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BIOLOGY

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Paper 4 Theory (Extended)

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MARK SCHEME

Maximum Mark: 80

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This document consists of **11** printed pages.

Mark schemes will use these abbreviations

- ; separates marking points
- / alternatives
- **I** ignore
- **R** reject
- **A** accept (for answers correctly cued by the question, or guidance for examiners)
- AW alternative wording (where responses vary more than usual)
- AVP any valid point
- **ecf** credit a correct statement / calculation that follows a previous wrong response
- **ora** or reverse argument
- () the word / phrase in brackets is not required, but sets the context
- underline actual word given must be used by candidate (grammatical variants excepted)
- max indicates the maximum number of marks that can be given

| Question | Answer | Marks | Guidance |
|----------|---|-------|---|
| 1(a)(i) | arrow / (s) from a vena cava through atria and into right ventricle ; | 1 | |
| 1(a)(ii) | C , aorta ; | 1 | |
| 1(b)(i) | ventricles relax ; increased volume of ventricles ; higher blood pressure in, the arteries / C , D and E / aorta and pulmonary artery (than in the ventricles) ; ora | 1 | |
| 1(b)(ii) | stop back-flow (of blood) / ensure (blood) flows one way ; | 1 | 1 pressure changes |
| 1(c) | 1 (right) ventricle contracts ; 2 blood pressure increases (in heart) ; 3 higher blood pressure in ventricles than in arteries ; 4 semilunar valve / valve 1 , opens ; 5 blood flows into, D / E / pulmonary artery ; 6 semilunar valve closes (when blood in pulmonary artery) ; 7 D / E , is a pulmonary artery ; 8 valve 1 is a semilunar valve ; | 4 | sequence of events must be in the correct order |
| 1(d) | 1 septum ; <i>either</i> 2 separates oxygenated and deoxygenated blood ; <i>or</i> 3 to allow a double circulation ; | 2 | |

| Question | Answer | Marks | Guidance |
|----------|---|-------|--|
| 2(a) | two cotyledons ; broad leaves ; leaves with branching veins ; petioles ; flower parts in multiples of four or five / flower parts not in threes ; pollen with three furrows or pores ; stem vascular bundles in a ring ; roots, develop from radicle ; AVP ; | 1 | A seed leaves A not adventitious e.g. secondary growth often present |
| 2(b)(i) | a length of <u>DNA</u> ; that codes for a <u>protein</u> ; | 2 | |
| 2(b)(ii) | different sequences of amino acids ; composed of different amino acids ; different shapes / folded differently / AW ; | 2 | |
| 2(c) | <i>mRNA to max 1</i> 1 mRNA carries copy of, gene / DNA / base pair sequence ; 2 goes from nucleus to, ribosome / cytoplasm ; 3 determines the specific, order / sequence, of amino acids ; <i>ribosome to max 1</i> 4 site of, protein synthesis ; ('protein synthesis' is in question) 5 ribosome assembles amino acids into proteins ; 6 passes through the ribosome / reads mRNA ; | 2 | |
| 2(d)(i) | 1 temperature ; 2 surface area of substrate ; 3 concentration / volume / amount / number, of enzyme (solution) ; 4 concentration / volume / amount, of (named) substrate (solution) ; 5 type of enzyme ; 6 type of substrate ; | 2 | |

| Question | Answer | Marks | Guidance |
|-----------|--|-------|----------------------------------|
| 2(d)(ii) | 1 increases and decreases ; 2 peaks at / optimum, at pH 4.0 / 0.55 (au) ; 3 no activity beyond pH 6.5 ; 4 curve is symmetrical / AW ; 5 any data quote, e.g. activity is 0.55 (au) at pH 4.0 ; | 3 | A works best / AW I denatured |
| 2(d)(iii) | 1 pH 4 is the <u>optimum</u> (pH) ; 2 pH 7 enzyme is <u>denatured</u> ; 3 enzyme / protein / active site, has changed shape at pH 7 ; 4 shape of active site is complementary to substrate (4) / not (7) ; 5 <u>enzyme-substrate complexes</u> form (4) / not (7) ; 6 (most) effective collisions (between enzyme and substrate) (4) / none (7) ; | 4 | |

| Question | Answer | Marks | Guidance |
|----------|--|-------|--|
| 3(a) | <i>description</i> 1 (stem) cells divide ; 2 by mitosis ; 3 to form, daughter / genetically identical, cells ; 4 nucleus buds off / AW ; 5 digested / broken down, mitochondria ; 6 only one of stem cells specialises / others continue to be stem cells ; <i>adaptations</i> 7 haemoglobin made prior to, mitochondria / nucleus removed / maturation ; 8 (loss of structures) gives space for, oxygen transport / haemoglobin ; 9 haemoglobin, transports / AW, oxygen ; 10 biconcave shape / described ; 11 large surface area (to volume ratio) ; 12 for diffusion of oxygen / gas(es) ; 13 AVP ; | 6 | MP1 I reproduce MP4 A no nucleus (in mature red blood cell) MP5 A no mitochondria (in mature red blood cell) MP7 must be in correct place in sequence of events MP8 A volume for space, I area MP12 I ref to gas exchange |
| 3(b) | plasma ; | 1 | |

| Question | Answer | Marks | Guidance |
|----------|---|-------|--|
| 3(c) | replacement / repair / wound healing ; cells die / are, rubbed off / exfoliated / AW ; growth ; | 2 | |
| 3(d)(i) | iron / Fe / Fe ²⁺ / Fe ³⁺ ; | 1 | R ion unqualified A vitamin <u>B₁₂</u> |
| 3(d)(ii) | tired / lethargic / 'no energy' / weakness / AW ; shortness of breath ; chest pain ; fast heartbeat ; frequent infections ; headache / dizziness / light-headedness ; cold, hands / feet ; inflammation / soreness, of tongue ; brittle nails ; unusual cravings for non-nutritive substances, such as ice, dirt or starch ; poor appetite ; tingling or crawling feeling in legs ; | 2 | A pale skin |
| 3(e) | 1 <u>mutation</u> ; 2 change in, base sequence / DNA ; 3 in gene / allele, for haemoglobin ; 4 inherit the <u>allele</u> (for sickle cell anaemia / mutated haemoglobin / Hb ^S) ; 5 having the recessive allele(s) / being, homozygous recessive / Hb ^S Hb ^S / heterozygous / Hb ^S Hb ^A ; 6 produce, abnormal / AW, haemoglobin ; 7 red blood cells have, sickle shape / described ; 8 AVP ; | 4 | I references to malaria MP4 A <u>allele</u> passed down from, a carrier / parent with sickle-cell anaemia |

| Question | Answer | Marks | Guidance |
|----------|--|----------|--|
| 4(a) | birds / Aves ; <i>Any two features for max 1 ;</i> <ul style="list-style-type: none"> • feathers • beak / bill • hard-shelled eggs • scaly legs • no teeth • air sacs • light-weight skeletons • AVP | 2 | 1 wings / four-chambered heart |
| 4(b) | 1 (isolated) group of individual animals / AW ; 2 of, one / the same, <u>species</u> ; 3 living in the same, habitat / ecosystem / environment / area / place / location ; 4 at the same time ; | 3 | |
| 4(c) | 1 killed by predators / not able to evade predators / new predators ; 2 not able to find food ; 3 more prone to disease / AW ; 4 poaching ; 5 ref to, low genetic variation ; 6 competition with new species ; 7 idea of no survival instinct /AW ; 8 AVP ; e.g. techniques not as advanced in 1980 | 2 | MP 7 A captive animals unable to 'cope' in wild / too docile / ref to artificial selection / not integrated with wild population of parrots |

| Question | Answer | Marks | Guidance |
|----------|--|-------|---|
| 4(d) | 1 inbreeding / described ; 2 less / little, (genetic) variation ; 3 reduced number of alleles ; 4 increased risk of <u>genetic</u> disease ; 5 cannot reproduce / sterile ; 6 not enough animals to breed ; 7 less likely to, adapt / to evolve to / cope with, (named) change in environment ; 8 cost ; 9 AVP ;; | 3 | |
| 4(e) | 1 to prevent extinction (of many species) / maintain (bio)diversity ; 2 ref to preventing disruption of food, chains / web ; 3 provide, habitats (for shelter / breeding grounds / AW) for many species ; 4 and 5 ecosystems provide, 'service', for humans ; ; 6 idea of areas for, recreation / (eco)tourism / education ; 7 ethical reasons / aesthetic reasons / AW ; | 3 | MP 1 A saves many species MP 4 examples <ul style="list-style-type: none"> • ref to flooding / natural disasters • ref to nutrients cycle • ref to maintenance of water cycle • ref to greenhouse gas / carbon storage / carbon sink waste disposal • provide, resources / food / fuel / drugs / raw materials / building materials • provide genes (for selective breeding / genetic engineering) |

| Question | Answer | Marks | Guidance |
|-----------|--|-------|--|
| 5(a)(i) | 72 (%) ;; | 2 | difference = $724 \text{ g m}^{-2} \text{ year}^{-1}$ = $724 / 1009 \times 100$ |
| 5(a)(ii) | 1 (fertiliser provides) nutrients / salts / ions / minerals (required by plants) ; 2 (nitrogen / nitrate) needed for making, amino acids / proteins / RNA / DNA / AW ; 3 proteins are used in growth ; 4 (magnesium for) making chlorophyll ; 5 (chlorophyll for) photosynthesis ; 6 AVP ; | 3 | A original soil lacked minerals |
| 5(a)(iii) | eutrophication ; | 1 | |
| 5(b) | 1 fertiliser decreases species diversity ; 2 at 21 weeks the difference is greater (than other weeks) ; 3 species diversity increases and decreases ; 4 peak at 6 weeks ; 5 week 24 with fertiliser not following the trend / AW ; 6 any data quote including data for both plots with units ; | 3 | I anomaly A increases |
| 5(c) | 1 some species compete much better than others / better at obtaining (named) resource(s) ; 2 competition for, light / water / nutrients / space / AW ; 3 some species grow faster ; 4 example of grassland, adaptations / fast growth ; 5 better at using ions released by fertiliser ; 6 more 'robust' / less successful at combating disease or pests ; 7 some cannot survive grazing by grassland herbivores / AW ; 8 ref to adaptations ; | 2 | MP 2 I competition for mates MP 4 examples: taller stems / larger leaves / longer roots |

| Question | Answers | Marks | Guidance |
|----------|--|-------|--|
| 6(a) | (disease is caused by) a <u>pathogen</u> ; passes from one host to another ; | 2 | |
| 6(b) | 1 <u>electrical</u> signal ; 2 passes along / AW, a, nerve cell / neurone ; 3 in one direction ; | 2 | 1 impulse |
| 6(c)(i) | 1 (vaccine contains) harmless / attenuated / dead / AW, form of, (named) pathogen / antigen ; 2 (antigens / vaccine) stimulate an <u>immune response</u> ; 3 ref to lymphocytes ; 4 lymphocytes / white blood cells, make antibodies ; 5 ref to specificity ; 6 production of memory cells ; 7 rapid, immune response / AW, if exposed to same, pathogen / antigen ; 8 gives long-term immunity ; 9 AVP ; | 4 | |
| 6(c)(ii) | 1 bacteria may still be present (in the population) ; 2 in carriers / in people who have no symptoms ; 3 infected people moving into the, country / area / AW ; 4 if few people are, immune / vaccinated, bacterium is more likely to be transmitted ; 5 idea of herd immunity ; 6 some people cannot respond to, antigens / vaccines ; 7 protects people who travel to other countries ; 8 booster vaccinations are sometimes required) / AW ; | 2 | MP5 A new people arriving in a country (who are not vaccinated) MP6 e.g. people with HIV / babies / elderly |
| 6(d)(i) | 1 antibodies are made of protein ; 2 proteins / antibodies, are digested / denatured, in the alimentary canal ; 3 direct route to site of infection ; | 2 | |

| Question | Answer | Marks | Guidance |
|-----------------|---|--------------|-----------------|
| 6(d)(ii) | 1 no (active) immune response ; 2 no memory cells ; 3 antibodies are broken down in the body ; 4 antibodies are not made by body's own lymphocytes ; | 2 | |