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Cambridge International General Certificate of Secondary Education

BIOLOGY

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Paper 4 Theory (Extended)

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MARK SCHEME

Maximum Mark: 80

Published

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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)	carbon dioxide / CO ₂ / water / H ₂ O (vapour) ; (respiring / all) cells / tissues / mitochondria / named tissue(s) / named organ(s) ;	2	R alveoli / lungs
1(a)(ii)	urea ; toxic / poisonous / harmful / waste / AW ;	2	A ammonia / ammonium / creatin(ine) / uric acid / urine
1(b)(i)	glomerulus ;	1	A ball / knot / AW, of capillaries A Bowman's capsule / basement membrane
1(b)(ii)	red (blood) cells / erythrocytes ; phagocytes ; lymphocytes ; named plasma proteins ; ; platelets ;	2	e.g. albumen / fibrinogen / insulin / glucagon / thrombin / antibodies / clotting factors
1(c)(i)	microvilli – E ; nucleus – A ; mitochondrion – C ;	3	
1(c)(ii)	stores / contains, chromosomes / genes / alleles / genetic information / DNA ; controls the (activity / reactions of the) cell ; controls how cells, develop / divide / reproduce / grow ; <i>idea that it stores instructions for, making proteins / protein synthesis / making RNA ;</i> AVP ;	1	I 'controls movement of cell' I giving instructions unqualified A 'codes for protein' e.g. making ribosome(s)
1(c)(iii)	small intestine / duodenum / ileum ;	1	A villi / jejunum / tongue / liver / egg cell / white blood cells / ear / nose

Question	Answer	Marks	Guidance
1(c)(iv)	<p>(microvilli give a) large surface area ; for diffusion / described as movement down a concentration gradient ;</p> <p>lots of, mitochondria / C ; C / mitochondria, are the site of (aerobic) respiration ; C / mitochondria, provide energy / make ATP ; energy / ATP, is needed for active transport ; (active transport needed for) movement against concentration gradient ;</p> <p>ref to carrier proteins (in cell membrane) ; AVP ;</p>	4	<p>mp2 is linked to mp1</p> <p>R 'produces energy'</p> <p>e.g. substances pass to blood to maintain concentration gradient</p>

Question	Answer	Marks	Guidance
2(a)	prevents contamination / transmission, of (named) pathogen / toxin ; prevents, infection / spreading of disease / illness ; ora	2	
2(b)	<p>1 low (concentration) of lactic acid in blood at, rest / the start / before ;</p> <p>2 lactic acid (concentration) increases, steeply / quickly / AW, during exercise ;</p> <p>3 reaches a peak / increases and decreases ;</p> <p>4 decreases steeply, then gradually after exercise ;</p> <p>5 any use of figures ;</p> <p><i>explanation</i></p> <p>6 oxygen, demand increases / does not reach muscles fast enough / AW ;</p> <p>7 <u>anaerobic respiration</u> ;</p> <p>8 provides / releases, energy ;</p> <p>9 anaerobic respiration produces lactic acid ;</p> <p>10 lactic acid diffuses from muscles into the blood ;</p> <p>11 lactic acid is, broken down / respired / oxidised / converted to glucose / AW ;</p> <p>12 in the liver ;</p> <p>13 ref. to <u>oxygen debt</u> ;</p>	6	<p>e.g. peak at $13.2 \text{ mmol dm}^{-3}$ at 15 minutes $\pm 0.2 \text{ mmol}$</p> <p>A produces ATP R produce / makes, energy'</p>
2(c)(i)	P $12 \text{ (km h}^{-1}\text{)}$ and Q $10 \text{ (km h}^{-1}\text{)}$;	1	<i>One mark only both must be right</i>
2(c)(ii)	<p><i>idea that</i> trained athlete / P, has a higher level of (aerobic) fitness (than Q) ;</p> <p>difference in, gender / age / height / mass / lung capacity / lung mass / stroke volume / muscle type ;</p> <p>AVP ;</p>	1	<p>A P, is fitter than Q / has trained more than Q</p> <p>e.g. ref to genetics but not different genes</p>

Question	Answer	Marks	Guidance
2(c)(iii)	<ol style="list-style-type: none"> 1 increase in demand for energy ; 2 increase in (aerobic) respiration ; 3 increase in demand for oxygen ; 4 increase in carbon dioxide (concentration) ; 5 decrease in pH / increase in acid, in the blood ; 6 detected by the, brain / chemoreceptors ; 7 (brain stimulates) an increase in breathing rate / faster breathing ; 8 (brain stimulates) an increase in depth of breathing / AW ; 9 ref to negative feedback in correct context ; 	4	<p>A 'needs' more energy</p> <p>e.g. rate of breathing remains high until carbon dioxide concentration returns to, normal / set point</p>

Question	Answer	Marks	Guidance
3(a)	<ol style="list-style-type: none"> 1 (immediate / steep) increase in numbers / no lag phase ; 2 exponential / log, phase ; 3 decelerating phase / described as increase slowing down ; 4 stationary phase / plateau / levels off / remains constant ; 5 levels, at 1.6 to 1.65 million / from between 1850 and 1875 ; 	3	

Question	Answer	Marks	Guidance
3(b)	<p><i>population increases</i></p> <p>1 more births than deaths ; 2 more sheep are imported ; 3 more food needed for increasing human population ; 4 <i>idea that</i> more sheep needed for, export / economy of Tasmania ;</p> <p><i>population remains constant</i></p> <p>5 <i>idea that</i> population reaches, carrying capacity / described ; 6 number of births = number of deaths / culling for meat / AW ;</p> <p>7 any ref to <u>limiting factor(s)</u> in correct context in either increase or plateau ; 8 any example of a limiting factor ; resources food supply water supply space / area of land for grazing / AW disease predators competitors</p>	3	<p>e.g. maximum that the land can support</p> <p>I drought / floods / any other natural disaster</p>
3(c)	<p>1 <i>idea that</i> farmer, chooses / selects (animals that are best adapted to conditions) ; 2 appropriate named feature(s) ; 3 selected animals bred together / (cross) breed them ; 4 select the offspring that show the features required ; 5 repeat, the selection and breeding / the process ; 6 <i>idea that</i> imports (male) sheep with desired features to mate with flock ; 7 uses artificial insemination ;</p>	4	
3(d)	<p>providing for the needs of (the increasing) humans (population) ;</p> <p>without harm to the (natural) environment / ecosystem(s) / habitat / biodiversity ;</p>	2	<p>A examples of development, e.g. roads / houses / cities / urbanisation / AW</p>

Question	Answer	Marks	Guidance												
4(a)	<p>little / less / AW / no, variation / (genetic) diversity ; ref to becoming homozygous ; less chance of, surviving / adapting / evolving, to, changing conditions / new environments / (new) disease ; risk of <u>extinction</u> ; increase chance of genetic disease ;</p> <p>adapted variety spreads / AW ; only one plant needed / no mate required ; R if 'asexual reproduction' is given greater chance of pollination / ensures pollination occurs ; <i>idea that</i> reproduction / fertilisation, successful if no other plants (of same species) nearby ; less wastage of pollen ; not dependent on (named) agent of pollination ;</p> <p>AVP ; no hybrid vigour / smaller gene pool</p>	4	<p>A fewer <u>alleles</u> I ref to gene(s) R cloning / uniform(ity)</p> <p>A increased risk of abnormalities /genetic 'weakness' / AW</p> <p>A gametes I no wastage</p>												
4(b)(i)	<table border="1" data-bbox="412 740 1337 1177"> <thead> <tr> <th data-bbox="412 740 770 786">term</th> <th data-bbox="770 740 1337 786">example in <i>P. sativum</i></th> </tr> </thead> <tbody> <tr> <td data-bbox="412 786 770 866">dominant trait</td> <td data-bbox="770 786 1337 866">purple flowers</td> </tr> <tr> <td data-bbox="412 866 770 946">recessive allele</td> <td data-bbox="770 866 1337 946">b ;</td> </tr> <tr> <td data-bbox="412 946 770 1026">phenotype</td> <td data-bbox="770 946 1337 1026">(flower) colour / purple (flowers) / white (flowers) ;</td> </tr> <tr> <td data-bbox="412 1026 770 1106">homozygous genotype</td> <td data-bbox="770 1026 1337 1106">BB and / or bb ;</td> </tr> <tr> <td data-bbox="412 1106 770 1177">heterozygous genotype</td> <td data-bbox="770 1106 1337 1177">Bb ;</td> </tr> </tbody> </table>	term	example in <i>P. sativum</i>	dominant trait	purple flowers	recessive allele	b ;	phenotype	(flower) colour / purple (flowers) / white (flowers) ;	homozygous genotype	BB and / or bb ;	heterozygous genotype	Bb ;	4	
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Question	Answer	Marks	Guidance
4(b)(ii)	<p><i>parental phenotype</i> purple flowers x white flowers purple flowers x white flowers</p> <p><i>parental genotype</i> Bb x bb BB x bb ;</p> <p><i>genotypes of gametes</i> B b + b (b) B B + b (b) ;</p> <p><i>offspring genotypes</i> Bb bb Bb (Bb);</p> <p><i>offspring phenotypes</i> purple flowers, white flowers ; purple flowers ;</p>	5	
4(c)(i)	<p><i>test cross 1</i></p> <p>GG x GG / GG x Gg A GG on its own R GG x gg ;</p> <p><i>test cross 2</i></p> <p>Gg x Gg ;</p>	2	A Gg on its own
4(c)(ii)	<p>white plants are, homozygous recessive / gg ; (white plants / no chlorophyll) cannot, photosynthesise / produce own food ; (therefore white plants) do not grow into mature plants / do not produce flowers / die before reproducing / AW ;</p>	2	I cannot survive unqualified

Question	Answer	Marks	Guidance
5(a)	<i>Helicobacter</i> ;	1	
5(b)	circular DNA / chromosome ; plasmid(s) ; cell membrane ; cell wall (not made of cellulose) ; cytoplasm ; capsule ; (small) ribosomes ; flagella ; AVP ;	2	A naked, DNA / chromosome I cilia e.g. pili
5(c)(i)	antibiotic(s) ;	1	
5(c)(ii)	(stomach / hydrochloric / gastric) acid / HCl / mucus ;	1	
5(d)	<i>active immunity</i> 1 exposure to <u>antigen</u> ; ora 2 after, infection by pathogen / vaccination ; 3 immune response occurs / antibodies produced ; <i>passive immunity</i> 4 <u>antibodies</u> acquired from another individual ; 5 e.g. by breast milk / injection of antibodies ; 6 active is, permanent / long-term (immunity) ; ora 7 ref to memory cells, in active / not in passive ; 8 response is slow on first exposure in active ; ora	4	

Question	Answer	Marks	Guidance																		
6(a)	<table border="1" data-bbox="439 244 1310 711"> <thead> <tr> <th data-bbox="439 244 685 320">blood vessel</th> <th data-bbox="685 244 1066 320">name of blood vessel</th> <th data-bbox="1066 244 1310 320">oxygenated / deoxygenated</th> </tr> </thead> <tbody> <tr> <td data-bbox="439 320 685 399">A</td> <td data-bbox="685 320 1066 399">hepatic portal vein</td> <td data-bbox="1066 320 1310 399">deoxygenated ;</td> </tr> <tr> <td data-bbox="439 399 685 477">B</td> <td data-bbox="685 399 1066 477">(inferior) vena cava</td> <td data-bbox="1066 399 1310 477">deoxygenated ;</td> </tr> <tr> <td data-bbox="439 477 685 555">C</td> <td data-bbox="685 477 1066 555">pulmonary vein</td> <td data-bbox="1066 477 1310 555">oxygenated ;</td> </tr> <tr> <td data-bbox="439 555 685 633">D</td> <td data-bbox="685 555 1066 633">aorta</td> <td data-bbox="1066 555 1310 633">oxygenated ;</td> </tr> <tr> <td data-bbox="439 633 685 711">E</td> <td data-bbox="685 633 1066 711">femoral artery</td> <td data-bbox="1066 633 1310 711">oxygenated ;</td> </tr> </tbody> </table>	blood vessel	name of blood vessel	oxygenated / deoxygenated	A	hepatic portal vein	deoxygenated ;	B	(inferior) vena cava	deoxygenated ;	C	pulmonary vein	oxygenated ;	D	aorta	oxygenated ;	E	femoral artery	oxygenated ;	4	
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6(b)(i)	chemical / substance, made by a gland ; travels in the blood (plasma) ; alters the activity of one or more specific target organs ;	2	I proteins R enzymes A alters activity of / affects, target organ(s) A controls																		
6(b)(ii)	1 controls blood, glucose / sugar, concentration / level ; 2 increased, uptake / respiration, of glucose ; 3 (stimulates cells to) convert glucose to <u>glycogen</u> ; 4 <i>idea that</i> target organs are, muscle / liver ; 5 (so) decreases blood glucose concentration ; 6 ref to, negative feedback / homeostasis ;	3																			
6(c)	1 shunt vessels, constrict / close / AW ; 2 less blood flow through shunt vessels ; 3 arterioles, widen / dilate / relax ; 4 <u>vasodilation</u> (in context of arteries and arterioles) ; 5 more blood flow (through capillaries) near the surface of the skin / AW ; 6 (more) heat loss from blood (by radiation) ;	3	R if in context of capillaries / veins A 'blood vessels'																		