PEARSON EDEXCEL A-LEVEL BIOLOGY A · 9BN0

BIOLOGY



MARK SCHEME

TOPIC 2: GENES AND HEALTH

SCORE	PERCENTAGE
/723	%

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Explain why people with cystic fibrosis can have breathing difficulties.

(4)

Cystic fibrosis means that they have a faulty channel protein called CFTR, this is responsible for the movement of ~~calcium~~ chloride, if this protein is faulty it means that the ~~calcium~~ chloride cannot get out of the cell membrane. this means that ~~calcium~~ chloride is no longer getting around our body, ~~calcium~~ help us breathe because it

Results Plus: Examiner Comments

This candidate recognises that CFTR is involved in the transport of chloride ions, but they have ignored mucus and consider the transport of chloride around the body instead.

Mark Scheme

Q1.

Question Number	Answer	Mark
(a)	1. rate is same for up to 30 minutes / eq ; 2. faster (uptake) for A than B / eq ; 3. (uptake of) A is linear throughout whereas (uptake of) B is not / eq ; 4. uptake of substance B levels off at {2 to 2.2} hours whereas uptake of A does not / eq ; 5. credit correct manipulation of comparative figures ;	maximum (3)

Question Number	Answer	Mark
* (b) QWC	(QWC - Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. correct ref to diffusion (of substance B) occurring due to concentration difference / eq ; 2. idea of rate of uptake decreases ; 3. as the concentration gradient decreases / eq ; 4. (net) uptake stops / eq ; 5. when concentration inside cell equals that outside the cell / eq ;	**maximum (4)**

Question Number	Answer	Mark
(c)	1. active transport is {against /eq} concentration gradient /eq ; 2. active transport requires ATP /eq ; 3. ref to involvement of (membrane) proteins in active transport ;	**maximum (2)**

Q2.

Question Number	Answer	Mark
(a)(i)	1. (central) C shown with H atom and three other groups attached ; 2. {COOH / COO^-} and {NH_2 / NH_3^+} shown ; 3. phenylalanine's R group drawn, attached to a C atom ;	**(3)**

Question Number	Answer	Mark
(a)(ii)	1. reference to formation of enzyme - substrate complex / eq ; 2. idea that the {phenylalanine / R group / substrate} {binds / fits} with active site (of enzyme) ; 3. reference to {bonds being broken / bonds made / induced fit / lowers activation energy / eq} ; 4. adding the OH group (to the phenylalanine R group) / eq ; 5. idea that {tyrosine / product} released from (enzyme / active site) ; 6. as {tyrosine / R group / product} no longer binds to active site / eq ;	**max (4)**

Question Number	Answer	Mark
(b)(i)	1. drop in blood levels of phenylalanine in first {7 / 21} days / eq ; 2. idea that it {levels out / stays low / fluctuates a little / eq} (for the rest of the time period) ;	**(2)**

Question Number	Answer	Mark
(b)(ii)	1. reference to use of normal {alleles / gene} ; 2. coding for {phenylalanine hydroxylase / enzyme} ; 3. reference to introduction of {allele / DNA / gene} into (target) cells ; 4. into {DNA / chromosome / nucleus} ; 5. reference to use of vector (to introduce gene into cells) ; 6. named vector e.g. virus, liposomes ; 7. credit reference to mode of delivery of vector e.g. nebuliser, spray , injection ;	**max (3)**

Question Number	Answer	Mark
(b)(iii)	water / saline / virus (only) / (empty) liposomes / vector (only) / use of placebo / eq ;	**(1)**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	1. idea that the rate of uptake {is constant for first 5 minutes / reduces after 5 minutes} ; 2. idea that { concentration of W reaches a maximum / no more uptake / stays at 0.6 mol dm^{-3} } from 10 minutes ; 3. suitable manipulation of figures e.g. rate of uptake in first 5 minutes is 0.1 $moldm^{-3}$ per minute ;	**1. ACCEPT** idea of linear increase in first 5 minutes	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	1. uptake {slows down / is less / stops} / eq ; 2. because of smaller {concentration / diffusion } gradient / eq ; 3. credit argument for why it is not another process e.g. not osmosis as the solute concentration rises from 0, not active transport as it will continue to rise and not reach a maximum ;	**2 ACCEPT** converse	**(2)**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	1. life expectancy is likely to be lower than {Aa / heterozygote} ; 2. because of higher chance of (developing) malaria / eq ; **OR** 3. life expectancy may be {higher / same } than {aa / homozygous recessive} ; 4. because of {less / similar} severity of anaemia ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
(ii)	1. idea they (heterozygotes) are less likely to have { malaria / anaemia } ; 2. idea that { *Plasmodium* / parasite / eq } unable to reproduce (and cause wider infection) **OR** lower (functional) red blood cell count / blocking of blood vessels causes {pain / cell death / eq} ;	**2 ACCEPT** parasite will die	**(2)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	1. idea of it being frequently inherited in the family e.g. 1, 7 and 10 all have affected offspring, 9 of the family have the disorder ; 2. individual { 1 / 3 / 7 / 10 } must be heterzygous / eq ; 3. use of the pedigree diagram to explain mark point 2 ; 4. appropriate use recessive allele argument e.g. if it were recessive then 2 would have to be {heterozygous / a carrier} ; 5. idea that it is unlikely that the unrelated parents { 8 / 11 } would also be carriers of the affected allele ;	**IGNORE** 50% are affected **1 ACCEPT** 8 of 14 descendants of 1 and 2 2 **ACCEPT** have one dominant allele	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	1. parents gametes displayed correctly (e.g. M, m and m ,m) ; 2. correct genotypes of offspring shown ; 3. probability matches genotypes shown e.g. 0.5 / ½ / 1 in 2 / 50% ;	**1. ACCEPT** gametes shown on a punnett square alone 3. **ACCEPT** other probabilities if match genotypes shown	(3)

Q6.

Question Number	Answer	Additional Guidance	Mark
(a)	1. (oxygen) is a {small / non polar} (molecule) ; 2. (oxygen) is able to diffuse (through phospholipid bilayers) ; 3. cell surface membrane has a phospholipid bilayer ;	1. NOT if large or polar ACCEPT uncharged	(2)

Question Number	Answer	Additional Guidance	Mark
(b)	1. chloride ions are charged ; 2. idea that (chloride ions) are NOT able to diffuse through {a phospholipid bilayer / artificial membrane} ; 3. idea that (chloride ions) need a {carrier / channel / transport / eq } protein (to move across a membrane) ; 4. reference to {active transport / facilitated diffusion} ; 5. reference to CFTR channel protein (present in epithelial cells) ;	IGNORE chlorine 1. IGNORE chloride ions are big / polar 3. ACCEPT transmembrane	(3)

Question Number	Answer	Additional Guidance	Mark
(c)	1. the cell membrane is more permeable to water (than the artificial membrane) ; 2. idea that water can move across the phospholipid bilayer ; 3. idea that water can also move through channel proteins ;	IGNORE references to rates or concentration gradients 1. NOT artificial membrane is impermeable to water 3. ACCEPT transmembrane proteins, aquaporins	(2)

Q7.

Question Number	Answer	Mark
(a)	A ;	(1)

Question Number	Answer	Mark
(b)	C ;	(1)

Question Number	Answer	Mark
(c)	C ;	(1)

Question Number	Answer	Mark
(d)	D ;	(1)

Question Number	Answer	Mark
(e)	D ;	(1)

Question Number	Answer	Mark
(f)	C ;	(1)

Question Number	Answer	Mark
(g)	A ;	(1)

Q8.

Question Number	Answer	Mark
(a)(i)	D ;	(1)

Question Number	Answer	Mark
(a)(ii)	A ;	(1)

Question Number	Answer	Mark
(a)(iii)	B ;	(1)

Question Number	Answer	Mark
(a)(iv)	D ;	(1)

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. idea that only one factor has changed ; 2. if intake went up, increase risk / obesity a risk factor / if intake went down could decrease CHD risk / eq ;	1. ACCEPT Less valid investigation / method , to allow comparison, variables need to be controlled IGNORE reliability, fair test	(2)

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. both diets decrease the risk / eq ; 2. both diets have less saturated fats / eq ; 3. saturated fat associated with heart disease / eq ; 4. idea that changing to unsaturated lipids has the greater effect ; 5. idea that excess carbohydrates may be stored as saturated lipids ; 6. idea that unsaturated lipids change HDL/LDL ratio ;	4. 30% more decrease	(3)

Q9.

Question Number	Answer	Mark
* (a) QWC	(QWC - Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. idea that there is a cascade of events (leading to blood clotting) ; 2. ref to *thromboplastin* (starting the cascade) ; 3. ref to conversion of *prothrombin* into *thrombin* ; 4. idea that {*thromboplastin* / *thrombin*} is {an enzyme / a catalyst} ; 5. ref to conversion of *fibrinogen* into *fibrin* ; 6. ref to formation of mesh of {fibres / *fibrin*} ; 7. ref to requirement of {calcium ions/ Ca^{2+} / vitamin K} ; 8. ref to {*platelets* / blood cells} getting trapped (in the mesh) ;	**maximum (4)**

Question Number	Answer	Mark
(b)(i)	1. snake venom decreases the clotting time /eq ; 2. (overall) as mass of snake venom increases the clotting time decreases /eq ; 3. idea that only a very small increase (0.004) in mass causes very sharp drop in clotting time ; 4. concentrations above {0.004 /0.02} cause little change in clotting time / eq ; 5. credit correct use of manipulated figures ;	**maximum (3)**

Question Number	Answer	Mark
(b) (ii)	idea of one of the following: if the snake venom has similar effects as a known clotting factor an idea of its mode of action can be worked out / how deadly the snake is / compare to normal (clotting) process / possible use as medication / for research into antidotes / eq ;	(1)

Question Number	Answer	Mark
(c) (i)	1. ref to an enzyme as a protein ; 2. ref to {3D / tertiary / globular} structure ; 3. ref. to named bonds (holding structure in place) ; 4. between the R groups ; 5. ref to active site ; 6. idea of specificity of active site ;	maximum (3)

Question Number	Answer	Mark
(c)(ii)	1. it is one of the enzymes /similar to one of the enzymes, in the clotting process / eq ; 2. idea that has active site complementary to one of the substrates ; 3. ref to it activating other enzymes ; 4. ref to effect on platelets ; 5. idea that it triggers the clotting process ;	maximum (2)

Q10.

Question Number	Answer	Additional Guidance	Mark
(a)	1. platelets ; 2. thromboplastin ; 3. enzymes ; 4. prothrombin ; 5. thrombin ;	NB: allow phonetic spelling 1. ACCEPT thrombocytes 2. ACCEPT enzyme if not given in Mp3 3. ACCEPT thromboplastin if not given in Mp2	(5)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. central carbon with {R / H / eq} and H attached by single bonds ; 2. {NH_2 / NH_3^+} attached to a carbon by single bond ; 3. {COOH / COO^-} attached to a carbon by single bond ;	Mp1 Must show C, H and R or a plausible R-group MP2 and 3 ACCEPT groups attached to a central C that is not shown (chemical notation) ACCEPT groups written wrong way round e.g. C-H_2N NOT incorrect bonding within groups if shown e.g. C=OH ACCEPT if correct group attached to wrong molecule e.g. glucose	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	peptide (bond) ;	ACCEPT peptide link NOT polypeptide or dipeptide	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. Idea that fibrinogen is globular and fibrin is fibrous ; 2. fibrinogen is soluble and fibrin is insoluble ; 3. Idea that they are different sizes ;	ACCEPT marks to be pieced together across the response. NB: answers must be comparative e.g. fibrin is fibrous fibrinogen is not 1. ACCEPT fibrinogen globular and fibrin (long) strand or chain. 3. ACCEPT fibrinogen is {smaller / larger / more amino acids} than fibrin	(2)

Q11.

Question Number	Answer	Mark
(a)(i)	1. no {amino / amine / NH_2 / NH_3^+ } group ; 2. no {carboxyl / carboxylic acid / COOH / COO^- } group ; 3. no {central / alpha} carbon (atom) / eq ; 4. no {R / residual} group(s) ; 5. ring structures present (amino acids only have them in some R groups) / eq ;	**(2)**

Question Number	Answer	Mark
(a)(ii)	1. idea that position of CH_3 different ; 2. idea that position of {H / NH/ N-H} different ; 3. reference to being isomerically different ;	**(2)**

Question Number	Answer	Mark
(a)(iii)	1. idea of specificity of {active site/enzyme} ; 2. idea that the products are different {shapes / structures} ; 3. idea that P450 consists of (at least) three {enzymes / active sites} ; 4. idea that products could be interconverted ;	**(3)**

Question Number	Answer	Mark
(b)	**Conclusion 1:** 1. idea that the first conclusion is {valid for some of the data / not valid (for all data) / misleading /eq} ; 2. coffee and hot chocolate do have different concentrations **OR** only 4 drinks tested / concentration not measured / volumes not controlled / eq ; **Conclusion 2:** 3. idea that the second conclusion is not valid ; 4. no indication of the volumes of tea and cola / volume not controlled / impossible to calculate concentration of caffeine in all four drinks (using information given) / eq ;	**(3)**

Q12.

Question Number	Answer	Mark
(a)(i)	1. different tissues have different activities of catalase / eq ; 2. Z has highest (activity) / eq ; 3. Y has the lowest (activity) / X and Y have very similar levels / eq ; 4. credit correct manipulation of figures e.g. Z has 12 more than Y / Z has 11 more than X ;	**(3)**

Question Number	Answer	Mark
(a)(ii)	1. idea activity in mussel E is not higher than M in all tissues ; 2. mussel E has lower (activity) in tissue X / eq OR (activity) is the same in tissue Y / eq OR mussel E has higher (activity) in tissue Z / eq ; 3. mussel E has more (overall activity)/ eq ; 4. credit correct comparative manipulation of figures ; 5. Idea that both mussels have tissues with same order of activity e.g. Y X Z ;	**(2)**

Question Number	Answer	Mark
(b)	1. reference to measuring volume of oxygen ; 2. suitable reference to time e.g. oxygen produced in unit time, time taken to produce same volume of oxygen ; 3. idea of measuring the initial rate of reaction ; 4. reference to controlled variable in relation to the mussel e.g. age, part of mussel, mass, surface area ; 5. reference to a controlled variable in relation to the experiment e.g. volume of hydrogen peroxide, temperature, concentration, pH ; 6. suitable reference to repeats ;	**(4)**

Q13.

Question Number	Answer	Additional guidance	Mark
(a)	1. phospholipid (bilayer) ; 2. credit details of phospholipid bilayer ; 3. proteins ; 4. credit details of proteins ; 5. reference to other named membrane components ;	ALLOW a clearly labelled diagram 2. e.g orientation because of hydrophobic and/or hydrophilic regions eg phospholipids are fluid 4. e.g. description of channel/carrier protein structure or position. (Intrinsic, extrinsic or transmembrane) 5.e.g. glycolipid, cholesterol, glycoprotein, carbohydrate chain, glycocalyx	**(3)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	**Solute P:** 1. (up to 30 minutes) the {concentration / number} of molecules of P increases inside the cell / eq ; 2. ref to {diffusion / facilitated diffusion}(of molecules of P into the cell) ; 3. down the concentration gradient (of P) / eq ; 4. {between 30 and 40 minutes / after 30 minutes } the {concentration / number} of molecules (of P) inside the cell stays the same / eq ; 5. concentration (of P) inside cell equals concentration outside cell / reaches equilibrium / eq ; **Solute R:** 6. solute R does not enter cell / eq ; 7. membrane is impermeable to R ;	IGNORE amount **max 4 marks for solute P** 2. NOT osmosis 3. ALLOW high to low concentration NOT high to low concentration gradient 4. ALLOW no net movement	**(5)**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	six white circles inside and outside the cell and 4 black circles outside cell ;		**(1)**

Q14.

Question Number	Answer	Additional Guidance	Mark
(a)	1. reference to phospholipid bilayer ; 2. correct orientation and structure of the phospholipids in the bilayer ; 3. explanation of why the phospholipids are orientated the way they are e.g. heads attracted to water OR tails repelled by water ; 4. proteins in the membrane (described / shown) ; 5. idea of two different locations of proteins e.g. extrinsic, intrinsic, transmembrane ; 6. glycoproteins / glycolipids (described / shown) ; 7. idea of cholesterol within the membrane (described / shown) ;	Read what is written on the lines first Accept points made on a clearly labelled diagram If diagram and description contradict then Mp not awarded 2. ACCEPT heads on outside and each with two tails if drawn 2. NOT if gap between phospholipids is too large e.g. as large as a phopholipid in the diagram 3. ACCEPT ref to heads being hydrophilic OR tails hydrophobic OR explained in terms of polarity 5. If only one protein located then still get Mp4	(5) Exp

Question Number	Answer	Additional Guidance	Mark
(b)	1. small ; 2. non-polar / non –charged ; 3. lipid soluble / eq ; 4. idea that they are recognised by (specific) protein receptors /eq ;	1. NOT 'size' alone 2. ACCEPT ref. to polar if correctly qualified 3. ACCEPT solubility in lipids NOT just 'solubility' NOT 'water soluble' ACCEPT 'fat soluble'	(2) Grad

Question Number	Answer	Additional Guidance	Mark
(c)	Similarity any **one** from: 1. use {carrier / channel} proteins **OR** 2. transport {hydrophilic / eq} molecules / named molecule ; Difference any **one** from: 3. idea that active transport requires {energy / ATP} / facilitated diffusion does not require {energy / ATP} **OR** 4. active transport moves molecules against a concentration gradient / facilitated diffusion allows molecules to move down a concentration gradient / eq ;	1. IGNORE protein unqualified IGNORE transport protein 2. ACCEPT charged / polar	(2) Grad

Q15.

Question Number	Answer	Additional Guidance	Mark
(a)	1. {phosphate group / heads} are hydrophilic ; 2. Idea that heads can be attracted to water ; 3. {fatty acids / tails} are hydrophobic ; 4. Idea that tails orientate themselves away from water / eq ; 5. Idea of aqueous environment on both sides of the membrane ;	ACCEPT marks for annotated diagram, phonetic spelling OK IGNORE "water loving / hating" 1. ACCEPT polar 2. not just facing water 3. ACCEPT non polar 4. ACCEPT repel water, face away from water, away from polar environment 5. ACCEPT polar environment	(3)

Question Number	Answer	Mark
(b)	B ; C ; A ;	(3)

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. both have a phospholipid bilayer and protein / eq ; 2. idea that the fluid mosaic model has {proteins within the phospholipid layer / protein channels } while the Davison – Danielli model has protein layer on the outside of the membrane only ; 3. reference to other components present in fluid mosaic model e.g. glycolipid, glycoprotein, cholesterol ;	1. ACCEPT point pieced together in response 2. needs clear comparative statement re the position of the proteins in the two models, but can be expressed in a number of ways.	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(ii)	1. idea that molecules would not be able to diffuse through the (two) protein layers / eq ; 2. idea of no {channels / carriers / protein } for {facilitated diffusion / active transport / osmosis} ; 3. comment on fluidity of membrane / limits fusion of vesicles /eq ;	1. ACCEPT osmosis in context of water passing through protein layer 2. ACCEPT pumps for active transport 3. ACCEPT endo/exocytosis	(2)

Q16.

Question Number	Answer	Additional guidance	Mark
(a)	Idea that (a change in) one variable (directly) results in the change of another variable ;	ALLOW causes, affects, etc and clear examples Eg increase in blood cholesterol causes an increase in the risk of CVD IGNORE correlation, link, relationship, trend, etc alone	**(1)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. reference to peptide bonds (joining amino acids); 2. between amino group (of one amino acid) and carboxyl group (of another) / eq ; 3. the sequence of amino acids is the primary structure of the protein / eq ; 4. reference to folding (of primary structure) held together by bonds / eq ; 5. {disulfide bridges / eq} / {hydrogen / H} bonds / ionic bonds / Van der Waals forces ; 6. between the R groups / eq ;	2. ALLOW from a labelled diagram ALLOW NH_2 and COOH 4. ALLOW ref to alpha helix or beta pleated sheet	**(4)**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. HDL is smaller ; 2. HDL contains more protein / eq ; 3. HDL contains less cholesterol / eq ;	**ALLOW** converse for LDL	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(i)	1. (risk due to) high blood pressure has fallen overall / eq ; 2. (risk due to) high blood cholesterol has fallen overall / eq ; 3. (risk due to) obesity has risen overall / eq ; 4. obesity was the lowest risk factor but is now the highest / eq ; 5. credit use of manipulated figures ;	Answers should cover total time period and not just 1980-1990 5. only credit overall change figures e.g. 17% drop for high blood pressure 16% drop for high blood cholesterol 10.5% increase in obesity	**(3)**

Question Number	Answer	Additional guidance	Mark
(c)(ii)	1. people more aware of the risks / eq ; 2. people consuming foods with lower {cholesterol levels / saturated fats / eq} / eq ; 3. people consuming foods with more fibre in them / eq ; 4. use of statins / eq ; 5. more screening / eq ; 6. more exercise / eq ;	1. ALLOW more aware of healthy diets 4. Use of sterols/named example 5. ALLOW self testing	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(iii)	Any **two** from: (being) male increase in age lack of exercise / inactivity smoking genetics high alcohol consumption high salt diet high saturated fat intake stress diabetes ;	IGNORE fat, LDL or cholesterol consumption	**(1)**

Q17.

Question Number	Answer	Mark
(a)(i)	1. A has a {greater / eq} effect than B / eq ; 2. A lowers total cholesterol more than B / eq ; 3. A lowers LDL more than B / eq ; 4. A raises HDL more than B /eq ; 5. manipulation of figures to quantify mp 2 or 3 or 4 ;	**max (3)**

Question Number	Answer	Mark
(a)(ii)	1. drug A ; 2. the {<u>total</u> cholesterol / LDL} levels are lower ; 3. statins inhibit cholesterol synthesis ; 4. statins result in more LDL receptors on liver cells ; 5. so more LDL will be {cleared /eq} from the blood /eq ;	**max (3)**

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Question Number	Answer	Mark
(b)	Any **two** from: gastrointestinal {problems / cancer} e.g. constipation, bowel complaints, {joint / muscle} problems e.g. cramps, myositis, pain, myopathy, muscle breakdown, liver problems, kidney problems, mental health problems e.g. depression, reduced vitamin uptake, respiratory cancer ;;	**max (2)**

Question Number	Answer	Mark
(c)(i)	1. reference to the (general) increase in heart disease with age ; 2. more 18-44 year old females develop heart disease than males / eq ; 3. in all other age groups more males have heart disease than females / eq ; 4. greatest difference between females and males in the group 65 - 74 ; 5. credit manipulation of figures ;	**max (3)**

Question Number	Answer	Mark
(c)(ii)	1. {420 / 425} - {30 / 35} / 390 / 385 / 395 ; 2. 11 - 13 ;	**(2)**

Q18.

Question Number	Answer	Additional Guidance	Mark
(i)	8		**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	6		**(1)**

Q19.

Question Number	Answer	Mark
(a)	1. both decrease ; 2. mortality rate in men is higher than that in women (throughout time period) / eq ; 3. this difference is greater at the start of the time period than at the end / eq ; 4. a valid comparison made about the difference in the changes e.g. between 1997 and 1998 the rate stays constant for males but falls for women / fall in mortality rate in men is steeper than the fall in women / decrease in mortality rate is greater in men than women / the decrease in men is less uniform than in women ; 5. correct manipulation of figures to quantify any of the above ;	max (3)

Question Number	Answer	Mark
(b)	1. {people more aware of the dangers / better health education} / appropriate named example /eq ; 2. less stress /eq ; 3. {better / more} screening / eq ; 4. better treatments / eq ; 5. more exercise being taken / eq ; 6. changed diet / less obesity / eq ; 7. less alcohol intake / eq ; 8. decrease in smoking ; 9. change in population genetics / eq ;	max (3)

Question Number	Answer	Mark
(c)	1. damage to {endothelial cells / epithelial cells /cells lining artery (wall)} ; 2. reference to inflammatory response ; 3. reference to (accumulation of) white blood cells in (damaged area) ; 4. {build up / eq} of cholesterol (in damaged area) ; 5. reference to build up of {calcium salts / fibrous tissue / fibrin / platelets} ; 6. reference to formation of {atheroma / plaque} ; 7. reference to {loss of elasticity (of artery) / narrowing of lumen} / eq ; 8. idea that this process is self-perpetuating ;	max (4)

Q20.

Question Number	Answer	Mark
* **(a) QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. {damage / eq} to {endothelial cells/ epithelial cells / lining / eq} of artery ; 2. ref to inflammatory response ; 3. ref to migration of white blood cells into area / eq ; 4. build up of cholesterol /eq ; 5. reference to formation of atheroma / plaque ; 6. reference to {calcium salts / fibrous tissue} ; 7. ref to {loss of elasticity (of artery) / narrowing of lumen} / eq ; 8. idea that this process is self–perpetuating ;	**(4)**

Question Number	Answer	Mark
(b)(i)	{the alleles / eq} present (in an organism) / eq ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	a (different) form of one gene / eq ;	**(1)**

Question Number	Answer	Mark
(c)	Any **two** from: More saturated fat / more cholesterol / more salt /obesity / more alcohol / more age / male / post-menopausal women / high blood pressure / smoking / diabetes / less activity / stress ;	**(1)**

Question Number	Answer	Mark
(d)	1. muscle {inflammation / pain / eq} ; 2. liver {damage / failure/ eq} ; 3. joint {aches / pains/ eq} ; 4. nausea/constipation/diarrhoea ; 5. kidney {damage / failure / eq} ; 6. cataracts ; 7. diabetes ; 8. allergies / skin inflammation / skin rash / eq ; 9. respiratory problems / persistent cough / eq ; 10. headaches / dizziness / depression ;	**(2)**

Q21.

Question Number	**Answer**	**Additional Guidance**	**Mark**
(a)	1. mutation changes the sequence of bases / eq ; 2. reference to stop code / idea of {insertion / deletion / eq} changes all triplets / frame shift / eq ; 3. {transcription / translation} does not occur / mRNA too short / protein too short / a different protein is made / eq ;	1. ACCEPT correct sequence of bases not there 2. IGNORE changes one triplet / codon ACCEPT no start codon, no ribosome binding site 3. IGNORE change of an amino acid ACCEPT wrong protein made, different sequence of amino acids	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)	1. in the (cell surface) membrane ; 2. of mucus-producing cells / eq ;	1. ACCEPT in phospholipid bilayer, apical membrane NOT on, attached, basal membrane 2. ACCEPT {epithelial/endothelial / lining} cells of appropriate named organ or system e.g. cells lining respiratory, digestive, reproductive	(2)

Question Number	Answer	Additional Guidance	Mark
(c)	1. (change in) {number / type / sequence / eq} of {amino acids / R groups} ; 2. So the {bonding / named bond } will be different / eq ;	2. ACCEPT hydrogen, disulfide bridges, van der Waal forces, ionic NOT peptide, glycosidic, ester bond, etc IGNORE references to shape including active sites	(2)

Question Number	Answer	Additional Guidance	Mark
(d)	1. CFTR is a channel protein / eq ; 2. idea that {fewer / no} chloride ions will be able to {enter / bind to / pass through / eq} the CFTR protein ; 3. idea that fewer chloride ions will leave the cell ;	NOT chlorine penalise once 1. NOT carrier 2. ACCEPT CFTR has a specific shape for chloride ions ACCEPT other ions can pass through	(2)

Question Number	Answer	Additional Guidance	Mark
(e)	1. less {chloride ions / water} in mucus / eq ; 2. idea that mucus is different e.g. thicker, stickier ; 3. in the {respiratory system / lungs / digestive system / pancreas / reproductive system / oviducts / fallopian tubes / cervix / sperm duct / vas deferens / eq } ; 4. credit correct reference to a consequence of thicker mucus ;	E.g. less ventilation, enzyme release, absorption of nutrients, more chest infections, reduced fertility, etc	(2)

Question Number	Answer	Additional Guidance	Mark
(f)	1. by {enzymes / proteases} ; 2. by hydrolysis / eq ; 3. of peptide bonds ;		(2)

Q22.

Question Number	Answer	Additional Guidance	Mark
(a) (i)	1. somatic involves {body / somatic} cells AND germ line involves {gametes / ovaries / testes / eq} / eq ; 2. somatic can't be inherited / germ line can be inherited / eq ; 3. somatic legal / germ line illegal / eq ; 4. somatic temporary treatment / germ line could be cure / eq ;	1. Must mention both 3 ACCEPT prohibited	(2) Exp

Question Number	Answer	Additional Guidance	Mark
(a) *(ii) (QWC)	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to {a vector / named vector} e.g. liposome, virus, plasmid ; 2. idea of inserting (functional) gene that codes for the CFTR protein ; 3. reference to method of getting into lungs e.g. nebuliser ; 4. CFTR protein made via { transcription/ translation } / eq ; 5. Allows chloride ions to leave cells / eq ; 6. idea that water leaves cells by osmosis / eq ; 7. idea that mucus is less sticky ;	QWC emphasis answer must be in a logical sequence Penalise once for point out of sequence / context 2. NOT replaces faulty gene 3. ACCEPT Inhalation /aerosol 7. ACCEPT not sticky / more runny / less viscous / thinner	(4) Exp

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea of loosens mucus ; 2. idea of mucus expelled from lungs (more easily) ; 3. idea of clearer airways / better breathing ;	1. IGNORE 'becomes thinner' ACCEPT sticks less 2. ACCEPT helps to remove mucus 3. ACCEPT less breathless, lower risk of chest infections, larger surface area for gas exchange in lungs. IGNORE less coughing	(2) Exp

Q23.

Question Number	Answer	Mark
* (a) QWC	(QWC - Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. reference to CFTR {protein / channel} eq ; 2. reference to a different {amino acid / sequence of amino acids / eq} (on defective CFTR protein) ; 3. reference to change in protein ; 4. reference to role of protein in transporting chloride ions ; 5. reference to (chloride) ions not {moving out of cells / going into mucus} ; 6. reference to sodium ions moving in ; 7. water does not move out (of cells) / water moves in (to cells) /eq ; 8. by osmosis / eq ; 9. mucus (on cell surface) {is not diluted / becomes thicker / becomes stickier} / eq ; 10. (thickened mucus) cannot be moved by {cilia / coughing} ;	max (5)

Question Number	Answer	Mark
(b)(i)	1. idea that mucus {traps / eq} {bacteria / pathogens} ; 2. idea that {bacteria / mucus containing the bacteria} cannot be removed (by cilia); 3. idea that mucus provides conditions for bacteria to {live / grow / develop / eq} ; 4. reference to antibodies not being effective ; 5. reference to trauma caused by coughing ; 6. idea that resident {phagocytes / macrophages} cannot destroy bacteria ;	max (2)

Question Number	Answer	Mark
(b)(ii)	1. {increase / eq} with age ; 2. (increases) {from 0 to 25 / up to 25} ; 3. {constant /eq} 25 to 35 ; 4. {decreases / eq} 35 to 45 ; 5. credit correct manipulation of figures ;	max (3)

Question Number	Answer	Mark
(b)(iii)	1. Overall increase in P and decrease in S ; 2. At 0 more S than P / between 0 and 7 years S is greater than P ; 3. After 7 years P is greater than S ; 4. S starts to decrease at year 15 but P {decreases at 35 years / continues to increase} ; 5. Maximum P is greater than maximum S ; 6. S {stays constant / is at its highest} between 10 and 15 years but P {stays constant / is at its highest} between 25 and 35 years ;	max (2)

Q24.

Question Number	Answer	Mark
* (a) QWC	(QWC - Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to CFTR {gene / channel} not functioning properly ; 2. reference to {thicker / stickier / eq } *mucus* ; 3. (*mucus*) blocks *(pancreatic)* {duct(s) / eq } ; 4. in the *pancreas* ; 5. idea that *enzymes* cannot {be secreted into / reach} small *intestine* ; 6. idea of reduced *digestion* of {food / named food} ; 7. reference to reduced *absorption* / eq ; 8. idea of {*malnutrition* / *weight* loss} ; 9. idea of {self-*digestion* of *(pancreatic)* cells / problems controlling blood sugar levels / *cysts* / *fibroids*} ;	**(4)**

Question Number	Answer	Mark
(b)	1. reference to {IVF / description of preimplantation} ; 2. {embryo / eq} DNA analysed / eq ; 3. presence of CFTR {gene mutation / faulty allele / eq} tested for / eq ;	**(3)**

Question Number	Answer	Mark
(c)	Any of the following paired points 1. who has right to decide if tests should be performed / eq ; 2. {implications of medical costs / disagreements over next step / embryo has rights} ; **OR** 3. issues relating to confidentiality of {parents / child} / eq ; 4. idea that {some other abnormality may be found / paternal DNA does not match / other family members have right to know results} ; **OR** 5. idea some other abnormality may be found / false negative ; 6. comment on possible problems with e.g. future employment / insurance / what constitutes a serious condition / eq ; **OR** 7. idea that embryo could be {damaged / destroyed / discarded / eq} / false positive ; 8. embryo {is a potential life / has rights} /destroying embryo is {wrong / unethical / murder / eq} ;	**(2)**

Q25.

Question Number	Answer	Mark
(a)	1. idea that these cells are {easy / painless} to collect ; 2. idea that a relatively {large amount of DNA / large number of cells} can be collected ; 3. they {contain diploid cells / have (23) pairs of chromosomes} ; 4. cells {are genetically identical / have same DNA / have same alleles} ; 5. any {recessive allele / mutated (CF) gene} will be present in them / eq ; 6. idea that if the gametes were tested they may not contain the {recessive allele / mutated (CF) gene}(as they are haploid) ;	maximum (2)

Question Number	Answer	Mark
(b)	1. cystic fibrosis results from one of a number of possible mutations (of this gene) /eq ; 2. idea that testing for only one will miss other recessive alleles ;	(2)

Question Number	Answer	Mark
(c)	1. ref to false negatives / eq ; 2. idea that the screening programme does not test for all the possible mutations that can cause cystic fibrosis ; 3. idea that a mutation may occur in the formation of the gametes ; 4. idea of mutation in both gametes ; 5. idea that a mutation may occur after fertilisation ;	maximum (2)

Question Number	Answer	Mark
(d)	1. idea that any other family member could be a carrier ; 2. idea that informed choices can be made about having children (if they know that they are carriers) ;	(2)

Question Number	Answer	Mark
(e)	1. heterozygous genotype of both parents shown or stated ; 2. possible alleles carried in the gametes shown (can be shown in a Punnet square) ; 3. possible genotypes of offspring clearly shown (can be shown in a Punnet square) ; 4. corresponding phenotypes given ; 5. (probability of having child with cystic fibrosis is) 25% / 1 in 4 / ¼ / 0.25 / ;	maximum (5)

Q26.

Question Number	Answer	Additional Guidance	Mark
(i)	1. chorionic villus sampling / amniocentesis ; 2. idea that (fetal) {cells / DNA} are obtained from appropriate source { placenta / amniotic fluid / eq } ; 3. (cells / DNA) tested for presence of {CFTR / recessive / faulty / mutant / eq} {allele / gene } / eq ;	1. **ACCEPT** CVS **DO NOT ACCEPT** chronic 2. **ACCEPT** from embryo 3. **ACCEPT** test for cystic fibrosis allele or gene	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	Any of the following paired points 1. idea that it may result in a miscarriage / choice of an abortion ; 2. {killing / eq} is {wrong / unethical / eq}; **OR** 3. idea of risk of false {positive / negative} ; 4. comment on consequence e.g. healthy fetus may be aborted / parents not prepared for child with cystic fibrosis / eq ; **OR** **5.** if cystic fibrosis or some other abnormality may be found ; 6. comment on possible problems with {future employment / insurance / what constitutes a serious condition} / eq ; **OR** 7. who has right to decide if tests should be performed / eq ; 8. {implications of medical costs / disagreements over next step} ; **OR** 9. issues relating to confidentiality of {parents / child} / eq ; 10. idea that {some other abnormality may be found / paternal DNA does not match / other family members have right to know results} ;	1. **ACCEPT** can {harm / damage / kill} the fetus 2. **ACCEPT** fetus has right to life / distress to parents / genetic discrimination / eugenics 3. **ACCEPT** it isn't 100% accurate 4. **ACCEPT** parents did not have choice of abortion	**(2)**

Q27.

Question Number	Answer	Additional Guidance	Mark
*	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that DNA used as a template to make mRNA ; 2. reference to RNA polymerase ; 3. reference to complementary base pairing / examples provided ; 4. idea that triplet of DNA bases makes one codon ; 5. one codon codes for one (specific) amino acid / eq ; 6. the primary structure is the sequence of amino acids / eq;	**QWC – emphasis on logical sequence.** 1. ACCEPT Idea that one gene codes for one polypeptide 4 & 5 combined allow one mark for triplet of DNA codes for one amino acid	**(4)**

Q28.

Question Number	Answer	Additional Guidance	Mark
	Difference 1. active transport requires { energy / ATP} whereas facilitated diffusion does not / eq OR 2. active transport { moves molecules against the concentration gradient / eq } whereas facilitated diffusion allows molecules to { move down the concentration gradient / eq } ; **Similarity** 3. both use proteins ;		**(2)**

Q29.

Question Number	Answer	Additional Guidance	Mark
	1. DNA is {double stranded/ has a double helix} and RNA is {single stranded / does not have a double helix} ; 2. DNA has {thymine / T } while RNA has { uracil / U } ; 3. DNA has deoxyribose while RNA has ribose ; 4. DNA is { larger / longer } than RNA / eq ;	**1. ACCEPT** mixtures e.g. DNA double helix mRNA is single strand **IGNORE** hydrogen bonds **2.NOT** thiamine, thyamine	**(3)**

Q30.

Question Number	Answer	Additional Guidance	Mark
(a) (i)	B ;		(1) comp

Question Number	Answer	Additional Guidance	Mark
(a) (ii)	B ;		(1) comp

Question Number	Answer	Additional Guidance	Mark
(a) (iii)	C ;		(1) comp

Question Number	Answer	Additional Guidance	Mark
(b) (i)	C ;		(1) comp

Question Number	Answer	Additional Guidance	Mark
(b) (ii)	D ;		(1) comp

Question Number	Answer	Additional Guidance	Mark
(c)	nucleus ;	ACCEPT chloroplast, mitochondria	(1) clerical

Question Number	Answer	Additional Guidance	Mark
(d) (i)	Advantage any **one** from: 1. prevent child dying late in pregnancy / eq 2. idea of less stress for parents / eq 3. parents can prepare for child { with / without } achondroplasia / eq 4. idea of making an informed choice ; Disadvantage any **one** from: 5. risk of miscarriage of healthy child / eq 6. idea of more stress for parents / eq 7. cost / eq 8. risk of false { negatives / positives } / eq ;	4. ACCEPT may choose termination 5. ACCEPT risk of spontaneous abortion	**(2) Exp**

Question Number	Answer	Additional Guidance	Mark
(d) (ii)	1. genotype of parents shown ; 2. alleles in the gametes shown ; 3. possible genotypes of children shown AND corresponding phenotypes shown ; 4. (probability =) 1/4 / 25% / 1 in 4 / 0.25 ;	4. NOT a ratio e.g. 1:4 ACCEPT 1/3, 33(.3)% , 1 in 3, 0.3 this assumes AA dies	**(4) Exp**

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Q31.

Question Number	Answer	Mark
(a)	(DNA) { polymerase / helicase / ligase} ;	(1)

Question Number	Answer	Mark
(b)	**Stage 1** 1. only one bond drawn in lower half of tube ; **Stage 2** 2. one only bond drawn (higher than the one drawn in stage 1) ; **Stage 3** Diagram 3. {1 / 2} molecules shown with one light and one heavy strand ; 4. {1 / 2} molecules shown with two light strands; Test tube 5. 2 bands shown in roughly correct position (middle to upper half of test tube) ; 6. bands should be of (roughly) equal width ; [consequential error from stage 2 should apply for both marking points 5 and 6]	(6)

Q32.

Question Number	Answer	Additional Guidance	Mark
(a)	1. triplet code / 3 bases to each code / eq ; 2. reference to adenine, thymine, guanine and cytosine ; 3. idea that each triplet of bases codes for one amino acid ; 4. idea that the code is not overlapping ; 5. idea that code is universal ; 6. idea that code is degenerate ;	1. IGNORE codon, triple 2. ACCEPT phonetic spelling	(2)

Question Number	Answer	Additional Guidance	Mark
* (b) QWC	(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence)	QWC– Spelling of technical terms must be correct – penalise 1st error only – can still reach Max 5 marks if 6 points given. **If context is transcription, Max 2 marks from Mp2, 5, 6, 7, 8.**	
	1. reference to *semi-conservative replication* ;	1. ACCEPT clear description	
	2. DNA (*molecule* / strands) {unwinds / separate / eq} ;	2. ACCEPT unzipped / hydrogen bonds broken / eq	
	3. *(mono)nucleotides* line up along (both) strands / eq ;	3. NOT RNA OR one strand only described IGNORE bases line up	
	4. reference to *complementary* pairing between bases ;	4. ACCEPT description, NOT uracil / U	
	5. reference to *hydrogen bonds* formed (between bases) ;	5. NOT between nucleotides in the same strand ACCEPT between (DNA) strands	
	6. reference to formation of *phospho(di)ester* bonds (between adjacent *mononucleotides*) ;		
	7. ref. to condensation reaction;		
	8. name of an enzyme involved in DNA replication ;	8. e.g. (DNA) *polymerase*, (DNA) *helicase, ligase*	(5)

Q33.

Question Number	Answer	Mark
(a)(i)	A ;	(1)

Question Number	Answer	Mark
(a)(ii)	8 ;	(1)

Question Number	Answer	Additional guidance	Mark
(b)	Transcription ;		(1)

Question Number	Answer	Additional guidance	Mark
(c)	1. idea that there is a change in the {DNA sequence / base sequence of a gene / eq } ; 2. change in amino acid / change in primary structure of { protein / enzyme } ; 3. reference to different R groups ; 4. leading to different {type / position / eq} bonding ; 5. idea of change in {shape / properties} of the active site ; 6. idea of {phenylalanine / substrate / eq} does not fit in the enzyme's active site ;	1. IGNORE mRNA 4. ACCEPT named bond e.g. hydrogen, ionic, disulphide NOT peptide 5. ACCEPT enzyme is not made 6. ACCEPT no enzyme-substrate complex made	(4)

Question Number	Answer	Additional guidance	Mark
(d)	1. loss causes whole amino acid sequence (beyond mutation) to change / causes frame shift / eq ; 2. replacement only changes one {codon / amino acid / may not change the amino acid if third base / eq } eq ; 3. idea that the number of amino acids remains the same with replacement ;		(2)

Q34.

Question Number	Answer	Additional Guidance	Mark
(i)	1. genotypes and phenotypes of parents ; 2. gametes clearly shown as individual alleles ; 3. offspring genotypes ; 4. phenotypes correctly matched to genotypes ;	IGNORE gender 1. & 4. ACCEPT carrier/ normal / healthy / unaffected /sufferer as a phenotype 2. NOT E.C.F. from 1. 2. & 3 can be awarded in a Punnett square 3. and 4. can be awarded as E.C.F. from 2	(4)

Question Number	Answer	Additional Guidance	Mark
(ii)	0.5 / ½ / 1 in 2 / 50% ;	IGNORE expressed as a ratio	(1)

Q35.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. cell membranes {damaged / permeable / eq} ; 2. vitamin C leaves the {cells / cabbage} (because it is water soluble) ; 3. vitamin C is destroyed by {boiling / enzyme / ascorbic acid oxidase } ;		(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	the { enzyme / ascorbic acid oxidase } would have been denatured (quicker when added to the boiling water) ;	**ACCEPT** for cold water: enzyme is more active as water is heated up or vitamin C leaks out as it heats up	(1)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that stored sauerkraut still contains some vitamin C. 2. cabbage would {rot / decompose / eq } ;	**ACCEPT** sauerkraut does not rot	(1)

Q36.

Question Number	Answer	Additional Guidance	Mark
(i)	1. as the enzyme concentration increase the rate of reaction increases / eq ; 2. idea that enzyme lowers activation energy / provides alternative reaction pathway ; 3. idea that the higher concentration of enzyme means that more active sites are available ; 4. more chance of a collision between {enzyme / active site } and substrate ; 5. reference to {enzyme – substrate complex / specific interaction between enzyme active site and substrate } ; 6. idea that substrate is in excess / enzyme concentration is limiting factor ;	**ACCEPT** bacteria as substrate 1. **ACCEPT** enzyme increases rate of reaction	**(3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	there were {anomalies / sources of error / random error / measurement inconsistencies / lack of precision / lack of accuracy / eq} ;	**ACCEPT** example of random error e.g. volume **IGNORE** systematic error, outliers	**(1)**

Q37.

Question Number	Answer	Additional guidance	Mark
(a)(i)	1. an increase in temperature increases the permeability / eq ; 2. idea that increase in permeability is non-linear e.g. greatest increase between 40 and 60 °C, less change up to 40°C ; 3. credit correct manipulation of figures e.g. 4.9 increase between 40 and 60 °C ;	2. NOT faster, slower, etc	(2)

Question Number	Answer	Additional guidance	Mark
(a)(ii)	1. idea that increased kinetic energy increases movement of molecules ; 2. reference to phospholipids moving / eq ; 3. idea that (membrane) proteins denatured ; 4. idea that there is more {denaturation / disruption / eq} at {higher temperatures / above 40 °C } ; 5. idea that {betalain / pigment} can escape from the {cell / vacuole /eq } when the membrane is disrupted ; 6. comment on the disruption of the vacuole membrane / eq ;		(3)

Question Number	Answer	Additional guidance	Mark
*(b)	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. appropriate standardisation of source of beetroot tissue ; 2. standardisation of size of beetroot pieces / eq ; 3. need for {washing / rinsing / eq} {beetroot / eq} (thoroughly) ; 4. use of waterbath (to maintain / change temperature) ; 5. reference to repeats at each temperature / replicates / eq ; 6. use of temperatures {below 20 / above 90 ^{0}C / smaller intervals / eq }; 7. reference to one other suitable variable e.g. time beetroot pieces left between cutting and use ; 8. reference to {calibration / zeroing / eq} of colorimeter ;	QWC emphasis clarity of expression	**(5)**

Q38.

Question Number	Answer	Additional Guidance	Mark
	1. provides a large surface area ; 2. short diffusion pathway / eq ;		**(1)**

Q39.

Question Number	Answer	Additional Guidance	Mark
	1. brings { oxygen to / carbon dioxide away from } exchange surface ; 2. maintains {concentration / diffusion} gradient / eq ;	ACCEPT alveoli / lungs	**(2)**

Q40.

Question Number	Answer	Additional Guidance	Mark
	nitrogen ;	**IGNORE** N if it is the only response	**(1)**

Q41.

Question Number	Answer	Mark
(a)	1. reference to {enzymes / biological catalysts} reducing activation energy / eq ; **Biological catalyst** 2. produced by {organisms /cells}; 3. speeds up (rate of) {reactions / processes} / eq ; **Activation energy** 4. energy needed for a reaction to occur / eq ; 5. By causing bonds to {break / weaken / form} / by increasing the number of collisions / eq ;	**max (4)**

Question Number	Answer	Mark
(b)	1. idea that there should be enough substrate molecules to saturate the enzyme ; 2. (to ensure that) substrate is not a limiting factor/ eq ; 3. {fastest / highest} rate / decreases after initial rate / eq ; 4. as reaction proceeds substrate concentration decreases / eq ; 5. as substrate gets used up {by enzyme / in reaction / eq } ; 6. substrate concentration should be constant (in each test) / eq ;	max (2)

Question Number	Answer	Mark
(c)	**Any two pairs** pH ; buffer ; temperature ; water bath ; not room temperature time of reaction ; stopwatch ; volume of {enzyme / substrate} ; not amount measuring cylinder / pipette ; type of enzyme ; same batch of enzyme ;	(4)

Q42.

Question Number	Answer	Additional Guidance	Mark
(a)	Diagram clearly showing: 1. central carbon with {R / H / eq} and H attached by single bonds ; 2. {NH2 / $NH3^+$ } attached to carbon by single bond ; 3. {COOH / COO^- } attached to carbon by single bond ;	1. Must show C, H and R or a plausible R group 2. and 3 ACCEPT groups attached to a central C that is not shown (chemical notation) ACCEPT groups written wrong way round e.g. C-H_2N NOT incorrect bonding within groups e.g. C=OH ACCEPT if correct group attached to wrong molecule e.g. glucose	(3) Exp

Question Number	Answer	Additional Guidance	Mark
(b) (i)	1. idea that enzymes reduce activation energy ; 2. reference to active sites (of enzyme) ; 3. reference to effect on collisions between enzymes and substrates / enzyme substrate complexes / eq ; 4. idea of number of active sites occupied ; 5. (levels off when) substrate becomes limiting factor ;	IGNORE increases the rate of the reaction 1. Accept 'decreases energy needed for reaction', provides an alternative reaction pathway 4. ACCEPT below 6a.u. all sites occupied OR above 6 a.u. not all occupied	(3) Exp

Question Number	Answer	Additional Guidance	Mark
(b) (ii)	1. idea of a range of concentrations of enzyme (at least 5) ; 2. idea of substrate concentration not limiting ; 3. reference to mixing ; 4. description of how to measure dependent variable with time ; 5. description of how to measure the initial rate of reaction ; 6. reference to an appropriate named controlled variable ; 7. reference to {replicates / repeats} at each enzyme concentration ; 8. control {described / used as comparison} ;	4. and 5. Must relate to reaction / enzyme named 5. ACCEPT clear indication of rate measured soon after mixing, plot and calculate rate from linear part of graph NOT time taken for all substrate to be converted but could get Mp4 6. ACCEPT e.g. pH, temperature, volume, concentration of substrate 7. IGNORE repeat for other concentrations ACCEPT repeat whole experiment 8. ACCEPT control used is with {no enzyme / distilled water}	(4) Exp

Q43.

Question Number	Answer	Mark
(a)	1. reference to enzyme increasing the rate of reaction (higher than the rate if no enzyme present) ; 2. idea that the rate of reaction with the enzyme present is non-linear ; 3. Idea that increase in (initial) rate of reaction is same with or without enzyme present above (substrate concentration) of {10 / 12} ; 4. credit correct manipulation of figures (in relation to the effect of the enzyme) ;	**(2)**

Question Number	Answer	Mark
(b)(i)	ester ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	Any **two** from: 1. fatty acid (s) / carboxylic acid(s) 2. glycerol / propan1,2,3 triol 3. monoglyceride 4. diglyceride ;;	**(2)**

Question Number	Answer	Mark
(b)(iii)	(pH) would {fall / drop / get lower / decrease / eq} ;	**(1)**

Question Number	Answer	Mark
* (c) QWC	**Take into account quality of written communication when awarding the following points.** 1. reference to use of a range of substrate (triglyceride) concentrations ; 2. idea of mixing (enzyme and substrate) ; 3. identification of a suitable dependent variable e.g. pH ; 4. description of how to measure the dependent variable e.g. use of pH indicator ; 5. reference to measuring time ; 6. description of how to calculate (initial) rate of reaction ; 7. idea of repeating experiment without the enzyme ; 8. idea of control of enzyme (lipase) concentration ; 9. reference to one other named controlled variable (e.g. temperature, type of triglyceride, volume of solutions) ; 10. reference to {replicates / repeats} (using the same triglyceride concentration) ;	**(5)**

Q44.

Answer	Additional Guidance	Mark
Any three from: 1 replication: uses DNA nucleotides / transcription: uses RNA nucleotides / eq ; 2 replication: uses DNA polymerase / eq / transcription: does not use DNA polymerase / uses RNA polymerase ; 3 replication: reference to semi-conservative / transcription: not semi-conservative / eq ; 4 replication: (copies) both DNA strands / eq / transcription: (copies) only {one strand / template / gene / eq} ; 5 replication: makes DNA double helix / eq / transcription: Makes single strand mRNA / eq ;	Must be clearly comparative for the mark **IGNORE** destination of the molecules 1. **ACCEPT** thymine / T, uracil / U comparison, deoxyribose and ribose, DNA and RNA bases 2. ACCEPT no ligase in transcription 4. **ACCEPT** whole DNA molecule unzipped for replication with only part for transcription **ACCEPT** all {DNA / genome} copied in replication only part in transcription 5. **NOT** just produces DNA and mRNA **ACCEPT** two {new strands of DNA / DNA molecules} compared to one mRNA (each time) **ACCEPT** if clear what is being produced elsewhere in the response	**(3)**

Q45.

Question Number	Answer	Additional Guidance	Mark
	1. homozygous ; 2. channel / transport / transmembrane / intrinsic / globular ; 3. chloride / Cl^- / Cl ; 4. reproductive / eq ;	1. **ACCEPT** (a) homozygote 3. **DO NOT ACCEPT** chlorine	**(4)**

Q46.

Question Number	Answer	Additional Guidance	Mark
	1. idea that this increased temperature changes the bonding in the enzyme ; 2. the active site is {denatured / changes shape} ; 3. the substrate no longer fits into the active site / the enzyme no longer {catalyses the reaction / lowers the activation energy / eq} ;	**IGNORE** enzyme is denatured **ACCEPT** bonds are broken 3. **ACCEPT** no enzyme substrate complex can form / eq	**(2)**

Q47.

Question Number	Answer	Additional Guidance	Mark
	1. idea that both of these alleles need to be present in order for the recessive phenotype to be expressed ; **AND any two of:** 2. different form of a gene / eq ; 3. same locus /position / eq ; 4. different base sequence / eq ;	1. ACCEPT not expressed in presence of dominant allele 2. ACCEPT type of same gene NOT just type of gene	**(3)**

Q48.

Question Number	Answer	Additional Guidance	Mark
	1. produces {thicker / stickier / more viscous / eq} mucus ; 2. blocking { trachea / bronchi / bronchioles / airway / eq} / eq ; 3. cilia are unable to move mucus out of lungs / eq ; 4. idea of reduced flow of {air / oxygen } to alveoli ; 5. idea of reduced concentration gradient for {oxygen / carbon dioxide} (in alveoli) ; 6. idea of loss of surface area / elasticity / eq ; 7. idea of reduced gaseous exchange ; 8. trapped bacteria may result in more respiratory infections / eq ;	1. ACCEPT sticky / thick in context, ACCEPT less water in mucus 2. IGNORE respiratory system ACCEPT alveoli 7. ACCEPT less O_2 diffuses into blood IGNORE larger diffusion pathway	**(4)**

Q48.

Many candidates were able to calculate the differences between the alveoli and capillary and relate this to concentration gradients and therefore the different rates of diffusion for both marks. A few mentioned the difference in size of the molecules.

However, there were a significant number who misinterpreted the question and described the fact that oxygen would move from alveolus to capillary and carbon dioxide would move the opposite way, with reasons, but without comparing the rates of diffusion. Some even tried to compare the rates of diffusion within an alveolus and within a capillary rather than between them.

Q49.

This was a very differentiating question with an almost perfect distribution of marks across the full range from 0 to 5.

Many candidates were successfully in linking factors of Fick's law (surface area, diffusion distance and concentration gradient) to either the lungs or capillaries but many failed to link to both and therefore did not gain full marks.

A number of candidates attempted to rationalise the mathematical theory of the formula for Fick's law given to them and ignored the biological concept. They therefore effectively turned the equation into a series of statements without any reference to the structure of the lungs or circulatory system.

Some candidates referred to the alveoli having a large surface area to volume ratio, and / or that both capillaries and alveoli have thin cell walls.

A few candidates referred to haemoglobin to carry oxygen but we saw response that identified that air is warmed due to the lungs being inside the body which therefore increases the rate of diffusion.

Mark Scheme

Q1.

Question Number	Answer	Mark
* **(a)QWC**	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. *(gas exchange)* occurs through the {*cell membrane / phospholipid bilayer*} ; 2. idea that the *membrane* is thin ; 3. *oxygen* enters cell (from water) / eq ; 4. *carbon dioxide* leaves cell (into water) / eq ; 5. {O_2 / *oxygen* / CO_2 / *carbon dioxide*} are {small / *non-polar*} (*molecules*) ; 6. reference to *diffusion* ; 7. {reference to / description} (suitable) *concentration gradient* ; 8. reference to *large surface area (to volume ratio)* ;	**(4)**

Question Number	Answer	Mark
(b)	1. reference to diffusion (in the cytoplasm) ; 2. through the cytoplasm / description of part of cytoplasm / eq ; 3. down a concentration gradient (in the cytoplasm) / eq ;	**(2)**

Q2.

Question Number	Answer	Mark
(a)	1. tumour has {decreased in size / grown less / eq} ; 2. decrease in size quantified ; 3. rats survive longer / eq ; 4. idea that {more rats survive / higher survival rate / lower death rate} ; 5. 80% ;	max (3)

Question Number	Answer	Mark
(b)(i)	1. reference to (virus acting as a) vector ; 2. idea that virus is used to get the {gene / DNA} into the cells ;	(2)

Question Number	Answer	Mark
(b)(ii)	reference to {neurones in spinal cord / endorphins being made in spinal cord / spinal cord connects to brain / eq} ;	(1)

Question Number	Answer	Mark
(b)(iii)	idea that endorphins have pain-reducing properties / more {endorphins / endorphins secreting cells} produced ;	(1)

Question Number	Answer	Mark
(b)(iv)	1. {little change / eq} in control but treated rats {rise and fall / eq} ; 2. in first {2 weeks / ½ month} level of tolerance is {(almost) the same in both groups slightly higher in control group} / eq ; 3. after the first 2 weeks the level of tolerance is higher in the rats given gene therapy / eq ; 4. between 2 weeks and 2 months there is an increase in tolerance in rats given gene therapy but control group {remains the same / drops (slightly)} / eq ; 5. ref to decrease in tolerance in group given gene therapy {in last month / after two months} and (slight) increase in control group ; 6. credit correct comparative manipulation of figures ;	max (3)

Q3.

Question Number	Answer	Additional guidance	Mark
*(a)	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to CFTR {protein / channel} / eq ; 2. idea of a different {amino acid / sequence of amino acids / primary structure / eq} ; 3. {shape / function} of {CFTR / protein/ channel / eq} changed / eq ; 4. role of protein in transporting chloride ions / eq ; 5. (chloride) ions not {moving out of cells / going into mucus} / eq ; 6. water does not move out (of cells) / water moves in (to cells) / eq ; 7. reference to osmosis ; 8. mucus (on cell surface) {is not diluted / becomes thicker / becomes stickier} / eq ; 9. (thickened mucus) cannot be moved by {cilia / coughing} ;	QWC –answer must be organised in a logical sequence)	**(5)**

Question Number	Answer	Additional guidance	Mark
(b)	1. reference to using {alleles / genes / eq} coding for the CFTR {protein / channel} ; 2. reference to introducing the {alleles / genes / eq} into the cells of the {lungs / pancreas / reproductive tracts / that produce mucus / eq} ; 3. using a {vector / named vector} ; 4. credit suitable delivery mechanism e.g. nebuliser, injection ; 5. idea that treatment needs to be repeated (due to cell replacement) ; 6. idea that {transcription / translation} of the gene produces the {normal/ functioning / CFTR / eq} protein ;	2. NOT replaces/ repairs	**(3)**

Q4.

Question Number	Answer	Additional Guidance	Mark
(a)	1. genotype **AND** gametes of parents shown ; 2. genotypes of possible children correctly shown ; 3. genotypes clearly matched to phenotypes of possible children ; 4. (probability =) ¼ / 25% / 1 in 4 / 0.25 ;	1. gametes can be shown on Punnett Square 3. ACCEPT carrier as phenotype 4. ACCEPT incorrect probability but based on their cross	(4)

Question Number	Answer	Additional Guidance	Mark
(b)	1. method for obtaining sample from baby described e.g. cheek swab, blood sample, heel prick, biopsy} ; 2. idea of extracting DNA (from cells) ; 3. test for presence of {normal / recessive / mutant / defective / MLD / eq} {gene / allele} ;	NOT Mp 1 and 2 if chorionic villus, amniocentesis, pre-implantation, etc 2. IGNORE testing DNA 3. ACCEPT even if method incorrect for Mp 1	(2)

Question Number	Answer	Additional Guidance	Mark
(c)(i)	1. idea of copy of {normal / functioning / eq} {gene / allele} now in cells ; 2. reference to transcription or translation of the {gene / allele} ; 3. idea that (normal) protein produced / cells function normally / eq ; 4. idea that stem cells produce more cells ;	1. NOT replaces / repairs faulty gene IGNORE dominant ACCEPT correct 4. ACCEPT mitosis, cell division	(3)

Question Number	Answer	Additional Guidance	Mark
(c) (ii)	1. idea of control (to see if the treatment made a difference) ; 2.idea that other variables controlled e.g. shared genes , environment ;	1. ACCEPT valid comparison IGNORE unqualified comparison 2. ACCEPT similar genes NOT genetically identical	(2)

Question Number	Answer	Additional Guidance	Mark
(d)	1. idea that risk from gene therapy very small ; 2. idea that consequences of the disorder more certain than risks of the therapy ; 3. idea that consequences of the disorder known while risks of the therapy are not known ; 4. idea that parents do not want their child to suffer the disorder e.g. will do anything to {treat / prevent / eq} the disorder, there is no other treatment available ; 5. idea that trial may lead to effective treatment e.g. could benefit others ;	2. ACCEPT more benefits than risks / idea that severity of the disorder makes it worth the risk 4. ACCEPT give the child a better quality of life / the best possible chance of a normal life / eq	(2)

Q5.

Question Number	Answer	Mark
(a)	x ✓ ✓ x ;; [Any two correct for one mark]	**(2)**

Question Number	Answer	Mark
(b)(i)	amniocentesis / chorionic villus sampling / CVS ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	1. idea of right to life ; 2. abortion is murder / ref to risk of miscarriage / eq ; **Or:** 3. false positive / negative / eq ; 4. consequences of false result e.g. abortion of (healthy) fetus ; **Or:** 5. who has right to decide if tests should be performed / eq ; 6. {implications of medical costs / discrepancies over next step} / parents {have a right to know / can prepare / eq} ; **Or:** 7. issues relating to confidentiality of {parents / child} / eq ; 8. idea that {some other abnormality may be found / paternal DNA does NOT match / other family members have right to know results} ; **Or:** 9. if abnormality found / eq ; 10. consequence of abnormality found e.g. abortion, comment on possible problems with {future employment / insurance / what constitutes a serious condition} / eq ; **Or:** 11. damage to fetus / risk of miscarriage ; 12. loss of fetus / risk to mother / eq ; **Or:** 13. ref. to stress to parents /eq ; 14. consequences of stress e.g. increased risk of miscarriage ;	**(2)**

Question Number	Answer	Mark
(c)(i)	1. reference to faulty {alleles / genes / DNA / eq} ; 2. idea that gene therapy uses {normal / functioning / healthy} {alleles / genes / eq} ; 3. so the normal {protein / gene product / RNA / eq } is produced (by the cells) / eq ;	**(2)**

Question Number	Answer	Mark
(c)(ii)	1. reference to using {alleles / genes / eq} coding for the CFTR {protein / channel} ; 2. reference to introducing the {alleles / genes / eq} into the cells ; 3. of the {lungs / pancreas / reproductive tracts / eq} ; 4. that produce mucus / eq ; 5. using a {vector / named vector} ; 6. credit suitable delivery mechanism e.g. nebuliser, injection ; 7. idea that treatment needs to be repeated (due to cell replacement) ;	**(3)**

Q6.

Question Number	Answer	Additional guidance	Mark
(a)	1. (the disorder results from a) defect in genes / eq ; 2. both (defective) alleles need to be present / homozygous / not expressed in the presence of a dominant allele / eq ;	1. ALLOW faulty allele	**(2)**

Question Number	Answer	Mark
(b)(i)	A ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	C ;	**(1)**

Question Number	Answer	Mark
(b)(iii)	A ;	**(1)**

Question Number	Answer	Mark
(b)(iv)	D ;	**(1)**

Question Number	Answer	Additional guidance	Mark
(c)QWC	(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. {isolation / identification / eq} of normal gene / eq ; 2. {inserted / eq} into vector / stem cells / eq ; 3. vector named as {liposome / virus} ; 4. injection of {vector / modified stem cells} into {blood / brain / target cells / eq} / eq ; 5. ref to use of control injection ;	**QWC** penalise once if mark point is not in a logical position	

	6. further detail of control injection e.g. use empty liposome / virus without gene inserted ; 7. progression of disease monitored / eq ; 8. life spans recorded / eq ; 9. reference to appropriate comparison with control eg untreated sheep ; 10. idea that treatment needs to be repeated; 11. idea of replication of investigation;		**(5)**

Q7.

Question Number	Answer	Mark
(a)(i)	1. an allele is the {different form / eq} of a gene / eq ; 2. a gene is {a section of DNA / sequence of bases} that codes for a {polypeptide / eq} /occupies a particular {locus / eq} on a chromosome / eq ;	**(2)**

Question Number	Answer	Mark
(a)(ii)	(allele) that is only expressed (in the phenotype of an organism) if the dominant allele is not present / eq ;	**(1)**

Question Number	Answer	Mark
(b)(i)	alleles (of a particular gene) are the same / eq ;	(1)

Question Number	Answer	Mark
(b)(ii)	1. Cara and Jasjeet ; 2. {Naveeda / one child} is an albino so must have inherited an albino allele from each parent / eq ; 3. Daniel ; 4. Cara must have inherited the albino allele from her father (as Susan was an unaffected homozygote) / eq ;	(4)

Question Number	Answer	Mark
(c)	1. idea that {fewer albino squirrels survive / squirrels may not breed so frequently} ; 2. a suitable reason given (e.g. more predation, less camouflage) ; 3. idea of {frequency of albinism allele in squirrel (population) is lower / chances of two squirrels with the allele less likely to mate} ; 4. comment on the lower mutation rate (in squirrels) ;	max (2)

Question Number	Answer	Mark
(d)	1. idea that dihydroxyphenyalanine cannot be synthesized from tyrosine if tyrosinase is absent ; 2. idea that precursor of melanin is dihydroxyphenylalanine / melanin only made if DHPA present ; 3. enzymes are (substrate) specific therefore no other enzyme will breakdown tyrosine / tyrosine does not breakdown on its own ;	max (2)

Q8.

Question Number	Answer	Additional Guidance	Mark
	U G A A A G C G G G C U 1. both uracils correct ; 2. the rest of the sequence correct ;		(2)

Q9.

Question Number	Answer	Additional Guidance	Mark
(i)	1. one amino acid changed / eq ; 2. idea of a change in one { triplet / codon } ; 3. substitution of one base ;	3. ACCEPT idea that other mutations involving {more than one base / addition / deletion} may { change whole sequence / missing amino acids / eq } ;	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	1. (one) different R group / eq ; 2. Idea that they have different charge e.g. one is polar other is non-polar ; 3. different bonds formed ; 4. different { tertiary structure / bonding to other molecules / affinity to oxygen / eq } ;	1. IGNORE different sequence of R groups 3. ACCEPT named bond or bond in different place NOT peptide	(3)

Q10.

Question Number	Answer	Additional Guidance	Mark
	Vitamin C : 1. polar / ionic ; 2. cannot pass through {phospholipid bilayer / hydrophobic region / eq} / uses protein {channels / carriers } ; Vitamin D: 3. non polar ; 4. will dissolve in phospholipid bilayer / eq ;	1. ACCEPT charged 2. ACCEPT not charged	(4)

Q11.

Question Number	Answer	Mark
(a)(i)	1. phospholipids ; 2. phosphate (head) ; 3. (two) fatty acid (tails) ; 4. reference to location of glycerol ; 5. correct reference to ester bonds ;	max (3)

Question Number	Answer	Mark
(a)(ii)	1. reference to {hydrophilic / polar / charged} part ; 2. reference to {hydrophobic / non polar / uncharged} part ; 3. reference to orientation of molecule in relation to water; 4. idea that aqueous environment is {on two sides / cytoplasm and {environment / tissue fluid / eq}} ;	max (3)

Question Number	Answer	Mark
(b)	**Active transport:** 1. idea that molecule {binds / fits into} {protein / carriers} ; 2. idea that {protein / carrier} changes shape ; 3. (molecules move) against a concentration gradient / eq ; 4. reference to use of {ATP / energy} ; [Submax 2 marks]	
	Facilitated diffusion: 5. reference to proteins as {channels / gates / pores / carriers} ; 6. idea that {channels can open or close / carriers change shape} ; 7. for {large / polar / charged} molecules (to pass through membrane) ; 8. (molecules move) down a concentration gradient / eq ; [Submax 2 marks]	**max (3)**

Question Number	Answer	Mark
(c)(i)	1. idea that both types of protein in fused cell in correct context ; 2. idea that the proteins are {intermingled / mixed / eq} ; 3. same original number of protein / eq ;	max (2)

Question Number	Answer	Mark
(c)(ii)	1. idea that {phospholipids / molecule A} allow {fluidity / movement/ eq} ; 2. idea that {fluidity / movement / eq} allow membranes to fuse; 3. idea that {fluidity / movement / eq} allows protein to {move / intermingle / eq} ;	max (2)

Q12.

Question Number	Answer	Mark
(a)(i)	D ;	**(1)**

Question Number	Answer	Mark
(a)(ii)	C ;	**(1)**

Question Number	Answer	Mark
(a)(iii)	A ;	**(1)**

Question Number	Answer	Mark
(b)	1. an increase in temperature increases the permeability / eq ; 2. idea of change in {colour / permeability} related to {42 °C / 64 °C} OR no change up to 42 °C ;	**(2)**

Question Number	Answer	Mark
(c)(i)	Any **two** from: 1. reference to pre-treatment e.g. rinsing method ; 2. {size / mass / surface area / volume / shape} of beetroot ; 3. beetroot storage conditions / eq ; 4. {same / type / species / eq} beetroot ; 5. {age of beetroot / storage time} ; 6. (incubation) time / eq ; 7. {volume / concentration / eq} of {water / solution}(added to beetroot) ; 8. pH ;	**(2)**

Question Number	Answer	Mark
(c)(ii)	1. reference to repeats / replicates / eq ; 2. idea that (colorimeter / readings) are {objective / quantitative / not qualitative / more accurate / provide numbers / more precise / measured not judged / eq} ;	**(2)**

Question Number	Answer	Mark
(c)(iii)	1. (pink colour due to) {pigment / dye /betalain / eq} ; 2. idea that this is released when {cells / vacuoles/ membranes} are damaged ; 3. and had not been washed off / eq ; ACCEPT converse argument when clear	**(2)**

Question Number	Answer	Mark
(c)(iv)	idea that the second experiment shows that the permeability increases between {5 / 22} °C and 42 °C / in first experiment 5 °C has an effect / eq **OR** idea that the second experiment's results are quantified ;	**(1)**

Q13.

Question Number	Answer	Mark
(a)	1. protein / glycoprotein ; 2. facilitated diffusion ; 3. active transport / eq ; 4. ATP / adenosine triphosphate ;	**(4)**

Question Number	Answer	Mark
(b)(i)	1. 77-70 / 7; 2. correct division by 77 (multiplied by 100) to give correct answer, e.g. 9.1 / 9.09 / 9.0 / 9 [CE applies] Correct answer = 2 marks	**(2)**

Question Number	Answer	Mark
(b)(ii)	1. idea that not all of the {juice / sugar} washed off / idea that the strawberries were not dried after rinsing properly / idea that some water reabsorbed (during washing) ; 2. loss of mass of strawberries not as high as it should have been / eq ; 3. (%) value too small / eq ; OR 1. idea that strawberry {tissue / juice} lost because {washing too vigorous / tissue stuck to towel when drying / squeezing strawberries / juice absorbed from strawberries} / water lost through evaporation / eq ; 2. loss of mass of strawberries higher than it should have been / eq ; 3. (%) value too high / eq ;	(3)

Question Number	Answer	Mark
(b)(iii)	1. correct reference to water gradient (between sugar and strawberries) ; 2. reference to osmosis (of water from inside of strawberry to outside) ; 3. idea that water is found in {cytoplasm / vacuoles} (of strawberry) ; 4. reference to water as a solvent (for the sugar) ; 5. reference to (di)polar nature of water / eq ;	(3)

Q14.

Question Number	Answer	Mark
* (a) QWC	(QWC - Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. idea of (*mutation* / named mutation) causing different base sequence ; 2. reference to different {sequence of *amino acids* / *primary* structure} / eq ; 3. reference to {β chain / *haemoglobin* / *protein* / *polypeptide*} being the wrong shape ; 4. *haemoglobin* no longer binds oxygen / binds less *oxygen* / eq ; 5. {less / no } *oxygen* {supplied / carried / eq} (to the cells) / eq ; 6. correct reference to *respiration* / eq ; 7. idea of breathlessness due to body trying to take in more *oxygen* ; 8. idea of tiredness due to lack of energy ;	max (4)

Question Number	Answer	Mark
(b)	<table><tr><td>25(%)</td><td>25(%)</td><td>50(%)</td></tr><tr><td>no chance / 0 (%)</td><td>no chance / 0 (%)</td><td>100 (%)</td></tr></table> All 3 in a row = 2 marks 1 or 2 in a row correct = 1 mark	(4)

Question Number	Answer	Mark
(c) QWC	1. reference to use of {normal / correct} {allele / gene}; 2. for {haemoglobin / β chain}; 3. reference to introduction of {gene / allele/ DNA} into cells ; 4. cells named as (bone) marrow / eq ; 5. reference to use of vector (to introduce gene into cells) ; 6. (named vector) e.g. virus, liposome ; 7. credit reference to appropriate mode of delivery of vector e.g. injection into (bone) marrow ; 8. reference to need for repeated treatment ;	max (4)

Q15.

Question Number	Answer	Mark
(a)	B ;	**(1)**

Question Number	Answer	Mark
(b)	C ;	**(1)**

Question Number	Answer	Mark
(c)	D ;	**(1)**

Question Number	Answer	Mark
(d)	B ;	**(1)**

Question Number	Answer	Mark
(e)	B ;	**(1)**

Question Number	Answer	Mark
(f)	C ;	**(1)**

Question Number	Answer	Mark
(g)	**mRNA** 1. idea of mRNA being a copy of the { antisense DNA strand / template DNA strand / coding DNA strand / gene / allele / part of DNA / eq } ; 2. idea that mRNA {made up of codons / codes for specific amino acids / code for amino acid sequence / eq} ; 3. idea of mRNA being taken {into the cytoplasm / to the ribosomes / out of the nucleus / eq} ; 4. used in translation ; 5. binds to ribosome ; **tRNA** 6. (tRNA) {attaches to / transports / eq } (specific) amino acid / eq ; 7. idea that tRNA binds to mRNA / reference to anticodon codon interaction ; 8. idea that two tRNA bring amino acids together (for peptide bonds to be formed) ;	**(4)**

Q16.

Question Number	Answer	Mark
(a)	1. {movement / diffusion / eq} of water through a partially permeable membrane / eq ; 2. from a region with more free water to a region with less free water / down water concentration gradient / eq ;	**(2)**

Question Number	Answer	Mark
(b)(i)	1. due to high uptake of more water / eq ; 2. as higher water concentration outside potato / eq ; 3. idea of largest difference in concentrations of solutions ;	(3)

Question Number		Mark
(b)(ii)	**EITHER** 1. {mass increased / positive change} at 0.6 and {mass decreased / negative change} at 0.8 (mol dm^{-3}) ; 2. idea that concentration is closer to 0.8 than 0.6 mol dm^{-3} as the decrease in mass is greater than the increase in mass - 0.11 is closer to zero than + 0.31 ; 3. idea of no net movement of water ; **OR** 1. results were plotted onto a graph ; 2. the line crossed the x axis at 0.75 mol dm^{-3} eq ; 3. idea of no net movement of water ;	max (2)

Question Number	Answer	Mark
(c)	**Any two from:** age, {type / variety / genotypes / country of origin / eq}, storage time, growth conditions, part of potato used, damage, sprouting, {storage conditions / temperature / humidity / light / eq} ;;	**(2)**

Question Number	Answer	Mark
(d)	**Any two from:** potato pieces are not straight, potato widths are different, edges may not be cut straight, rulers are {subjective / analogues}, change in length is small, only measuring changes in one plane ;;	**(2)**

Q17.

Question Number	Answer	Mark
* (a)QWC	(QWC - Spelling of technical terms *(shown in italics)* must be correct and the answer must be organised in a logical sequence) 1. appropriate tissue named e.g. beetroot ; 2. reference to {washing / soaking} {beetroot / eq} (thoroughly) ; 3. reference to waterbath (to maintain / change temperature) ; 4. reference to {range / at least 5] {temperatures / alcohol concentrations} ; 5. appropriate controlled variable named e.g. length of time, size of beetroot ; 6. indication of what is being used to judge permeability colour of solution, absorbance, transmission ; 7. description of how permeability can be assessed e.g. use of colorimeter, standard solutions ; 8. reference to repeats / replicates ;	max (5)

Question Number	Answer	Mark
(b)(i)	no {relationship / correlation} eq ;	(1)

Question Number	Answer	Mark
(b)(ii)	permeability of cell membrane increases as the solubility (in oil relative to water) increases / eq ;	(1)

Question Number	Answer	Mark
(b)(iii)	1. circle drawn in top left quarter of graph ; 2. {circle/dot} drawn is equal to or smaller than smallest printed circle, e.g. fits within one square ;	(2)

Question Number	Answer	Mark
(b)(iv)	1. reference to phospholipid bilayer ; 2. reference to hydrophobic nature (of bilayer / tails) ; 3. idea that {non-polar molecules / molecules that have high solubility in oil compared with water} will pass through the membrane more readily **OR** idea that {polar molecules / molecules with low solubility in oil relative to water} will pass through less readily ; 4. idea that permeability linked to readiness to dissolve ; 5. reference to {fluidity / movement} of phospholipids ;	max (3)

Q18.

Question Number	Answer	Additional Guidance	Mark
(a)	1. increasing ethanol concentration increases the intensity (of colour of the solution) / eq ; 2. idea that increase in intensity is non-linear e.g. greatest increase between 30 and 70% ethanol / less increase above 70% / less increase below 30% ethanol ; 3. intensity of colour higher in test 2 than test 1 (at all ethanol concentrations) / eq ; 4. credit correct manipulation of figures e.g. 0.1 increase from 0 to 30% in test 1 ;	1. ACCEPT positive correlation IGNORE descriptions of sequences of changes 2. ACCEPT greatest increase between 50 and 70, no increase above 70 in test 2 ACCEPT comments on gradient e.g. steeper IGNORE rapid / faster / slower 4. ACCEPT subtraction from identified test IGNORE quoted figures, unidentified test	(3)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that ethanol causes the membrane to be {disrupted / eq} ; 2. idea that this is due (phospho)lipids dissolve in ethanol ; 3. idea that (membrane) proteins denatured by ethanol ; 4. comment on the disruption of the vacuole membrane / eq ; 5. idea that {betalain / pigment} can escape from the {cell / vacuole /eq } when the membrane is disrupted ;	1. IGNORE more permeable, more fluid ACCEPT gaps in the membrane 3. ACCEPT protein changes shape NB this also gains Mp1 5. ACCEPT dye	(4)

Question Number	Answer	Additional Guidance	Mark
(c)	1. beetroot cells may have been damaged when cutting / eq ; 2. idea that beetroot pieces not rinsed before being placed in ethanol solution ; 3. idea that colorimeter was not {calibrated / zeroed / eq} (properly) ; 4. idea that test 2 is done some time after test 1 OR beetroot left in solution longer than 20 minutes in test 2 ; 5. idea that different parts of the beetroot may have different pigment concentrations ; 6. smaller volume of ethanol used in test 2 ;	2. ACCEPT blotted IGNORE dried 5. IGNORE different beetroot	(2)

Q19.

Question Number	Answer	Mark
(i)	A a hydrogen bond ;	**(1)**

Question Number	Answer	Mark
(ii)	D a peptide bond ;	**(1)**

Question Number	Answer	Mark
(iii)	D glucose ;	**(1)**

Question Number	Answer	Mark
(iv)	C glycerol ;	**(1)**

Q20.

Question Number	Answer	Mark
(a)	1. amino acids ; 2. peptide ; 3. condensation / polymerisation ; 4. amino / amine / NH_3^+ / NH_2 ; 5. carboxyl / carboxylic (acid) / COO^- / COOH ; [Accept answers for 4 and 5 the opposite way round]	**(5)**

Question Number	Answer	Mark
(b)(i)	ALLOW Mps in context of clearly labelled diagram 1. globular / eq ; 2. reference to active site ; 3. reference to specific shape of active site ; 4. reference to {bonds /named bond / interaction / eq} between R groups ; 5. credit correctly named {bond/interaction} e.g. disulphide bond, hydrogen bonds, hydrophobic interactions (between R groups) ;	**(3)**

Question Number	Answer	Mark
(b)(ii)	1. (primary structure) {position / sequence / order /eq} of the {amino acids / R groups} / eq ; 2. idea that this determines the {positioning / type} of the {bonds / folding / eq} ; 3. determining the {shape / properties} of the active site / eq ; 4. idea of interaction of active sites and substrates e.g. enzyme substrate complex forms ; 5. idea of {polar / hydrophilic} on the outside of enzymes / {non polar / hydrophobic} on the inside / eq ; 6. reference to solubility ;	**(3)**

Q21.

Question Number	Answer	Mark
(a)(i)	1. {sequence / order} of amino acids ; 2. joined by peptide bonds ;	**(2)**

Question Number	Answer	Mark
(a)(ii)	1. idea that primary structure determines (three-dimensional) folding / eq ; 2. reference to types of amino acids determine {types of bonds / (other than peptide bonds) / named bond}; 3. reference to position of amino acids determines position of{bonds / correctly named bond} ; 4. correct reference to two cys (amino acids) form bonds ; 5. idea that {shape / position / eq} of active site is determined by position of amino acids ; 6. reference to shape of active site being correct to bind to substrate ;	

	7. reference to {amino acids / R groups} involved in {chemical reaction / eq} ; 8. reference to {globular/ soluble / enzyme }molecules being {relatively short /small / made up of relatively few amino acids} ; 9. reference to {globular / soluble proteins/ enzyme} having relatively high number of { polar / small} { amino acids / R groups} ; 10. reference to {polar R groups / eq} facing outwards ;	max (5)

Question Number	Answer	Mark
(b)(i)	1. reference to mRNA as a copy of the {genetic code / DNA} ; 2. of the protein (being synthesized) / eq ; 3. moves {out of the nucleus / to ribosomes } / eq ; 4. idea that it {acts as a template / has the instructions} for translation ;	max (3)

Question Number	Answer	Mark
(b)(ii)	1. correct reference to translation ; 2. binds to an amino acid / takes the amino acid to the {ribosome / mRNA} ; 3. reference to tRNA being specific to amino acid ; 4. holds the amino acid in place / eq ;	max (3)

Q22.

Question Number	Answer	Mark
(a)(i)	D phosphodiester bonds ;	(1)

Question Number	Answer	Mark
(a)(ii)	B 200 ;	(1)

Question Number	Answer	Mark
(a)(iii)	C 0% thymine;	(1)

Question Number	Answer	Additional Guidance	Mark
(b)	1. contains {Ribose / 5C sugar / pentose} AND phosphate ; 2. reference to (nitrogenous) base / adenine / guanine / cytosine / uracil / eq ;	IGNORE references to bonds ACCEPT correctly labelled diagram which might use Pi 1. both components needed for the mark NOT deoxyribose, sugar with no 5C, phosphate head, P 2. NOT thymine, IGNORE A, G, C, U NOT plural bases if only referring to one mononucleotide	(2)

Question Number	Answer	Additional Guidance	Mark
(c) *QWC	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. reference to ribosome (attaches to mRNA) ; 2. idea that tRNA carries an amino acid ; 3. idea of {anticodon codon interaction / complementary base pairing } between tRNA and mRNA ; 4. formation of hydrogen bonds (between the tRNA and mRNA) ; 5. reference to peptide bond (between amino acids) ; 6. (peptide bond) formed by a condensation reaction ; 7. idea that tRNA released from {mRNA / ribosome} ; 8. idea that ribosome {attaches to / detaches from / eq} {sequence / eq} on mRNA ;	**QWC emphasis answer must be in a logical sequence** Penalise once for point out of sequence / context IGNORE descriptions of transcription ACCEPT AA for amino acid 1. ACCEPT rough endoplasmic reticulum, RER 2. NOT amino acids unless tRNA plural 3. ACCEPT description of complementary base pairing 5. ACCEPT peptide link 6. ACCEPT by an enzyme 8. ACCEPT ribosome moves along mRNA, a start codon / AUG, stop codon / UAA / UAG / UGA	(5)

Q23.

Question Number	Answer	Mark
	1. transcription ; 2. mRNA / eq ; 3. translation ; 4. ribosomes / rough endoplasmic reticulum / RER ; 5. tRNA / eq ; 6. peptide / covalent ;	(6)

Q24.

Question Number	Answer	Mark
(a)(i)	1. reference to alteration in DNA ; 2. change in {base (sequence) / quantity of DNA} / eq ;	**(2)**

Question Number	Answer	Mark
(a)(ii)	idea that both of these alleles need to be present in order for the recessive phenotype to be expressed ;	**(1)**

Question Number	Answer	Mark
(b)	1. idea of a gene being a sequence of bases that code for the sequence of amino acids in the {protein / polypeptide chain /enzyme / galactocerebrosidase} ; 2. (gene) mutation will alter {DNA triplet / DNA code / codon / eq} / eq ; 3. this may result in a different {amino acid / stop codon / amino acid sequence / primary structure / eq} / eq ; 4. idea that this may change the {shape / eq} of {protein / enzyme} ; 5. therefore causing {no synthesis / incomplete / eq} of {enzyme / galactocerebrosidase} / change of active site / eq ;	**(3)**

Question Number	Answer	Mark
(c)	1. genotype of parents shown ; 2. alleles in the gametes shown ; 3. possible genotypes of children shown ; 4. corresponding phenotypes shown ; 5. (probability =) ¼ / 25% / 1 in 4 / 0.25 ;	**(5)**

Question Number	Answer	Mark
(d)	amniocentesis / chorionic villus sampling / CVS / eq ;	**(1)**

Q25.

Question Number	Answer	Additional guidance	Mark
(a)	1. idea that DNA (molecule){ unwinds / unzips / uncoils / eq} (DNA) strands separate ; 2. (RNA mono) nucleotides {line up against / attach to} {one strand / template / antisense strand / eq} / eq ; 3. ref to complementary base pairing (between DNA and mononucleotides) ; 4. ref to formation of phosphodiester bonds ;	1. ALLOW description e.g. breaking of hydrogen bonds 2. NOT DNA strand**s,** DNA nucleotides 3. ALLOW description of complementary base pairing	



Question Number	Answer	Mark
(b)(i)	B ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	B ;	**(1)**

Question Number	Answer	Mark
(b)(iii)	D ;	**(1)**

Question Number	Answer	Additional guidance	Mark
(c)	1. tRNA is folded (and mRNA is {straight / unfolded}) / eq ;	1. IGNORE double stranded / branched ALLOW tRNA clover shaped / looped	
	2. tRNA has hydrogen bonds (holding the structure together) (but the mRNA does not / eq) ;	2. ALLOW tRNA has complementary base pairing / double stranded sections NOT (all) double stranded	
	3. tRNA is a fixed {size / length} (but mRNA {is not / length depends on size of gene}) / eq ;		
	4. tRNA has an anticodon (but mRNA has codons) ;	4. NOT is an anticodon	
	5. tRNA has an amino acid binding site ;		**(2)**

Q26.

Question Number	Answer	Additional Guidance	Mark
	1. idea of formation of secondary or tertiary structure ;	1. **ACCEPT** e.g. alpha helix, beta pleated sheet, globular structure **ACCEPT** folding (of primary structure) **IGNORE** 3D shape	**(3)**
	2. idea of bonding between R groups ;	2. **ACCEPT** hydrophilic R groups go to outside/ hydrophobic R groups go to inside / eq	
	3. named bond e.g. ionic, disulfide, hydrogen ;	3. **DO NOT ACCEPT** peptide	

Q27.

Question Number	Answer	Mark
(a)	1. overall increase in number of deaths / eq ; 2. 1920 - 1924: no change / eq ; 3. {slight / eq} increase between 1924 and {1936 / 1937} ; 4. {sharp / eq} increase between {1936 / 1937} and {1955 / 1960 / 1969} ; 5. drop after 1969 / eq ; 6. correct manipulation of figures to quantify any of mps ;	**max (3)**

Question Number	Answer	Mark
(b)(i)	when one variable changes there is also a change in an accompanying variable / eq ;	**(1)**

Question Number	Answer	Mark
(b)(ii)	1. {the shape of the two graphs is similar /eq} / change in number of deaths from lung cancer similar to change in number of cigarettes smoked / eq ; 2. idea that the changes in number of deaths is approximately the same number of years after the changes in cigarette smoking ;	**(2)**

Question Number	Answer	Mark
(b)(iii)	Any **two** from: number of people in survey, where the survey was carried out, information about their occupation, their family medical history, age, did they smoke, information on lifestyle ;;	**max (2)**

Question Number	Answer	Mark
(c)	1. credit a reference to reduced diffusion (of gases) ; 2. this results in {less / slower} exchange of {gases / oxygen / carbon dioxide} / eq ; 3. reference to decrease in surface area of {alveoli / gas exchange surface} ; 4. (destruction of capillaries results in) less surface area of capillaries / eq ; 5. (also) less blood flow / eq ; 6. less oxygen carried by blood / eq ; 7. suitable reference to effect on concentration gradient ;	**max (4)**

Q28.

Question Number	Answer	Comments	Mark
(a)	(QWC– Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. (α) *glucose* ; 2. *glycosidic* {bonds / links} ; 3. *amylose* and *amylopectin* ; 4. *amylose* has 1- 4 *(glycosidic)* {bonds / links} **AND** *amylopectin* has 1- 4 and 1- 6 (glycosidic) bonds / eq ; 5. *amylose* is {spiralled / coiled} ; 6. *amylopectin* is branched / eq ; 7. compact *molecule* / eq ;	QWC spelling of words in italics should be correct. Penalise just once – ALLOW max score of 5 if 6 mpts met but one lost due to spelling mistake.	**(5)**

Question Number	Answer	Additional guidance	Mark
(b)(i)	1. speeds up the rate of reaction / eq ; 2. without being {changed/used up / eq} ; 3. lowers activation energy / provides an alternative reaction pathway / eq ; 4. does not change {products / position of equilibrium / eq } / eq ;		**(2)**

Question Number	Answer	Additional guidance	Mark
(b)(ii)	1. breaks the (glycosidic) bonds / eq ; 2. reference to use of water ;	1. IGNORE hydrogen bonds 2. NOT makes water / eq	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)	idea that { maltose / disaccharide / glucose / monosaccharide} {is produced / tastes sweet} ;	ALLOW dextrins / sugar NOT any other named sugar eg sucrose	**(1)**

Q29.

Question Number	Answer	Additional Guidance	Mark
	idea that the (RNA) nucleotides attach to this strand OR idea of {nucleotide / base } sequence that directs the synthesis of {complementary sequence / mRNA / eq} ;	ACCEPT complementary to RNA nucelotides, codes for mRNA, {part of the DNA / antisense } strand that the mRNA is built along, NOT DNA nucleotides, plural strands	**(1)**

Q30.

Question Number	Answer	Additional Guidance	Mark
	Diagram showing: 1. correct R group $-CH_2-CH_2-COOH$ connected to central C atom ; 2. NH_2 connected to central C atom ; 3. H and COOH connected to central C atom ;		(3)

Q31.

Question Number	Answer	Mark
(a)	1. thick wall drawn ; 2. {two / three / four} layers indicated ; **Max two from the following correctly labelled:** 3. lumen ; 4. {endothelium / epithelium / endothelial layer / epithelial layer / tunica intima} ; 5. { (smooth) muscle / elastic fibres / elastin / tunica media } ; 6. {connective tissue / tunica adventitia} ;	**max (3)**

Question Number	Answer	Mark
(b)	1. idea of {wide wall / eq} (to withstand) blood under high pressure ; 2. reference to narrow lumen to maintain high pressure ; 3. reference to presence of {elastic fibres / eq} to allow vessel to stretch ; 4. recoil {maintains pressure / squeezes blood} ; 5. reference to (smooth) muscle contracts to {squeeze / eq} blood along} ; 6. idea that {smooth lining / eq} reduces friction ; 7. {folded lining / eq} to allow artery to stretch / eq ;	**max (2)**

Question Number	Answer	Mark
(c)	1. (walls of) veins more than one layer of cells and capillaries one layer /eq ; 2. (walls of) veins contain {connective tissue /(smooth) muscle / collagen / elastic tissue}, capillaries do not / eq ; 3. veins have valves in them and capillaries do not / eq ; 4. veins do not have pores but capillaries do /eq ; 5. veins have wide lumen, capillaries have narrow lumen /eq ;	max (2)

Q32.

Question Number	Answer	Mark
	1. (double) helix ; 2. deoxyribose ; 3. phosphate / phosphate group; 4. phosphodiester / phospho(di)ester / covalent ; 5. thymine ; 6. guanine ; 7. hydrogen ; 8. sixteen / 16 ;	(8)

Q33.

Question Number	Answer	Mark
(a)	D ;	(1)

Question Number	Answer	Mark
(b)	A ;	(1)

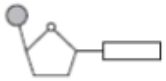
Question Number	Answer	Mark
(c)	B ;	(1)

Question Number	Answer	Mark
(d)	B ;	(1)

Question Number	Answer	Mark
(e)	C ;	(1)

Question Number	Answer	Mark
(f)	C ;	(1)

Q34.

Question Number	Answer	Additional Guidance	Mark
(i)	C 		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	B G - A - U - U - C - A - C - G - U		(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	C 3 1 4 2		(1)

Q35.

Question Number	Answer	Additional Guidance	Mark
	1. water will move out of cells by osmosis ; 2. to an area of higher solute concentration ; 3. idea that cell volume will reduce ;	1. IGNORE diffuse 4. ACCEPT lower water potential / higher salt concentration **5.** ACCEPT cells will shrink	(3)

Q36.

Question Number	Answer	Additional Guidance	Mark
(i)	no {starch / substrate } left / eq ;		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	1. more {kinetic energy / movement / eq} ; 2. more {collisions / enzyme substrate complexes formed / eq } ;		(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	1. steeper curve to the left of 23°C ; 2. graph levels off at the same height as the other two lines ;	NOT above max quantity produced	(2)

Question Number	Answer	Additional Guidance	Mark
(iv)	1. range of amylase concentrations used / eq ; 2. control {volume / concentration } of starch ; 3. method of controlling temperature at 23°C e.g. temperature controlled water bath ; 4. {record / compare } initial rate of reaction / description of how dependent variable measured ;	4. e.g. quantity of maltose produced, time for starch to be completely broken down	(4)

Q37.

Question Number	Answer	Mark
(i)	**The only correct answer is B – letter Q** ***A*** *is not correct because P is a ribosome* ***C*** *is not correct because R is a tRNA molecule with a distinctive shape* ***D*** *is not correct because S is an anticodon part of the tRNA molecule*	(1)

Question Number	Answer	Mark
(ii)	**The only correct answer is C – letter S** ***A*** *is not correct because Q is an mRNA molecule that has codons not the anticodons* ***B*** *is not correct because R is not the part of the tRNA molecule that will bind with the mRNA* ***D*** *is not correct because T is the codon on the mRNA molecule*	(1)

Question Number	Answer	Mark
(iii)	**The only correct answer is C - peptide bonds** ***A*** *is not correct because they are not called amino bonds, because the amino group is only one of the groups bonded together* ***B*** *is not correct because hydrogen bonds because a covalent bond is formed* ***D*** *is not correct because phosphodiester bonds do not form between amino and carboxyl groups, no phosphate is involved*	(1)

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Question Number	Answer	Additional Guidance	Mark
(iv)	translation ;		(1)

Q38.

Question Number	Answer	Additional Guidance	Mark
(i)	deoxyribose ;		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	5 ;		(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	thymine ;	NOT thiAmine or thyAmine ACCEPT thimine / thimyne	(1)

Q39.

Question Number	Answer	Mark
(a)	1. presence of amine group /eq ; 2. presence of carboxyl group / eq ; 3. reference to R group ; 4. reference to central carbon atom ; [award marks on correctly drawn diagram]	(2)

Question Number	Answer	Mark
(b)	1. correct reference to transcription ; 2. DNA {unwinds / strands separate / eq} ; 3. (RNA) (mono)nucleotides {line up against / attach / eq} to one (DNA) { strand / template / eq} ; 4. reference to <u>complementary</u> base pairing (between DNA and (mono)nucleotides) ; 5. reference to {(mono)nucleotides joining together / formation of phosphodiester bonds} ; 6. correct reference to condensation reaction ; 7. correct reference to named enzymes involved / eq ; 8. mRNA detaches (from DNA) / eq ;	(4)

Question Number	Answer	Mark
(c)(i)	DISCOUNTED QUESTION / DO NOT MARK	(0)

Question Number	Answer	Mark
(c)(ii)	B ;	(1)

Question Number	Answer	Mark
(c)(iii)	D ;	(1)

Q40.

Question Number	Answer	Additional Guidance	Mark
(i)	**D** – passive transport		(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	**C** - ions move down a concentration gradient		(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	**B** - involves the production of a vacuole or vesicle		(1)

Q41.

Question Number	Answer	Additional guidance	Mark
(a)	1. phospholipid bilayer – correct orientation ; 2. glycosidic protein – in outer layer only ; 3. intrinsic protein – spanning both layers ;	IGNORE labels 1. NOT if gap between layers bigger than one phospholipid 2. NOT if floating above layer 3 ACCEPT in one layer only	(3)

Question Number	Answer	Additional guidance	Mark
(b)	<table><tr><td></td><td colspan="3">Process</td></tr><tr><td>Description</td><td>Simple diffusion</td><td>Facilitated diffusion</td><td>Active Transport</td></tr><tr><td>ATP required</td><td>×</td><td>×</td><td>✓</td></tr><tr><td>Membrane protein molecules involved</td><td>×</td><td>✓</td><td>✓</td></tr><tr><td>Direction of transport is always down a concentration gradient</td><td>✓;</td><td>✓;</td><td>×;</td></tr></table>		(3)

Question Number	Answer	Additional guidance	Mark
(c)	1. idea that the rate increases when the concentration increases / eq ; 2. this increases the concentration gradient / eq ; 3. idea that {plateau / levelling off} of curve due to channel proteins being saturated with molecules (of the substance) / eq ; 4. idea that no more can be carried (per unit time) / max rate of entry reached /eq ;		(2)

Q42.

Question Number	Answer	Additional Guidance	Mark
(i)	1. 5 dm^3 = 5000 cm^3 ; 2. $\frac{5000}{200}$ = 25 (min) ;	correct answer scores 2	(2)

Question Number	Answer	Additional Guidance	Mark
(iii)	1. removes {waste / excess/ eq} { urea / water / salts / eq } ; 2. ensures that dialysis fluid has a lower concentration of {urea / eq} than the blood / eq ; 3. maintains concentration of { glucose / salt } in the blood / eq ;		(2)

Q43.

Question Number	Answer	Mark
(a (i)	D ;	(1)

Question Number	Answer	Mark
(a (ii)	B ;	(1)

Question Number	Answer	Mark
(a)(iii)	B ;	(1)

Question Number	Answer	Mark
(a)(iv)	A ;	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. (total) cholesterol levels in people with mutation are not higher than people without mutation / eq ; 2. LDL (cholesterol) levels in people with mutation are not higher than people without mutation / eq ; 3. HDL (cholesterol) levels in people with mutation are not lower than people without mutation / eq ; 4. credit correct use of manipulated figures ;	1, 2, 3: ACCEPT converse, similar / little difference. Decreased/reduced is **not** equivalent to lower. 1. IGNORE same 2. IGNORE same 3. ACCEPT ref to HDL to LDL ratio higher in people with the mutation. 4. must be manipulated e.g. difference calculated and not just quoted (difference in LDL= 10, total cholesterol= 7) ACCEPT without units	(2)

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	(plant) statin ;	IGNORE named drug, sterol, stanin	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. muscle {inflammation / pain / eq} 2. liver {damage / failure / eq} 3. joint {aches / pains / eq} 4. nausea/ constipation / diarrhoea / indigestion / flatulence / loss of appetite / eq 5. kidney {damage /failure /eq} 6. cataracts / blurred vision 7. diabetes 8. allergies / skin inflammation / skin rash / eq 9. respiratory problems / persistent cough / nosebleeds / eq 10. headaches / dizziness / depression / insomnia / ringing in ears / fatigue / eq ;	NOT cancer or reduced vitamin absorption IGNORE affect ACCEPT problems as equivalent to damage etc 2. ACCEPT disease 4. ACCEPT vomiting 5. ACCEPT kidney disease 10. ACCEPT mood swings	(1)

Q44.

Question Number	Answer	Additional Guidance	Mark
(a)	1. glycerol drawn correctly with three OH groups ; 2. 3 fatty acids ; 3. fatty acid(s) have COOH included at the end ;	Mp1 and 3 ACCEPT OH / HO NOT double bond to OH 2. ACCEPT 3x one fatty acid stated ACCEPT R or zig-zag chain for fatty acid chain	(3)

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea of energy imbalance ; 2. loss of weight / eq ; 3. reduced metabolic rate / eq ; 4. lack of protein / reduced insulation / eq ; 5. idea that they will need to eat more {carbohydrate / protein / eq} for energy balance ;	2. ACCEPT lower BMI 3. ACCEPT fatigue 4. ACCEPT muscle wastage, Malnourishment, reduced immune system	(2)

Question Number	Answer	Additional Guidance	Mark
(c) *QWC	**(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence)** 1. idea that there is a change in the {DNA sequence / base sequence of a gene / eq } ; 2. change in amino acid / change in primary structure of { protein / enzyme } ; 3. reference to different R groups ; 4. leading to different {type / position / eq} bonding ; 5. idea of change in folding e.g. different 3D structure ; 6. idea of change in {shape / properties} of the active site ; 7. idea of {lipid / substrate / eq} does not fit in the enzyme's active site ;	**QWC emphasis clarity of expression** 1. IGNORE mRNA 4. ACCEPT named bond e.g. hydrogen, ionic, disulphide NOT peptide 5. ACCEPT change to tertiary structure 7. ACCEPT no enzyme-substrate complex made	**(5)**

Q45.

Question Number	Answer	Mark
(i)	**D** have a sugar-phosphate chain ;	**(1)**
(ii)	**C** semi-conservative replication is possible ;	**(1)**
(iii)	**A** 10% ;	**(1)**

Q46.

Question Number	Answer	Additional Guidance	Mark
	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. reference to change in primary structure ; 2. reference to different R group ; 3. leading to different named bond e.g. ionic, hydrogen, disulfide ; 4. different { folding / secondary / tertiary / 3D structure / globular } ; 5. suggested change in properties of the haemoglobin e.g. change in solubility, flexibility, affinity for oxygen / eq ;	**QWC emphasis is on logical sequence Maximum of 3 from Mps 1 to 4** 1. **IGNORE** sequence of amino acids 3. **ACCEPT** type or position of bonds **IGNORE** peptide 5. **ACCEPT** {less/no} oxygen will bind to haemoglobin	**(4)**

Q47.

Question Number	Answer	Additional Guidance	Mark
	1. idea that water has moved into the cell ; 2. by osmosis ; 3. idea of a solute concentration gradient ; 4. cell membrane ruptures / eq ;	**3. ACCEPT** water {potential / concentration} gradient	**(3)**

Q48.

Question Number	Answer	Additional Guidance	Mark
	1. O_2 diffuses more quickly than CO_2 ; 2. different concentration gradients / eq ; 3. molecules are different sizes / eq ;	2. **ACCEPT** higher concentration gradient for O_2. **ACCEPT** gradients are 7 for oxygen and 2 for carbon dioxide	**(2)**

Q49.

Question Number	Answer	Additional Guidance	Mark
	(QWC – Spelling of technical terms must be correct and the answer must be organised in a logical sequence) 1. idea that large surface area provided by alveoli ; 2. idea that large surface area provided by capillary network ; 3. idea that concentration gradient maintained by {ventilation of / air flow in / eq } the lungs ; 4. idea that concentration gradient maintained by {circulation / mass flow / eq } of blood ; 5. idea that diffusion pathway is small because alveoli have a thin wall ; 6. idea that diffusion pathway is small because capillaries { have a thin wall / are in contact with alveoli / are only one cell thick / eq } ; 7. idea that air is warmed because lungs are in core of body ; 8. warmer air enables faster {movement / diffusion / eq } of gases / eq ; 9. reference to { respiratory pigment / haemoglobin / red blood cells / eq } to carry oxygen ;	**QWC emphasis is on clarity of expression** 1&2. **IGNORE** large surface area to volume ratio unless in context of whole body 5.& 6. NOT cell wall	**(5)**