**Cambridge International Examinations**
Cambridge International General Certificate of Secondary Education

**BIOLOGY** **0610/41**

Paper 4 Theory (Extended) **May/June 2016**

MARK SCHEME

Maximum Mark: 80

**Published**

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.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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This syllabus is approved for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

**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

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

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

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

| Question | Answer | Mark | Guidance |
|---|---|---|---|
| (ii) | (Bb x bb)<br><br>**B** , **b** + **b** , (**b**) ;<br><br>*offspring genotypes* **Bb** and **bb** ;<br>**A** heterozygous and homozygous recessive<br><br>*offspring phenotypes* normal / carrier and acatalasia ; | [3] | <table><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> |
| (iii) | test (cross) ; | [1] | |
| | | **[Total: 9]** | |
| **4 (a)** | carbon dioxide / $CO_2$ ;<br>(aerobic) respiration ;<br>(simple) diffusion ; | [3] | **A** excretion **I** gas exchange |
| **(b)** | water enters by <u>osmosis</u> ;<br>down a <u>water potential</u> gradient / high(er) to low(er) <u>water potential</u> ;<br>through partially permeable membrane ;<br>needs to remove water to prevent bursting ; | [max 3] | **R** water concentration<br>**A** semi- / selectively / differentially |
| **(c)** | as concentration of sea water increases the removal of water decreases ;<br>as concentration of sea water increases the water potential gradient decreases ;<br>therefore less water enters at higher concentrations of sea water ;<br>less excess water ; | [max 3] | **A** 0% to 12% |

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

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

| Question | Answer | Mark | Guidance |
|---|---|---|---|
| (d) | *definition of sustainable resource*<br><br>renewable / self-renewing / regenerates / described ;<br>e.g. produced as rapidly as it is removed<br><br>resource, does not / will not, run out / become exhausted ;<br><br>replanting / reseeding / regrowing ;<br><br>AVP ; e.g. pollarding / coppicing / leaving mature trees | [max 3] | **I** reused / recycled |
| | | **[Total: 19]** | |
| 6 (a) | $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$ ;; | [2] | one mark for the correct chemical formulae<br>one mark for balancing the equation correctly<br>**R** word equation |
| (b) | as <u>wavelength</u> increases, rate (of photosynthesis) decreases and increases ;<br><br>high rates in, blue and violet and red / 400–475 nm and 675 nm ;<br>low(est) rate in, green and yellow / 550–600 nm ;<br><br>*either*<br>maximum rate = 0.9 $cm^3$, at 675 nm / red<br>*or*<br>minimum rate = 0.2 $cm^3$, at 550 nm / green ; | [max 3] | units must be used once in the answer<br>**A** volume of gas for rate |
| (c) | divide the volumes by, five (minutes) / time ; | [1] | |

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