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

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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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<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

H</td><td>pulmonary artery

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
E</td><td>left atrium
left ventricle ;</td></tr>
<tr><td>chamber of the heart that pumps deoxygenated blood</td><td>J
G</td><td>right atrium
right ventricle ;</td></tr>
</table>
</td><td>[6]</td><td>A ‘AV valve’
R right atrioventricular valve</td></tr>
<tr><td>(b) (i)</td><td>pulse rate increases and remains constant ;
immediate / sudden / steep / rapid / AW, increase in pulse rate ;
increases from 44–48 bpm to 164–170 bpm ;

maximum / 164–170 bpm, at, 4 min(utes) / 2 min(utes) after race starts ;</td><td>[max 3]</td><td>units must be used
R exponential
increases by 120–126 bpm / by 3.5 to 4 times
or approx. 4</td></tr>
</table>

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Question	Answer	Mark	Guidance
(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 lungs (per unit time) ; more, blood / oxygen / glucose, to muscles ; 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
(c) (i)	*either* **pot P** – (uniform) light AND **pot Q** – no light / dark / covered (up) **;** *or* **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)	*idea that* leaves / seedlings / plants / chloroplasts, get more light **;** more (light) energy, 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 *or* sense light / ref to turgor pressure	[max 4]	**I** 'found, in / on' **A** 'dark / shaded, side' **I** comments about roots
		[Total: 16]	
3 (a)	*gene* a length of DNA that codes for a protein **;** *gene mutation* a change in base sequence of DNA **;**	[2]	**R** chromosome / molecule of / genome
(b) (i)	1 **Bb ;** 2 **bb ;** 3 **Bb ;**	[3]	

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Question	Answer	Mark	Guidance
(ii)	(Bb x bb) **B** , **b** + **b** , (**b**) ; *offspring genotypes* **Bb** and **bb** ; **A** heterozygous and homozygous recessive *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 ; (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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Question	Answer	Mark	Guidance
(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)	*idea that* '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)	*between 1950 and 2012* 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]	*units must be used at least once* **A** 16 to 18 / increase of 72 to 74 mp4 cannot be awarded without mp3

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

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Question	Answer	Mark	Guidance
(d)	*definition of sustainable resource* renewable / self-renewing / regenerates / described ; e.g. produced as rapidly as it is removed resource, does not / will not, run out / become exhausted ; replanting / reseeding / regrowing ; 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 one mark for balancing the equation correctly **R** word equation
(b)	as <u>wavelength</u> increases, rate (of photosynthesis) decreases and increases ; high rates in, blue and violet and red / 400–475 nm and 675 nm ; low(est) rate in, green and yellow / 550–600 nm ; *either* maximum rate = 0.9 cm^3, at 675 nm / red *or* minimum rate = 0.2 cm^3, at 550 nm / green ;	[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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Question	Answer	Mark	Guidance
(d) (i)	to keep the light intensity 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]	

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