



BIOLOGY

0610/43

Paper 4 Theory (Extended)

October/November 2017

MARK SCHEME

Maximum Mark: 80

Published

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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 or reverse argument
- ora
- () 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)	carbon dioxide / CO ₂ ; water (vapour) ;	1								
1(b)	<p>1 B are cilia ;</p> <p>2 C is mucus ;</p> <p>3 C / D, are goblet cells ;</p> <p>4 E is cartilage ;</p> <p>5 B / cilia, waft / beat, mucus / C (up / out of, the airway) ;</p> <p>6 C / D / goblet cells, secrete, mucus / C ;</p> <p>7 C / mucus, traps, particles / pathogens ;</p> <p>8 B / C / D / AW, prevent infections ;</p> <p>9 E / cartilage, keeps the, airway / trachea, open ;</p>	6	<p>max 2 marks for labels</p> <p>A prevent collapse</p>							
1(c)(i)	<table border="1" style="width: 100%; text-align: center;"> <tr> <td style="width: 12.5%;">U</td> <td style="width: 12.5%;">P ;</td> <td style="width: 12.5%;">T</td> <td style="width: 12.5%;">S</td> <td style="width: 12.5%;">Q</td> <td style="width: 12.5%;">R ;</td> <td style="width: 12.5%;">V</td> </tr> </table>	U	P ;	T	S	Q	R ;	V	2	
U	P ;	T	S	Q	R ;	V				
1(c)(ii)	<p>1 for, gas exchange / diffusion / movement of CO₂ <u>and</u> O₂ ;</p> <p>2 short distance (for diffusion / gas exchange) ;</p> <p>3 fast (gas exchange / diffusion) ;</p>	2								
1(d)	<p>1 haemoglobin is, abnormal / rigid / AW ;</p> <p>2 abnormal haemoglobin carries less oxygen (than normal haemoglobin) ; ora</p> <p>3 <u>red</u> blood cells are, sickle shaped / AW ;</p> <p>4 (sickle cells) stick together / clot (in blood vessels) ;</p> <p>5 fewer red blood cells ;</p>	3	<p>A abnormal haemoglobin does not carry O₂</p> <p>A not biconcave</p> <p>A blocked vessels / stuck / more red blood cells broken down</p>							

Question	Answer	Marks	Guidance
2(a)(i)	<p>1 exercise will increase heart rate (from resting rate) ;</p> <p>2 after exercise heart rate will, remain high / start decreasing ;</p> <p>OR</p> <p>3 there is no effect of exercise on heart rate ;</p> <p>is the null hypothesis ;</p>	2	A before exercise heart rate will be lower
2(a)(ii)	<p>1 fingers on, wrist / neck / artery ;</p> <p>2 number beats over a period of time / bpm ;</p> <p>3 use a heart rate monitor / AW ;</p> <p>4 contact of sensor with skin ;</p>	2	
2(b)	<p>1 lack of, blood supply / oxygen / glucose to heart, wall / muscle / tissues / cells ;</p> <p>2 less / no, (aerobic) respiration / described ;</p> <p>3 (heart) tissue / cells, die ;</p> <p>4 heart (muscle) cannot contract ;</p>	2	A more anaerobic
2(c)	<p><i>description</i></p> <p>1 no difference between groups at 0 months ;</p> <p>2 HRR in A increases <u>and</u> B increases and then decreases ;</p> <p>3 (at) 3 months, little difference between groups / group B higher ;</p> <p>4 (at) 6 months / at end, group A <u>higher</u> HRR (than group B) ;</p> <p>5 comparative data quote with units ;</p> <p><i>explanation</i></p> <p>6 (regular) exercise improves, HRR / fitness ;</p> <p>7 exercise, strengthens heart muscle / increases, stroke volume / cardiac output ;</p> <p>8 <i>idea that</i> anaerobic respiration / oxygen debt reduces HRR ; ora</p> <p>9 given plan has better long term effect / without given plan better short term effect ;</p> <p>10 patients may stick to given plan better (than their plan) ; ora</p> <p>11 without a given plan patients probably started with a higher intensity plan ; ora</p> <p>12 given plan may be better designed (to improve HRR long term) ; ora</p>	6	<p>A fitness or HR for HRR throughout</p> <p>A both groups increase HRR overall</p>

Question	Answer	Marks	Guidance
2(d)	<p>1 reduced, salt / (saturated) fats / cholesterol ;</p> <p>2 stop smoking ;</p> <p>3 reduce stress ;</p> <p>4 AVP ; e.g. / medication qualified / control diabetes / reduced alcohol / reduce blood pressure</p>	1	

Question	Answer	Marks	Guidance
3(a)(i)	DNA ;	1	A correct elements I RNA
3(a)(ii)	<p><i>parental phenotypes</i> resistant x not disease-resistant</p> <p><i>parental genotypes</i> Rr ; x rr ;</p> <p><i>gametes</i> R r x r (r) ;</p> <p><i>offspring genotype</i> Rr and rr ;</p> <p><i>offspring phenotype</i> resistant and not resistant / AW ;</p>	5	ecf from previous line above throughout
3(b)(i)	heterozygous, plant / parent, carry the not-resistant / r, allele ; some offspring would be, not-resistant / rr / homozygous recessive ; using heterozygotes results in profit loss / AW ;	2	A homozygous dominant = no r allele / <u>only</u> R A therefore all offspring are disease-resistant
3(b)(ii)	paint pollen onto selected trees / AW ; isolate plants / cover flowers, of unselected trees ; identify not disease resistant trees ; AVP ; remove not-resistant trees	1	A artificial pollination
3(b)(iii)	human choice (rather than environmental pressures) / AW ; less, diversity / variation ; faster change ; AVP ; e.g. mating is not random	2	A named features for human use A reduced fitness (of species)

Question	Answer	Marks	Guidance
4(a)(i)	(species) M ;	1	
4(a)(ii)	(species L) because most stable ;	1	
4(a)(iii)	300(%) ;;	2	<i>If no answer or wrong answer award one mark for working: $(2000-500) / 500 \times 100$</i>
4(b)	increased, predation ; disease ; lack of food ; migration ; (named) relevant pollution ;; (named) relevant environmental change ;; introduction of <u>new</u> species ;	2	I competition unqualified A new predators A competition for food e.g. eutrophication / rubbish / acid rain e.g. habitat loss / el Niño / global warming / climate change / hurricane / tsunami
4(c)(i)	(larger holes) allow, more / small / immature, fish through ; ora nets more specific to target species / prevents by-catch ;	1	

Question	Answer	Marks	Guidance
4(c)(ii)	<p>1 education / awareness ; Accept commercials / advertising / tax consumer</p> <p>2 reduced demand (to eat from unsustainable fish stocks) / public pressure / campaigning ;</p> <p>3 steps taken by fisherman voluntarily / AW ;</p> <p>4 (legal) quotas / treaties / licenses / laws / restricted catch weight ;</p> <p>5 ensuring sustainable population size / recovery of, endangered / specific, species ;</p> <p>6 no-catch zones / nursery zones / protected areas / MPAs ; ora</p> <p>7 overflow of target species / increase in population outside zone / breeding recovery ;</p> <p>8 limited fishing <u>season</u> ;</p> <p>9 stock recovery / optimises breeding seasons ;</p> <p>10 fines;</p> <p>11 discourage / punish, poor practice ;</p> <p>12 restocking / captive breeding and release ;</p> <p>13 increases gene pool / number of young / reproductively-viable, fish ;</p> <p>14 fish farming ;</p> <p>15 alternative source of fish ;</p>	4	<p><i>max 3 for methods only</i> <i>explanations must be linked to correct method</i></p> <p>e.g. use of better fishing methods</p> <p>MPA = marine protected areas</p> <p>A patrols / policing</p>

Question	Answer	Marks	Guidance
4(d)	<p>1 guillemots / gulls / squid / seals, <u>reduce</u> in numbers ;</p> <p>2 guillemots / gulls, become extinct ; Accept ref to alternative food sources for any other named species</p> <p>3 because their food / energy, source has reduced / (intraspecific) competition for their food increases ;</p> <p>4 zooplankton, might increase / stay same / decrease <u>and</u> valid explanation ;</p> <p>5 phytoplankton decrease because zooplankton increase ; 6</p>	4	<p>mp4 <i>examples of valid explanations:</i></p> <p>increase leads to less cod predation</p> <p>decrease leads to more squid predation</p> <p>stay same leads to balance squid and cod predation</p>
4(e)	development providing the needs of increasing human population ; without harming the, environment ;	2	

Question	Answer	Marks	Guidance
5(a)(i)	respiration ; aerobic (respiration) ; release energy / make ATP ;	2	<p>A respiration using oxygen</p> <p>A provide energy</p> <p>R produce / generate, energy</p>
5(a)(ii)	different composition of cell wall ; no, chlorophyll / chloroplasts / heterotrophic ; extracellular digestion / saprophytic / decomposer / AW ; hyphae / mycelium ; no (central) vacuole ; AVP ;	2	<p>A not, autotrophic / photosynthetic / AW</p> <p>A enzymes secreted from cells to digest food</p> <p>I spores</p> <p>e.g. multinucleate / reproduction by budding</p>

Question	Answer	Marks	Guidance
5(b)	respiration / fermentation ; carbon dioxide released ; (bubbles / carbon dioxide) causes, dough / bread, to rise ; (yeast produces) enzymes ; enzymes / amylase, digest starch ; AVP ;	3	e.g. yeast, are not toxic / does not produce toxins / reproduce rapidly / can be stored dry / are single celled / cheap
5(c)(i)	(fungus) grown / put, in fermenters ; aerobic conditions / AW ; (provide) sugars / nitrogen source / nutrients ; purification / filtration, of product / penicillin ; batch culture / AW ; sterile conditions ; AVP ;	3	A bioreactors A bubble air through e.g. ammonia / amino acids / protein e.g. described maintenance of culture / penicillin produced, when sugar source decreases / in stationary phase A fermentation conditions such as stirring / use of water jacket / controlling temp / pH etc.
5(c)(ii)	bacteria are made of cells ; ora	1	A viruses are not alive / do not have a cell wall
5(d)	mechanical barriers ; example of mechanical barriers ;; chemical barriers ; example of chemical barriers ;; blood clotting ;	max 3	A physical barriers / dead layer of cells for skin e.g. skin / hairs in nose / ear wax A mucus as mechanical or chemical e.g. mucus / stomach acid / vaginal acid / tears / lysozymes A scab

Question	Answer	Marks	Guidance
6(a)(i)	X – sensory; Y – motor / effector ;	2	

Question	Answer	Marks	Guidance
6(a)(ii)	sweat glands ; blood vessels ; hair erector muscles ;	1	
6(a)(iii)	<u>negative feedback</u> ;	1	
6(b)(i)	shunt vessels, constrict / close / AW ; more / redirect, blood flow to skin (capillaries) ; heat from blood, lost / radiates ; vasodilation (of arterioles) ;	3	A vasoconstriction A heat loss from blood vessels
6(b)(ii)	sweat, secreted / made (by sweat glands) ; evaporative (cooling) ; hair erector muscles relax ; (hairs lie flat) so that less (air) insulation / allows more air movement (across skin) ;	3	A less air trapped
6(c)(i)	quick(er) (response) ; long-term response is not required ;	1	
6(c)(ii)	insulin ; <u>glucagon</u> ; ADH ; AVP ;	2	