OCR
Oxford Cambridge and RSA

GCE

Biology B (Advancing Biology)

Unit **H422A/02:** Scientific literacy in biology

Advanced GCE

Mark Scheme for June 2017

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

Annotations

Annotation	Meaning
DO NOT ALLOW	Answers which are not worthy of credit
IGNORE	Statements which are irrelevant
ALLOW	Answers that can be accepted
( )	Words which are not essential to gain credit
__	Underlined words must be present in answer to score a mark
ECF	Error carried forward
AW	Alternative wording
ORA	Or reverse argument

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

Question			Answer	Marks	Guidance
1	(a)	(i)	(in) thylakoid / grana / lamellae ✓	1	
		(ii)	(plant thylakoids in) chloroplast(s) / stacks/grana **ora** ✓ (cyanobacteria thylakoids) near, cell surface membrane / cell wall ✓	2	**IGNORE** ref to thylakoids attached (to cell surface membrane)
		(iii)	stroma (in chloroplast) ✓ carboxysomes (in cytoplasm) ✓	2	
		(iv)	increased CO_2, around Rubisco / in carboxysomes ✓ (therefore) CO_2 , binds to / AW , Rubisco not O_2 ✓ (Membrane-bound) pumps for HCO_3^- (entry into cell)✓ carbonic anhydrase for CO_2 (entry into carboxysome)/ conversion of HCO_3^- ✓	3 max	**ACCEPT** *idea of* CO_2 outcompetes O_2

Question			Answer	Marks	Guidance
1	(b)	(i)	different <u>concentrations</u> of enzyme (in the different types of tobacco plants) ✓	1	
		(ii)	• correct axis labels **AND** both axes scaled appropriately ✓ • three data sets plotted **AND** correctly identified / labelled ✓ • all points correctly plotted to within ± half square **AND** plots joined by straight lines **OR** appropriate line of best fit ✓ • SD / error bars, plotted for all data points ✓	4	i.e. x-axis label: CO_2 concentration / μmol dm^{-3} y-axis label: (mean) rate / mol CO_2 fixed per mol active sites s^{-1}

Question			Answer	Marks	Guidance
	(b)	(iii)	*yes because* (carboxylase) activity / rate is, greater in modified tobacco plants (than in wild type) ✓ data quoted to support this conclusion, including correct units used at least **once** ✓ differences (between modified and wild type) are , (statistically) significant / not due to chance ✓ (between modified and wild type) error bars do not overlap / all SDs are small ✓ *however* only three CO_2 concentrations tested ✓	**3 max**	**ALLOW** named modified tobacco plant only if clear comparison with wild type 1 rate for, RbcX/M35, and wildtype
		(iv)	*valid because* M35 has higher rate of, CO_2 fixation/carboxylase activity (at all concentrations) ✓ *not valid because* error bars overlap so, differences due to chance / not statistically significant ✓ large(r) SD so more variation in results ✓	**2 max**	

	(c)		***Summary of instructions to markers:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* o *award the higher mark where the Communication Statement has been met.* o *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***

	(c)		**Level 3 (5–6 marks)** A comprehensive account of the risks and benefits of growing supercrops. The points are clearly linked to the article and their (wider) relevance discussed. *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** An account of some risks and benefits of growing supercrops. Some of these points are linked to the article and some discussion of their (wider) relevance. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.*	**6**	**Indicative scientific points may include** **Risks:** Modified plants may outcompete wild type plants Dominate or disrupt ecosystems Reduce biodiversity (inserted) genes transferring to wild plants (inserted) genes enter the food chain no information about how modified crops might affect human health herbicide resistant crops leads to superweeds **Benefits:** Increase in primary productivity of food crops Improved, agricultural yields Could produce more food Upgrading wild plants would make whole ecosystems more productive Increased photosynthesis would reduce carbon emmissions / greenhouse gases Increased photosynthesis would allow growth/high yield, in all, climates/weather

			Level 1 (1–2 marks) An account of the risks **or** benefits of growing supercrops, with reference or a quote from the article. No discussion of wider relevance. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*		

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>(a)</td><td>(i)</td><td>Meiosis ✓</td><td>1</td><td>IGNORE ref to I or II</td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th>Event</th><th>Type of nuclear division</th><th>Stage in nuclear division</th></tr>
<tr><td>Chromosomes line up on the equator; there is no association between homologous chromosomes.</td><td>mitosis</td><td>(early / late) metaphase ✓</td></tr>
<tr><td>Homologous chromosomes form bivalents.</td><td>meiosis</td><td>prophase I ✓</td></tr>
<tr><td>Homologous chromosomes separate and are pulled to opposite poles.</td><td>meiosis</td><td>anaphase I ✓</td></tr>
<tr><td>Crossing over occurs.</td><td>meiosis</td><td>prophase I ✓</td></tr>
</table>
</td><td>4</td><td>1 mark per row – needs correct type and stage</td></tr>
<tr><td></td><td>(b)</td><td>(i)</td><td>(rising level of oestrogen) inhibits FSH / causes secretion of LH ✓

LH causes, maturation of follicles / release of secondary oocyte / ovulation ✓

(LH causes) development of corpus luteum (after secondary oocyte release)✓</td><td>2 max</td><td></td></tr>
</table>

Question			Answer	Marks	Guidance
		(ii)		3 max	
			oestrogen production remains high (for most of adulthood) ✓		**ALLOW** suitable age range (e.g. from 12 to 50)
			(primary) oocytes are paused in prophase I (of meiosis) ✓		
			idea that (high) oestrogen cause, completion /continuation, of meiosis I✓		
			(so) forms secondary oocyte ✓		
			(secondary oocyte) is paused in (metaphase of) meiosis II ✓		

Question			Answer	Marks	Guidance
	(c)	(i)	**D1** follicle number decreases with age / negative correlation ✓ **D2** (the reduction is) exponential / a logarithmic relationship ✓ **D3** rapid / AW, decline after about 40 years ✓ **E1** as (some) follicles, mature / rupture / release oocytes ✓ **E2** (other) follicles, disappear over time / undergo apoptosis ✓ **E3** (because) oestrogen declines from about 40 years ✓	**4 max**	**ALLOW** max 2 for **D** and max 2 for **E**, marks **DO NOT ALLOW** idea of no change between birth and puberty
		(ii)	menopause ✓	**1**	
		(iii)	Any **two** for **one** mark from: change in regularity of periods heart pounding / high heart rate night sweats flushed skin / hot flushes insomnia / (increased) anxiety / depression vaginal dryness ✓	**1 max**	**Mark first two answers only**

Question			Answer	Marks	Guidance
3	(a)	(i)	homeostasis ✓	1	**IGNORE** negative feedback
		(ii)	chemoreceptors ✓ medulla oblongata ✓ parasympathetic ✓ negative feedback ✓	4	
		(iii)	an objective / quantitative measurement OR level of pain is (too) subjective ✓ *idea that* heart rate is controlled by the autonomic nervous system ✓	1 max	
	(b)	(i)	(opening of VGSC leads to) Na^+ / sodium ions, entering, cell/neurone/receptor ✓ (leads to production of) generator potential ✓ (if potential) exceeds the threshold value / reaches -50mV ✓ positive feedback / more VGSCs open✓ (this) creates an action potential ✓	3 max	**DO NOT ALLOW** Na^+ / sodium ions, entering membrane
		(ii)	drugs will not interfere with other types of VGSC ✓ other parts of the nervous system, continue to function / generate action potentials ✓	2	

Question			Answer	Marks	Guidance
	(c)	(i)	DNA, cut/ fragmented, using, restriction enzymes / endonucleases ✓ separate fragments using gel electrophoresis ✓ sequence fragments / add labelled probe ✓ compare to database / DNA samples from other individuals ✓	2 max	**ACCEPT** any valid method of labelling
		(ii)	greater risk of, developing breast cancer / having mutated gene, if have family history ✓ high cost means screening must be restricted ✓ living relative needed to identify faulty gene ✓ (this gene) tested for in the individual / predictive testing ✓	2 max	

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>(a)</td><td>(i)</td><td>A adenine / <u>purine</u> ✓

B <u>deoxyribose</u> / pentose ✓

C phosphate ✓</td><td>3</td><td></td></tr>
<tr><td></td><td></td><td>(ii)</td><td>
<table>
<tr><th rowspan="2">DNA strand</th><th colspan="4">Percentage of each base</th></tr>
<tr><th>A</th><th>C</th><th>G</th><th>T</th></tr>
<tr><td>strand 1</td><td>25</td><td>(35)</td><td>(22)</td><td>18</td></tr>
<tr><td>strand 2</td><td>(18)</td><td>22</td><td>35</td><td>25</td></tr>
</table>
✓✓</td><td>2</td><td>2 rows correct = 2 marks
1 row correct = 1 mark</td></tr>
<tr><td>4</td><td>(b)</td><td></td><td>hydrogen bonds broken by <u>helicase</u> (to separate the strands) ✓

hydrogen bonds between free nucleotide and exposed (template) base ✓

2 bonds between A & T and 3 between C & G ✓

complementary, bases / base pairing ✓

joins, DNA strands / polynucleotides / old strand and new strand ✓</td><td>2 max</td><td>DO NOT ALLOW hydrolyses hydrogen bond</td></tr>
</table>

Question			Answer	Marks	Guidance
	(c)		Mutation / fault / damage, in DNA is not removed ✓ (this) increases (general) mutation rate / accumulation of DNA damage ✓ (increased) mutation in proto-oncogenes / tumour suppressor genes ✓ apoptosis, is not triggered/does not occur ✓ (leads to) uncontrolled, mitosis / cell division ✓	3 max	Look for linking of faulty DNA repair mechanisms with increase in mutation rate.

Question			Answer	Marks	Guidance
5	(a)	(i)	contains (purified) <u>antigens</u> ✓ from (several) different strains ✓	1 max	
		(ii)	vaccine does not contain any, bacterial genetic material / virulence factor ✓ vaccine does not contain bacteria that could replicate ✓	1	**IGNORE** ref to viruses **ALLOW** DNA / nucleic acid / nucleus **DO NOT ALLOW** RNA
		(iii)	(because) related strains of bacteria have, similar/ same, antigens / glycoproteins /surface proteins✓ antibodies (produced after vaccine), recognise / AW, antigens on (these) related strains of bacteria✓	2	

5	(b)		***Summary of instructions to markers:*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* o *award the higher mark where the Communication Statement has been met.* o *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***

			Level 3 (5–6 marks) A comprehensive evaluation of the importance of herd immunity in the control of epidemics, including risks and benefits of vaccination. A reasoned conclusion is drawn about the benefits to society and/or the individual resulting from herd immunity including ethical issues. . *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. The information presented is relevant and substantiated.* **Level 2 (3–4 marks)** A limited evaluation of the importance of herd immunity, with some reference to risks and/or benefits. An attempt is made to link ethical issues with the benefits of herd immunity. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented in the most part relevant and supported by some evidence.* **Level 1 (1–2 marks)** A description of herd immunity and link to epidemics. Little or no mention of risks or ethical issues. *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.* **0 marks** *No response or no response worthy of credit.*	**6** **20**	**Indicative scientific points may include:** Epidemic is a sudden increase in incidence of infectious disease in an area. **<u>Herd immunity</u>** Successful vaccination programme requires large population to be immune. Can eradicate an infectious disease Reduces chances of pathogen being passed on, so reduces risk of epidemics. Requires 80 – 95% of population to be immune. Depends on how easily pathogen is spread. Reference to ring vaccination. **<u>Vaccination risks</u>** Live-attenuated vaccines may revert and cause disease. Possibility of allergic reaction / anaphylaxis / side effects. May not be effective in all individuals due to genetic differences Reference to discredited study of MMR risks. **<u>Ethical issues</u>** Balance between individual's right to refuse consent and need to establish minimum immunity levels. Herd immunity protects those who cannot be immunised. Helps to eradicate a pathogen so it cannot spread to other countries where immunisation levels low due to socioeconomic reasons Helps to contain the spread so it doesn't reach those who cannot be immunised

Question			Answer	Marks	Guidance
6	(a)	(i)	(correct determination of P_{50} for **both** curves) normal = 3.5 and anaemia = 4.5 ✓ (calculation of % increase to 3 sig. figs) 28.6 ✓	**2**	**ALLOW** +/- 0.2 for each P50 value **ALLOW ECF** from incorrect P_{50} values
		(ii)	Hb/its, affinity (for O_2) would decrease / reduce ✓ oxyhaemoglobin, dissociates at <u>higher</u> pO_2 / has lower (%) saturation (than normal control) at same pO_2 ✓ (limited) haemoglobin releases oxygen more, easily / readily ✓ so <u>more</u> oxygen to (respiring) tissues ✓	**3**	
	(b)	**(i)**	(plasmolysis) occurs in plant cells / erythrocyte is not a plant cell ✓	**1**	
		(ii)	allow time for equilibration before observation **OR** observe immediately and after 10 – 15 min ✓ use more concentrations ✓ count cells using , haemocytometer measure (diameter of) cells using, scale / graticule ✓	**2 max**	**ALLOW** other valid improvements

Question			Answer	Marks	Guidance
7	(a)	(i)	**D** = <u>plasma</u> / cell surface , membrane ✓ **E** = Golgi (body / apparatus) ✓ **F** = (secretory) vesicle ✓ **G** = nuclear , envelope / membrane ✓ **H** = <u>rough</u> endoplasmic reticulum / <u>R</u>ER / ribosome✓	5	 **ALLOW** lysosome **ALLOW** nucleus
		(ii)	**H** = site of protein synthesis ✓ **H** = (allows for) folding of (glyco) proteins / secondary structure formation / tertiary structure formation ✓ **J** = synthesis / storage / transport , of , lipids / phospholipids / carbohydrates ✓	3	**ALLOW** description of protein synthesis **ALLOW** removal of leader sequences, packaging into vesicles

Question			Answer	Marks	Guidance
7	(b)	(i)	**K** = (R)ER / ribosome ✓ (VSVG- GFP) fluorescence is, highest / present at 0 min, at site of synthesis ✓ **OR** (VSVG- GFP) fluorescence declines rapidly as proteins move, through / from, K ✓ **L** = Golgi ✓ (VSVG- GFP) fluorescence increases as K decreases so protein moved to L which is next in sequence **OR** (VSVG- GFP) fluorescence lasts longer so protein being modified✓ **M** = plasma / cell <u>surface</u> membrane ✓ (VSVG- GFP) fluorescence, equals total curve / declines at the same level as total, so M is where protein is secreted✓	**6**	**IGNORE** ref to vesicles
		(ii)	answer in the range 135 – 145 (minutes) ✓	**1**	
	(c)		movement of (secretory) vesicles requires microtubules ✓ (so) no movement of vesicles (containing VSG-GFP) to , plasma / cell surface , membrane ✓ movement , to / through the , Golgi must be, via a different mechanism / not involving microtubules ✓	**2 max**	

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