is made up of amino acids / enzymes are proteins / enzymes are made up of amino acids;
Specific reference needed to proteins or amino acids.

2

(c) 1. Prevents contamination by (other) microorganisms;
Accept alternatives such as microbes, bacteria, other fungi.

2. Which also produce the enzyme / catalase / which would produce substances that affect catalase;

2

(d) (i) 90 hours;
Hours must be specified in answer to (c)

1

(ii) 70 – 80 (hours);
Allow with no reference to units.
Incorrect units negates answer.

1

(e) 1. Extra steps (with intracellular enzymes);

2. Cells have to be broken open;

3. Cell walls / bits of cells have to be removed / separated from enzyme;

4. Needs to be separated from all the other enzymes in the cell;

2 max

[11]

Q55.

1. Vaccines contain antigens / dead / weakened pathogens / antigens dead / weakened pathogens are injected;
Ignore references to T or B cells.

2. Memory cells made;

3. On second exposure memory cells produce antibodies / become active / recognise pathogens;
3. Idea of memory cells responding.

4. <u>Rapidly</u> produce antibodies / produces <u>more</u> antibodies;
4. Production of antibodies must be qualified for mark.

Underlined ideas essential.

5. Antibodies destroy pathogens;

5. Accept bacteria / viruses etc but not disease

[5]

Q56.

(a) Nitrification;

Accept nitrifying.

Do not accept nitrogen fixing.

1

(b) 1. Uptake (by roots) involves active transport;

Reject all references to bacteria

2. Requires ATP / aerobic respiration;

2

(c) (i) 1. Not enough time / fast flow washes bacteria away;

"Not enough time for bacteria to convert all the ammonia to nitrate" gains 2 marks

2. (Not all / less) ammonia converted to nitrate / less nitrification;

2

(ii) 1. Algal bloom / increase in algae blocks light / plants / algae die;

2. Decomposers / saprobionts / bacteria break down dead plant materials;

3. Bacteria / decomposers / saprobionts use up oxygen in respiration / increase BOD causing fish to die;

3. Accept alternatives such as microbes / saprophytes.

3

[8]

Q57.

(a) (i) Hydrolysis;

Accept phonetic spelling.

Ignore reaction.

1

(ii) (Alpha) glucose;

Accept α glucose.

Reject β glucose / beta glucose

1

(b) (i) Add Benedict's (reagent) <u>and</u> heat / warm;

Red / orange / yellow / green (colour);

Reject Add HCl

Accept brown, reject other colours

2

(ii) 2 products / 2 sugars produced;

*Look for idea of **<u>two</u>***

Accept named monosaccharides produced.

‘‘More” insufficient for mark

Neutral if incorrect products named

Neutral ‘‘lactose is a polysaccharide”

Neutral “lactose is not a reducing sugar”

Neutral: Reference to surface area.

1

(c) 1. Galactose is a similar shape / structure <u>to lactose</u> / both complementary;

Q Reject: <u>Same</u> shape / structure

2. (Inhibitor / Galactose) fits into / enters / binds with <u>active site</u> (of enzyme);

Accept blocks active site

3. Prevents / less substrate fitting into / binding with (active site) / fewer or no E-S complexes;

Look for principles:

1. Shape

2. Binding to active site

3. Consequence

2 max

[7]

Q58.

(a) 1. Uses energy / ATP;

2. Against concentration gradient / low to high concentration;

3. Does not use channel proteins / <u>only</u> uses carrier proteins;

Assume ‘‘it” refers to active transport.

1. Facilitated diffusion is passive - neutral

2. Along / across concentration gradient - neutral

Accept up / down concentration gradient

Accept AT does not need concentration gradient.

2 max

(b) (i) To see the effect of the drug / effect not due to anything else in the tablet;

Neutral ‘‘to compare results”

1

(ii) Placebo / dummy drug / tablet without drug;

(Otherwise) treated the same;

No drug - neutral

Accept: Example e.g. tablet given at same time

2

(c) Decrease for 3 hours;

Accept decreases from 1 - 4 hours

1

[6]

Q59.

(a) Cell wall;

Starch (store);

Chloroplast;

Accept: phonetic spelling

2 max

(b) Insoluble;

Reduces / 'stops' water entry / osmosis / does not affect water potential / is osmotically inactive;

Accept: description for first point e.g. 'does not dissolve'.

2

(c) Light sensitive eyespot / eyespot detects light;

Flagellum enables movement towards light;

Chloroplast / chlorophyll absorbs light / for photosynthesis;

Do not penalise references to 'many chloroplasts'.

3

[7]

Q60.

(a) Water will affect the mass / only want to measure water taken up or lost;

Amount of water on cylinders varies / ensures same amount of water on outside;

Neutral: removes water

Accept: '(sodium chloride) solution' for water

Do not accept 'sodium chloride'

Neutral: refs. to fair testing

2

(b) 4 cm^3 (of 1.0 mol dm^{-3} sodium chloride solution) and 16 cm^3 (of distilled water);

Reject: factors and multiples of these figures e.g. 2 cm^3 and 8 cm^3, as final volume should be 20 cm^3

1

(c) Allows comparison / shows proportional change;

Idea that cylinders have different starting masses / weights;

Reject: if comparison is in context of the start and final mass of the same cylinder

Neutral: different masses

Neutral: different starting sizes

2

(d) (Allows) anomalies to be identified / ignored / effect of anomalies to be reduced / effect of variation in data to be minimised;

Makes the average / mean / line of best fit more reliable / allows concordant results;

Accept: 'outliers' instead of anomalies

Q *Reject: abnormalities*

Reject: idea of not recording anomalies / preventing anomalies from occurring

Accept: 'cancels out anomalies' as bottom line response

Q *Reject: makes the average / mean more accurate*

Neutral: makes the average / mean more valid

Neutral: makes 'it' / results / conclusion more reliable

2

(e) 0.35 (mol dm^{-3})

1

[8]

Q61.

(a) 1. (Simple / facilitated) <u>diffusion</u> from high to low concentration / down <u>concentration gradient</u>;

Q *Do not allow across / along / with concentration gradient*

2. Small / non-polar / lipid-soluble molecules pass via phospholipids / bilayer;

Reject: named molecule passing through membrane by an incorrect route

Accept: diagrams if annotated

OR

Large / polar / water-soluble molecules go through proteins;

3. <u>Water</u> moves by osmosis / from high water potential to low water potential / from less to more negative water potential;

4. <u>Active transport</u> is movement from low to high concentration / against <u>concentration gradient</u>;

Only penalise <u>once</u> if active transport is not named
e.g. 'movement against the concentration gradient involves proteins and requires ATP' = 2 marks

5. Active transport / <u>facilitated diffusion</u> involves proteins / carriers;

Accept: facilitated diffusion involves channels

Reject: active transport involves channels

6. Active transport requires energy / ATP;

7. Ref. to Na^+ / glucose co-transport;

Credit ref. to endo / exocytosis as an alternative

5 max

(b) 1. Many alveoli / alveoli <u>walls</u> folded provide a large surface area;
Neutral: alveoli provide a large surface area

2. Many capillaries provide a large surface area;

3. (So) fast <u>diffusion</u>;
Neutral: greater / better diffusion
Neutral: fast gas exchange
Allow 'fast <u>diffusion</u>' only <u>once</u>

4. Alveoli or capillary walls / epithelium / lining are thin / short distance between alveoli and blood;
Reject: thin membranes / cell walls
Accept: one cell thick for 'thin'

5. Flattened / squamous epithelium;
Accept: endothelial

6. (So) short <u>diffusion</u> distance / pathway;

7. (So) fast <u>diffusion</u>;

8. Ventilation / circulation;
Accept: descriptions for ventilation / circulation

9. Maintains a diffusion / concentration gradient;

10. (So) fast <u>diffusion</u>;
Do not double penalise if description lacks detail
e.g. thin membranes so a short diffusion distance = 1 mark

5 max

[10]

Q62.

Affects germination of Y more than (germination of) X;

After four days:
No effect on (germination of) X up to 15 (mmol dm^{-3}) and then constant decrease / (causes) sharp decrease in (germination of) Y up to 15 (mmol dm^{-3}) and then more gradual decrease;

After eight days:
Decrease in (germination of) X up to 45 (mmol dm^{-3}) and then no further decrease / sharp decrease in (germination of) Y up to 15(mmol dm^{-3}) and then more gradual decrease;

[3]

Q63.

(a) (i) (Lactose +) <u>Water</u>; → (Glucose +) <u>Galactose</u>;
Accept: H_2O for water

2

(ii) <u>Hydrolysis</u>;

Accept: if phonetically correct

1

(b) (i) (Add Biuret reagent to both solutions) – no mark;
Neutral: positive / negative result

Lactase / enzyme will give purple / lilac / mauve;
Neutral: incorrect reference to the method

OR

Lactose / reducing sugar will not give purple / lilac / mauve / will remain blue;

1

(ii) Lactase / enzyme is a protein;
Accept: lactase / enzyme contains peptide bonds

1

[5]

Q64.

(a) (i) 1.08;
Must be to 3 significant figures, as in the table

1

(ii) Allows comparison / shows proportional change;
Neutral: sizes / amounts

Idea that discs had different starting masses / weights;
Neutral: different masses

2

(iii) (Allows)
Accept: outliers instead of anomalies

Anomalies to be identified / effect of anomalies to be reduced / effect of variation in data to be minimised;
Reject: idea of not recording anomalies / preventing anomalies from occurring

A mean to be calculated;
Neutral: average

2

(b) (i) Plot (sodium chloride) concentration against ratio / draw line of best fit;
Reject: if wrong axes or type of graph

Find (sodium chloride concentration from the graph) where the ratio is 1 / there is no change in mass;

2

(ii) Line / curve of best fit is more reliable / precise;
Neutral: graph

Intercept / point where line crosses axis is more reliable / precise;

Reject: references to 'more accurate'

OR

Can plot SD values / error bars;

(To show) variability about the mean / how spread out the results are;

2

[9]

Q65.

(a) (Blood) plasma;

1

(b) More / larger proteins / less urea / carbon dioxide / more glucose / amino acids / fatty acids / oxygen / high(hydrostatic) pressure;

***Q** Reference to blood cells / water potential = neutral*
***Q** <u>No</u> Protein should not be credited*

1

(c) (i) <u>Contracts</u>;

***Q** Do not accept pumping of heart / heart beating*

1

(ii) Loss of fluid / volume;

Friction / resistance (of capillary wall);

***Q** Reference to a narrow lumen is not sufficient to gain a mark unless friction or resistance is mentioned.*

1 max

(d) <u>Water potential</u> (in capillary) not as low / is higher / less negative / water potential gradient is reduced;

More tissue fluid formed (at arteriole end);

Less / no <u>water</u> absorbed (into blood capillary) by <u>osmosis</u>; (into blood capillary);

***Q** The last two marking points must be in context of movement into the blood capillary*

3

[7]

Q66.

(a) No effect on dry mass / <u>small</u> increase in dry mass;

Decrease in fresh mass;

Ignore reference to figures.

2

(b) Water potential inside tomato plant becomes higher / less negative;

Water drawn out of tomato plants / more difficult for tomato plants to take up water;

By osmosis;

Most of the fresh mass is (mass of) water;

3 max

[5]

Q67.

(a) Lengthways / down the root;

Through one tissue only / through same part / same proportion of tissues;

2

(b) To prevent the water from evaporating / prevent evaporation;

Changing the concentrations / water potential (of solution);

2

(c) (i) Plot data on a graph;

Find (sucrose concentration) from the graph where the ratio is 1;

2

(ii) No, because the results are given as a ratio / as a proportion of initial length;

1

[7]

Q68.

(a) (i) Many people do not go to the doctor;

1

(ii) 36000;

No marks awarded for working here as calculation is very straightforward

1

(b) Same sugars / antigens on bacteria / nerve cells;

Do not accept references to same shape as equivalent to complementary.

Bind with antibody / form antigen-antibody complex;

Reject react

Have complementary shape / fit binding site;

Reject active site

3

(c) Diaphragm will not move down / flatten / contract;

Ignore references to breathing out

Thoracic cavity / lung volume not increased so cannot breathe in;

2

[7]

Q69.

(a) (i) no cell wall / only has (plasma) membrane;

1

(ii) has capsule / slime layer;

1

(b) correct approach which makes use of scalebar; *ignore* reference to units.

1

(c) cellulose / starch / amylose / amylopectin;

1

(d) (i) <u>water potential</u> lower / more negative in cell;
(water enters by) <u>osmosis</u>;

2

(ii) plant cell wall made of a different substance / cellulose / penicillin
does not affect cellulose;

1

[7]

Q70.

(a) partially / selectively permeable *accept semi-permeable*
allows water to pass through but not potassium nitrate / solute;

1

(b) potassium nitrate (solution);
cell wall permeable;

2

(c) water potential more negative / lower in cell E; water removed;
greater solute / sap concentration (in cell);

3

[6]

Q71.

(a) Measure diameter of field <u>with</u> ruler; And proportion taken up by the cell; or Measure length with (eyepiece) graticule / eyepiece scale;
Calibrated against stage micrometer / something of known length;
Reject divide apparent length by magnification

2

(b) Membrane / cytoplasm shrinks / pulls away from cell wall / cell plasmolysed / goes flaccid; Water moves down water potential gradient / to lower / more negative water potential; By osmosis;

3

(c) (i) Reaches equilibrium / no further / maximum change in length;
Reject osmosis takes time

1

(ii) Line / curve of best fit; Extrapolate (and read off) / find where it crosses x-axis;

2

(iii) Greater decrease / length smaller; More water removed;

Greater difference in water potential / cell with higher / less negative water potential; Starch is insoluble / has no effect on osmosis

max 2

[10]

Q72.

(a) Several / more than one polypeptide chain in molecule;

Evidence must only relate to 4° structure

1

(b) Chemical bonds formed between sulphur-containing groups / R-groups / form stronger disulphide bonds;
Bind chain(s) to each other;

2

(c) Different number / sequences of amino acids;
Bonds in different places which gives different shape;

2

(d) Outer layer of skin cells are dead / do not respire
Do not contain mitochondria / do not produce ATP / release energy;
Cells do not have required proteins / carriers;

3

(e) Advantages:

1 Small objects can be seen;

2 TEM has high resolution as wavelength of electrons shorter;

Accept better

Limitations:

3 Cannot look at living cells as cells must be in a vacuum;

4 must cut section / thin specimen;

5 Preparation may create artefact

6 Does not produce colour image;

6

[14]

Q73.

(a) greater rate of oxygen consumption / leads to greater rate of respiration and greater rate of uptake;

(allow this mark even if spread through account but cause and effect must be within the correct context)

oxygen required for respiration;
respiration produces ATP / releases energy;
(ignore ref to producing or making energy)
potassium ions taken up by active transport / against concentration gradient;

4

(b) (i) 0.25 (mol dm^{-3});

1

(ii) 1 mark Incorrect answer but derived from ratio of 1.2 and initial length of 90 mm
2 marks Correct answer of 108 mm;

2

(iii) water potential inside potato higher / less negative than in solution;
water moves out by osmosis;

2

[9]

Q74.

(a) antibiotic has diffused / spread / moved into agar;
killed / inhibited bacteria;

2

(b) largest clear area / inhibition zone / killed the most bacteria;

1

(c) disrupts cell wall / prevents cell wall synthesis;
stops DNA replication;

2

[5]

Q75.

(a) Does not have the resolution / cannot distinguish between points this close together;
As light has longer wavelength;
The key ideas in marking this part of the question are resolution and wavelength.

2

(b) Lipid soluble / small / non-polar / not charged;

1

(c) (i) Concentration <u>of sodium ions</u> (outside cell);
As concentration / independent variable increases so does the rate of diffusion;

2

(ii) Sodium ions are passing through the channels / pores at their maximum rate;
Rate is limited by the number of sodium channels / another limiting factor;

2

[7]

Q76.

(a) To prevent contamination of apparatus with other microorganisms / bacteria;
To prevent personal contact with bacteria;
To prevent release of bacteria into air;

max 2

(b) (i) Diffuses slowly;

1

(ii) B;

Produces inhibition zone greater than the minimum diameter;

2

[5]

Q77.

(i) Lack of ATP;
Pump = <u>active</u> transport / requires <u>energy</u> / ATP provides <u>energy</u> / transport is up concentration gradient;

2

(ii) Concentration of Na^+ inside cell no longer less than concentration in gut lumen / no longer a concentration gradient;
No (facilitated) diffusion of NA^+ ions possible / amino acid absorption requires diffusion of Na^+ ions into cell;

2

(iii) Diffusion / facilitated diffusion;

1

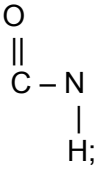
[5]

Q78.

(a) Rate of movement / diffusion proportional to concentration gradient / difference in concentration;
High concentration of potassium ions inside cell compared to outside;
Must mention high concentration. Ignore reference to other factors if reasoning is appropriate.

2

(b) (i)



1

(ii) 10;

1

(c) Action of vanilomycin depends on fluidity of membrane;
Fluidity reduced / not fluid at low temperatures;
Pore formed by gramicidin A remains in place / permanent;

3

(d) Pore between sterol molecules lined with polyene antibiotic;
Hydrophobic region next to sterol;

2

[9]

Q79.

(a) Large surface area to volume ratio;
For diffusion;
OR
Flat / thin;
So oxygen can reach all haemoglobin / centre rapidly / short pathway;

max 2

(b) (i) Partially permeable / allows water through but not sucrose;
Accept semi-permeable / selectively permeable.

1

(ii) Phospholipid (in membrane) / bilayer dissolved / broken down;
Allows haemoglobin / contents to leak out;

2

[5]

Q80.

(a) (i) Pattern described as constant / decrease to 04.00 / 06.00 then rising;

1

(ii) Corresponds to ventricles contracting / systole;

1

(iii) Less / little difference between maximum and minimum / less variation / constant / not pulsed / smoother;
pressure in vein lower

2

(b) (i) The larger the molecule, the less permeable;
Over 68 000 walls not permeable;

2

(ii) Plasma proteins / albumin and globulin too large to leave capillary;
Water lost / Increase in concentration of proteins in blood / plasma;

2

(iii) Haemoglobin in red blood cells /
Haemoglobin too large to pass through membrane of RBC /
Red blood cells (containing haemoglobin) too large to pass through wall;

1

[9]

Q81.

(i) In all cases reject 'energy' unless qualified

A – facilitated diffusion as transport protein needed but ATP not needed;
B – active transport 'energy' unless as (transport protein and) ATP needed; qualified
C – (simple) diffusion as neither ATP nor transport protein needed;
(Ignore all references to concentration gradients)

3

(ii) creates low concentration of amino acids / Na^+ in cell concentration gradient established between lumen and cell (of amino acids or Na^+)

2

[5]

Q82.

(a) Digestion / hydrolysis / breakdown of a disaccharide into monosaccharides;

OR
(glucose and galactose form lactose) glucose is a monosaccharide;

max 1

(b) (i) Dipeptidase / disaccharidase / named disaccharidase;

1

(ii) Enzymes not lost (with gut contents) / more effective absorption of products formed by these enzymes;

1

(c) No ATP formed / no energy released by respiration;
[reject "making" energy]

Link ATP to active transport (of galactose) into cells;

2

[5]

Q83.

(a) (i) 31 / 31.2;

1

(ii) Ratio would be less / smaller;
Cell is thin / has large surface area / (adapted) for diffusion;
Accept converse. Must relate to concept of ratio.

2

(b) (i) 6;

1

(ii) 11;

1

(c) Water potential inside vesicle more negative / lower;
Water moves into vesicle by osmosis / diffusion;

2

(d) Mitochondria supply energy / ATP;
For active transport / absorption against concentration gradient / synthesis / anabolism / exocytosis / pinocytosis;
Do not credit references to making, creating or producing energy.

2

(e) 1 Phospholipids forming bilayer / two layers;
2 Details of arrangement with "heads" on the outside;
3 Two types of protein specified;
e.g. passing right through or confined to one layer / extrinsic or intrinsic /
channel proteins and carrier proteins /
two functional types
4 Reference to other molecule e.g. cholesterol or glycoprotein;
5 Substances move down concentration gradient / from high to low concentration;
Reject references to across or along a gradient
6 Water / ions through channel proteins / pores;
7 Small / lipid soluble molecules / examples pass between phospholipids /

through phospholipid layer;
8 Carrier proteins involved with facilitated diffusion;

Ignore references to active transport.

Credit information in diagrams.

max 6

[15]

Q84.

(a) Transports Na^+ and K^+ ;
By active transport / pump / against concentration gradient;
Restores ion balance after an action potential;
[*reject* K^+ out and Na^+ in]

2

(b) (i) each protein has a specific tertiary structure / shape;
because the ions have different sizes / shape / charge;
[*reject* receptors binding]

2

(ii) fewer protein B molecules, which transport sodium ions / more protein A molecules, which transport potassium ions;

1

[5]

Q85.

(a) *two of the following:*
form(water) impermeable barrier to water-soluble substances / selectively permeable / allows non-polar molecules to pass through;
allows cell to maintain different concentrations either side;
makes membranes self-sealing / able to fuse with other membranes / able to form
vesicles / gives flexibility / fluidity;

2 max

(b) (surface / extrinsic protein) for cell recognition / binding to hormones / identification

1

(c) (i) involves carrier / transmembrane / transport proteins;
(reject channel proteins)

1

(ii) requires energy / requires use of ATP / moves substances / ions / molecules against a concentration gradient;

1

(iii) the curve levels off above a certain external concentration of substance; as channel proteins are saturated with molecules (and no more can be carried);

2

[7]

Q86.

(a) contain nitrogen-fixing bacteria in roots / nodules (so don't need fertiliser);

nitrogen containing compounds added to the soil
when plant dies / after harvest of crop;

2

(b) low(er) / more negative water potential in soil (than in the plant);
prevents roots from taking up water (from the soil) / plants still lose water by transpiration; plants lose water to soil by osmosis;

2

Q87.

(i) less / no calbindin protein;
{reject carrier protein)
calcium not transported / moved (across the cytoplasm);
so diffusion gradient reduced at small intestine interface;

2

(ii) **A** is channel / pore protein (for calcium ions);
passage by facilitated diffusion down diffusion / concentration gradient;

2

B is carrier protein(for calcium ions);
passage by active transport against concentration gradient
/ requires energy / ATP;

2

[6]

Q88.

(a) feature and adaption; for example

1 phospholipid bilayer (as a barrier);
2 forms a barrier to water soluble / charged substances /
allows non-polar substances to pass

OR

maintains a different environment on each side / compartmentalisation;

3 bilayer is fluid;
4 can bend to take up different shapes for phagocytosis /
form vesicles / self repair;
5 channel proteins (through the bilayer) / intrinsic protein;
6 let water soluble / charged substances through / facilitated diffusion;
7 carrier proteins (through the bilayer);
8 allow facilitated diffusion / active transport;
9 surface proteins / extrinsic proteins, glycoproteins / glycolipids;
10 cell recognition / act as antigens / receptors;
11 cholesterol;
12 regulates fluidity / increases stability;

6 max

principle mark (only for 5, 6, 7, 8)
proteins transport material across the membrane

3 features max

(b) curve description:

1 Curve goes down when the poison is added and rises when ATP added;

1

explanation:

2 Ion movement is by active transport;
3 ATP / energy needed for active transport;
4 respiration provides ATP / energy;
5 poison inhibits / stops respiration / ATP production;

3 max

[10]

Q89.

(a) 1 shore crab rapidly colonises / rapid growth;
2 ability to live different environments / no natural predators / will have similar / overlapping niche with native species / valid example / shore crab may be carrier of disease;
3 shore crab better competitor / more aggressive;
4 decreased population of prey species;
5 ecosystem less stable;

5

(b) between A and B water potential of blood rises as water potential of blood rises as water potential of surrounding water rises, after B rise in water potential less rapid / at C no further change occurs;

1

(c) No – as blood is isotonic with surrounding water / blood and surrounding water have same water potential;

1

(d) (i) water potential of blood maintained;
so (blood) cells not destroyed (by osmosis);

OR

replaces ions / salts lost diffusion;
ions / salts required for named metabolic process;

2

(ii) rate of respiration decreases;
less ATP made;
insufficient to maintain water potential of blood when in estuary;
isotonic in sea so no need to transport salts;

OR

sea temperature higher than river;
higher metabolic rate / higher enzyme activity;
advantage of this crab e.g. still able to escape from predators;

3 max

[12]

Q90.

(a) (i) absorbed by diffusion;

no energy / ATP available / active transport requires energy / ATP;

2 max

(disqualify energy made)

(allow energy reference in either (i) or (ii))

(ii) absorbed by active transport;

1

(b) (absorption by) diffusion no longer occurs / diffusion / movement of ions equal in both directions;
because no concentration / diffusion gradient / reached equilibrium;

2

(c) malonate fits into / blocks active site of enzyme / complementary to active site;
(prevents fitting neutral)
competes with substrate / is a competitive inhibitor / prevents substrate forming enzyme-substrate complex;

2

[7]

Q91.

(i) (graph shows) greater uptake (of ions) in aerobic (conditions);
aerobic respiration / conditions releases more energy / ATP
(for active transport);

(reject produces / makes energy)

2

(ii) ATP / energy limiting;
active transport stops;
diffusion gradient lost / equal concentrations of ions / no net movement of ions;

(do not allow store of ATP runs out)

1 max

[3]

Q92.

(a) cell has lower water potential than external medium;
so, water enters by osmosis;

2

(b) (i) active transport;
by specific carrier proteins / pumps;

2

(ii) sodium ions transported more into vacuole (than to outside);
because more sodium carrier proteins / pumps in vacuole membrane;
or
vacuole membrane less permeable to sodium ions / allows slower sodium ion diffusion (back out);
membrane has fewer sodium channels;

2 max

[6]

Q93.

(a) B;
D;

2

(b) idea of molecules / named molecules <u>moving</u> = Fluid;
idea of both <u>proteins and phospholipids</u> = Mosaic;

2

(c) slow rise, sharp rise, levelling off (*reject 'becomes constant'*);
<u>diffusion</u> rate increases / description of diffusion rate,
e.g. increase in kinetic energy increases loss of ions;

1

sharp rise / above 50°C proteins are denatured;
levelling off due to concentration of chloride ions in water becoming equal / maximum loss of Cl^- ions;

2 max

[7]

Q94.

(a) sterilisation of equipment (*once*);
use of pipette / syringe to transfer culture suspension to plate;
use of spreader / shake ;
detail regarding lid, e.g. keeping over plate during transfer / spreading;

3 max

(b) 2.25 = 2 marks
(*general principle* $(1.5^2 \div 1^2)$ *gains 1 mark*)

2

(c) increased temperature increases rate;
increased concentration increases rate;
increased molecule size decreases rate;
(allow increased distance decreases rate)

3 max

[8]

Q95.

(a) (i) **A** = phospholipid

B = protein;
(both correct)

1

(ii) allows movement of lipid soluble / non-polar molecules / named e.g. water / gases;
prevents movement of water <u>soluble</u> / polar molecules / named e.g. ions / amino acids;
idea of selection / membrane partially / differentially permeable / large molecules do not move through, small molecules do;
(accept semi-permeable)

2 max

(b) (i) diffusion
(reject facilitated)

1

(ii) higher rate of exchange / diffusion;
prevents cooling of the blood / prevents increase in viscosity;

2

(iii) concentration gradient maintained / equilibrium never achieved;
blood always meets fluid with lower concentration of urea;
diffusion / exchange along the whole length of surface;

2 max

(iv) $0.2 \times 60 = 12\ dm^3\ h^{-1}$;
(principle: volume per hour)

$12 \times 5 = 60\ dm^3$;
(correct answer 2 marks)

2

[10]

Q96.

(a) (i) potato more negative water potential / hypertonic;
(accept more concentrated)

water enters by osmosis causing cells to extend / become turgid;

2

(ii) little / no water remaining in potato / fully plasmolysed /
all water has moved out;
cell wall prevents further shrinkage / sucrose solution moves in;

or, water potentials are equal / equilibrium / isotonic;
no net movement of water / no further osmosis;

2

(b) (i) faster rate (of decrease) in 0.8 mol dm^{-3};

1

(ii) bigger water potential gradient / greater difference in water potentials
(between potato and surrounding solution);

1

(c) (i) water moved into the solution from the potato;
solution diluted / becomes less concentrated;

2

(ii) no net movement of water (in or out);
drops move up / less dense;

or, no net movement of water (in or out);

drop would not move / densities the same;

2

[10]

Q97.

(a) beating / pumping of heart / contraction of ventricles / heart;

1

(b) (at arterial end) hydrostatic pressure / blood pressure;
greater than pressure of water potential gradient / greater than osmotic uptake;

2

(c) removed by lymphatic system / lymph; returned to blood;

2

(d) less protein in blood;
water potential gradient is lower (less –ve / higher Ψ).

2

[7]

Q98.

(a) description of interspecific competition / competition between species / birds with beaks of different lengths;
link length of beaks to different positions of prey / reference to named bird with particular prey e.g. curlews with longer beaks able to feed on ragworms;

2

(b) variation in beak length in curlews / one species;
longer / more curved beaked curlews outcompete / at advantage / suggested advantage e.g. larger / curled beaks access more food;
reproduction;
genes passed on (to offspring);

4

(c) body has lower water potential;
water diffuses along a water potential gradient / by osmosis;

2

[8]

Q99.

(a) (i) 11g sucrose dissolved in water (and made up to) 50 cm^3 / 50g;

1

(ii) make a series of volumes of 22% sucrose solutions;
measure how far each travels up the chromatography paper;

2

(b) (i) both (volume) of nectar and (mass) of sucrose / sugar increased by regular removal;
(proportionately) greater effect on nectar than sucrose;

2

(ii) nectar from flower B has greater concentration of sugar;
(accept references to figures (A has 6.2 – 6.6 µg mm^{-3}, B has 12 – 12.4 µg mm^{-3}))

1

(iii) nectar always available for insects;

1

(c) (adding sucrose solution) decreases nectar secretion / less nectar produced than control;
(allow correct processed figures)

1

adding sucrose solution results in reabsorption of sugar

(gains 2 marks);;

(BUT adding sucrose solution reduces secretion of sugar in nectar / sugar moved out gains 1 mark);

2

(d) via (intrinsic) proteins;

(reject channel proteins)

using ATP / active transport / energy;

2

[12]

Q100.

21 – 25	Extended abstract Generalised beyond specific context	Response shows holistic approach to the question with a fully integrated answer which makes clear links between several different topics and the theme of the question. Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained. No significant errors or irrelevant material. For top marks in the band, the answer shows evidence of reading beyond specification requirements.
16 – 20	Relational Integrated into a whole	Response links several topics to the main theme of the question, to form a series of interrelated points which are clearly explained. Biology is fundamentally correct A-level content and contains some points which are detailed, though there may be some which are less well developed, with appropriate use of terminology. Perhaps one significant error and, or, one irrelevant topic which detracts from the overall quality of the answer.
11 – 15	Multistructural Several aspects covered but they are unrelated	Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question. Biology is usually correct A-level content, though it lacks detail. It is usually clearly explained and generally uses appropriate terminology. Some significant errors and, or, more than one irrelevant topic.

6 – 10	Unistructural Only one or few aspects covered	Response predominantly deals with only one or two topics that relate to the question. Biology presented shows some superficial A-level content that may be poorly explained, lacking in detail, or show limited use of appropriate terminology. May contain a number of significant errors and, or, irrelevant topics.
1 – 5	Unfocused	Response only indirectly addresses the theme of the question and merely presents a series of biological facts which are usually descriptive in nature or poorly explained and at times may be factually incorrect. Content and terminology is generally below A-level. May contain a large number of errors and, or, irrelevant topics.
0		Nothing of relevance or no response.

Commentary on terms and statements in the levels mark scheme

The levels mark scheme for the essay contains a number of words and statements that are open to different interpretations. This commentary defines the meanings of these words and statements in the context of marking the essay. Many words and statements are used in the descriptions of more than one level of response. The definitions of these remain the same throughout.

Levels mark scheme word/statement	**Definition**
Holistic	Synoptic, drawing from different topics (usually sections of the specification)
A fully integrated answer which makes clear links between several different topics and the theme of the question	All topics relate to the title and theme of the essay; for example, explaining the biological importance of a process. When considering, for example, the importance of a process, the explanation must be at A-level standard. ‘Several’ here is defined as at least four topic areas from the specification covered. This means some sentences, not just a word or two. It does not mean using many examples from one topic area.
Biology is detailed and comprehensive A-level content, uses appropriate terminology, and is very well written and always clearly explained.	Detailed and comprehensive A-level content is the specification content. Terminology is that used in the specification.

	Well written and clearly explained refers mainly to biological content and use of terminology. Prose, handwriting and spelling are secondary considerations. Phonetic spelling is accepted, unless examiners are instructed not to do so for particular words; for example, glucagon, glucose and glycogen.
No significant errors or irrelevant material.	A significant error is one which significantly detracts from the biological accuracy or correctness of a described example. This will usually involve more than one word. Irrelevant material is several lines (or more) that clearly fails to address the title, or the theme of the title.
For top marks in the band, the answer shows evidence of reading beyond specification requirements.	An example that is relevant to the title and is not required in the specification content. The example must be used at A-level standard.
Response mostly deals with suitable topics but they are not interrelated and links are not made to the theme of the question.	Not addressing the biological theme of the essay (e.g. importance) at A-level standard.

Please note that to obtain full credit, students must use information to show **the importance of osmosis to living organisms.**.

Topics

1	definition (D)
2	effects on cells (C) turgity and support plasmolysis (idea) lysis
3	importance in animals (A) role in relationship between plasma and tissue fluid role in medulla of kidney reabsorption in gut *sweat production neutral*
4	importance in plants (P) role in movement of water from soil to leaves in plants

	role in mass flow hypothesis for movement in plants

1	ATP (A) synthesis from ADP and P role as an energy source
2	photosynthesis (P) excitation of electrons generation of ATP and reduced NADP photolysis reduction of glycerate phosphate to carbohydrate structure of chloroplast in relation to energy transfers
3	respiration (R) net gain of ATP in glycolysis production of ATP in Krebs cycle synthesis of ATP associated with electron transfer chain ATP production in anaerobic respiration structure of mitochondrion in relation to energy transfers
4	uses of energy in biological processes (B) active transport muscle contraction nerve transmission synthesis translocation kidney function nitrogen fixation receptors

In order to fully address the question and reach the highest mark bands students must also include at least four topics in their answer, to demonstrate a synoptic approach to the essay.

Students may be able to show the relevance of other topics from the specification.

Note, other topics from beyond the specification can be used, providing they relate to the title and contain factually correct material of at least an A-level standard. Credit should not be given for topics beyond the specification which are below A-level standard.

[25]

Q101.

(a) passive / do not require energy / ATP;
movement down a concentration gradient / by diffusion;
go through phospholipid (bilayer) / not by protein / carriers;

(not by active transport gains mark if no other mark awarded)

2 max

(b) active transport;

1

occurs when oxygen present because energy / respiration required, or against a concentration gradient because there is no uptake in curve **Z**;

1

(c) concentration inside cells higher than surrounding solution;

1

(d) diffusion is proportional to the concentration gradient;

1

[6]

Q102.

(a)
1. permeable capillary wall / membrane;
2. single cell thick / thin walls, reduces diffusion distance;
3. flattened (endothelial) cells, reduces diffusion distance;
4. fenestrations, allows large molecules through;
5. small diameter / narrow, gives a large surface area to volume / short diffusion distance;
6. narrow lumen, reduces flow rate giving more time for diffusion;
7. red blood cells in contact with wall / pass singly, gives short diffusion distance / more time for diffusion;

(allow 1 mark for 2 features with no explanation)

4 max

(b)
1. (hydrostatic) pressure of blood high at arterial end;
2. fluid / water / soluble molecules pass out (*reject plasma*);
3. proteins / large molecules remain;
4. this lowers the water potential / water potential becomes more negative;
5. water moves back into venous end of capillary (*reject tissue fluid*) by osmosis / diffusion;
6. lymph system collects any excess tissue fluid which returns to blood / circulatory system / link with vena cava / returns tissue fluid to vein;

6

[10]

QWC 1

Q103.

(a) rate of photosynthesis increased;
normal atmospheric concentration a limiting factor / more / faster production of biomass or sugars / more products of photosynthesis transported to fruits;

2

(b) (increased temperature) increases rate of respiration;

rate of photosynthesis too low to replace respiratory loss

2

(c) lower water potential of nutrient solution;
less water absorbed into roots (by osmosis);
(not: water lost from roots)

2

[6]

Q104.

(a) (i) presence of -COOH group;

1

(ii) similar structure so fit same protein / receptors;

1

(b) 2,4-D adds to effect of IAA (already present) / affects all cells;
stimulates growth in parts other than growing points / stimulates uncontrolled growth / makes walls of cells stretch too much / makes growth outstrip nutrient availability;

2

[4]

Q105.

(a) phospholipids in a double layer / area covered is twice total surface area of red blood cells;
evidence of calculation of number × surface area ($4.74 \times 10^9 \times 99.4\ \mu m^2$) /
calculation of area of 1 cell $\frac{0.92}{4.74 \times 10^{-9}}$;
$0.471\ m^2 \approx 0.5 \times 0.92\ m^2$ / $194\ \mu m \approx 2 \times 99.4$;

3

(b) EITHER feature + explanation
red blood cells do not contain organelles / nucleus;
so only surface membrane / no internal membranes in macerate;
OR
red blood cells have simple / regular / spherical shape;
so easy to calculate surface area;
OR
any two features, e.g.
simple / regular shape;
all same size;

2

[5]

Q1.

Question (a) was a question requiring recall of a definition from the specification. Almost 60% of students gained the mark; those who failed to score only gave the first part of the definition, i.e. it is a small unit. Many students also used simpler descriptive words, such as ‘building blocks.’

Question (b) required a similarity and a difference; students generally performed well with the similarity, but failed to give a difference, with answers such as “lactulose contains fructose”. Students must state the actual difference when asked, e.g. lactulose contains fructose but lactose contains glucose.

Question (c) showed that many students do not understand high and low water potentials, confusing the two. Also, many students thought water moved from the lactulose solution into faeces, thereby showing a lack of understanding of water movement by osmosis. Only 28.6% scored two marks.

In question (d), students did not show an understanding of how to use standard form, with many choosing to ignore it. Only 12.2% of students scored two marks, and 77.9% scored zero. A common error was to base the calculation on the lower range of H^+ concentration.

Q2.

Most answers to (a) achieved one mark for describing the movement of substances down a gradient. Some went further to identify the concentration gradient in diffusion and the water potential gradient in osmosis. No marks were awarded when movement was described inaccurately as being along or across a gradient, or from one gradient to another gradient. A commonly held misconception about passive processes was found in a large number of answers which described these processes as ‘requiring no energy’.

Many students answered question (b) well by applying an understanding of facilitated diffusion to explain the shape of the curve and 9.3% of them achieved all three marks. Often these explanations demonstrated logical progression of thought, by describing a trend in the data and explaining how the action of carrier proteins accounted for it. The principles of diffusion were well understood. The most common errors were to suggest that the loss of a concentration gradient accounted for levelling off in the curve or to write about no uptake between C and D: they suggested these students had not taken sufficient notice of the y-axis label. The description of a correlation, to achieve the second marking point, was often little more than a ramble of tortuously unclear comparisons. A significant minority referred incorrectly to enzyme active sites in the context of carrier proteins.

In question (c), on the whole, students demonstrated good ability to apply their understanding of facilitated diffusion and membrane structure to the graph and scored marks. Their ability to describe the relationship shown by the monoglyceride curve, however, was weaker. Many described the change in rate as ‘constant’, when what they really meant was ‘constant increase’, or they did not include both variables in the description of the relationship. Some stated incorrectly that concentration had no effect on the rate of uptake. Most students understood that the graph indicated the absence of active transport and carrier proteins. Students often went on to discuss the phospholipid bilayer, but occasionally failed to mention diffusion or the solubility of monoglycerides in the bilayer.

Q3.

This question was loosely based on the skills students would have developed when completing required practical activity 2 – “Preparation of stained squashes of cells from plant root tips; set-up and use of an optical microscope to identify the stages of mitosis in these stained squashes and calculation of a mitotic index”. Students should have observed cells undergoing mitosis surrounded by many cells that were not and, therefore, should have considered why they looked different.

Many incomplete answers were seen to question (a). Students were required to give evidence **and** to explain that piece of evidence, but often only gave half the story. Some students used **Figure 2** rather than **Figure 1** and some tried to explain which stage of mitosis was shown, rather than simply that it was happening. Confusion was demonstrated here and in question (e) between a homologous pair of chromosomes and a pair of chromatids in a single chromosome. Worryingly, 62% of students failed to score on this opening question; only 5.8% gained both marks.

In part (b), 69.3% of students correctly identified that these cells were in prophase.VWithin required practical activity 2, students needed to spread the cells out to gain a clear view; question (c) was based on a similar principle, but using a different method. It required standard knowledge of osmosis, but the novel context threw many students. The majority could state that the water would move into the cells by osmosis, but then often referenced increased pressure, rather than the idea of the volume of the cells increasing. Some complex, incorrect answers were seen in which students attempted to describe changes in polar interactions between the chromosomes and water, and how these would change.

Question (d) tested Assessment Objective 2 (application of knowledge) and there were several parts of the specification from which students could select material to support their answer. 42.2% did this successfully; those who did not often did not describe sufficiently how a feature would be different along the length of the chromosome to result in the striped appearance. For example, mentioning “histones” or “bases” alone was not creditworthy.

In question (e), only 36.9% of students could define the term ‘homologous chromosome’. It is likely that more students could have written about independent segregation or crossing over of homologous chromosomes, but this question revealed that they did not fully understand this biological term. Many students only referred to the origin of the chromosomes as paternal and maternal.VFor question 01.6, most students (83.2%) scored at least one mark, but there were many good answers limited to one out of two by demonstration of fundamental misunderstanding. The most common of these was that only eukaryotic DNA is a double helix and that prokaryotic DNA is single-stranded.

Q4.

This question was based on a variant of required practical activity 3 – “Production of a dilution series of a solute to produce a calibration curve with which to identify the water potential of plant tissue”.

Although question (a) was based on a more straightforward investigation of osmosis, very similar principles apply to those used when carrying out the required practical. When asked for a method, students must write out what actions need to be carried out as if instructing a fellow student. Generic statements, such as “keep the temperature the same” or “record the mass at set intervals”, were not credited. Instead, students should give specific instructions about how the results would be obtained, for example using a water bath set to 30°C, removing the potato chips every 10 minutes to record their mass, and blotting the potato chips dry with a paper towel.

Question (b) was the first question on the paper testing mathematical skills (specifically MS 3.5 and MS 4.1). Students needed to calculate rate of change from a graph showing a

linear relationship; this was the most successfully completed part of the calculation, although using the wrong part of the graph or incorrectly reading from the graph was not uncommon. Students also needed to calculate the surface area of the one large cube and the eight smaller cubes, but only a small number of students could do this correctly. Only 5% could correctly combine these to come up with two correct rates per unit surface area. There was a small but sizeable minority of students who did not show the steps in their calculations, but just gave the final (incorrect) answer, meaning it was not possible to award any marks. A small minority wrote descriptions of the change in mass shown by the graph, or explained why the cubes with large surface area would lose mass more quickly, without any calculations, thereby ignoring the question stem. Disappointingly, 56.4% of students failed to gain even one mark for this question.

Q5.

There were no problems with question (a); it was well answered.

Question (b) asked for the advantages of lipid droplet **and** micelle formation. Students seemed to group both together ('they' or 'it') and give the same advantages. Many students failed to use the diagram to help them. For mark point two, there were lots of answers referring to making digestion easier; easier digestion does not equate to faster digestion. Only 3.7% of students scored all three marks.

As with (b), students did not use the diagram to help them answer question (c). Most answers just referred to lipids rather than to triglycerides. There were also a lot of generic answers of "packages and processes proteins"; failing to acknowledge that the question is about triglycerides, not proteins. There were several answers stating that the Golgi apparatus produces proteins from lipids or mistaking lysosomes for vesicles. Only 2.9% scored four marks, with over 70% scoring 1 or 2 marks.

Q6.

Considering question (a) tested recall from the specification, the answers were not strong. Only 32% of students scored all three marks. Some did not seem to consider **properties** of water, so stated 'condensation' and 'hydrolysis'. Some of the properties were confused, for example 'high latent heat capacity', and some were incomplete, for example just 'latent heat of vaporisation' and 'heat capacity' but neither stated as high.

Question (b) scored surprisingly badly with only 28% of students gaining the mark. Most answers simply stated dilution. Some odd methods were suggested including "Benedict's test", "colorimetry" and "heating gently".

The main issue with question (c) was not being able to calculate the ratios, despite being told how to do so in the question. Examiners saw many scripts in which axes had been drawn, but no data points plotted. 81% of students scored at least one mark, but only 22% scored all three marks.

The majority of answers given for question (d) were at GCSE level and only 41% of students scored two marks. The most common error was a failure to use the term water potential.

Q7.

Practical question (a) was poorly answered by students with only 3% gaining both marks. It was not uncommon for students to write about water potential and those who did refer to the concentration of the pigment rarely linked too much water with a less concentrated solution, or the converse. General answers relating to controlling variables were also frequent. Surprisingly few students realised that using the same volume of water was

necessary to make the results comparable.

In answering question (b), only 17% of the students stated correctly that to monitor the temperature, several readings of the temperature must be taken. Most thought that placing a thermometer in the tube or using a water bath would monitor the temperature.

Almost half of the students could draw a suitable curve between the points in question (c). Both a smooth S-shaped curve and ruled point-to-point lines were accepted. Those who did not gain this mark often extrapolated the line beyond the points given, or drew an inappropriate curve.

In answering question (d), a quarter of the students gained at least 1 mark. These students usually wrote about damage to the cell-surface membrane whilst a few students enhanced their answer with a more detailed explanation of membrane proteins denaturing or increased fluidity of the phospholipid bilayer. Reponses failing to gain credit often referred to enzymes or kinetic theory and it was not uncommon to see references to the cell wall bursting.

Q8.

This question tested topics 3.1.2 and 3.2.3 with a combination of AO1 and AO2.

(a) The majority of students scored mark point 2 for the idea that glycogen is a branched molecule or that it contains glycosidic bonds. Although many students knew that glycogen is a ‘chain’ of alpha glucose, fewer could use the correct terminology to state that it is a polysaccharide or a polymer. Students must take care to specify alpha glucose or α-glucose rather than a-glucose. It was not uncommon for students to describe glycogen as if it were identical to starch and to include references to amylose and amylopectin in their answers.

(b) This question required a little application of biological principles, with students’ knowledge of glycogen. Many students started their answers with reference to branching molecules providing many ‘ends’ for enzymes – this was not relevant and is indicative of students rushing to write all they know, rather than considering what is relevant to answer the specific question asked. As with question (a), students often knew the basic principle of breaking down glycogen to release the glucose, but did not use the appropriate term of ‘hydrolysis’ to gain the first mark point. Many students suggested that this hydrolysis of glycosidic bonds releases energy, rather than thinking about glucose as the substrate for respiration in all human cells.

(c) Although this question gave the context of the adaptation of the cell-surface membranes of cells lining the uterus, making it an AO2 question, this should have been fairly straightforward application of knowledge from 3.2.3. Many students did not gain full marks because they seemed not to read the question sufficiently carefully. It required reference to the cell-surface membranes only, so answers relating to “one cell thick”, “many mitochondria”, or “a good blood supply” were not relevant. The question also required a suggestion **and** an explanation to gain each mark. It was not uncommon to see reference to “thin membranes”, indicating a clear confusion between the phospholipid bilayer structure of a cell-surface membrane and the epithelial layer of an exchange surface. Reference to ‘villi’ also demonstrated similar confusion and prevented a student from obtaining mark point 1. It is important to note that, when referring to protein carriers / channels, only carriers can be used for active transport; either can be involved in facilitated diffusion. Also, for a membrane to be adapted for rapid transport, it must have **more** of these proteins, rather than them just being present.

(d) As with all calculations that meet the national requirement to be at the standard of

higher tier GCSE Mathematics, this required a multi-step process. Firstly, students needed to work out that there would be 128 cells after 3 days: 2 cells after the first day, then another 6 divisions. This was where many students struggled. It was pleasing to see how many students could correctly use standard form to express their final answer. It should be noted that the convention for standard form to be correct is to have a number greater than 1 and less than 10, multiplied by 10 to a power, i.e. the decimal point should be after the **first** digit.

Q9.

(a) There were some excellent answers here, but many students did not gain marks because their answers failed to focus on the NHE3 carrier protein. Many tried to explain why the ions would move, often describing how movement of one ion would generate an electrochemical gradient allowing the other to move (by facilitated diffusion), rather than sticking with the question of **how** the active transport (as stated in the stem of the question) of these two ions could work.

(b) This question was the first test of AO3 skills in this paper and gave students their first opportunity to interpret and evaluate scientific information. There were two parts to the mark scheme. The first required students to explain why an increase in mean mass of contents in the gut would allow scientists to reach the conclusion that salt absorption had been reduced. Many students successfully achieved these two marks, although some showed confusion between the contents in the lumen of the gut and in the cells lining the gut wall. The second required students to interpret the statistical test; this was often not attempted by students and those who did were rarely completely successful. Even though the stem contained a statement to help students (The scientists carried out a statistical test to see whether the difference in the means was significant), many referred to significant 'results', and very few could correctly describe what the P value showed with appropriate use of the words 'probability' and 'chance'.

(c) This question required students to apply their knowledge of topic 3.3.4.1 and only 15% could do this with sufficient detail to score both marks. The question was carefully worded to lead students to the high salt concentration in the blood entering the capillaries, with the hope that an explanation linked to decrease in water potential of the tissue fluid would be given. Those who went down this route often scored this mark, but then referred to less 'tissue fluid' being reabsorbed at the venule end, rather than less water reabsorbed by osmosis. Students are not expected to have knowledge of how salt affects the blood, but may have some knowledge of the fact that a high salt diet can lead to an increase in blood pressure. Any explanation of how a high salt concentration increased blood pressure was ignored, and only the part of the answer focusing on what happens at the capillary bed to cause a build-up of tissue fluid was marked. Consequently, many students scored one mark for salt increasing the blood pressure (although it had to be clearly high**er** than normal; statements referring to 'high' pressure at the arteriole end were insufficient to gain credit). Only a few could go on to suggest that, as a result, **more** fluid would move out at the arteriole end of the capillary.

Q10.

This question was based on required practical activity 4 – an investigation into the effect of a named variable on the permeability of cell-surface membranes. The practical skills assessed here are found in section 8.3 of the specification.

(a) Some good understanding was demonstrated here, but students often failed to gain credit due to poor use of language. "Amount" and "level" are not accepted units; pH and light must be qualified, e.g. 'soil pH' and 'light intensity', and 'nutrients' is not an

acceptable alternative to mineral ion concentration at this level.

(b) A very small number of students achieved 4 marks here. The most commonly awarded mark was for identifying that 2,4-D increased the release of ions from wild oats but had very little effect on wheat (mark point 1). There was quite a lot to read and understand in the stem of the question, and some students did not appreciate that disruption of the cell-surface membranes was linked to loss of ions, and so damage to the plant itself. Some students confused these ions from leaves with ions in the soil and consequently suggested greater ion concentration in the water would allow more ion uptake, to be used for growth. The lowest significant difference (LSD) was a novel context, and many students did not read / understand the explanation, and assumed the LSD was a form of standard deviation.

(c) Unfortunately, many students did not fully link the context of this question to the practical they had carried out, and so were not confident in their suggestions here. Many mistakenly thought that the 2,4-D was in the water at this point. Those who did appreciate that the temperature must remain constant, to avoid further changes in membrane permeability (rather than enzyme activity), were often too vague in their responses to gain credit. Better students often appreciated that temperature would affect the rate of diffusion of ions out of the leaf discs. Why the leaf discs were shaken was generally better answered, although those who showed some idea of maintaining the diffusion gradient for ions often gave vague, imprecise answers that could not be given credit.

Q11.

(a) This was a factual recall question that discriminated well. Examiners expected students to use appropriate A-level terminology, including references to calcium ions, channel proteins and the (facilitated) diffusion of calcium ions in through the (presynaptic) membrane. Weak answers included statements about calcium crossing the membrane.

(b) This question required application of knowledge of how myosin and actin interact. Many students treated it as a factual recall question, not infrequently referring to shortening of the sarcomere. The best answers (about 12% of students) scored both marks by focusing on the information given and noted that, in this circumstance, myosin moves past actin and pulls the mitochondrion along.

(c) Around half of the students obtained one mark for noting that mitochondria produce ATP. Just over 40% got a second mark, usually for relating the use of ATP to some aspect of recycling of neurotransmitter, or the active transport of an appropriate ion. Some students failed to score the point relating to ATP because of references to ‘the production of energy’, rather than ‘the supply of energy’.

Q12.

(a) 57% of students could do the calculation and obtained both marks. Some wrongly used the diameter of the capillary tube, rather than the radius. Others neglected to multiply by 4 in order to get the rate per hour. In either case, they could obtain one mark.

(b) This question discriminated well, but only 2.3% of students got all three marks. Many correctly suggested using graph paper to find the surface area of one side of a leaf, but then failed to multiply by 2 in order to get the total surface area. Some students described how they would find the rate of water loss using the potometer and didn’t get as far as the leaves. Others described methods not using a potometer to find the rate of water loss. Some wrongly used mass/volume of water lost, rather

than rate of water loss.

(c) This was intended to be a relatively simple exercise in evaluating the method used. Only 17% of students noted that the shoot in the potometer has no roots, which is where water normally enters a plant.

(d) 56% of students obtained one mark by looking at Figure 2 and suggesting the molecules had either similar sizes, or similar shapes. Only 22% suggested both for two marks. There were many references to polarity (either polar or non-polar), but these were not credited. Some suggested that both contained oxygen, as seen in Figure 2, and this would bind to the aquaporin. This was given credit.

(e) Many students did not grasp the link between the ssRNA, coded for by the foreign gene, and blocking of translation by interference with mRNA. The question still discriminated reasonably well, but 63% of students scored zero. The observed outcome may also be due to this part of the specification not being as familiar to students as more traditional topics.

(f) Given the failure of many to comprehend what was required in (e), it was not surprising that only 28% of students obtained the mark in (f). Many were awarded a mark for suggesting that not all cells of the plant had been transformed by the foreign gene.

(g) Students performed better on this part. 18% obtained all three marks and only 10% failed to score. The question discriminated well. This evaluation proved safer ground for most, especially since SDs are actually shown in the graph. The frequency with which the mark points were awarded coincided with their order on the mark scheme.

Q25.

(a) Most gave good answers including correct reference to water potential and to osmosis. Mark point 2, however, required reference both to osmosis and that loss or gain of water would be prevented; this detail was missed by some. Mark point 3 was less often awarded as “so the valves aren’t damaged” does not fulfil the mark point and some responses did not include reference to cells or tissues as required.

(b) As stated at the beginning of this report many responses did not meet the minimum requirement set out in the mark point, both “kills / stops growth of bacteria” and “that could cause infection” or “that could damage the valve” were needed. Many partial responses were seen without fully using understanding of the action of antibiotics and why this was important in this situation.

(c) Again, partial responses were common here. The Marking Guidelines required both “(new) valve closes fully” idea <u>and</u> “so preventing blood flowing back into the heart / out of the artery”.

(d) Many descriptions of the data did not go into sufficient detail to fulfil mark points 1-3. Mark points 1 and 2 required reference to the mean increasing or decreasing <u>and</u> coming within the normal range in order to gain credit. Many students achieved mark point 3, although some did not pick out that this statement only referred to the minimum pressure. Mark point 4 was least commonly awarded with students only making use of the data in the tables when writing their responses rather than using all the information provided in the resource as suggested in the question stem.

(e) Mark points 2 and 3 were the most commonly awarded here, with mark points 1 and 4 being rarely achieved.

(f) Students generally found it difficult to use their knowledge of the definitions of standard deviation and range to give a correct response to this question.

Q26.

About two thirds obtained the mark in (a) for a correct description of the difference between a triglyceride and a phospholipid. Those who failed to score either did not know about the structure of these molecules or just described the structure of a phospholipid (or triglyceride).

In (b), about 40% of students could fully describe how to test for a lipid and obtained both marks. A minority described tests for other biological molecules. Many made errors in their descriptions of the emulsion test or of a positive result. These errors included: adding water before ethanol, heating the mixture, the presence of a precipitate and failing to note that the colour of the emulsion would be white.

Most students scored the mark in (c). Those who didn't got saturated and unsaturated the wrong way round in terms of carbon-carbon double bonds.

In (d), 28% obtained both marks for stating that the fat substitute would not bind to the active site of lipase because it has a different shape to a triglyceride. A similar percentage obtained one mark. Those who failed to score often ignored the question's reference to lipase and wrote about bile salts, micelles and methods of absorption.

Q27.

It was pleasing to see that 73% of students obtained all three marks in (a). It was also pleasing to see 80% correctly identify hydrogen bonds in (d).

In both (b) and (c), students usually appeared to ignore the diagram and the information given, despite being instructed to use both in their answers. Students were told that the diagram shows how a plant cell produces its cell wall. In the stem of (b), they were told that one function of protein Y is to transport cellulose molecules across the bilayer. The figure shows substrate molecules approaching the end of the cellulose molecules. Only 12% of students put all this together and wrote that Y was an enzyme (one mark) that makes cellulose (one mark), or that Y makes cellulose (one mark) from β glucose (one mark). Some identified Y as an enzyme for one mark but then had it breaking down cellulose into substrate. Most students (68%) wrote about Y transporting various ions or other substances not mentioned in the information or figure, or about membrane stability. In (c), many students did not seem to appreciate that evidence is something to be seen.

Q28.

(a) Approximately 50% of students correctly identified the type of enzyme as a dipeptidase. The most common incorrect response was protease.

(b) Only one in five students obtained both marks in this question. Students who obtained one mark usually correctly identified the role of either endopeptidases or exopeptidases. However, there were many students who confused the roles of these enzymes or suggested that endopeptidases work outside cells and endopeptidases inside cells.

(c) In marking this question, particular care was taken to ensure that no students were disadvantaged due to the error in the diagram. Consequently, any references to ATP producing ATP and Pi were not penalised. Most students obtained the mark for stating that the respiratory inhibitor would prevent the production of ATP. Students who did not gain this mark usually referred to the inhibitor blocking or changing the

shape of the carrier protein involved in moving the amino acid rather than mentioning ATP or active transport. Over 40% of students obtained a second mark for describing that the movement of sodium ions would be affected. Many other students simply referred to amino acids no longer being absorbed without any reference to sodium ions. Answers obtaining maximum marks clearly explained that a diffusion/concentration gradient for the movement of sodium ions would not be maintained. Again, incomplete explanations simply referred to the movement of amino acids without any reference to sodium ions. Overall on the paper, this question proved to be the most effective discriminator.

Q29.

(a) The vast majority of students correctly identified the process as diffusion. The most common incorrect responses were osmosis and facilitated diffusion.

(b) Almost two thirds of students gained at least one mark for this question. Often this was achieved by explaining that the small/thin body of a tubifex worm would provide a short diffusion distance. A significant number of students named specific features of the body of a tubifex worm but did not explain how they allowed efficient gas exchange. Conversely, some students referred to a large surface area to volume ratio without relating this to a specific body feature.

(c) Less than 5% of students gained both marks for this question. The vast majority of students did not refer to the percentage saturation of haemoglobin in relation to the partial pressure of oxygen. Most students simply stated that the haemoglobin had a high affinity for oxygen at low partial pressures of oxygen. Approximately, a third of students gained one mark, invariably for referring to the use of oxygen for respiration.

(d) Most students gained one mark for correctly stating that seawater would have a lower water potential than the tubifex worm. Almost a third of students then gained the second mark by explaining that the worm would lose water by osmosis. However, many students did not gain this second mark as they either attempted to relate water potential to oxygen uptake or failed to refer to osmosis. A significant number of students suggested that the tubifex worm would ‘burst’ in seawater despite correctly identifying the water potential gradient.

Q30.

(a) This question required recall of the mechanism for co-transport of glucose and sodium ions but only 2% were able to give the full story correctly. Many stated correctly that sodium ions were actively transported out of the epithelial cell but they often stated that the ions went into the lumen rather than into the blood. It was apparent that some students did not understand the term lumen, confusing lumen with epithelial cell, which made most of their answer incorrect. Many had both sodium ions and glucose entering the cell by facilitated diffusion with only the most able students stating that glucose enters against its concentration gradient. Weaker answers included references to transport of chloride ions or to the effect of the ions on water potential. Many students went to describe the movement of glucose from the epithelial cell into the blood which was not required. This is an exam technique issue, to understand what is asked, rather than churning out everything that has been learnt, and thus wasting lots of exam time for no gain in marks.

(b) This question discriminated well and some excellent answers were seen, with 10% gaining all 5 marks. Many students were aware of the properties of chloride ions and oxygen and how these affected their ability to cross the phospholipid bilayer, although many just wrote about the relative size of chloride ions and oxygen

molecules, often incorrectly. Students often failed to access the mark points as they were imprecise in their use of terminology. Chloride ions were referred to as chloride molecules and chloride ions or oxygen were said to be soluble, without stating in what they were soluble. Weaker responses tended to concentrate on whether the ion or molecule was needed by the cell and many wrote about osmosis and water potential.

Q31.

(a) Almost 80% of students scored both marks, in a question which tested straightforward recall. Some described pathogens entering cells and reproducing without going on to clarify the damage that would have been caused to the cells. A minority misinterpreted the question and described two ways in which pathogens were transmitted.

(b) The context of this question proved difficult for many students with fewer than half the students explaining that water would move out of the bacterial cell by osmosis because of the water potential gradient. A large number incorrectly wrote about water being drawn out of the blood and washing away the bacteria and many argued that water would enter the bacteria causing osmotic lysis. Few students went on to explain why the loss of water would kill the bacteria

Q32.

(a) Over 40% gave the correct response of regulator protein. Students who failed to score often gave a generic response about what should be in a vaccine, ‘antigen’ being insufficient for this mark. Students should ensure that they relate their answer to the information given in the question.

(b) Students were expected to have seen from the passage that the LDL would bind to a receptor on the surface membrane of the liver cell and then use their knowledge of the structure of the membrane to suggest a suitable route into the cell, for example through a carrier protein or channel protein. Many students failed to use the information in the passage and therefore could only gain one mark. A significant number of students recognised that the LDL would be lipid soluble and could pass through the phospholipid bilayer. This alternative was also credited.

(c) This question discriminated well with weaker students struggling to interpret the information given in the passage. They frequently confused the antibody-antigen response with enzymes, referring to active sites on the antibody or antigen and the formation of enzyme-substrate complexes. There was also mention of receptor "cells" and "antigens on the cell surface membrane of the regulator protein" by students who clearly had a poor understanding of the molecules. However, the more able students were able to gain two marks, usually for referring to the antibody binding to the regulator protein which prevented it from binding to the receptor.

(d) It was clear that many students had learnt a generic answer to this type of question. Most students knew that the control group would be treated the same as the experimental group but the generic response of ‘give a placebo’ was insufficient because the answer needs to be related to the information in the question. The mark scheme required students to write about injection of saline without the monoclonal antibody. The second marking point, ‘treated the same’ was sometimes expressed as ‘given the same diet’, or the ‘same amount of exercise’ or ‘have the same amount of LDLs’. It is worth noting that the same treatment will include the medical experience and measurements taken, so identifying a particular control variable, such as diet, in isolation, was insufficient to gain this mark.

Q33.

(a) Most students gave reasonable suggestions for the purpose of treatments 1 and 2 but found the purpose of treatment 3 more difficult to explain. In this question and in question (c)(i), it was important that students had read the information in Resource B stating that these leaves have stomata only on their lower surface.

(b) (i) Students still find it difficult to describe a trend on a graph such as this accurately. Many students failed to state clearly that the rate stayed constant for the first 60 minutes and then fell (as required for mark point 1).

(ii) Some students were not explicit enough in their answer that the water is lost through the stomata in order to achieve mark point 1.

(c) (i) Students who stated that there were stomata on the upper surface of the leaf could not be awarded this mark, as Resource B stated that these leaves have stomata only on their lower surface.

(ii) Most students achieved mark point 1 but only better answers went on to explain why this meant there was no uptake of carbon dioxide.

Q34.

This question was intended to provide an accessible start to the paper. In practice, it discriminated quite highly, with students who scored highly on the paper as a whole tending to get the highest marks.

(a) About two thirds obtained both marks. Quite a few students used the terms hydrophilic and hydrophobic the wrong way round. Others appeared confused about the position of the ‘heads’ and ‘tails’ of phospholipids. Some had them the wrong way round in the membrane and others had heads facing out of the cell and tails facing into the cell.

(b) (i) There were many good answers and just over 60% obtained both marks. Some students confused the roles of the rough endoplasmic reticulum and the Golgi apparatus.

(ii) A range of related functions was allowed in part (ii) and just over 70% obtained this mark.

Q35.

(a) Very few students failed to score the mark on this question.

(b) Very few students scored two marks here. Few used the term ‘confounding variable’, which made it necessary to explain the concept; weak powers of expression meant that these explanations often failed to be creditworthy. Better answers often scored on marking points 3 and / or 4.

(c) Very few students failed to score the mark on this question. It was rare to come across a spelling error.

(d) This question produced a full range of marks. Some students referred to the effect of watering on the concentration of salt in the soil, rather than the effect on yield. It was clear from the responses which students had carefully studied the resource and clearly understood the effects of the different watering treatment.

(e) This question produced the whole range of marks. Some students simply repeated

what they had written in the previous question. Many students could come up with the fact that irrigation with sea water increases the salt concentration in the soil. A few students correctly went on to relate this to lower water potential in the soil and linked this to a reduction in water uptake. Only a small number of students then considered the effects of this watering being repeated every year. This resulted in fewer responses relating to marking points 3, 4 and 5.

Q36.

(a) Students do need to refer to the Resource(s) when answering questions in this section. This question referred to differences between the curves for dog and sheep. This meant describing patterns within the curves and the overall trends. Some assessors incorrectly gave credit for statements suggesting that a higher percentage of dog cells haemolysed at lower concentrations of sodium chloride.

(b) Few had difficulty with the calculation in this question.

(c) It is generally the rule that repeating information given in a question stem, or in this case, the Resource material, attracts little or no credit. It was not enough to say that the red colour was due to a red pigment; identifying haemoglobin was vital. Furthermore, an expression of the relationship between depth of colour and the release of haemoglobin from ruptured cells was essential if full credit was to be achieved.

(d) Many students scored the first marking point, appreciating that the 0.9% sodium chloride solution does not cause haemolysis in any of the mammals. Not all assessors took into account all of the various approaches that were possible for achieving the second marking point.

Q37.

(a) Calculating percentage change still remains a problem for a number of students.

(b) Students generally did not score more than two marks for this question. Most were able to gain the ‘Yes’ mark, identifying that running times were faster after the sports drink, and recognise that both groups had shown improvement. Few considered that the runners might have drunk different volumes or that, as mean times rather than individual times were given, there could be variation in performances. It was rare to see students comment on the lack of standard error bars and the implications of such.

(c) Most students scored at least two marks in this question but some struggled to identify relevant factors beyond age and sex. There was often a lenient interpretation of marking point 6 despite the requirement that a health factor should be named.

(d) There were some excellent answers to this question but, equally, there were some very poor ones as well. In some cases, assessors gave credit when the required answer for a particular marking point was incomplete. This was particularly noticeable with marking points 3, 5 and 6. Many students omitted a reference to sodium *ions* and this omission was not always recognised by assessors.

Q38.

This question was not answered well and, in some cases, not marked well either. Students and assessors alike did not consider responses in the context of an energy

boost. Words like ‘quickly’, ‘rapidly’, ☐more’ or ‘respiration’ were frequently lacking. It is vital that assessors appreciate both what a question is asking and the essence of the marking points.

Q39.

(a) The majority of students gained both of the marks on this question, although some failed to score because they made unqualified references to protein or lipid. Although some students had learnt the term ‘integral protein’, few qualified this to show they recognised this integral protein spanned the membrane. A few answers referred to guard cells, microvilli and mitochondria, suggesting that the students had not understood the difference between the molecular structure of a membrane and the gross structure of cells or organelles.

(b) (i) Most students knew this term although some were clearly guessing between condensation and hydrolysis, having written both down and then crossed out one or other of the terms.

(ii) The great majority of students gave mark points 3 and 4, with a few failing to score because they used abbreviations such as ER or RER. These abbreviations were not accepted, since students were asked to name the organelle. The full name endoplasmic reticulum is given in the specification, with no abbreviation offered as an alternative. Where Golgi was given as the organelle, the associated function was not often correctly linked to protein formation. For mark point 6 (release of energy / make ATP), references to producing or making energy were not given credit. Incorrect references to cilia, microvilli, stomach acids and lysosomes suggested that some students did not understand what was meant by the term organelle.

Q40.

(a) Generic answers that included ideas such as improved accuracy, reliability, validity and so on did not gain marks in this question. A few students clearly understood what the units meant and the way in which they would ensure comparability between results at different temperatures. The majority of the rest of the students who did gain these marks gave rather unconvincing responses and apparently hit the target by accident.

(b) This calculation of percentage increase gave a significant number of students difficulty. The majority selected the correct figures from the table but then had little idea of how to use them, and many scripts showed much crossing out and re-writing. Quite a large number of students did not attempt the calculation. Some students with correct calculations did not do as instructed and give their answer to 1 decimal place.

(c) (i) A number of students did not answer the question as set. Many wrote about the effect of increasing temperature on the kinetic energy available in the system, rather than comparing the data for the two different temperatures. Some read ‘rate of uptake’ as the concentration of imatinib inside the cells and so gave movement up the concentration gradient as the evidence for active transport.

(ii) This was another question that was quite frequently not attempted. Some students had a good understanding of active transport as a process involving trans-membrane carrier proteins and could apply this to the rate of uptake in the cells levelling off at 37°C. Others appeared to be guessing, suggesting that enzymes had been denatured, or that the imatinib had all been used up.

Q41.

(a) (i) This was done well by many students. Where the mark was not given it was usually because a student stated that the antigen was foreign but did not go on to add that it would cause an immune response.

(ii) Difficulties with this question were linked to poor understanding of the ways in which substances pass through membranes. Weaker answers referred to the antigens not being 'allowed' through, rather than incompatibility between the shape of the antigen and the shape of trans-membrane protein channels.

(b) Many students scored full marks. Rather than microfold cells being the route by which vaccines could enter the body, weaker responses included ideas such as the vaccine being given as treatment for a disease, or people being injected with microfold cells.

Q42.

Large numbers of good and excellent essays were seen.

The vast majority of students appeared to understand that this is a synoptic exercise, where they have to draw on a wide range of examples to obtain a high mark. Some students only dealt with one or two topics but in great detail and depth. Unfortunately, this severely limited the mark they could obtain.

The membranes of different types of cells are involved in many different functions.

Most students started with a description of membrane structure. Many did no more than that and did not relate this to *function;* for example, selective permeability to lipid-soluble substances. There were quite frequent references to incorrect Biology; such as 'the fluid-mosaic membrane usually found in animal cells' and 'the cellulose membrane in plant cells'. Transport mechanisms were often named but less frequently described in any correct detail. Credit was available for descriptions and explanations of facilitated diffusion and active transport. There was considerable confusion between the two processes and between channel and carrier proteins. Co-transport was a popular topic and most students identified as their example glucose transport with sodium ions by epithelial cells of the small intestine. There were some really good descriptions of the active transport of sodium ions to generate/maintain a concentration gradient for facilitated diffusion of glucose and sodium ions. It was not uncommon for students to get rather confused about what was transported, where and by which process.

The role of thylakoid membranes in photosynthesis was quite frequently described. The best examples gave these as the location of photosynthetic pigments and the electron transport chains, as well as describing the role of the membrane in the chemiosmotic synthesis of ATP and the production of reduced NADP. Poor responses often started by saying that thylakoids are important in photosynthesis, with no further detail of how. They then often moved on to irrelevant detail of all the other stages of photosynthesis. A similar picture was seen with the role of cristae in respiration, except that most students seemed to have a somewhat better grasp of this than the role of thylakoids.

The roles of membranes involved in protein synthesis and secretion were rarely seen. The nearest that many came was to write about nuclear pores and the passage of mRNA for protein synthesis. There were many good descriptions of the roles of membrane-bound receptors, antigens and antibodies in the immune response. These often included the fusion of lysosomes with phagocytic vesicles / vacuoles. Some students did get rather confused about which cells displayed receptors, antigens and antibodies on their surface. A few students strayed into details of vaccines, secondary responses, memory cells and antibody action with no reference to membrane function.Horizontal transmission of genetic

material between bacteria was quite often seen. Some students did not make clear the function of the membrane in this and wrote mainly about plasmids and antibiotic resistance.

The Pacinian corpuscle was a popular choice. There were many good accounts of stretch-mediated sodium ion channels in membranes and the production of action potentials. Students often obtained credit here for the role of the membrane in the production of an action potential. Most students wrote about axons as a separate topic, sometimes going on to Pacinian corpuscles as an extension of the same paragraph. There were many good descriptions of how proteins in membranes are involved in maintaining resting potentials and producing action potentials. Some got the ion flows the wrong way round, or at the wrong times. A few wrote about the wrong ions, such as calcium.

Most students wrote about synaptic transmission and most focused on the functions of membrane. The best accounts wrote about calcium ion channels, fusion of vesicles with the pre-synaptic membrane, receptors being only on the post-synaptic membrane and the opening of sodium ion channels. This was a topic area where good extension material was often seen. One example seen in a number of essays was the role of GABA in opening chloride ion channels and the inhibitory effect on action potential formation. Those who wrote about synapses quite often went on to write about muscle contraction. There were good accounts of the role of the muscle membrane at the neuromuscular junction and the roles of T tubules and sarcoplasmic reticulum in calcium ion movements. Some weaker accounts just said that membranes are involved and then wrote about actin, myosin and contraction.

Hormones were frequently written about. The best accounts focused on the involvement of membranes. Many wrote about the lipid nature of oestrogen and how this allowed it to enter through the phospholipid bilayer of cells. Others wrote about insulin but details of its effects on transport of glucose across membranes were relatively rare. Glucagon and adrenaline were also commonly used as examples and frequently involved good outlines of the second messenger concept.

Large numbers of students wrote in one way or another about osmosis. Plant roots were a common setting for these accounts. There were some good accounts of active transport of mineral ions by root hairs, leading to lowering of water potential inside the cell and entry of water by osmosis. Accounts of the same sort of sequence involving endodermal cells were rare. Many students appeared to be totally confused between apoplast and symplast. This was a topic area where quite a few drifted into accounts of water movements in the xylem and through leaves which contained no references to membranes.

Q43.

Students did not score highly on this question. They often failed to interpret the question and use the data appropriately. Few students quoted correct figures and many failed to realise that the figures for stomach cancer and heart disease showed little difference. Many wrote in terms of contracting the disease rather than dying from it, as referred to in the resource. Others vaguely referred to ‘certain diseases’ and therefore failed to gain credit. In many cases, students simply repeated answers they had learned from past papers. These answers often gained one mark for referring to the idea that other factors are involved.

Q44.

In this question there was some confusion between channel and carrier proteins and their roles in facilitated diffusion and active transport. Quite a large number attempted to write about co-transport and obtained credit via the mark points for facilitated diffusion and

active transport. Some who took this approach got themselves rather confused about what moved where, and how. About a third of students scored five marks.

Q45.

(a) (i) Most students were aware that an organ consists of more than one tissue. Students who failed to score, usually described a tissue rather than an organ.

(ii) This proved to be a good discriminator. Just over half the students gained full marks for being aware that muscles contract, causing vasoconstriction of an arteriole. Weaker responses often used scientific terms in the wrong context. It was not uncommon in such responses to read that muscles 'constrict' or that arterioles 'contract', 'stretch' or 'recoil'. Similarly, some students did not seem to remember which way around these events occur in the context of *reducing* blood flow. Consequently, some students stated that muscles contract *and* relax, and arterioles constrict and dilate but did not make clear which of these *reduced* blood pressure.

(b) (i) Most students were aware that a thin wall provides a short diffusion pathway. Weaker responses often referred to a diffusion gradient being maintained or faster diffusion occurring.

(ii) Most students correctly linked slow blood flow in capillaries to more time for exchange. Again, weaker responses usually referred to faster diffusion occurring.

(c) It was disappointing that just over 40% of students scored zero. Many were aware that the water potential in the capillary would increase. However, the ability to tell the rest of the story proved to be an excellent discriminator. Weaker responses usually lacked precision or were out of context. They often referred to the movement of tissue fluid, rather than water. Similarly, some students described the movement of water out of the capillary, rather than less water moving into the capillary. It was clear that some students had difficulty in applying their knowledge of tissue fluid to an unfamiliar context and simply wrote all they knew about how tissue fluid is formed and reabsorbed.

Q46.

(a) This proved to be an excellent discriminator. Nearly half of students scored full marks. This was usually for stating that the cell wall does not form, leading to cell lysis due to entry of water. It was usually only the best responses that referred to a lower water potential in the bacterium. Weaker responses revealed a number of misconceptions. These often referred to the cell wall being broken down or that isoniazid *caused* the cell wall to become permeable to water.

(b) Half of students were aware that human cells may lack enzyme **B**, use different substrates, or produce different fatty acids. Weaker responses usually fell into one of two types. The first suggested the idea that isoniazid is an enzyme. This led to widespread references to enzyme inhibition and active sites on a variety of molecules. The second used the fact that human cells do not have cell walls. The question asked why isoniazid does not affect the production of *fatty acids* in human cells. Hence, reference to cell walls was out of context and was not credited.

(c) Two-thirds of students scored full marks and all marking points were regularly seen. Weaker responses were marked by the use of scientific terms in the wrong context, e.g. 'different amino acids produced', 'base sequence of the enzyme', 'amino acid base sequence', 'amino acids coding for' and 'different hydrogen bonds form

between bases'.

Q47.

(a) Many students complicated what should have been a straightforward question by adding a lot of unnecessary information. Many failed to recognise that the question was asking for what happened between times P and Q and described what was happening at P and at Q. Others did not distinguish between the instructions 'describe' and 'explain' and went on to give an unnecessary explanation. There was also some confusion as to whether the diaphragm moved up or down when the muscle contracted.

(b) Over half the students answered well and gained all three marks. However, as in part (a) there were many who included a lot of unnecessary information, usually about the intercostal muscles. While this did not necessarily result in the student failing to gain credit, it did waste time. Students should be encouraged to use the correct terminology; it was common to see references to space and size rather than volume, and concentration rather than pressure. There was some confusion between cause and effect with students stating that it was the intake of air that caused the movement of the diaphragm and the increase in volume. Students who stated that the air entered by diffusion could not gain the final marking point.

(c) Most students gained one mark for stating that the oxygen moved by diffusion but only the more able students referred to the epithelial or endothelial cells that made up the walls of the alveoli and capillary.

Q48.

(a) The majority of the students were able to read the correct figures from the graph and divide concentration by time to gain both marks. Those who made errors in reading from the graph often gained one mark for the correct method. As in previous years, there was a significant number of students who did not attempt a calculation.

(b) This was answered less well, with many students not describing how cyanide affects the uptake of ions. Instead they described changes in the shape of the graph or wrote about the concentration of ions in the solution. Data to support the answer were often incorrect, resulting from inaccurate reading of the y axis. The better students had read the question carefully and therefore answered in terms of changes to the rate of uptake of sodium ions and supported their answer with correct data from the graph.

(c) Students were told that cyanide affects respiration and then asked to explain why cyanide reduced the uptake of sodium ions. Many students simply repeated that respiration would be affected without stating that respiration would be inhibited or slowed down. An encouraging number of students were able to make the link between a shortage of ATP from respiration and therefore a shortage of ATP for active uptake of sodium ions. Some students attempted to write about there being no co-transport of sodium and glucose and therefore no glucose for respiration. These students had clearly ignored the information given in the question stem and often failed to score.

Q49.

(a) The Benedict's test for reducing sugars was well known with most students gaining all three marks. The main problem here was that many students failed to heat the solution, either by not mentioning heating at all or simply saying 'put it in a water bath' without specifying a temperature - water baths can be at any set temperature.

There was a significant number who confused the tests for reducing and non-reducing sugars and a small number who described other biochemical tests.

(b) (i) It was encouraging to see that the best students were able to apply their knowledge of several different parts of the unit and explain their answers well. These answers were often concise, explaining that more maltose would be produced, lowering the water potential so that water entered by osmosis.

There were many confused answers, however, and it was evident that some students were unsure as to whether pH 2 was acidic or alkaline. Most understood that amylase would hydrolyse the starch into maltose but then went on to write at length about the effect of pH on the rate of enzyme action.

(ii) Most students gained this mark, realising that you need to look at a range of pH values to be able to conclude what the optimum pH is, but some obviously thought that optimum simply meant the best of those considered. There was a surprising number of students who inexplicably referred to the optimum temperature.

Q50.

(a) Many students gave the correct answer, hydrolysis. Those who failed to score usually confused hydrolysis with condensation.

(b) Many students correctly identified that the peptide was too large or insoluble and therefore gained one mark. Only the more able students went on to explain that peptides would therefore not be able to pass through the carrier or channel protein. There was a significant number of students who wrote about active transport despite facilitated diffusion being referred to in the question.

(c) This question was generally answered well with most students recognising that the peptide would be considered “foreign” or “non-self”. Those students who failed to score often referred to the peptides as cells.

(d) Some students failed to use the information in the passage, which stated that the drug had already been tested on patients with coeliac disease, and produced answers referring to trialling on animals or people without the disease. The majority correctly wrote about side effects, though some gave this answer twice with slightly different wording. Large numbers of answers gave generic responses here such as age or gender, without giving any thought to the context of the question.

Q51.

(a) (i) The term diffusion was known well, with the majority of students answering correctly.

(ii) This question was successfully answered by the vast majority of students. Where students failed to gain a mark it was because they referred to the flatworm having a large surface area rather than a large surface area to volume ratio.

(b) (i) Many students could recall that an organ is a group of tissues.

(ii) Few students gained all three marks for this question but most achieved one or two marks in clearly appreciating that carbon dioxide enters a leaf through the stomata. Students clearly understood the process of diffusion but failed to gain credit where they stated that diffusion occurs across or along, rather than

down, the gradient.

Q52.

(a) (i) The first part of this question was answered well by the many students who appreciated that the resulting increase in surface area would result in greater water loss.

(ii) It was relatively uncommon to see full credit awarded for answers to this part of the question. Although most students appreciated that the solution would add to the mass of the strawberry slices, few appeared to appreciate that the quantity involved would be variable.

(b) Good responses were generated to this question and most students were aware that this was the initial mass.

(c) The table showed that the length of time in the sucrose solution affected both percentage loss in mass and texture. Despite the mark allocation and spacing suggesting that a response of some length or detail was required, many students confined their answers to comment on percentage loss in mass. Many of those who did refer to the change in texture failed to note the levelling out in values.

(d) Most answers to this question focused on the use of a graph but, not infrequently, neglected to indicate what should have been plotted or, in some cases, incorrectly suggested plotting time against texture. A curve of best fit was usually suggested but relatively few students suggested that the point where there was no further change in mass should be determined. It was not uncommon to find answers suggesting that the time should be taken at which the mass off the strawberries fell to zero.

Q53.

(a) (i) The advantage of using a percentage in the context of this question was widely appreciated, and many students gained full credit.

(ii) Many students failed to appreciate the specific aspects of experimental design implicit in cooking the turkey pieces until the temperature in the centre of each reached a specific value. As with question **4 (a)**, they frequently fell back on answers based on “fair” and “reliable” and failed to offer the necessary amplification. Occasional students were more concerned about the health issues associated with eating undercooked poultry.

(iii) Use of the command word “Evaluate” should have suggested that there were two sides to this statement. Most students attempted with some degree of success to link loss in mass with water loss, but very few appeared to appreciate that heating might remove other substances that contributed to the mass of the turkey pieces.

(b) It was encouraging to note that a substantial number of students appreciated that the data in the graph could not be explained in terms of loss of water by osmosis. Less able students experienced difficulties, frequently because they were determined to fly in the face of the data provided and explain what they thought ought to have happened.

Q54.

(a) (i) The many students who understood the concept of water potential were able to gain maximum credit here.

(ii) Many students appeared of the opinion that this was another question centred on water potential. Others sought, more appropriately, to link this to enzyme action and growth. Not all of these students, however, appeared to understand that cooling an enzyme does not lead to its denaturation.

(b) Those students who could identify a chemical element as such and understood the protein nature of enzymes generally answered this question well. Some, who clearly appreciated the underlying principle, were handicapped by poor expression. Thus, it was not unusual to read such statements as “enzymes contain protein” or “proteins are turned into enzymes”.

(c) Most answers centred round the idea of contamination but relatively few students amplified this basic statement with a reference to other microorganisms.

(d) Most students gave appropriate values from the graph although there were occasional errors involving units. It was not unusual to find the time given in seconds rather than hours.

(e) One of the key ideas in answering questions in examinations is that of adding value. Students were provided with the information that “intracellular enzymes stay inside the cells that produce them” and “intracellular enzymes are more expensive to produce”. The many students who took four or more lines to write that because intracellular enzymes stay inside the cells that produce them they are more expensive to purify therefore gained no credit.

Q55.

The starting point for questions requiring longer responses must be careful determination of precisely what is required. This question required students to explain how vaccines protect people against disease but few could resist the temptation to describe in great detail everything they knew about immunology. This often resulted in the allocated space being filled with material that, at the very best, could only be regarded as of marginal relevance. Most students should have been able to access the first three points on the scheme and indicate that antigens on weakened or dead pathogens stimulated the production of memory cells. The fact that credit was not always awarded stemmed from interchangeability of the terms pathogen and disease, and uncertainty over the origin and nature of memory cells. The second part of the mark scheme referred to the generation of a secondary immune response. Those students who finally arrived at this concept, often did no more than offer a few passing thoughts at the very end of the page or on an extra sheet. As always with questions on this topic, the use of language was often far from convincing and there were many references to antibodies "fighting" and memory cells "remembering".

Q56.

(a) Nitrogen-fixing was the commonest wrong answer in this question. The majority of responses were correct.

(b) This question was answered poorly because students did not think through the processes that were taking place in the reed bed. There were many incorrect responses referring to processes in the reeds that result in the formation of nitrates from ammonia / nitrite. Some then went on to gain one mark for active transport of these nitrates into the plant roots. Better students correctly linked the use of ATP from aerobic respiration in the active transport of nitrates, and wrote clearly and concisely. There was a surprising amount of confusion between diffusion and active transport, with active transport being said to be needed to diffuse nitrogen-containing substances from areas of high to low concentration. The oxygen was also

thought to create a concentration gradient to allow the roots to take up the nitrogen-containing substances by diffusion.

(c) There were some very clear answers to part (i) from students who understood that too fast a flow would not allow time for the nitrification to occur, hence the decrease in concentration of nitrates. There was also not enough time for the saprophytes to decompose the sewage to release ammonium compounds. Some failed to mention the ammonia being converted. Other answers suggested that the soil would become waterlogged, preventing the action of the nitrifying bacteria, or that the reeds would take up more of the nitrates or that numbers of denitrifying bacteria would increase, converting the nitrate to nitrogen gas. A number thought that if the flow was too fast, the reeds would be unable to take up the nitrates, so they would end up in the lake. The fast flow was also thought to reduce the oxygen concentration in the water, thus preventing the action of the nitrifying bacteria. There was also confusion with leaching and eutrophication. There were only very occasional references to the bacteria being washed away by the fast flow. The fast flow was also said to maintain a steep diffusion gradient and increase uptake by the plant roots.

In part (ii), it was clear that many students had learnt this topic thoroughly and included all marking points. Weaker students could not explain the increase in decomposers breaking down the dead plants and using up the oxygen in the water in their respiration. The algae were often described as 'feeding' on the nitrates. A common incorrect reason for the death of the fish was a lack of food once the plants in the lake died. A minority of students had no understanding of the process of eutrophication and thought that dehydration and osmosis caused the fish to die or that high nitrate concentrations were toxic to both fish and algae. Increasing concentrations of carbon dioxide were also thought to be responsible for the death of the fish.

Q57.

(a) (i) Most candidates correctly named the type of reaction as hydrolysis.

(ii) Most candidates correctly named glucose.

(b) (i) Most candidates gained full marks for describing the test for reducing sugars accurately. Some did not mention the need for heat, and a few could not recall the correct test – the biuret test being the most common error. A few candidates lost credit because they described the non-reducing sugar test and hydrolysed with hydrochloric acid first.

(ii) The majority of the candidates could explain the idea that one molecule of lactose was being hydrolysed to give two molecules of product, both of which were reducing sugars. The commonest reason for missing the mark was when students paraphrased the stem of the question, stating that the reason there was a higher concentration of reducing sugar was because there was more reducing sugar present. A surprising number of candidates gave answers relating to an increase in surface area.

(c) Although many candidates gained full marks on this question there was a significant number who were confused about the position of the active site, placing it on the sugar rather than the enzyme. A number of candidates thought that galactose would bind to lactose rather than lactase.

Q58.

(a) Most candidates were well prepared for this question and were able to differentiate

between active transport and facilitated diffusion with many gaining both marks. Some candidates were unclear when referring to concentration gradient. Phrases such as ‘along the gradient’ or ‘across the gradient’ were not accepted. The specification terms ‘carrier protein’ and ‘channel protein’ were often not used.

(b) (i) The question asked why a control group was used „in this trial’. Candidates needed to apply their knowledge to an unfamiliar context and were required to do more than simply define the term. It was, therefore, not enough to say ‘to allow comparison’.

(ii) This question was well answered with many candidates gaining both marks. A large number referred to a placebo tablet being used, although this term was not required. Some candidates failed to gain the first marking point as they stated that no drug would be given without appreciating that a tablet would still need to be administered. Most explained that both groups should be treated in the same way.

(c) This question required the candidates to look carefully at the graph and describe it. Many incorrectly stated or implied that the volume of acid secreted per hour would decrease for 4 hours, failing to notice that the treatment started 1 hour after volumes were recorded. More able candidates realised that the acid secretion would decrease for 3 hours, or from 1 – 4 hours.

Q59.

(a) The vast majority of candidates obtained both marks, usually by naming the cell wall and chloroplast as structures that are present in plant cells but not in animal cells. Very few candidates scored zero.

(b) Most candidates gained one mark for stating that starch is insoluble. However, less than half the candidates were then able to suggest an advantage of this in terms of osmosis or water potential. A common error was to suggest that starch would not move into or out of the cell by osmosis.

(c) Most candidates scored two on this question and over a third of candidates gained all three marks. Generally there was a clear understanding of the roles of the chloroplast and eyespot. A smaller percentage of candidates was able to explain the role of the flagellum. A significant number incorrectly involved the starch store in their answer.

Q60.

(a) 60% of candidates gained one mark for the idea that water on the outside of the cylinders would affect the mass, or that only the water taken up or lost should be measured. Only the very best candidates were aware that the amount of water on the cylinders would vary. A common response by weaker candidates was that water on the outside of the cylinders would allow further osmosis before reweighing. This was not credited. Vague responses that referred to greater reliability or accuracy were common.

(b) One third of candidates gave the correct volumes of $4cm^3$ and $16cm^3$.

(c) It was encouraging to note that candidates did better on this question than they did on a comparable question in January 2010. One third of candidates gained full credit. Many were aware that expressing a change as a percentage allows a comparison to be made. However, it was usually only better candidates who wrote that the cylinders would have different starting masses. The stem of the question

made it clear that both the starting and final masses of the cylinders were recorded. It therefore had to be clear to which of these the candidates was referring. Weaker candidates often referred to ‘different sizes’ or ‘different masses’. These responses were not credited.

(d) Two thirds of candidates gained one mark for the idea that anomalies could be identified. However, some thought that repeats prevented anomalies from occurring or being recorded. It was only the very able candidates who wrote that repeats allow a more reliable mean to be calculated. Taking additional readings does not necessarily allow results to be closer to the true value. Hence, references to ‘a more accurate mean’ were not credited. Weaker candidates often referred to ‘the results’ being more reliable or more accurate without qualifying their answers.

(e) 70% of candidates correctly read off the intercept on the x-axis at 0.35 mol dm^{-3}.

Q61.

This question discriminated well across the ability range and there were many excellent answers to parts (a) and (b). Weaker candidates were often let down by poor expression and this was particularly notable for part (b).

(a) Approximately half of the candidates gained at least three marks. Most correctly described movement down a concentration gradient by diffusion and against a concentration gradient by active transport. The requirement for energy or ATP in active transport was frequently noted. Similarly, many candidates were aware that membrane proteins are involved in active transport or facilitated diffusion. However, some disqualified this mark for stating that active transport involves channel proteins. Better candidates also referred to the movement of water by osmosis and related the property of a molecule to its route through the plasma membrane. Weaker candidates sometimes confused active transport and facilitated diffusion. Similarly, a minority described the structure of the membrane, without any reference to transport across it.

(b) Just over half of candidates gained at least four marks. It was pleasing to see better candidates often scoring full marks. References to a flattened epithelium or many capillaries providing a large surface area were rare. However, all other marking points were frequently seen. Many candidates appreciated the role of ventilation or circulation in maintaining a concentration gradient. Unfortunately, weaker candidates often gave answers that lacked detail or were out of context e.g. ‘thin membranes’, ‘better diffusion’ and ‘faster gas exchange’. Similarly, they did not usually relate ‘large surface area’ to the many alveoli present. A minority of candidates started their answer with Fick’s equation but did not relate this to the question in sufficient detail.

Q62.

Many students seemed confused by this apparatus and described the syringe as a gas syringe. Others related it to a type of potometer, where they were moving the bubble to the start of the scale to take the next reading (presumably thinking the measurement was of the bubble movement rather than the size of the bubble produced).

Q63.

(a) (i) It was disappointing that only one third of candidates scored full marks on this question, given that it was targeted at grade E and involved straightforward recall. However, most candidates gained at least one mark for correctly

naming water as the reactant or galactose as the product. A common incorrect response for the missing reactant was ‘lactase’, despite this being given in the stem of the question. There was a wide variety of suggestions for the missing product. These included water, fructose, maltose and sucrose.

(ii) Over 70% of candidates correctly named the reaction as hydrolysis. The most common incorrect responses seen were ‘digestion’ and ‘condensation’.

(b) There was widespread failure to read the stem of each question part, which resulted in only a minority of candidates gaining full credit. It was also clear that many candidates had failed to distinguish between the terms ‘describe’ and ‘explain’ for part (i) and (ii) respectively.

(i) There were numerous references to the Benedict’s test for reducing sugars and, to a lesser extent, iodine solution and universal indicator. It was also clear from the colour changes given that many candidates were not familiar with basic food tests. Candidates who did refer to the biuret test often limited their answer to describing the method and naming the reagents involved. For those who did mention a purple colour, it was not often clear if they were referring to lactose or lactase.

(ii) Many candidates gave the answer to (b)(i) here but failed to explain why this result would be achieved.

Q64.

(a) (i) Almost three quarters of candidates gave the correct answer of 1.08. However, some answers showed an excessive number of decimal places. Similarly, some candidates subtracted the final mass from the starting mass to give an answer of 1.8.

(ii) Most candidates were aware that a ratio enabled a comparison to be made between different sets of data. Unfortunately, some gave this in the wrong context by referring to a comparison of the start and final mass of the same disc. Similarly, it was usually only the better candidates who wrote that the discs had different starting masses. Some candidates narrowly missed out on this mark through a lack of detail e.g. ‘different sizes’ and ‘different masses’. The table showed the start and final masses of each disc. It therefore had to be clear which of these was being referred to. As was the case last year, weaker candidates had difficulty in understanding the concept of a ratio. Their answers usually made reference to a ratio allowing ‘a better graph to be plotted’ or ‘it being easier to draw conclusions’.

(iii) Many candidates gained one mark for the idea that anomalies could be identified. However, some mistakenly thought that additional readings prevented anomalies from occurring or being recorded. These were not credited. Relatively few candidates mentioned that a mean could be calculated. There was also widespread failure by weaker candidates to read the stem of the question. This usually resulted in descriptions of methods that could be used to take additional readings.

(b) (i) This question was asked in the first paper of the series and it is encouraging to note that candidates did much better this time. Most candidates scored one mark for describing the correct graph to be plotted. There were, however, some suggestions to plot sodium chloride concentration against water potential. The second mark proved to be a good discriminator. It was usually only the better candidates who appreciated the concept of using a ratio of 1.

Some candidates clearly remembered doing this practical but were let down by a lack of detail e.g. ‘read off where line crosses x-axis’, with no mention of a ratio. Once again, the concept of a ratio was too much for weaker candidates. Similarly, a minority of candidates were aware that there would be no change in mass but then disqualified this mark by using a ratio of 0.

(ii) Only the most able candidates scored one mark on this question. This was either for mentioning a more reliable line of best fit or that error bars could be plotted. However, there was widespread failure by most candidates to distinguish between the terms ‘accurate’ and ‘reliable’. Taking additional readings does not necessarily allow results to be closer to the true value. Hence, references to ‘accuracy’ were not credited. The term ‘precise’ was rarely used. However, credit was given if this term was used in the correct context as highly precise and highly reliable results both have very little spread about the mean value.

Q65.

(a) Most candidates correctly named fluid **F** as plasma or blood plasma. A common response not credited was blood.

(b) Very few candidates obtained this mark despite the large number of alternative answers available on the mark scheme. A very common error was to state that tissue fluid has no protein rather than less or smaller proteins. References to blood cells were not credited as fluid **F** is plasma rather than blood, the latter consisting of plasma and blood cells.

(c) (i) Many candidates did not obtain this mark as most referred to ‘pumping’ or ‘beating’ of the ventricle rather than using the precise term contraction.

(ii) Unfortunately many candidates simply stated that the pressure decreases as distance from the heart increases. Better candidates explained the reason for this decrease in pressure in terms of friction or loss of fluid from capillaries.

(d) Answers to this question were very disappointing with very few candidates obtaining all three marks and many candidates scoring zero. Candidates gaining credit often appreciated that a decrease in the concentration of protein in the blood would increase the water potential in the capillary. However, candidates often failed to use the term osmosis in the correct context, describing the movement of a wide range of substances by osmosis. Even better candidates often failed to gain credit by referring to fluid rather than water moving by osmosis. Additionally, there was considerable confusion in the direction of movement of water between the tissue fluid and plasma.

Q66.

This question was answered well across the ability range, with most candidates gaining at least one mark for stating that the fresh mass decreased. The most common reason for candidates not achieving the second mark was for a lack of detail in describing the effect on the dry mass stating ‘dry mass increases’ without reference to the small size of this increase.

Q67.

This unit requires practical work to be undertaken that includes the effect of solute concentration of water uptake by plant tissue. In this question, therefore, candidates were required to demonstrate their understanding of such prescribed practical techniques. It

was evident from the responses to this question that although many candidates had some experience of related practical investigations, they had little understanding of the procedures involved. Many otherwise sound candidates gained very little credit on this question.

(a) The diagram clearly showed two different tissues, but only the best candidates based their answers on this information and described cutting the cylinders in such a way as to ensure that they consisted of the same tissue. Many of the answers did little more than reiterate what have become standard responses in past practical assessments without attempting to apply general principles to a novel situation. In this particular case, references to the same cork borer or the same length were irrelevant. There were also a number of vague references to ensuring that this would be a fair test. Candidates would be well advised not to use this term without appropriate amplification.

(b) It was immediately apparent from marking this question that many of the less able candidates had undertaken practical investigations without any understanding of what they were trying to do. Thus there were numerous responses that indicated confusion with investigations of enzyme activity or respiration. Where candidates did appreciate that the essential purpose of the bungs was to minimise evaporation, it was uncommon for them to refer to the evaporation of water evaporating resulting in a change in the concentration of the sucrose solution.

(c) Candidates who read this question with sufficient care should have noted that it referred to the results provided in the table. Accounts, therefore based on repeating the investigation with other sucrose solutions were inappropriate and did not gain credit. The investigations carried out for assessment of practical skills at AS all require candidates to plot their data as appropriate graphs, and it was hoped that candidates would have applied a similar approach here. Relatively few did, and of these, even fewer appreciated that they should identify the concentration of sucrose in which the ratio of final length to initial length was 1. Few candidates displayed an understanding of the concept of a ratio in part (ii).

Q68.

(a) Most candidates were able to extract the relevant information from the passage and explain that many of those with the illness failed to see a doctor. The concept of a ratio in part (ii) proved difficult for some to understand. Although there were many correct answers there were many that should have been considered, at best, to have been improbable.

(b) Many candidates were able to comment on the identical nature of the sugars in the bacterial antigens and on the surface of nerve cells. For some, this led to a comprehensive account of antibody binding and the formation of an antibody-antigen complex. Others rather lost their way at this stage and did no more than suggest that this led to antibodies ‘attacking’ the nerve cells.

(c) There were many lengthy accounts presented in answer to this part of the question. Able candidates frequently described the entire process of ventilation and extended their answers onto additional sheets before eventually arriving at a point where they describe the effects of paralysis. It was clear, however, that many candidates had little idea of the precise role of the diaphragm. It was not infrequently described, for example, as ‘pushing the ribs up and out’. Such statements as ‘breathing in causes the diaphragm to flatten’ were common and revealed confusion between cause and effect.

Q69.

(a) Knowledge of cell structure was sound and most candidates provided evidence supporting the identity of cell B. Those who failed to gain credit often incorrectly identified the surrounding layer as a wall. Although most were also able to recognise the significance of the third cell layer possessed by cell C, terminology raised problems for some of the less able candidates. Although some of these offered acceptable alternatives to capsule, others suggested that there was an extra cell wall or even an extra membrane. Examiners were of the impression that some candidates attempted to recall similar questions from past papers and there were numerous references to nuclei and membrane-bound organelles, features that were not visible in the diagrams.

(b) Few candidates attempted to make use of a scale bar in calculating magnification, many falling back on uncertain memory of the relationship between the size of the object, the size of the image and magnification. The simplest correct approach was to divide the actual length of the scale bar, in micrometres, by 0.5. Candidates who adopted this method experienced few difficulties in gaining the mark. Others recognised that they should involve the scale bar in some way but were uncertain of to how to progress. The most frequent approach was to divide the size of the cell by the length of the scale bar without appreciating that this technique would give rise to different “magnifications” depending on whether the length or breadth of the cell were measured.

(c) While most candidates named an appropriate polysaccharide, there were many references to “chlorophyll” and “chloroplast”.

(d) Despite the emphasis in the specification on the link between osmosis and water potential, many candidates fail to use the term in explaining osmotic phenomena. Such was the case here. Those who adopted the required approach frequently gained maximum credit for part (i) although there were possibly more instances than in the past of negative values presenting difficulties. There were many excellent answers to part (ii), but some less able candidates were clearly unable to link the lack of action of penicillin on plant cell walls to some aspect of their structure. Many such candidates appeared distracted by the content of later modules and sought responses based on aspects of immunology.

Q70.

(a) Candidates were usually able to gain credit where they confined their responses to appropriate terms such as “partially permeable”. They experienced difficulties, however, when they used less acceptable phrases such as “fairly permeable”, or attempted to explain what they meant in terms of “letting potassium nitrate through”.

(b) Somewhat surprisingly many of the less able candidates appeared aware that potassium nitrate would be present in the space indicated, although they were unable to support this with a convincing explanation. Others had little idea, and there were frequent references to empty spaces, vacuums, cytoplasm and a variety of cell organelles. The examiners were of the opinion that although many candidates can reproduce the sequence of events associated with osmosis, they have little real understanding of plasmolysis.

(c) Answers to this part of the question were much more convincing and the underlying principles were widely understood. Predictably, some candidates encountered difficulties over expressing comparisons between the negative values of different water potentials. Most of these arose where they attempted to use terminology relating to both more and less negative, and to higher and lower. Contradiction often resulted.

Q71.

(a) It was apparent from the answers that few candidates were conversant with section 10.1 of the specification which refers to the requirement for practical microscopy including the estimation of size. Most simply measured the image without explaining how, and then used a formula to relate magnification and observed length to real length.

(b) The answers were generally sound and many of the better candidates correctly related the water potential gradient to osmotic movement from the cell and plasmolysis. There was, however, evidence of less certainty about this topic than has been shown in the past, in particular with the direction of water movement. Candidates are free to discuss values of water potential either in terms of higher and lower values or as being less negative or more negative, respectively. They would be well advised, however, to stay with the same approach throughout. Combining both tends to lead to contradiction and an inevitable failure to gain credit.

(c) There were few references in part (i) either to achieving equilibrium or to allowing a maximum change in length. Most candidates referred somewhat imprecisely to osmosis taking a long time or being slow. Candidates should be familiar from their practical work with the use of graphs as analytical tools. There was, however, a frequent misconception in part (ii) that the sucrose concentration equating with no change in length was where the curve levelled out, suggesting that many candidates failed to examine the data with sufficient care before attempting the question. What was required here was the drawing of a curve of best fit and extrapolating this to obtain the required value. Candidates found part (iii) difficult especially when they abandoned osmosis in favour of diffusion or hydolysis of starch. However, most candidates were able to gain some credit for recognising that starch was insoluble even if they subsequently failed to link sufficient steps in the reasoning to produce a coherent explanation.

Q72.

(a) Difficulties were experienced with this question where answers were frequently unselective, relating not only to quaternary structure but to aspects of secondary and tertiary structure as well. To gain credit here, candidates needed to confine their answers to the fact that keratin molecules consisted of several polypeptide chains.

(b) Most candidates clearly appreciated that the bonds formed between sulphur-containing amino acids were strong and helped to bind the individual polypeptide chains. Less able candidates often confused these bonds with peptide bonds or did little more than paraphrase the wording of the question.

(c) As was not infrequently the case with the answers to many of the questions in this paper, less able candidates gave the impression of relying on the recall of mark schemes from broadly similar past questions. In this case they either simply described the primary structure of a protein, which gained little credit, or described how the primary structure of a protein affected its tertiary structure which was potentially, at least, a better option. Those who read the question carefully were usually able to comment on differences in the amino acid sequence leading to differences in bonding and in molecular shape. There was some confusion, presumably among candidates who had also completed Module 2 or 3, between amino acids, proteins and bases.

(d) As in part (c), the principal requirement here was to answer the question as written. Unfortunately, the response offered by many was no more than a description of active transport. In this question candidates were expected to use this knowledge along with information available in the passage to explain why substances were

unable to pass through the outer layer of skin cells. Those who approached the question in the right way generally pointed out that the cells were dead and progressed to make an appropriate comment about respiration and the release of energy or generation of ATP. A not infrequent misconception was that since movement against a concentration gradient involves active transport, active transport cannot be involved in movement down a gradient.

(e) The many good answers to this part of the question suggested that most candidates had a clear understanding of the principles of electron microscopy and were able to offer a lucid account of its advantages and limitations. Less able candidates were usually able to explain the advantages associated with high resolution but the limitations they suggested concerning expense, size, the production of black and white images and the need for technical support were of a more anecdotal nature and seldom gained significant credit.

Q73.

(a) There were many candidates sitting this unit who displayed an excellent knowledge of the facts and principles contained in the module, but who revealed an inability to describe and interpret the data presented in the table in this part of the question. The descriptions revealed that such candidates often failed to appreciate that the experimenters had changed the concentration of oxygen bubbled through the mixture. They also occasionally referred to a decrease in the rate of uptake of potassium ions from 90 to 80 arbitrary units at a 20.8 % concentration of oxygen, further suggesting unfamiliarity with tabulated data. Candidates who recognised the table as relating to active transport, were generally able to produce a convincing interpretation of the figures. Others frequently suggested that potassium ions were used as a respiratory substrate, or combined with ADP to produce ATP.

(b) An understanding of water potential should have resulted in candidates being able to interpret the graph, even if they experienced difficulties with understanding the ratio on the y-axis. They should also have appreciated that the x-axis represented sucrose concentration, not time.

(i) Evidence that this was not the case came from the many who suggested that the length of the potato remained the same at a concentration of 0.5 mol dm^{-3}, presumably identifying the point where the graph levelled out.

(ii) An understanding of ratio was required. Answers based on 180 presumably reflected those who thought that 1.2 represented a ration of 1:2 but other responses suggested incorrect reading of the graph, or the inability to calculate the required length from the correct ratio.

(iii) Answers need reference to water potential. Responses based simply on concentration were unable to gain maximum credit.

Q74.

(a) Almost all candidates scored one mark for the idea of bacteria being killed or inhibited but very few mentioned diffusion of the antibiotic. Candidates should note that two marks are rarely given for a single idea in a question of this type.

(b) Some candidates failed to gain marks by casual references to large or larger clear areas instead of saying this was the largest.

(c) Many candidates scored two marks but some, disregarding the question, wrote about protein synthesis or gave general statements about bactericidal or

bacteriostatic compounds. Some were confused as to whether the cell wall or the cell membrane was disrupted.

Q75.

(a) Candidates are increasingly aware that observation of fine detail is a consequence of greater resolution, and there were few answers based purely on the idea of limited magnification. Most of the problems that arose stemmed from imprecise use of pronouns. The statement 'it has a longer wavelength' needed to be linked to light. In the context of the question, 'it' could only refer to the microscope itself.

(b) The most frequent correct answers related to small size and lipid solubility and many candidates correctly identified one of these properties. There were some problems with terminology, however, particularly where candidates contradicted themselves in attempting to explain what they meant by nonpolar or un-ionised.

(c) Two skills were being tested in part (i); interpretation of the graph, and the ability to translate graphical information into words. Many candidates experienced difficulties with both of these skills. The limiting factor was often incorrectly identified but more often than not described imprecisely as 'concentration' or 'sodium' while the dependent variable became 'rate of reaction'. Candidates also reversed independent and dependent variables and wrote that 'as the rate of diffusion increased, the concentration of ions increased'. Others insisted on describing the complete curve rather than the part between **A** and **B**. Many of the difficulties that arose in part (ii) stemmed from a failure to understand that the rate of diffusion was constant after point **C**. Candidates frequently equated constant with zero. Better candidates appreciated that something other than the concentration of sodium ions was now limiting, but then lost sight of the fact that this curve related to facilitated diffusion not to active transport or enzyme-controlled reactions.

Q76.

In part (a), there were large numbers of answers which lacked specificity, such as preventing the bacteria escaping. There were the inevitable references to 'fair tests' and suggestions that bacteria entering the dish might somehow negate the effect of the antibiotics. In (b)(i), many poor answers were seen. Few commented on slow diffusion. Many simply stated that an antibiotic with a small clear zone could still be effective. In part (ii), most candidates identified **B** and gave a suitable answer. A few candidates chose **A** because it had the biggest clear zone, and some even gave a named antibiotic such as streptomycin or chloramphenicol.

Q77.

Some candidates clearly did not know the meaning of the term oxidative phosphorylation, in part (i), and thought that the poison DNP was a direct inhibitor of pump **Y** in the plasma membrane of the intestinal epithelial cell shown in the diagram, due to its direct attachment to the membrane protein. Others thought the DNP prevented the breakdown of ATP rather than its synthesis, although a fair proportion were on the right track and many realised that there could be no active transport in the presence of DNP (for whatever reason) and hence scored at least one mark. Some candidates left this section blank, presumably preferring not to wrestle with the complexities of what may have been to them an unfamiliar diagram.

In (ii), many candidates were unsure about the nature of the concentration gradient in the presence of DNP and implied there would now be a 'greater' concentration of sodium ions inside the cell than in the lumen of the small intestine – although by what mechanism was not at all clear. Many were content to state that no more entry of sodium ions and amino acids would be possible rather than giving the extra detail that diffusion would no longer

be able to occur.
Opinions were divided in part (iii), although most realised that diffusion or facilitated diffusion of amino acids out of the epithelial cell would occur at point **Z** on the diagram. 'Active transport' was a common wrong answer, despite the lack of use of ATP at **Z** compared with its breakdown illustrated elsewhere – at point **Y**.

Q78.

(a) Although most candidates were able to identify active transport as the process by which potassium ions normally enter bacterial cells, they enjoyed less success in using Fick's law to explain the leakage of these ions when the plasma membrane was damaged.

(b) Most candidates, in drawing the peptide bond in part (i), attempted to link the relevant groups, although they were not always certain as to the origin of the constituent atoms of the water molecule. In part (ii), candidates who sketched tyrocidin as a cyclic polypeptide generally, but by no means always, correctly determined the number of peptide bonds. Although nine was perhaps understandable as an incorrect response, it was difficult to identify the logic underlying the choice of two and five, which figured more frequently than might have been expected.

(c) The answers to this part of the question were in the text, the key points being that transport by vanilomycin depended on the fluid nature of the membrane while Gramicidin A formed a permanent pore. Although many candidates offered comprehensive answers based on these ideas, others incorrectly identified one or other of the antibiotics concerned as an enzyme and, as a result, offered inappropriate explanations.

(d) Candidates clearly found part (f) demanding and although there were those who recognised that a pore lined by molecules of the polyene antibiotic would provide the most likely solution, most failed to distinguish between the possible and the extremely unlikely.

Q79.

(a) A number of candidates either failed to read the question with sufficient care, or chose to ignore the instruction about shape, and produced inappropriate answers relating to the absence of a nucleus or the possession of haemoglobin. Those who confined their answers to relevant points usually referred to the surface area of the cell, unfortunately frequently stopping short of a reference to the all-important principle of the surface-area to volume ratio. The role of diffusion in the uptake of oxygen was seldom mentioned.

(b) Although it was clear from the answers to part (i) that most candidates recognised that osmosis accounted for the shrinkage of the cells in the sample, few were able to draw the conclusion that the plasma membrane was partially permeable. Candidates seldom went further than to explain that the observation resulted from water loss, or reflected a thin membrane. Less able candidates also attempted to explain the role of detergent in terms of osmosis. Of those who recognised that a lipid solvent would dissolve the phospholipids present in the plasma membrane, few provided a satisfactory explanation of the result. There were a number of incorrect references to the leakage of organelles from the cell accounting for the red coloration.

Q80.

(a) Although many candidates gained the mark in part (i), others failed either to identify the trend or offered interpretations not in keeping with the data provided. Thus there were numerous answers which were based on highly regimented views of sleeping and waking hours, but made no reference to specific times. The answer to part (ii) should have been straightforward, but many clearly interpreted the term cardiac cycle as referring to long-term events associated with the heart. Others clearly understood the underlying concept but confused atria and ventricles, or systole and diastole. Part (iii) produced some sound answers, although a number of candidates simply produced the converse statement for the second point. There were, for example, numerous references to a lower pressure in the vein for the first point and a higher pressure in the artery for the second. A popular misconception was that the pressure in the vein varied more as a result of valve action.

(b) QCA's performance descriptors for candidates expected to gain a grade E indicate that they should be able to describe trends and patterns shown in data presented as tables and graphs. The answers to part (i) indicated that candidates across the entire ability range have difficulties with this skill. Most noted a decrease in permeability with increasing relative molecular mass, but many either described this in terms of cell walls or failed to note that the capillary wall was completely impermeable to molecules of the size of albumin and above. The concept of tissue fluid formation is still poorly understood by many and in the case of part (ii) this was compounded by a failure to take sufficient note of the requirements of the question. Many candidates clearly sought to repeat earlier mark schemes and often described at considerable length the formation and reabsorption of tissue fluid. There was also much confusion over which end of the capillary was under consideration and a widespread failure to use any of the information provided. In part (iii), those candidates who were aware that red blood cells contain haemoglobin could generally offer a sensible explanation for its absence from tissue fluid. Others attempted a functional approach and displayed an alarming lack of understanding.

Q81.

In (i), candidates needed to be aware of the distinction between kinetic energy and energy stored in a molecule of ATP. It is incorrect to say that diffusion and facilitated diffusion require no energy. They require no ATP but the molecules must have kinetic energy or they will not move. In part (ii), some candidates explained why amino acids are continually absorbed into the capillary, but most, correctly, explained how removing amino acids by active transport maintains a low concentration in the epithelial cell and, therefore, a concentration gradient between the lumen and the cell.

Q82.

(a) It was common to see answers that referred to galactose as the single breakdown product of ll lactose and answers of this nature did not gain credit.

(b) Part (i) tended to be well answered by candidates though part (ii) did not elicit the desired response in many instances. Many candidates answered in terms of surface area. Some candidates realised the enzymes would pass out of the body but identified this as an example of excretion. Unfortunately these candidates often made the same error in 2 (a) (i).

(c) The assertion that mitochondria *made* energy prevented a significant number of candidates scoring one of the marks available. Many candidates scored both the marks available.

Q83.

(a) Although, in part (i), most candidates showed sufficient familiarity with the concept of a ratio to be able to calculate the answer correctly, part (ii) presented more difficulties. The few candidates who analysed the question with sufficient care and began their answers with wording along the lines of “The height to breadth ratio of an epithelial cell . . “ were usually able to obtain credit. The main problems which arose elsewhere were either a failure to make any reference to a ratio, or to answer in terms of the milk-producing cell. These approaches, coupled with confused explanation, severely limited the marks that could be awarded in many cases.

(b) Most candidates recognised that a molecule of galactose would contain six oxygen atoms. Predictably, the most frequent incorrect answer in part (ii) was 12 and this appeared with considerable frequency.

(c) This question required candidates to apply their knowledge of water potential to unfamiliar material. Most demonstrated that they understood the principles involved but gave the impression, yet again, of relying on their knowledge of seemingly similar, but very different, questions which had been set in the past. Those who related their answers to the vesicles usually gained full credit. Unfortunately many lost their way by attempting to describe water movement into the cell or, in some cases, the membrane.

(d) Those candidates who avoided the obvious pitfall of describing mitochondria as “making” energy and referred to releasing energy or producing ATP were able to gain at least one mark. They were not always successful in gaining the second, however. Some of these less convincing answers were based on bland statements about the ATP or energy being “needed” by the cells. Others treated energy as a specific substance required by the baby.

(e) There were some outstanding answers to this question and candidates from some centres demonstrated not only a good understanding of membrane structure but were able to relate this clearly to diffusion. Less able candidates showed that they understood the structure of a plasma membrane in terms of the phospholipid bilayer but were less certain of the role of proteins in diffusion, often failing to link them with facilitated diffusion.

Q84.

BYA6

(a) Surprisingly, less than 25% of the candidates scored both marks here. Generally candidates were aware that the protein was involved in active transport but only the better ones then went on to explain its role in restoring the resting potential or the movement of sodium and potassium ions.

(b) (i) Again few candidates scored both marks. They usually described the difference in either different ions or different proteins, but rarely both.

(ii) Most candidates had no trouble relating the numbers of proteins to the differential permeability.

BYA7

(a) Most candidates realised that protein C must be involved in the active transport of ions across the axon membrane and a good number of these were able to identify it as the sodium/potassium ion pump.

(b) (i) Too many candidates tried to explain their answers in terms of ions binding to

the proteins rather than passing through the ion channels. Good candidates realised that different ions have different sizes and charges and so would need proteins with different tertiary shapes to transport them across the membrane.

(ii) Disappointingly few candidates correctly related the relative abundance of protein A and scarcity of protein B to the differential permeability of the membrane to sodium and potassium ions. Some even suggested that, because of this relative abundance, protein A must be the sodium ion transport protein.

Q85.

This question was generally well answered and the majority of candidates gained at least half marks.

(a) Most candidates gained one mark for selectively permeability, or a description of this concept. Only the more able candidates gained a second mark, usually for describing membranes as being fluid. Virtually no one gained the alternative mark for stating that membranes maintain different concentrations either side of the membrane.

(b) There were mixed responses to this part and they tended to be centre-specific. The most common mistakes related to transferring materials across the membrane.

(c) (i) There were mixed responses to this part. Some candidates gave the correct answer of ‘carrier protein’, but then disqualified their answer by stating that it was also a ‘channel protein’. Other candidates simply said ‘have proteins’.

(ii) This was answered well by the majority of candidates, even those getting the previous part wrong.

(iii) Many candidates gained the first mark for the ‘graph levelling off’, but there were some very poor descriptions relating to the carrier proteins being limiting.

Q86.

(a) This was not well answered by many candidates. Most knew that legumes fixed nitrogen but references to roots, nodules or bacteria were often missing or incorrect. Very few discussed the advantage in a crop rotation, and just discussed the need for less fertiliser.

(b) This was either well answered or very poorly answered. If candidates made the link between fertiliser and water potential, they usually scored both marks but many candidates were unable to make this link.

Q87.

This question proved to be the best-answered question on the paper, yet proved a good discriminator by producing a full range of marks.

(i) Most candidates gained the first mark for stating clearly that calbindin proteins were either not present (or present in decreased numbers). However, fewer candidates explained precisely the consequences of this absence. The last marking point about

a reduction in the diffusion gradient near membrane protein **A** was a very uncommon, if welcome, sight.

(ii) This synoptic part question was very well known and well answered by the majority of candidates, with many scoring at least three marks. Weaker candidates were confused by concentration gradients and let down by using inaccurate terminology i.e. protein **A** was a channel (not carrier) protein and protein **B** was a carrier (not channel/transport) protein, and this could be improved. There was also a lot of reference to active sites and receptor proteins – a clear indication of confusion with enzymes and hormone actions. Some candidates believe that facilitated diffusion needs ATP to work.

Q88.

(a) Many candidates showed a good knowledge of the structure of the phospholipid bilayer, but fewer were able to give accurate descriptions of its functions. Carrier and channel proteins were well understood, but many candidates did not make their specific function clear enough. Very few candidates referred to the fluidity of the membrane and, even where it was mentioned, almost no one knew a specific function of taking up different shapes for phagocytosis, to form vesicles or for self-repair. Some candidates confused the plasma membrane with a cellular epithelial layer. However, there were many candidates who answered this question succinctly and accurately and were able to score high marks. The question was a good discriminator.

(b) Many candidates scored full marks, even though they had not scored particularly well in some other parts of the paper. The curve was generally described well by all candidates. Some candidates, however, failed to mention that ion transport occurred using active transport.

Q89.

(a) Most candidates scored two or three marks for mentioning the lack of predators, the impact on prey populations or the effect of competition. Only a minority discussed niche overlap, the effect of other species in the food web or ecosystem stability. A significant number stated there would be no competition or that the niche of the crab would not be occupied.

(b) Most candidates either failed to see or describe the plateau in the curve.

(c) Most candidates correctly explained the isotonic equilibrium.

(d) This was intended as a grade A discriminator, but it was only correctly answered by a very few candidates. In part (i), most candidates tried to explain the uptake of salts in terms of preventing water loss from the crab, not realizing that water would actually be entering the crab, and that the salts were required to prevent internal changes in water potential from occurring. In part (ii), most candidates answered the question in terms of the crab needing to keep warm, either by using the warmer sea or by producing heat internally. Only a very few realised that the reduction in temperature would limit the ATP production by respiration, and that there would insufficient to maintain the active uptake.

Q90.

(a) (i) Candidates found this question the most difficult with very few achieving good marks and a significant number only managing to gain marks in part (c).

(ii) Many candidates were unable to link respiration with the uptake of potassium ions. Many appeared to believe that potassium ions are necessary for respiration or attempted to explain the data by suggesting that potassium ions act as the inhibitor of respiration by blocking active sites. Candidates recognising that inhibition of respiration prevented active transport often failed to explain the decrease in concentration of potassium ions in the presence of an inhibitor as diffusion. The decrease was often attributed to the presence of a store of ATP which allowed some active transport to occur. Weaker candidates misread the data assuming that it referred to the concentration in the roots and tried to explain it in terms of loss of potassium ions. Others simply described the curves without providing an explanation.

(b) This proved to be the most demanding question in the paper. Candidates only performed well on this question if they had understood part (a). A number did recognise that the equilibrium had been reached but very few were able to explain that there was no net diffusion of ions due to the absence of a concentration gradient.

(c) This was better answered. Many candidates understood and were able to explain competitive inhibition, although a lack of clarity due to poor expression did penalise some. A minority lost marks by describing non-competitive inhibition.

Q91.

(i) The graph was well used by the majority of candidates. They correctly spotted the greater uptake of mineral ions when oxygen is present and then made a relevant link between the presence of oxygen and aerobic respiration. Few went on further to give a reason why the uptake is greater under these conditions. Some candidates lost this mark when the reason they gave stated energy is “produced” in respiration. It was difficult for examiners to determine whether this reflected poor communication or a misconception about a law of thermodynamics. Some candidates believe no energy is released in anaerobic respiration.

(ii) Some misconceptions featured in quite a few answers given to this question: for example, plant tissue is poisoned by the lactate produced in anaerobic respiration, and plants without any ATP can survive but are unable to take up mineral ions. This was the most difficult section of the question for many candidates, but it was often answered well by candidates from the upper range of ability.

Q92.

(a) It was very pleasing to find that the vast majority of candidates correctly explained the uptake of water into the cell in terms of water potentials and osmosis.

(b) (i) Many candidates obtained one mark here for identifying active transport as the means by which sodium ions are transported across the membrane. Quite a few got a second mark for linking this to carrier proteins. Some candidates failed to get the second mark because they got confused between carrier proteins and channel proteins.

(ii) Only the better candidates scored one or two marks for this question. About equal numbers of those who did score opted for arguments based upon the number of carrier proteins, or a reduced permeability to sodium ions.

Q93.

(a) The channel protein was correctly identified as **B** by the majority of candidates, but the second part of the table was less well answered. A significant number gave **C** as the answer, showing a lack of understanding about the structure of phospholipids. A number left this section of the table blank.

(b) There were many poor responses to this question. The concept of the fluidity of the membrane appears difficult for candidates. There were many vague references to the membrane moving and a lack of clarity about the individual components. Mosaic is also not well understood.

(c) This proved a difficult question for candidates and few gained all the marks. Many gained some reward for realising an increase in temperature increased the energy and subsequent diffusion rate of the ions. The data were often misinterpreted and answers relating to enzyme action were frequently given. Other candidates attempted explanations in terms of osmosis. Marks were missed for incomplete descriptions of the graph and because of a failure to appreciate the effect of temperature on the structure of membranes. Few were able to explain adequately the level section of the graph, with some answers suggesting that all the ions had left the cell, or that no more movement was taking place.

Q94.

(a) A majority of candidates failed to refer to '…when flooding the agar plate with bacteria' required by the question. Thus, the examiner was given long accounts of mopping benches with disinfectant, autoclaving of dishes and safe disposal of dishes. Reference to use of a spreader was comparatively rare.

(b) Many candidates achieved the correct answer, but few realised that 'π' cancelled out and went on to do unnecessarily long calculations.

(c) Many candidates realised that factors such as concentration, temperature and molecule size would affect the rate, but failed to state how the rate would be affected by these. Weaker candidates gave explanations in terms of bacteria, or of the strength of the antiseptic.

Q95.

(a) The molecules in the membrane were well identified with many candidates qualifying the type of protein present. There was some confusion in (ii) over the distinction between the movement of water-soluble molecules and water itself with some candidates failing to appreciate that water can move across the membrane in the same way as other very small molecules such as oxygen. A small number of candidates still referred to the membrane as *semi-permeable* and should be encouraged to follow the Institute of Biology recommended terminology of *partially permeable* whenever possible.

(b) This question produced a wide spread of marks. Most candidates identified the process of diffusion and went on to recognise an increase in rate related to temperature but very few referred to the cooling effect on the blood. Only more able

candidates were able to apply the principles of countercurrent flow to the novel situation and gain both marks in part (iii). Many candidates correctly related volume to time in the calculation but were then unable to express this in the correct units, indicating problems with cm^3 and dm^3.

Q96.

(a) This question was well answered with many candidates confident in the use of the appropriate water potential terminology. Weaker candidates, however, referred to high/low water concentrations or less/more water potential. Only more able candidates were able to link equilibrium with no net movement of water in part (ii).

(b) Although the majority of candidates had the right idea, many described the difference in terms of more movement of water rather than faster rate of movement and then failed to link the water potential values to differences in gradient, referring only to size.

(c) Those students who understood osmosis gave clear logical answers linking dilution of the blue solution with the movement of water in relation to the potato and were able to score full marks. Weaker candidates described the movement of the blue drop and gained one mark but failed to relate this to movement of water into or out of the potato in the initial experiment.

Q97.

Overall this was very well answered with many candidates attaining maximum marks.

(a) Many candidates correctly identified the contraction of the heart as the cause of the pressure. However, too many gave the type of pressure represented, i.e. hydrostatic pressure, rather than its cause.

(b) Able candidates answered this well with clear explanations of the roles of both hydrostatic pressure and water potential. Weaker answers explained the loss of water only in terms of high hydrostatic pressure or only gave vague references to water potential. A common misconception was that water moves out of the capillary down a water potential gradient when in fact it is being moved against the water potential gradient. Often the term ‘pressure’ was used, rather than ‘hydrostatic pressure’ or ‘blood pressure’.

(c) Most candidates were able to describe the role of the lymphatic system in dealing with the ‘extra fluid’, but did not specify the destination of that fluid. Although it was accepted in the mark scheme that lymph was returned ‘to the blood’ it was disappointing to note that many candidates wrote that lymphatic fluid returned to a range of incorrect vessels. Some candidates incorrectly suggested that lacteals and the digestive system are involved in absorbing and breaking down the tissue fluid.

(d) Only the more able candidates were able to attain two marks by accurately explaining how a shortage of dietary protein affects the water potential gradient between blood plasma and tissue fluid. Weaker answers frequently gave vague references to ‘concentration gradients’ without making it clear whether the concentration was water or protein. Many failed to indicate the direction of the gradient. Some weaker candidates gave answers in terms of lack of protein carriers in the membranes of capillaries or the cells making up the tissue.

Q98.

(a) Although most candidates clearly understood the question, many failed to gain

marks by poorly explaining interspecific competition or failing to refer adequately to the diagram, giving vague references to different birds feeding on different prey. A few suggested that interspecific competition referred to the different species of prey, with a small minority discussing intraspecific competition.

(b) This question produced a range of answers from clearly linked explanations of natural selection to poorly expressed ideas which paid more credence to Lamarckism than Darwinism, suggesting that the long beak was produced in response to a need to develop one. Marks were frequently lost by referring to competition between species or discussing godwits rather than restricting their descriptions to the curlew. Variation within the curlew species was rarely given and this aspect of evolution seems poorly understood with a number of candidates suggesting that a single mutation had produced a bird with a longer beak. The weakest answers discussed the evolution of godwits into curlews or of interbreeding between species.

(c) This question was usually well answered with many candidates gaining full marks. Only a few candidates failed to refer to water potential or incorrectly described the movement of water in terms of water potential. Most clearly understand the concept but some discussed differences in water potentials on the seashore, which was beyond the scope of the question.

Q99.

Whilst a full range of marks was seen on this question, few candidates gained twelve marks and zero was rarely seen. Even the best candidates seemed to find it hard to score more than eight or nine marks. These candidates usually did well on parts (b) and (c), (data interpretation), but lost marks in part (a), (practical techniques).

(a) Not many correct answers were seen in part (i). The most common answer was 'dissolve 11cm^3 of sucrose in 39cm^3 of water'. In general, there was a disappointing failure to use mass rather than volume in this context. There were a reasonable number of correct responses in part (ii). The most common errors involved references to colorimetry or chromatography. Often, candidates referred to different concentrations of sucrose rather than different volumes.

(b) In part (i), the majority of candidates obtained one mark for references to increased nectar and sucrose production, but only a small minority referred to the greater effect on nectar secretion. Only a minority of candidates provided the correct answer in part (ii), the majority opting for a lower concentration of sucrose in B. A majority of students correctly suggested that increased nectar production might lead to more frequent visits by pollinators in (iii).

(c) Most candidates obtained two marks, for references to less nectar and a lower mass of sucrose. Quite a large number obtained the third mark, for reference to reabsorption. This question discriminated very well.

(d) Most candidates obtained one mark with references to active transport, or the use of ATP. Only a minority made reference to protein being involved, and some of these failed to gain the second mark, because of references to 'channel' proteins.

Q100.

Three times as many candidates attempted the essay on osmosis as on the energy transfers inside living organisms. Most candidates provided some form of plan, although these varied greatly in length and detail. A few candidates spent a disproportionate amount of their time on a plan to the detriment of the essay itself. There was some

evidence to support the view that candidates were better prepared for the essays, particularly in terms of providing relevant information and breadth of knowledge, although many candidates are under the impression that full marks will only be awarded if they include material, from most of the modules in the specification. Consequently, these candidates give a shallow treatment of many areas, rarely explaining concepts in depth. Most examiners commented on a general improvement from last year although quality of written communication and poor handwriting remains a problem for a significant number of candidates. It was pleasing to note that a significant number of candidates obtained full marks for the essay.

Most candidates scored well on breadth and relevance, because they were able to identify suitable material. Where they failed to gain marks on breadth it tended to be because of failure to consider cellular aspects such as turgor. Candidate commonly failed to gain relevance marks where they drifted into considerations of organisms living either in water, or in conditions where water is very scarce. This did not in itself debar them from marks but it tended to be the weaker candidates who took this approach.

Scientific content produced the expected range of responses in terms of both knowledge and use of terminology. Most candidates had memorised reasonable definitions of osmosis, though a significant number gave definitions in terms of 'concentration' rather than water potential. The most common error was failure to discuss the role of partially permeable membranes.

There were significant differences in the amount and accuracy of detail given relating to the roles of osmosis in the kidney, transpiration and translocation. Relatively few candidates referred to osmosis in the proximal tubules, a majority suggesting that most water reabsorption occurs in the loop of Henle. There was widespread confusion about the relative permeability of the ascending and descending limbs of the loop of Henle to water and ions.

Descriptions of the role of osmosis in plants were often superficial and frequently suggested that transport of water through xylem vessels is by osmosis. Whilst there were many excellent accounts of translocation, many failed to refer to the role of osmosis-induced hydrostatic pressure in the process.

Many candidates successfully referred to the role of osmosis in maintaining a suitable viscosity of mucus in the respiratory tracts.

Q101.

(a) The majority of candidates gave correct answers, but some candidates gave diffusion, and a description of it, as two separate points. Very few identified the route through the membrane as a similarity.

(b) Active transport was named by the majority of candidates but most failed to use information from the graph to support their explanation, commonly omitting the need for the presence of oxygen and referring only to the requirement for energy or respiration.

(c) This was a good discriminator. Weaker responses tended to refer to lack of active transport rather than differences in concentration and uptake by diffusion.

(d) A very small minority of candidates showed any appreciation of how a concentration gradient can influence rate of diffusion and therefore rate of uptake.

Q102.

There were many very clear and accurate answers to both parts (a) and (b), showing an excellent understanding and a high standard of communication skills.

(a) This part of the question required candidates to describe and explain the features of a single capillary, which adapt it for exchange. Good answers described a feature, such as a wall, which is only one cell thick, and then explained how it enables efficient exchange, such as the reduction of diffusion distance. Many answers described a feature but then gave an incomplete explanation, such as 'makes diffusion more efficient'. The narrow lumen of capillaries and red blood cells in contact with the capillary wall were frequently described as features, but with no explanation of how these features affect the exchange of substances.

(b) The explanations of how tissue fluid is formed and how it is returned to the blood system indicate that this topic is well understood by many candidates. There were many excellent explanations of how hydrostatic pressure causes the loss of fluid from capillaries at the arterial end and how changes in water potential bring about the return of fluid at the venous end of a capillary. Candidates failed to gain marks by using inaccurate language, such as 'plasma' being lost from capillaries, or 'tissue fluid' being returned to them.

Q103.

(a) Most recognised that the rate of photosynthesis would increase, and quite a few mentioned that carbon dioxide concentration would normally be limiting. Very few gave a clear link to increased yield, often only making a vague statement, such as 'there would be more food for growth'

(b) Several noted that respiration would increase, but few pointed out that faster use of respiratory substrate would reduce the amount available for growth or that the rate of photosynthesis would be too low to replace the respiratory loss.

(c) Most candidates appreciated that the sodium chloride would lower the water potential in the solution, although some assumed that it would be taken up to the fruits. Only the better candidates who had thought about the information given suggested that the rate of water uptake would be reduced; most assumed a net loss, which would not only reduce yield but also kill the plants.

Q104.

(a) (i) Some were aware of the significance of the carboxyl group, but many invoked some very fanciful chemistry, e. g. the presence of nitrogen.

(ii) Very few linked the similarity in structure to binding with proteins in the cell wall.

(b) Some sensible ideas were expressed relating to over-rapid stretching of cell walls and to uncontrolled growth. None of the candidates pointed out that the herbicide would add to the effect of the IAA naturally present.

Q105.

(a) A majority of candidates did not attempt to calculate the total surface area of the red blood cells. Most of those who made the attempt had difficulty with units or with standard form, consequently only a handful successfully completed the calculation and were able to make the correct deduction from the data.

(b) Most candidates obtained at least one of the two marks, but relatively few could

relate the feature they described to measurement of membrane surface area.