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Cambridge International General Certificate of Secondary Education

BIOLOGY

0610/41

Paper 4 Theory (Extended)

May/June 2016

MARK SCHEME

Maximum Mark: 80

Published

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This document consists of **10** printed pages.

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Abbreviations used in the Mark Scheme:

- ; 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

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| 1 (a) | <table border="1"> <thead> <tr> <th>function</th> <th>letter on Fig. 1.1</th> <th>name</th> </tr> </thead> <tbody> <tr> <td>structure that separates oxygenated and deoxygenated blood</td> <td>F</td> <td>septum ;</td> </tr> <tr> <td>structure that prevents backflow of blood from ventricle to atrium</td> <td>D</td> <td>bicuspid / mitral / atrioventricular, <u>valve</u> ;</td> </tr> <tr> <td>blood vessel that carries oxygenated blood</td> <td>A</td> <td>aorta</td> </tr> <tr> <td rowspan="2">blood vessel that carries deoxygenated blood</td> <td>B</td> <td>pulmonary artery</td> </tr> <tr> <td>H</td> <td>vena cava ;</td> </tr> <tr> <td>structure that prevents backflow of blood from pulmonary artery to right ventricle</td> <td>K</td> <td>semilunar <u>valve</u> ;</td> </tr> <tr> <td rowspan="2">chamber of the heart that contains oxygenated blood</td> <td>C</td> <td>left atrium</td> </tr> <tr> <td>E</td> <td>left ventricle ;</td> </tr> <tr> <td rowspan="2">chamber of the heart that pumps deoxygenated blood</td> <td>J</td> <td>right atrium</td> </tr> <tr> <td>G</td> <td>right ventricle ;</td> </tr> </tbody> </table> | function | letter on Fig. 1.1 | name | structure that separates oxygenated and deoxygenated blood | F | septum ; | structure that prevents backflow of blood from ventricle to atrium | D | bicuspid / mitral / atrioventricular, <u>valve</u> ; | blood vessel that carries oxygenated blood | A | aorta | blood vessel that carries deoxygenated blood | B | pulmonary artery | H | vena cava ; | structure that prevents backflow of blood from pulmonary artery to right ventricle | K | semilunar <u>valve</u> ; | chamber of the heart that contains oxygenated blood | C | left atrium | E | left ventricle ; | chamber of the heart that pumps deoxygenated blood | J | right atrium | G | right ventricle ; | [6] | <p>A 'AV valve'</p> <p>R right atrioventricular valve</p> |
| function | letter on Fig. 1.1 | name | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| structure that separates oxygenated and deoxygenated blood | F | septum ; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| structure that prevents backflow of blood from ventricle to atrium | D | bicuspid / mitral / atrioventricular, <u>valve</u> ; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| blood vessel that carries oxygenated blood | A | aorta | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| blood vessel that carries deoxygenated blood | B | pulmonary artery | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | H | vena cava ; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| structure that prevents backflow of blood from pulmonary artery to right ventricle | K | semilunar <u>valve</u> ; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| chamber of the heart that contains oxygenated blood | C | left atrium | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | E | left ventricle ; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| chamber of the heart that pumps deoxygenated blood | J | right atrium | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | G | right ventricle ; | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (b) (i) | <p>pulse rate increases and remains constant ; immediate/sudden/steep/rapid/AW, increase in pulse rate ; increases from 44–48 <u>bpm</u> to 164–170 <u>bpm</u> ;</p> <p>maximum/ 164–170 <u>bpm</u>, at, 4 <u>min</u>(utes)/2 <u>min</u>(utes) after race starts ;</p> | [max 3] | <p><i>units must be used</i></p> <p>R exponential increases by 120–126 bpm / by 3.5 to 4 times or approx. 4</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| (ii) | adrenaline stimulates increase in, heart/pulse, rate ; increase in blood, carbon dioxide (concentration)/acidity, detected ; nerves stimulate heart to beat faster ; ref to muscle contraction/AW ; muscles require more energy/muscles are doing more work ; (rate of aerobic) respiration increases ; increase demand for, oxygen/glucose ; ref to removal of, carbon dioxide/lactic acid/heat ; more, blood/carbon dioxide, to <u>lungs</u> (per unit time) ; more, blood/oxygen/glucose, to <u>muscles</u> ; AVP ; e.g. ref to ATP/vasodilation in muscles | [max 4] | A decrease in pH 'more'/'increases', is only needed once R 'produce energy' once only |
| | | [Total: 13] | |
| 2 (a) | central (nervous system) ; peripheral (nervous system) ; spinal cord ; | [3] | R spine |
| (b) (i) | sensory neurone ; | [1] | A afferent neurone R sensory nerve |
| (ii) | simple reflex/reflex ; | [1] | A reflex arc |
| (iii) | slower/takes more time ; needs thought/uses (higher centres of) the brain/conscious control ; learnt/not inherited/not innate/needs training/AW ; not automatic ; response is not always the same to the stimulus ; | [max 2] | |

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| Question | Answer | Mark | Guidance |
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| (c) (i) | <i>either</i> pot P – (uniform) light AND pot Q – no light/dark/covered (up) ; <i>or</i> pot P – (uniform) with /plus, magnesium AND pot Q – no magnesium ; | [1] | A pot P has all nutrients |
| (ii) | positive ; (photo)tropism / (photo)tropic ; | [2] | R (photo)trophic/geotropic/gravitropic |
| (iii) | <i>idea that</i> leaves /seedlings / plants / chloroplasts, get more light ; more (light) <u>energy</u> , absorbed /trapped /AW ; more photosynthesis ; more, growth /biomass / glucose / starch / AW ; | [max 2] | 'more' is only required once |
| (iv) | (auxins) made /produced, in (shoot), tip / apex ; pass / move / diffuse / spread (down the stem) ; auxins collect in the side, in the dark /away from light ; greater (cell) elongation on side in the dark ; AVP ; e.g. absorption of water (by osmosis) /stretching of cell walls / phototropin(s) / plants detect <i>or</i> sense light / ref to turgor pressure | [max 4] | I 'found, in / on' A 'dark / shaded, side' I comments about roots |
| | | [Total: 16] | |
| 3 (a) | <i>gene</i> a length of DNA that codes for a protein ; <i>gene mutation</i> a change in <u>base</u> sequence of DNA ; | [2] | R chromosome / molecule of / genome |
| (b) (i) | 1 Bb ; 2 bb ; 3 Bb ; | [3] | |

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|----------------|--|-------------------|---|--|--|--------------|--|--|--|----------|----------|----------------|----------|-----------|-----------|------------|-------------|-------------|
| (ii) | $(Bb \times bb)$ $B, b + b, (b) ;$ <i>offspring genotypes</i> Bb and bb ; A heterozygous and homozygous recessive <i>offspring phenotypes</i> normal / carrier and acatalasia ; | [3] | <table border="1"> <tr> <td colspan="2"></td> <td colspan="2">male gametes</td> </tr> <tr> <td colspan="2"></td> <td>B</td> <td>b</td> </tr> <tr> <td rowspan="2">female gametes</td> <td>b</td> <td>Bb</td> <td>bb</td> </tr> <tr> <td>(b)</td> <td>(Bb)</td> <td>(bb)</td> </tr> </table> | | | male gametes | | | | B | b | female gametes | b | Bb | bb | (b) | (Bb) | (bb) |
| | | male gametes | | | | | | | | | | | | | | | | |
| | | B | b | | | | | | | | | | | | | | | |
| female gametes | b | Bb | bb | | | | | | | | | | | | | | | |
| | (b) | (Bb) | (bb) | | | | | | | | | | | | | | | |
| (iii) | test (cross) ; | [1] | | | | | | | | | | | | | | | | |
| | | [Total: 9] | | | | | | | | | | | | | | | | |
| 4 (a) | carbon dioxide / CO ₂ ; (aerobic) respiration ; (simple) diffusion ; | [3] | A excretion I gas exchange | | | | | | | | | | | | | | | |
| (b) | water enters by <u>osmosis</u> ; down a <u>water potential</u> gradient / high(er) to low(er) <u>water potential</u> ; through partially permeable membrane ; needs to remove water to prevent bursting ; | [max 3] | R water concentration A semi- / selectively / differentially | | | | | | | | | | | | | | | |
| (c) | as concentration of sea water increases the removal of water decreases ; as concentration of sea water increases the water potential gradient decreases ; therefore less water enters at higher concentrations of sea water ; less excess water ; | [max 3] | A 0% to 12% | | | | | | | | | | | | | | | |

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| (d) | cell walls, inelastic / do not stretch / rigid / inflexible / keep shape of cell ; cells, are turgid / have high turgor pressure ; resist any increase in, volume / pressure ; these cells do not absorb excess water ; the cells will not burst ; | [max 3] | I strong / tough / don't break A (very) little water enters |
| | | [Total: 12] | |
| 5 (a) (i) | vertical axis – numbers / population ; horizontal axis – time / years ; curve showing exponential increase / log phase ; | [3] | I lag phase / curve starting at origin |
| (ii) | <i>idea that</i> 'birth' / reproduction / breeding, rate is greater than death rate ; no limiting factors ; no / little, competition ; plenty, of food / nutrients / space / mates / oxygen / resources ; no / few, predators ; no / few, parasites / pathogens / disease ; AVP ; e.g. no / little, pollution / waste products / toxins | [max 4] | I definitions of exponential growth |
| (b) | <i>between 1950 and 2012</i> mass of fish caught increased and levels off ; 17 to 90 million tonnes / increase = 73 million tonnes ; fluctuations / increases and decreases / described ; e.g. around 1970 / any time after 1990 ; maximum catch, 94 million tonnes / in 1996 ; steep increase between, 1950–1970 / 1973–1989 ; | [max 3] | <i>units must be used at least once</i> A 16 to 18 / increase of 72 to 74 mp4 cannot be awarded without mp3 |

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| Question | Answer | Mark | Guidance |
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| (c) | <p><i>answers can refer to seas, lakes and/or rivers</i></p> <p>international, agreements/treaties ;</p> <p>quotas/permits/licenses ;</p> <p>fines/sanctions, for, overfishing/illegal/unauthorised, fishing ; fishery protection vessels/wardens/patrols/AW ;</p> <p>restrictions on times when fishing can occur ;</p> <p>exclusion zones/nursery zones/‘no take’ zones/reserves ;</p> <p>total ban for some species ;</p> <p>regulations on method of fishing ; e.g. mesh size of nets/ban nets/use of lines instead/size of fishing vessel/‘fishing effort’</p> <p>education/raise awareness/any example ;</p> <p>monitoring fish stocks ;</p> <p>captive breeding (of wild fish) ; re-stocking (of wild stocks) ;</p> <p>encourage farmed fish ; e.g. provide subsidies</p> <p>AVP ; e.g. tax on wild fish/increase the cost of wild fish</p> | [max 6] | <p>A set maximum mass/number/amount/quantity</p> <p>A ‘ban unauthorised fishing’</p> <p>A consequences other than fines</p> <p>A not in breeding season</p> <p>A descriptions or examples</p> <p>A named examples</p> <p>I ban on all wild fish</p> |

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| Question | Answer | Mark | Guidance |
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| (d) | <p><i>definition of sustainable resource</i></p> <p>renewable / self-renewing / regenerates / described ; e.g. produced as rapidly as it is removed</p> <p>resource, does not / will not, run out / become exhausted ;</p> <p>replanting / reseeding / regrowing ;</p> <p>AVP ; e.g. pollarding / coppicing / leaving mature trees</p> | [max 3] | I reused / recycled |
| | | [Total: 19] | |
| 6 (a) | $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 ; ;$ | [2] | one mark for the correct chemical formulae one mark for balancing the equation correctly R word equation |
| (b) | <p>as <u>wavelength</u> increases, rate (of photosynthesis) decreases and increases ;</p> <p>high rates in, blue and violet and red / 400–475 nm and 675 nm ; low(est) rate in, green and yellow / 550–600 nm ;</p> <p><i>either</i> maximum rate = 0.9 cm³, at 675 nm / red <i>or</i> minimum rate = 0.2 cm³, at 550 nm / green ;</p> | [max 3] | units must be used once in the answer A volume of gas for rate |
| (c) | divide the volumes by, five (minutes) / time ; | [1] | |

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| (d) (i) | to keep the <u>light intensity</u> the same ; | [1] | R temperature I 'fair test' A 'control light intensity' / 'light intensity is a control(led) variable' |
| (ii) | to provide carbon dioxide / so carbon dioxide is not a limiting factor / so the only limiting factor is wavelength ; | [1] | |
| (e) | for, respiration / energy ; converted to sucrose ; used to make, nectar / fruits ; used to make, cellulose / lignin ; used in cell walls ; used to make, starch / oils / fats ; storage ; used to make, amino acids ; used to make, chlorophyll ; | [max 3] | I protein synthesis / growth / active transport R produces energy I 'makes food', but A 'stores food' for 1 mark |
| | | [Total: 11] | |