
BIOLOGY

0610/41

Paper 4 Theory (Extended)

May/June 2016

MARK SCHEME

Maximum Mark: 80

Published

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

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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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Question	Answer	Mark	Guidance	
1 (a)	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]	A 'AV valve' R right atrioventricular valve	
(b) (i)	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> ; maximum/ 164–170 <u>bpm</u> , at, 4 <u>min</u> (utes)/2 <u>min</u> (utes) after race starts ;	[max 3]		<i>units must be used</i> R exponential increases by 120–126 bpm / by 3.5 to 4 times or approx. 4

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Question	Answer	Mark	Guidance
(ii)	<p>adrenaline stimulates increase in, heart/pulse, rate ; increase in blood, carbon dioxide (concentration)/acidity, detected ;</p> <p>nerves stimulate heart to beat faster ;</p> <p>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> ;</p> <p>AVP ; e.g. ref to ATP/vasodilation in muscles</p>	[max 4]	<p>A decrease in pH</p> <p>'more'/'increases', is only needed once</p> <p>R 'produce energy' once only</p>
		[Total: 13]	
2 (a)	<p>central (nervous system) ; peripheral (nervous system) ; spinal cord ;</p>	[3]	R spine
(b) (i)	sensory neurone ;	[1]	A afferent neurone R sensory nerve
(ii)	simple reflex/reflex ;	[1]	A reflex arc
(iii)	<p>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 ;</p>	[max 2]	

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Question	Answer	Mark	Guidance
(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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Question	Answer	Mark	Guidance															
(ii)	<p>(Bb x bb)</p> <p>B , b + b , (b) ;</p> <p><i>offspring genotypes</i> Bb and bb ; A heterozygous and homozygous recessive</p> <p><i>offspring phenotypes</i> normal / carrier and acatalasia ;</p>	[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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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)	<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
(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
(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 / reseeded / 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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Question	Answer	Mark	Guidance
(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]	