



Cambridge International Examinations
Cambridge International General Certificate of Secondary Education

BIOLOGY

0610/41

Paper 4 Theory (Extended)

October/November 2016

MARK SCHEME

Maximum Mark: 80

Published

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This document consists of **14** printed pages.

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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
- 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 words given must be used by the candidate (or grammatical variants of them)

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Question	Answer	Mark	Guidance
1(a)(i)	(antibiotics) kill / damage / destroy / eliminate, pathogens / bacteria / fungi; Bacteria / fungi / pathogen can cause illness / disease / infections; (antibiotics), prevent growth / reproduction of, bacteria / fungi / pathogen; AVP ref. to how antibiotics kill bacteria; e.g. ref. to cell wall / production of proteins / inhibition metabolism;	2	I virus
1(a)(ii)	<ol style="list-style-type: none"> 1 all (bacteria / pathogens) need to be killed / destroyed; 2 any remaining (bacteria) will reproduce / multiply; 3 illness / disease would continue; 4 ref to problem of antibiotic resistance; 5 antibiotics no longer effective; 6 new antibiotics have to be developed; 	3	A prevents growth I virus I any reference to immunity
1(b)	fungus / mould;	1	A <i>Penicillium</i> (<i>notatum</i>)
1(c)(i)	steam; autoclave / high temperature <u>and</u> high pressure; UV / gamma, radiation / X rays; bleach; AVP; e.g. sterilise nutrients / air supply / items, entering fermenter	2	A any reference to sterilizing substances that are <u>added</u> to the fermenter.

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Question	Answer			Mark	Guidance
1(c)(ii)	letter from Fig. 1.1	name	function	5	one mark for each correct row
	P	water jacket	Maintain / control, temperature;		
	S	paddles / stirrers / mixers / vanes	mixes / stirs / maintains a suspension / stops solids settling / keeps nutrients moving / gives uniform mixture;		
	Q	nutrient inlet	supplies glucose / ammonia / amino acids / nutrients for growth / nutrients for respiration / energy;		
	R	Probe / sensor / data logger	monitors, temperature / pH;		
	U	air supply	supplies oxygen for respiration;		
	T	outlet	allows collection of the liquid containing penicillin after fermentation		

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Question	Answer	Mark	Guidance
1(d)	penicillin is, separated / extracted / filtered / centrifuged / evaporated / purified / crystallised / precipitated / dried / impurities removed;	1	A downstream processing
		Total: 14	

Question	Answer	Mark	Guidance
2(a)	group / number, of organisms / AW, from one species; living in same, area / place / environment / time, together;	2	
2(b)	<ul style="list-style-type: none"> 1 mode is / majority / most fish are, between 12.1 and 16.0 cm long; 2 range / body length, varies up to 24 cm / varies 0 to 24 cm; 3 very few fish are less than 4 cm; 4 no fish longer than 24 cm; 5 normal distribution / bell-shaped curve / similar number of fish longer and shorter than the mean; AW 6 Data quote of range with units and thousands of fish; 7 AVP ref to actual range may be shorter than 0–24 cm; 	3	A mean
2(c)(i)	4 + 8 + 10 + 6 + 4 + 2 (thousand); = 34 thousand (fish);	2	

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Question	Answer	Mark	Guidance
2(c)(ii)	quotas/licences/permits/limits; fines for overfishing/taxes; only adult fish caught/young fish returned; (laws to) restrict net size; no fishing, zones/seasons; encourage, fish farms/nurseries/hatcheries/captive breeding; international fishing agreements/treaties; reduce, pollution/silting (of rivers)/avoidance of environmental factors detrimental to fish; education; restocking/add more, fish than removed / AW;	4	A 'regulation of fishing' A 'eutrophication' if linked to the death of fish.
2(d)(i)	genetics/inherited (genes); environmental factors ; any two named environmental factors; (natural) selection;	2	examples of named environmental factors: nutrition/pollution/temperature/predation/disease/fishing
2(d)(ii)	bar chart;	1	
		Total: 14	

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Question	Answer	Mark	Guidance
3(a)(i)	amino acids;	1	
3(a)(ii)	stomach;	1	
3(b)(i)	ref. to surface area; affecting enzyme / enzyme activity; allows comparison; make experiment valid; controlled variable;	2	
3(b)(ii)	water-bath / in a beaker of water / incubator; insulate test-tube; allow solutions to equilibrate to temperature (before experiment); use a thermometer to check the temperature (is constant);	2	
3(c)	(pH) 8 ± 1 ;	1	

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Question	Answer	Mark	Guidance
3(d)	enzymes are protein; enzymes can be reused / are unchanged in the reaction; enzymes are specific; (enzymes are) catalysts / speeds up reaction; lowers the energy needed for the reaction; successful collisions / enzyme-substrate complex / ESC; active site; (enzyme and substrate) fit together; complementary shape; (digestive enzymes perform) chemical digestion / hydrolysis / catabolic reactions; break down, large / insoluble, molecules into, small / soluble, molecules; amylase converts starch to sugars / maltose; lipase converts lipid / fats, to fatty acids and glycerol; maltase converts maltose to simple sugars / glucose; ref to pH; ref to denaturation;	6	
		Total: 13	

Question	Answer	Mark	Guidance
4(a)(i)	pancreas;	1	
4(a)(ii)	recognize a specific, pathogen / antigen; lock on antigens / antibody-antigen complex; agglutination / clumping; destruction by, phagocytes / white blood cells / lymphocytes; AVP; e.g. neutralise / inhibit toxins;	2	A bacteria / fungus / virus / parasite

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Question	Answer	Mark	Guidance
4(b)(i)	lack of sun(light)/ dark skin AW; lack of fish (oils)/ egg (yolk)/liver; unbalanced diet; kidney/ liver/ digestive, disease;	1	
4(b)(ii)	muscle cramps; soft/bent, bones/rickets; stunted growth; prone to infections; fatigue; reduced ability to absorb calcium (ions);	2	
4(c)	lack of vitamin D leads to more cases of type 1 diabetes in mice / ora; there is no difference in cases/ same number of cases (wrt normal mice) until after 50 days; at 100 days there are more cases (in vitamin D mice); (vitamin D mice) levels off before normal mice /levels off after 150 days; comparative data use ;e.g. 20% more cases at day 200 or at 250 days normal mice is 46% , deficient mice is 65%;	3	

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Question	Answer	Mark	Guidance
4(d)	frequent urination; thirst / AW; hunger; fatigue; weight loss; itchy skin; wounds heal slowly / more susceptible to infection; blurred vision / AW; vomiting; glucose in urine; high blood, glucose/sugar;	4	A nausea A hyperglycaemia.
4(e)	insulin; by injection / insulin pump; regular blood sugar tests; regular meals; AVP; exercise / restrict carbohydrate content of diet	3	
		Total: 16	

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Question	Answer	Mark	Guidance
5(a)	root hair (cells); long and thin; thin cell wall; large surface area; for absorption; (water by) osmosis ; (ion / nutrients by) active transport; against the concentration gradient; protein (pumps) in membrane; require energy / ATP; ref. to many mitochondria;	5	
5(b)(i)	(positive) gravitropism;	1	A geotropism R negative gravitropism
5(b)(ii)	auxin;	1	

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Question	Answer	Mark	Guidance
5(b)(iii)	<p>in space / AW; because no gravity;</p> <p>in a clinostat / AW; gravity constantly changing / AW;</p> <p>remove root tip; no auxin source;</p> <p>lateral roots; searching for, water / nutrients / hydrotropic;</p> <p>light source below, plant / root; roots grow away from light / negatively phototropic;</p> <p>anaerobic mud / mangrove swamp / pneumatophores; need oxygen (for respiration); ORA</p> <p>roots attaching plant to solid objects for support eg walls / other host plants; material is too hard for root to grow through (takes line of least resistance);</p> <p>AVP; e.g. epiphytes / parasitic plants</p>	2	paired marking points
		Total: 9	

Question	Answer	Mark	Guidance
6(a)(i)	T, C, A, G;	2	all correct = 2 marks 2 or 3 correct = 1 mark
6(a)(ii)	double helix;	1	
6(b)	<i>species C with species D: 4;</i> <i>species G with species H: 3;</i>	2	
6(c)	species A and species D	1	
6(d)		3	4 correct = 3 marks 2 or 3 correct = 2 marks 1 correct = 1 marks
6(e)(i)	<u>genetic engineering</u> ;	1	

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Question	Answer	Mark	Guidance
6(e)(ii)	<p>drought / salt / pollution / metal / frost / stress / cold, resistant; increased, yield / productivity; extend range where crops can be grown;</p> <p>herbicide resistance; increased yield / productivity;</p> <p>pesticide resistance; increased yield / productivity;</p> <p>crop plants produce own insecticides; less insecticide used; increased yield;</p> <p>vitamin / nutrient, enrichment / β carotene (Golden rice); increased nutritional value;</p> <p>pathogen resistant / Bt; increased productivity / less pesticide use;</p> <p>antigens / vaccines / pharmaceuticals; e.g. insulin cheap production of medicines;</p> <p>flavour / texture / ripening; Improved customer satisfaction / shelf life;</p>	4	<p>linked marking points 2+2</p> <p>R bacteria (as not a crop plant)</p> <p>A 'more profit' once.</p>
		Total: 14	