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UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2011 question paper for the guidance of teachers

9700 BIOLOGY

9700/21 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

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/	alternative answers for the same point
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AW	alternative wording (where responses vary more than usual)
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max	indicates the maximum number of marks that can be given
ora	or reverse argument
mp	marking point (with relevant number)
ecf	error carried forward
I	ignore

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1 (a) **P** to protein on right hand side (closed carrier protein) **;**
Q to channel protein on left (open carrier protein) **;**
*allow 1 mark if **P** and **Q** wrong way round*

R to, central / left, sugar chain on glycoprotein **;**
S to circles of phospholipids on the lower surface **;**
T to cholesterol **;**
accept names instead of labels
accept if letters put on the appropriate structures without using label lines, letter must be within each structure [5]

(b) attachment (of bacteria) to receptor(s) **;** AW
ref. ability to attach to antibody (bound to antigen on bacterium)

infolding / invagination / AW, of membrane **;** **A** membrane engulfs **A** pseudopodia form (round bacterium)
fusion / AW, of membrane **;**
formation of, vacuole / vesicle **;** [max 3]

[Total: 8]

2 (a) (i) tangent drawn on the graph as close as possible to time 0 e.g. 1.6 / 6 **;**
0.27 **;**

accept
correct volume of gas — e.g. $\frac{2.5}{10}$ $\frac{4.3}{20}$
stated time, up to and including 20 secs
or
tangent drawn on the graph before 20 secs $\frac{5.8}{20}$
;

correct calculation **;** e.g. 0.25 ($cm^3\ s^{-1}$), 0.22 ($cm^3\ s^{-1}$) **A** 0.215
e.g. 0.29
award one mark if the time is 21–40 s but the calculation is completed correctly [2]

(ii) *accept hydrogen peroxide or reactant for substrate*
initially high concentration of substrate so, rate of reaction high / enzyme activity at a maximum / AW **;**
(rate slows as) concentration of substrate decreases **;** **A** substrate being used up
no further change in volume / AW, reaction has stopped **;**
correct data quote to support explanation(s) **;**

correct ref. to number of (successful) collisions**;**
correct ref. to enzyme-substrate complexes / active sites occupied**;** [max 3]

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(b) **1** (copper ions act as enzyme) inhibitor **;** **R** competitive inhibitor
2 non-competitive (inhibition) **;**
3 (non-competitive) inhibitor / Cu^{2+}, combines with enzyme at site other than active site **;**
4 active site shape / tertiary structure / 3D shape, changes **;**
5 active site no longer accepts substrate / enzyme-substrate complex not formed / AW **;**
6 independent of substrate concentration / increase in substrate concentration has no effect / AW **;**
7 comparative rates quoted from Fig. 2.2 **;**
e.g. max, 3.25 $cm^3\ s^{-1}$ v 0.22–0.25 $cm^3\ s^{-1}$
8 AVP **;** e.g. actual rate depends on the relative concentration of inhibitor / AW
V_{max} not reached
effect of ion presence on tertiary structure [max 4]

(c) enzymes are proteins **;**
ref. transcription **;** *accept description*
ref. to mRNA **;** } *in correct context*
ref. translation **;** *accept description*
ref. to further folding / glycosylation / modifying, in, RER / Golgi body **;** [max 3]

[Total: 12]

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3 (a) *primary*
sequence / arrangement / order / AW, of amino acids **;**

secondary
α, helix / helices **;** **A** description *ignore any ref to β / pleated, sheet*

tertiary
folding of, one / each, polypeptide / globin **;** **A** coiling
(shape) held in place by interactions between, R-groups / side chains **;**
A three or more named interactions

quaternary
(arrangement / interaction, of) four polypeptides / four globins / two α and two β globins **;** **A** chains **A** ref. to more than one polypeptide if specific ref. to α and β chains
haem / prosthetic group **;** **A** porphyrin [max 4]

(b) six / first five and seventh, amino acids are the same **;** ora amino acid at position 6 is different
both are 1. val-2.his-3.leu-4.thr-5.pro….7.glu **;** *take from diagram*
variant 1 is, glutamic acid / glu (whereas), variant 2 is, valine / val **;** [3]

(c) (i) withstands pressure **;**
prevents, overstretching / AW **;**
prevents, bursting / rupture / AW **;** [max 1]

(ii) *assume answer is about collagen unless told otherwise*
1 polypeptides are not identical (v. 2 identical, α / β, polypeptides) **;**
2 triple helix *or* three, polypeptides / helices (v. 4 polypeptides) **;**
3 only composed of amino acids *or* no, prosthetic group / haem / iron **;**
4 (fibrous so) not globular **;**
5 no complex folding / AW (v. complex folding) **;** **A** no tertiary structure
6 glycine is repeated every 3rd position / more glycine **;**
7 repeating triplets of amino acids / large number repeating amino acid sequences (v. greater variety) **;**
8 AVP **;** e.g. different primary structure / AW
variation in amino acid sequences (v specific sequences)
all polypeptides, helical / AW (v. α different to β, polypeptides)
hydrogen bonds between polypeptides (v. Van der Waals)
covalent bonds between molecules (to form fibrils) (v. none)
300nm long polypeptides (v 5–10nm)
each polypeptide over 1000 amino acids (each 141 / 146 amino acids) [max 1]

[Total: 9]

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4 (a) (i) chemical carcinogens **;** **A** *named carcinogenic chemical e.g.* asbestos / tar / benzpyrene / aniline dyes / mustard gas / ethidium bromide **;** *allow two named chemicals for two marks*
virus, qualified **;** e.g. with oncogene / ability to convert host proto-oncogene / named virus e.g. HPV / retrovirus / HIV / HTLV
ionizing radiation / X-rays / gamma rays / particles from radioactive decay / ultraviolet light / alpha particles / beta particles **;**
allow two named radiation examples for two marks
free radicals **;**
hereditary predisposition / AW **;**
tobacco smoking **;**
obesity **;** **A** qualified ref. to diet
AVP **;** e.g. if immunocompromised [max 2]

(ii) not transmissible from one person to another / AW **;**
not caused by a pathogen **;** **R** bacterium / virus / fungus / AW / 'worm' [max 1]

(b) both drugs effective in treating tumours (compared to no drug) **;**
comparative data quote, both drugs compared to no drug **;**

ref. T138067 more effective than vinblastine against, tumour A (after day 18) / tumour B / both tumours (A and B)
relevant comparative data quote **;** e.g. volume of 220 v 160 mm^3 at day 25 for tumour A
little difference in effectiveness between vinblastine and T138067 against tumour A up to day 18 **;** AW
ref. similar effectiveness against tumour B until after day 15 **;**
ref. to effectiveness of both drugs detectable from about 7–10 days **;** AW
both drugs, not completely effective in stopping growth / tumours continue to grow **;**
AVP **;** e.g. greater effectiveness of, T138067 with B / vinblastine with A [max 4]

(c) ref. growth of tumour involves mitosis **;** **A** cell division
not simple enlargement of cells / AW **;**
mitosis stops / metaphase → anaphase → telophase, cannot proceed **;**
accept two named stages
ref. to role of spindle during stages of mitosis **; ;**
e.g. (prophase) to attach to chromosomes
(metaphase) to align chromosomes
(anaphase) to separate chromatids
} *if stage named, must be correct*
no separation of chromatids at centromere **;**
AVP **;** e.g. detail of assembly of microtubules
ref. apoptosis when cell cycle disrupted [max 3]

[Total: 10]

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5 **(a)** 9 µm **;;**
award one mark if 8.9 or 9.1µm given
or
correct measurement is divided by the magnification (x 10 000) but conversion factor incorrect [2]

(b) *explanation to max 4*
hydrogen ion / H^+, pumped / AW, out of, transfer cell / companion cell **;**
R if to sieve tube element
active / using ATP / energy requiring **;**
hydrogen ion gradient build-up **;** AW
hydrogen ions, co-transport / with / AW, sucrose **;** *in context of <u>into</u>, transfer / companion cells*
diffusion / facilitated diffusion (of hydrogen ions and sucrose) through co-transporter (membrane protein) **;**
A through membrane protein *if 'cotransport' already used*
sucrose, diffuses / AW, through plasmodesmata into sieve tube element **;**

ref. to Fig. 5.1
mitochondria for ATP production **;**
ref to infoldings of cell wall **;**
large surface area of cell membrane **;**
for more, protein pumps / co-transporter proteins **;** [max 5]

(c) *sucrose / assimilates / phoem sap, in sieve tube (elements) in, source / leaf*
low(ers) / less negative, water potential **;**
water enters, qualified **;** e.g. by osmosis / from surrounding tissue**;**

increases the <u>hydrostatic</u> pressure **;**

sucrose unloaded at sink **;**
lowers water potential in surrounding tissue **;**
water moves out and decreases <u>hydrostatic</u> pressure (in source) **;** *allow ecf if hydrostatic not used*

pressure difference (causes flow) **;**
(pressure difference) forces sap through sieve tubes / causes mass flow (towards sink) **;** AW [max 4]

[Total: 11]

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6 (a) bone marrow **;** [1]

(b) (i) **A** = macrophage / APC **;** **A** monocyte
B = B, lymphocyte / cell **;**
C = T, lymphocyte / cell **;**

allow one mark if lymphocyte given for both B and C but not qualified or incorrectly qualified [3]

(ii) thymus **;** [1]

(c) *max 4 if no reference to, antigen / non-self*

foreign / AW, antigens are non-self **;**
non-self / foreign antigens, induce immune response **;** AW ora

*macrophage / APC (**A**)*
phagocytosis / described **;**
cuts up / AW, bacterium / pathogen **;**
presents antigens / becomes antigen presenting cell / antigens on cell surface **;**

*B/T, cells (**B** and **C**)*
antigen recognition by lymphocytes **;**
(with) complementary / specific, receptors / immunoglobulins (B) / antibodies (B) **;**
divide by mitosis **; A** clonal expansion
ref. formation of memory cells (for secondary response)**;**

*T_h cells (**C**)*
secrete cytokines to stimulate B cells **;**
cytokines stimulate macrophages **;**

*Tc/k cells (**C**)*
ref. destroy pathogen / AW **;**
produce perforin / AW **;**

*B cells (**B**)*
B cells become plasma cells **;**
(plasma cells) secrete antibodies **;**

AVP **;** e.g.
macrophages, non-specific / faster response
ref. specificity of, lymphocytes / B and T cells
antibody variable region is the antigen binding site **;** [5 max]

[Total: 10]

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1 (a) (i) cilia ; **R** cilla **R** ciliated epithelium *mark first on line* [1]

(ii) transport / exchange / AW, oxygen / carbon dioxide ; **R** air [1]

(b) *mark first feature on line if more than one feature given unless nothing written on other line*

smooth / AW, muscle; **A** smooth muscle cells
cartilage ;
connective tissue ; **A** elastic, fibres / tissue **A** collagen fibres
A collagen and elastic fibres **A** elastin and collagen fibres
mucous gland ; **A** mucus-secreting cells **R** goblet cells [max 2]

(c) emphysema ; [1]

(d) **1** no / few / damaged / destroyed / AW, cilia / **A** ; **R** killed / dead
*allow ecf from **(a)(i)***
2 scar tissue ;
3 fewer / damaged / AW, (columnar) epithelial cells / epithelium ;
A ciliated cells *epithelial cells replaced by scar tissue = 2 marks*
4 goblet cells, enlarged / AW ;
5 enlarged mucous glands ;
6 more (smooth) muscle ;
7 large numbers of white blood cells ; **A** macrophages, phagocytes
8 inflammation ; **A** swelling *in context of inflammatory response* [max 4]

(e) **1** pathogens / AW, enter from, inhalation / external atmosphere / AW ; **R** germs
2 (sticky) mucus traps pathogens ; AW
3 mucus, accumulates / not swept away (because cilia destroyed) ;
4 pathogens / AW, remain / multiply (in gas exchange system) ;
5 increased time leads to increased opportunity to gain entry into cells / AW ; [max 2]

[Total: 11]

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2 (a) *'cell' is not required as it is in the stem of the question*

(i) macrophage **;** **A** antigen-presenting cell **R** mycrophage [1]

(ii) neutrophil **;** **A** PMN / polymorphonuclear leucocyte [1]

(iii) T-killer / T_K / T-cytotoxic / T_C, lymphocyte **;** **A** cell for lymphocyte [1]

(iv) memory B- lymphocyte **;** A cell for lymphocyte [1]

(b) (i) ill-health / absence of well-being / abnormal condition / AW, (affecting an organism) **;**
reduced effectiveness of, functions / named function **;** AW
(illness with a set of) symptoms **;** AW **A** signs
poor / AW, physical, mental or social, well-being **;** **A** *two out of the three*
absence of well-being for two of the three = 2 marks [max 2]

(ii)
1 stable virus / virus did not mutate (frequently) **;**
2 same vaccine could be used all the time **;**
3 cheap to produce / ease of production **;**
4 used a, vaccinia / harmless, virus (so people could not get smallpox) **;**
5 able to use a 'live' virus (for stronger immune response) **;** **A** live vaccine
6 vaccine, thermostable / AW **;** **A** no requirement for keeping in cold
7 vaccine easy to administer **;** **A** no need for boosters [max 2]

(iii) *cholera up to max 4*
1 transmission cycle is difficult to break**;** **A** described with example(s)
2 ref. difficulty in administering e.g. refugee camp, displaced, disaster **;**
3 poor diet, lowered immune response **;**
4 more than one strain (needs more than one type of vaccine) **;** **A** more than one type (that causes cholera) **R** constantly mutating
5 vaccine, only gives short-term protection / requiring boosters **;**
6 antigenic concealment **;**
7 qualified **;** e.g. organism in intestines, difficult for antibodies to reach
8 ref. (older or newer oral) vaccine, not successful for everyone / variable (60–65% up to 90% depending on population group) protection **;**
9 no requirement by health authorities (for vaccine) / vaccine not used by health authorities **;** AW

sickle cell
1 no vaccine available **;** **A** cannot vaccinate against sickle cell
2 not caused by pathogen / non-infectious / non-transmissible / non-communicable **;**
3 genetic / inherited, disease / AW **;** **A** caused by a mutation
4 affects all red blood cells so vaccine would lead to their destruction **;** [max 5]

[Total: 13]

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3 (a) (i) active, transport / uptake **;**

max 2
movement, against the concentration gradient / from low to high concentration **;** **A** diffusion gradient
requires energy (from ATP) **;**
specificity / specific binding site **;** **A** complementary shape
conformational change / change in 3-D shape **;** **A** ref. to, 'flip-flop' / 'kissing gate' mechanism [max 3]

(ii) (70S) ribosomes **;** *ignore size* [1]

(iii) ammonia / ammonium / ammonium ions **;** **A** NH_3 / NH_4^+ [1]

(b) (i) *two marks for correct answer*
35(%) **;;**

1 mark if correct working but not to whole number
90 / 255 × 100 = 35.29 / 35.3 [2]

(ii) idea that nitrogen removed is replaced by nitrogen added **;**
denitrification / denitrifying bacteria **;** **A** named bacteria e.g. *Pseudomonas aeruginosa / Thiobacillus denitrificans*
convert / AW, nitrate / nitrite (to nitrogen gas) **;**
AVP **;** e.g. occurs, when oxygen depleted / waterlogged soils
volcanic action adds nitrogen [max 2]

(c) 1 increase / maintain, nitrogen content of soil **;** **A** add, ammonium / nitrates, to soil
2 increase / maintain, soil fertility **;**
3 uptake / absorption, of, ammonium ions / nitrates /fixed nitrogen (by plants) **;**
4 (plants use) for, amino acid / protein, production **;**
5 increased, growth / yield, of (crop) plants **;**
6 ref. feeding, livestock / human populations **;**
7 reduced need for fertilisers **;**
8 example of environmental benefit of reduced fertilisers **;**
9 cost saving from reduced use of fertilisers **;**
10 qualified ref. to, *Rhizobium* / legumes **;** [max 3]

[Total: 12]

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4 **(a)** *allow points on annotated diagram*
if only diagram drawn, max 1 mark if not annotated
if written response given, only use diagram (if correct) to confirm mark points

1 6 carbons **;** (v. 5 carbons) **A** 1 more
2 6 oxygens **;** (v 4) **A** 2 more
3 12 hydrogens **;** (v10) **A** 2 more
4 5 OH groups v 3 OH groups **;**
A more *if correct diagram drawn*
5 6-membered ring / pyranose **;** (v. 5-membered ring / furanose)
6 carbon 2, OH (pointing down) / has O **;** (v. H pointing down / no O) AW
7 H and OH other way round on carbon 1 **;** AW
8 H and OH other way round on carbon 3 **;** AW [max 3]

(b)

type of bond(s)	biological macromolecule
β,1-4 glycosidic	cellulose **;**
α,1-4 and α,1-6 glycosidic	amylopectin **;**
phosphodiester	mRNA **;**
peptide	protein **;**

R if more than one molecule in box [4]

(c) condensation / polymerisation / esterification **;** [1]

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(d)

	replication	*transcription*
1	DNA polymerase	RNA polymerase **;**
2	(free activated) DNA nucleotides	RNA nucleotides **;**
3	(complementary) base pairing A-T	base pairing A-U **;**
4	both strands, involved / act as template / AW	one strand involved **;**
5	all / AW, the DNA molecule, is copied / unzips / AW	part / gene(s), copied **;**
6	(two) DNA molecules produced **A** DNA produced	messenger RNA / mRNA / pre-mRNA , produced **;**
7	molecule(s) produced are double-stranded	single-stranded molecule produced **;**
8	occurs, in late interphase / S-phase / prior to mitosis	occurs throughout interphase / AW **;**
9	important in, mitosis / meiosis **A** cell / nuclear, division	important in, protein / polypeptide, synthesis **;**
10	AVP **;** e.g. Okazaki fragments / breaking and joining (of DNA) required	mRNA produced as continuous molecule

[max 4]

[Total: 12]

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5 **(a)** (smokers smoking) 25 and above (g day^{-1}) **;** *must be in correct context* [1]

(b) **1** epidemiological (evidence) **;**
2 increase in tobacco smoked increased death rate in, coronary thrombosis / lung cancer **;**
3 use of data to show increasing death rate (with increased tobacco smoked) **;**
4 non-smoker lower death rate than smoker for, coronary thrombosis / lung cancer **;**
5 use of numerical data for non-smoker versus smoker for coronary thrombosis / lung cancer **;**
6 no clear link between smoking and cardiovascular disease / AW **;**
7 comment on disease of other diseases of gas exchange system, 25g and above **;**
8 (mp 6 / 7) use of data e.g. non-smokers, higher death rate / 2.23, than, 1–14g / 2.07 or 15–24g / 1.58, smokers **;**
9 no females included in the survey **;**
10 other aspects of smoking tobacco not included **;**
11 lack of information e.g. on deaths as a proportion of the sample **;**
12 AVP **;** [max 4]

[Total: 5]

6 **(a)** line to nucleolus labelled **C ;**
line to Golgi apparatus labelled **D ;** **R** to vesicle
line to mitochondrion labelled **E ;** [3]

(b) **1** hydrogen ion / H^+, pumped / AW, out of companion cell **;** **R** if to sieve tube element
2 active / using ATP / energy requiring **;**
3 against the concentration gradient **;**
4 hydrogen ion gradient build-up **;** AW
5 hydrogen ions, co-transport / with / AW, sucrose **;** *in context of <u>into</u> companion cells*
6 <u>diffusion / facilitated diffusion</u> (of hydrogen ions and sucrose) through co-transporter (membrane protein) **;** **A** through membrane protein *if 'cotransport' already used*
7 <u>diffusion</u> of sucrose into (phloem) sieve tube (cell) **;**
8 via plasmodesmata **;** [max 4]

[Total: 7]

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1 (a) 40 000 **;;**
if no answer, incorrect answer or answer to too many significant figures, award one mark for correct measurement – 2 cm / 20 mm / 20 000 µm divided by 0.5
20 000 / AW or $\frac{89\ (000)}{20\ (000)} \times 0.5 = 2.225$, $\frac{89\ 000}{2.225}$ **A** $\frac{90\ 000}{2.25}$ / $\frac{20\ 000}{0.5}$
A correct use of standard form [2]

(b) *Mark the first answer on each line if more than one;*
If one answer line or two answers left blank, mark first three answers that stand.

features must be structures present in animal cells (look for the positive)

mitochondrion / mitochondria **;**
nucleus / nuclear membrane / nuclear envelope **;** ***ignore*** 'lying free'
nucleolus **;**
DNA associated with, histone(s) / protein(s) **;** **A** chromosomes / linear DNA
ignore 'not naked DNA'
(smooth / rough) endoplasmic reticulum **;** **A** ER / SER / RER **;**
Golgi (body / apparatus / complex) **;**
lysosomes / Golgi vesicles / secretory vesicles **;**
ignore (double) membrane-bound organelles
large(r) / 80S, ribosomes **;** **A** anything between 20 and 30 nm centrioles **;**
AVP **;** e.g. cytoskeleton, (9 + 2) microtubules, microfilaments, proteasome, peroxisome, cilium / cilia, flagellum / flagella [max 3]

(c) cells not sectioned in LS **; ora**
A cross-section shown / depends on angle of cut / cut in different planes / end view [1]

(d) (i) glycosidic **;** ***ignore*** covalent / qualifications of glycosidic1

(ii) *accept any two likely effects on vegetables or vegetable plants*
ignore killed or death

1 breakdown, of, calcium pectate / middle lamella **;** **R** breakdown of pectin
2 production of (correctly named), sugars / disaccharides / monosaccharides **;**
3 (plant) cells will not be 'stuck together' to each other / AW / described **;**
A tissue disintegrates / cells not attached to each other
R cells disintegrate
4 vegetable will become, soft / mushy / inedible / lose firmness *or* turgidity / AW **;**
5 vegetable susceptible to other, infections / diseases **;**
6 starts, rotting / being decomposed **;**
7 so, change in appearance **;** *needs to be linked to mp4, 5 or 6*
8 AVP **;**
9 AVP **;**
e.g. ref to impaired, transport ***ignore*** photosynthesis / respiration
e.g. give off a bad smell / low yield [max 2]

[Total: 9]

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2 (a) (i) acts as a pacemaker / regulates heartbeat **;**
A ref. to myogenic / described e.g. as rythmn / AW

releases / AW, waves of excitation / depolarisation / (electrical) impulses / action potentials **;**

R nerve impulses / signals / messages / waves unqualified

atrial systole / atrial contraction(s) **;** **A** initiates, heart beat / cardiac cycle
ref. to nervous innervation allowing changes **;** [max 2]

(ii) delays, impulse / AW **;**
R nerve impulses / signals / messages / waves unqualified
A *ecf* from **(i)**

sends impulse to, Purkyne fibres / Bundle of His / ventricles / septum **;**

allows atrial systole to complete before ventricular, systole / contraction(s) **;**
A *idea that* allows ventricles to fill (before they contract)
A *idea that* allows atria to, empty completely / complete contraction [max 2]

(iii) *either*
stops backflow (of blood) **;**
(stops backflow) from ventricle to atrium **;** **R** if ref. to right

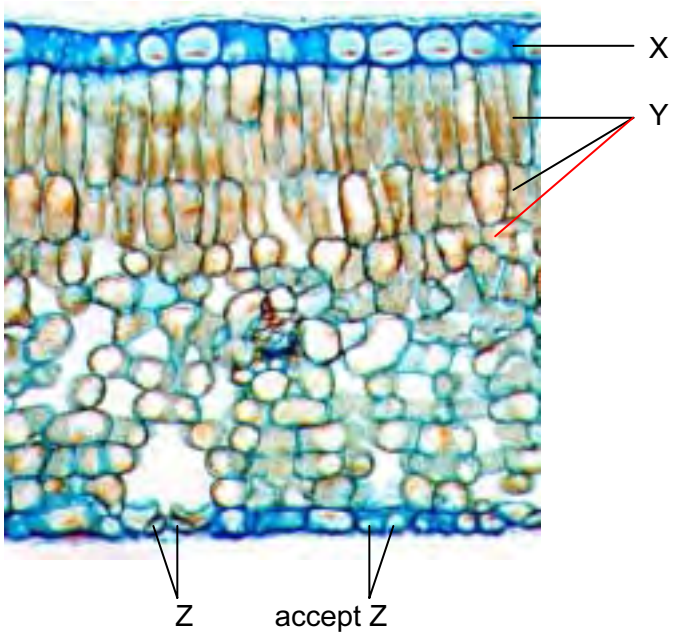
or
allows one-way flow of blood **;**
allows flow from atrium to ventricle **;** **R** if ref. to right [max 2]

(b) C **;**
G **;**
G **;**
B / C **;** [4]

[Total: 10]

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3 **(a)** correct labelling



X ;
Y ;
Z ;

A names instead of labels
A if letters put on the appropriate structures without using label lines, letter must be within each cell
ecf max one mark *if use brackets for X* ***and*** *Y enclosing upper epidermis and one, two or three layers of palisade mesophyll* [3]

(b) **1** (water) moves out of, cell / **Q**, by osmosis / down a water potential gradient **;**
2 through the, cell (surface) / plasma, membrane **;**
3 to, surface / cell wall of, the spongy mesophyll cell, cell **Q ;**
4 <u>evaporates</u> into (sub-stomatal) air space **;** **A** water changes to water vapour
5 water vapour diffuses out through (open) stomata **;**
A moves out down a, water potential / water vapour concentration, gradient

if evaporates, then do not insist on vapour [max 4]

(c) thick (waxy) cuticle **;**
large / big / thick, upper epidermis / upper epidermal cells **;**
many / two / three, layers of palisade cells **;**
thick leaf **;**
densely packed with spongy mesophyll / many spongy mesophyll cells **;**
fewer / small, air spaces **;**
no, stomata / guard cells, on upper surface **;** ***ora*** <u>only</u> on lower surface
many chloroplasts (within spongy mesophyll cells) **;**
R xeromorphic features **NOT** visible, e.g. sunken stomata [max 3]

[Total: 10]

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4 (a) (i) *(estimated) number of newly infected people*

1 increases (steeply) (from 1990) until 1996 / 1997 **;**
2 peaks at, 3.5 million / any figure between 3 and 4 million / 3 to 4 million **;**
3 (gradual) decrease from, 1996 / 1997 **;**
4 number of new cases in 2008 is greater than in 1990 **;** [max 3]

(ii) *stated precaution(s) to reduce risk of infection by*

1 using, condoms / femidoms **;**
A safe(r) sex / use protection during sexual intercourse
2 abstinence / monogamy / less promiscuity **;**
3 not sharing needles / using sterile needles / needle exhange **;** **A** syringes
4 not breast feeding **;**
5 (heat) treated blood (products) / testing potential blood donors or donated blood **;**

6 ref to contact tracing **;**
7 increased awareness of, precautions / risks / transmission **;**
8 increased use of (antiviral) drugs reduces transmission **;**
9 some strains are less infective than others **;**
10 less reporting of new cases **;**
11 AVP **;** e.g. fewer HIV+ babies born (to HIV+ mothers)
improved, screening / detection, qualified [max 3]

(b) *idea that* estimates are subject to large uncertainty / AW **;**

idea that needed for any use of the data for planning health services / AW **;**

AVP **;** e.g. *explanation of mp 1 rather than general statement, such as*
symptomless carriers
many new cases not diagnosed
many new cases not reported
remote areas [1]

(c) 1 increase in new infections of HIV linked to increase in deaths from HIV/AIDS **;** ora
in context of time delay
A small number deaths in 1990 as few infected eight years before
2 HIV/AIDS may take several years to develop after HIV infection **;**
3 peak for new infections is in 1997 and for deaths is 2005 (delay of 8/9/10 years) **;**

number of deaths in always lower than number of new infections
4 comparative data quote in support of lower number of deaths than infections **;**
5 not all HIV+ people die from HIV/AIDS (over period of study) **;**
6 not all HIV+ people, have / develop, AIDS **;**
7 many deaths of HIV+ people recorded as due to, (named) opportunistic infections **;**
8 (antiviral) drugs delay, AIDS / opportunistic infections / AW **;**

9 AVP **;** e.g. cheaper drugs / greater availability of drugs [max 4]

[Total: 11]

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5 (a) (i) box drawn round one phosphate, sugar and base **;** [1]

(ii) label P to circle **;** **A** phosphate / no label but clear a circle is intended [1]

(b) **1** DNA (double helix), unwinds / AW **;** **A** uncoil
2 hydrogen bonds between (complementary) bases broken **;**
ignore DNA unzips
3 complementary, base / nucleotide, pairing **;** **A** A-T **and** C-G
4 phosphodiester bonds **;**
5 both strands used as templates **;** **A** both strands are copied
6 produces two identical DNA molecules **;** **A** 'DNAs'
7 semi-conservative / each new DNA = one 'old' and one 'new' strand **;**
8 ref to DNA polymerase **;**
9 correct ref to other named enzyme **;** e.g. helicase (unwinds), topoisomerase (cuts backbone), ligase (formation of phosphodiester bonds)
10 ref to Fig. 5.1 **;** e.g. described dotted lines as H bonds that need to be broken
look for annotations on Fig. 5.1
11 AVP **;** e.g. replication fork(s), replication bubble(s), antiparallel nature, Okazaki fragments, activated nucleotides (3 phosphate groups) [max 5]

(c) **1** tRNA carries amino acid to ribosome **;**
2 ref to specificity of amino acid carried **;**
3 anti-codon on tRNA complementary to codon on mRNA **;**
A example for complementary, e.g. AUG and UAC
4 ref to two sites / P(eptidyl) and A(mino-acyl) sites, of ribosome **;**
5 peptide bond is formed between amino acids **;** **R** 'polypeptide bond'
6 tRNA, can be re-used / collects another amino acid **;** [max 3]

[Total: 10]

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6 (a) (i) population ; [1]

(ii) ecosystem ; [1]

(iii) denitrification ; [1]

(b) (i) *if more than one answer – take first answer only*

secondary consumer ; **A** second consumer / 2° consumer
A third trophic level **R** carnivore [1]

(ii) *do not award marks unless it is clear there are energy losses in the crabs (not the mangrove)*
energy losses in
respiration ;
movement / muscle contraction ;
reproduction / AW ;
digestion ;
egestion / food not absorbed / loss in faeces ;
excretion / loss in urine / ref to named excretory product ;
ecdysis / moulting ;
(named) inedible parts ; *there is energy in shells*
dead crabs eaten by, other consumers / detritivores / decomposers ; [max 2]

(c) 1 protein / amino acids, (in leaf litter) ;
2 ref to, decomposition / decay / decomposers / saprobiotic bacteria or fungi ;
3 <u>deamination</u> ;
4 amino acid converted to, ammonia / ammonium ;
5 ammonia / ammonium, converted / oxidised , to nitrite (ions) / NO_2^- ;
6 nitrite (ions) / NO_2^-, converted to, nitrate (ions) / NO_3^- ;
7 by, nitrification / nitrifying bacteria / named example ; e.g. *Nitrosomonas / Nitrobacter*
8 nitrate (ions) / NO_3^-, taken up / absorbed, by mangrove / plant (roots) ;
9 AVP ; e.g. ammonia / ammonium, taken up [max 4]

[Total: 10]

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