OCR
Oxford Cambridge and RSA

GCE

Biology B (Advancing Biology)

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

Advanced GCE

Mark Scheme for June 2018

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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.

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

Marking Annotations

Annotation	Use
BOD	Benefit of Doubt
CON	Contradiction
	Cross
ECF	Error Carried Forward
GM	Given Mark
	Extendable horizontal wavy line (to indicate errors / incorrect science terminology)
I	Ignore
	Large dot (various uses as defined in mark scheme)
	Highlight (various uses as defined in mark scheme)
NBOD	Benefit of the doubt not given
	Tick
^	Omission Mark
BP	Blank Page
L1	Level 1 answer in Level of Response question
L2	Level 2 answer in Level of Response question
L3	Level 3 answer in Level of Response question

Question			Answer	Marks	Guidance
1	(a)	(i)	*Similarity (presence of)* axon / cell bodies / dendrites / synaptic knobs / myelin (sheath) / Schwann cells / nodes of Ranvier ✓ *difference* cell body at end of motor neurone **AND** cell body in middle of sensory neurone **OR** sensory neurone has a dendron / sensory neurone has short axon **AND** motor neurone has long axon ✓	2	**IGNORE** ref to function or direction of impulse. **ALLOW** suitably labelled diagrams **DO NOT ALLOW** both have long axons
		(ii)	both sensory and motor neurones are damaged ✓ impulse cannot, reach muscles / pass through motor neurone ✓ prevents impulse transmission, through sensory neurone / from receptors ✓	2 max	**IGNORE** signals/messages/information for 'impulses' **ALLOW** from stimulus for 'from receptors'.
		(iii)	insulates (the axon) / prevents passage of ions ✓ saltatory conduction ✓ (this) increases / speeds up , (rate of) transmission of impulses ✓	2 max	**IGNORE** signals/messages/information for 'impulses' **ALLOW** action potential jumps from node to node for 'saltatory conduction'.
		(iv)	Schwann cells	1	

Question			Answer	Marks	Guidance
	(b)	(i)	MRI / fMRI (functional MRI) / CT ✓	1	**ALLOW** lower case letters
		(ii)	**1** (both) show difference, between healthy **and** damaged areas ✓ *MRI / fMRI* **M2** uses magnet(s) / magnetic field ✓ **M3** detects, increase in water (content) / swelling / inflammation / (changes in) blood flow ✓ **M4** (can be used to) detect areas of demyelination ✓ **OR** *CT* **C2** uses X-rays (and computer) ✓ **C3** builds up 3-D image (of the spinal cord) ✓ **C4** shows areas with, poor blood supply / bleeding / blood clot ✓	3 max	**IGNORE** ref to tumours or other conditions not related to SCI **IGNORE** ref to technique other than **1bi** answer **ALLOW** 3DMRI gives a 3D image
	(c)		**1** neural stem cells / human brain tissue stem cells / MSCs, are multipotent ✓ **2** (as) derived from adult (stem cells) / able to differentiate into a limited range of cell types ✓ **3** embryonic stem cells are pluripotent ✓ **4** (as) they can differentiate into any type of cell ✓	3 max	**ALLOW** ref to trial names (e.g. Balgrist / Neuralstem) for 'neural stem cells/MSCs' **ALLOW** pluripotent in the context of iPSCs **ALLOW** ref to Asterias trial for 'embryonic stem cells' **ALLOW** embryonic stem cells are totipotent as early embryo used

Question	Answer	Marks	Guidance
(d)	***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):* ○ *award the higher mark where the Communication Statement has been met.* ○ *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.***		

Question			Answer	Marks	Guidance
			Level 3 (5–6 marks) An evaluation of the risks and benefits and the ethical issue of using stem cells. There is clear reference to the future potential of stem cell therapy. *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. There are clear links to the information in the article. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** An evaluation of the benefits and risk or risks and benefit of using stem cells including any ethical issue surrounding this use. There is reference to the future potential of stem cell therapy. *There is a line of reasoning presented with some structure and use of appropriate scientific language. There is a link to the information in the article The information presented is mostly relevant.*	**6**	**Indicative scientific points may include** ***Risks*** Risk of rejection Risk of infection with many injections or collection of MSCs Risk of further injury with many injections Need for immunosuppression Unknown long-term effect May not work Risk of teratogenesis / oncogenesis (with iPSCs) Too much emphasis on data with small sample size ***Benefits*** Reduces symptoms of SCI/ treats SCI Replace damaged cells Patients could walk/move, again Prevents further damage due to SCI Still under research/ not known Lack of other treatments Gives hope to patients No rejection if from own bone marrow Data used to help future sufferers ***Ethical*** Destroying embryos Use of iPSCs Use of human brain tissue Gives false hope

Question			Answer	Marks	Guidance
			Level 1 (1–2 marks) An evaluation of the risk or benefit and any ethical issue related to the use of stem cells. However, there is no reference to future potential. *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.		***Future potential*** Stem cell therapies will be approved Use of iPSCs Data gathered can be used in future

Question			Answer	Marks	Guidance
2	(a)		(*Coleus & Portulaca respectively)* 13.4 **AND** 27.3 ✓	1	
	(b)	(i)	(relative) humidity ✓ air movement / draughts ✓ light intensity ✓ water (given to pot plants) ✓	2 max	**ALLOW** wind for 'air movement'
		(ii)	*Yes because* Higher rate (compared to potometer) in , pots / normal , for, daisy / coleus / portulaca✓ geranium / plant, with lowest rate has no difference ✓ % (rate in potometer compared to pots) increases as transpiration rate in pots decreases (from geranium – coleus)✓ comparative figures to include 2 plants in pots with 2 plants in potometers **AND** mg cm^{-2} (leaf) hr^{-1}✓ *No because* coleus has lower % but lower rate (in pots) **OR** daisy has higher % but higher rate (in pots) ✓	3	**IGNORE** ref to *large difference* as in stem of question. **ALLOW** the lowest value of 0.65 shows no difference between pots and potometer **ALLOW** an analysed comparison e.g. '*a daisy has a 5x faster rate mg cm^{-2} (leaf) hr^{-1} in a pot but only a 3.7x increase in portulaca'*.

Question			Answer	Marks	Guidance
	(c)	(i)	*line graph with*: • both axes scaled appropriately **AND** correct axis labels ✓ • **all** points correctly plotted to within ± half square ✓ • appropriate line of best fit ✓	3	divisions on each axis should be equidistant and plotted points should occupy at least 50% of the grid area i.e. x-axis label: time / min y-axis label: Increase in mass of tube / mg line must pass through zero and majority of other data points.
		(ii)	**1**. calculation of gradient from graph = 6.25 ✓ **2**. rate of transpiration = 6.25 / 22.28 = 0.2805 ✓ **3**. 2.81 x 10^{-1} mg min^{-1} cm^{-2} / 1.69 x 10^{2} mg cm^{-2} h^{-1} ✓	3	**ALLOW** gradient in the range 6.18 to 6.32 **ALLOW** range of 0.2774 to 0.2837 **ALLOW** answer to any number of significant figures (correctly rounded) **ECF** value of gradient / 22.28 **ALLOW** range of 2.78 x 10^{-1} mg min^{-1} cm^{-2} to 2.84 x 10^{-1} mg min^{-1} cm^{-2} **ECF** from mp2 value to 2 dp in standard form with correct units.

Question			Answer	Marks	Guidance
	(d)	(i)	(drought resistance) involves many, genes / loci ✓ Involves (possible), multiple / variety, alleles (at each locus) ✓	2	**ALLOW** (drought resistance) is polygenic **IGNORE** different alleles
		(ii)	(gene/ transcription factor) can be used to identify, genes / alleles, involved / activated, in drought resistance ✓ promoters allow, gene expression / transcription ✓ remove / knockout, (miRNA 156) gene and observe, phenotype / drought resistance ✓	2	 **ALLOW** RNA Polymerase binds to promoters
		(iii)	place plasmid in *Agrobacterium* / use gene gun ✓ screen for, transgenic/ recombinant, cells ✓ details of selectable marker ✓	2max	**ALLOW** use *Agrobacterium* as vector for 'place plasmid in *Agrobacterium*'. **ALLOW** a description of a gene gun **IGNORE** ref to viruses / liposomes **IGNORE** ref to antibiotics

Question			Answer	Marks	Guidance
3	(a)	(i)	*Mycobacterium, tuberculosis* / *bovis* ✓	1	Italics not required
		(ii)	(cover mouth because) spread by (inhalation of) infected droplets ✓ (open windows) reduce chance of inhalation / removes droplets from, room / air ✓ (not sleep in same room because) long periods of contact required for infection ✓ (not sleep in same room because) cannot, control coughing / cover mouth, when asleep ✓	2max	
		(iii)	bacteria are, inaccessible to antibiotics / protected inside tubercles ✓ (many antibiotics required as) bacteria may be resistant to (any) one antibiotic ✓ (longer period required to*)* stop antibiotic resistance developing ✓	2 max	**ALLOW** granuloma / macrophage, for 'tubercle' **IGNORE** general ref to bacteria being antibiotic resistant **ALLOW** bacteria unlikely to be resistant to all antibiotics 0
	(b)	(i)	(single stranded) RNA / ribonucleic acid ✓	1	
		(ii)	B = capsid / capsule proteins / capsomeres **AND** C = (lipid) membrane ✓	1	**ALLOW** phospholipid bilayer **IGNORE** plasma (membrane)

Question			Answer	Marks	Guidance
		(iii)	reverse transcriptase ✓ creates (double stranded) DNA from, (viral) genome / RNA ✓ **OR** integrase ✓ Inserts viral, (c)DNA / genome, into host genetic material ✓	2	**ALLOW** forms cDNA for 'creates DNA '
	(c)	(i)	Viral (c)DNA becomes part of the host cell, DNA /genome / chromosomes ✓ (integrated cDNA known as) provirus ✓ (provirus) can remain dormant in the, genome / DNA / chromosome / nucleus, for years ✓	2 max	
		(ii)	HIV, infects / targets, helper T / T_H / CD4, cells ✓ T (helper) cells decrease ✓ T cells/ phagocytes / immune cells, cannot destroy pathogen ✓	2max	**ALLOW** patient is, immunocompromised / immunosuppressed / described
	(d)		enzymes ✓ thromboplastin ✓ fibrinogen ✓ fibrous ✓	4	**ALLOW** 'insoluble' **OR** 'filamentous' for 'fibrous'

Question			Answer	Marks	Guidance
4	(a)	(i)	(erectile dysfunction) is the inability to, get / maintain, an erection ✓ (infertility) is due to problems with, sperm production / release ✓	2	**IGNORE** sperm cannot fertilise egg unqualified **ALLOW** abnormal sperm / low sperm count / blocked vas deferens / cannot ejaculate
		(ii)	medication / diabetes / (long term) stress ✓	1	**ALLOW** nerve damage **IGNORE** too much alcohol
	(b)	(i)	increases the risk of **CHD**, **stroke** and **breast cancer** (compared with placebo) ✓ reduced risk of hip fracture and colorectal cancer ✓ differences may not be significant / no error bars shown ✓	3	**DO NOT CREDIT** if colorectal cancer or endometrial cancer are included **IGNORE** ref to endometrial cancer **ALLOW** no statistical analysis / SD / SE
		(ii)	***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):* ○ *award the higher mark where the Communication Statement has been met.* ○ *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.***		

Question			Answer	Marks	Guidance
			Level 3 (5–6 marks) A clear discussion of the cardiovascular and cancer risks of HRT based on previous guidance and changes that have occurred due to the new guidelines. *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** Discussion of the cardiovascular or cancer risks of HRT based on previous guidelines and a link with changes due to new guidelines. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.* **Level 1 (1–2 marks)** Discussion of HRT risk using either new guidelines or previous guidelines . *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**	**Indicative scientific points may include** Previous guidance risks; • history of breast, endometrial or ovarian cancer • history of blood clots / thrombosis • history of heart disease / CHD / stroke • untreated high blood pressure • liver disease • irregular periods New guidelines changes; • history of CHD risk not as great • cancer risk not so high. • Stopping HRT decreases risk • More recent study • More evidence *Do not give credit for simply repeating information in the question; it must be put into context of 'previous guidance' and 'new guidelines'.*

Question			Answer		Guidance
5	(a)	(i)	allows comparison between (areas with) different population sizes ✓	1	**ALLOW** can compare as population size doesn't have to be taken into account
		(ii)	(population increase) 2 100 000 ✓ (divided by 52 years =) 40 385 thousand year^{-1} ✓ = 4.0 x 10^4 (thousand year^{-1}) ✓	3	**ALLOW** figure in the range 1 900 000 – 2 200 000 **ECF** any value divided by 52 **ECF** value from previous mark in standard form and 1 dp
		(iii)	*population in Africa increase because* more births than deaths ✓ birth rate (always) higher in Africa compared to Europe ✓ *population in Europe decreases because* more deaths than births ✓ death rate (now) higher in Europe compared to Africa ✓	3 max	
	(b)	(i)	(cereals endosperm is), rich in starch / a good source of carbohydrate ✓ (endosperm from some) cereals be used to make bread ✓ cereals can grow in hot climates ✓	2max	

Question			Answer	Marks	Guidance
		(ii)	increase in cereal (imports and production) correlates with decrease in death rate ✓ death rate due to malnutrition decreases ✓ (however) other factors / named example, will reduce death rate ✓	2max	**ALLOW** negative correlation between cereal (imports and production) and death rate **ALLOW** more people live as they have plenty of food **ALLOW** improved sanitation / healthcare
	(c)		food security ensures access to safe & nutritious foods ✓ (rising population) greater demand for food ✓ **Increased** risk to food security ✓ (rising population) makes sustainable farming practices less likely (to be maintained) ✓ (increased cereal production) reduces biodiversity ✓ (as) increased use of monoculture ✓ (increased use of) pesticides will kill other insects / herbicides will kill other plants ✓ (increase in) imported foods may not be safe ✓	5 max	**ALLOW** (rising population) is major threat to food security **ALLOW** description of food security being at risk (e.g. 'less likely to be able to supply food to everyone') **ALLOW** genetic diversity is low **ALLOW** imported cereals may have decreased food security

Question	Answer	Marks	Guidance

Question			Answer	Marks	Guidance
6	(a)	(i)	bone marrow ✓	1	**ALLOW** haemocytoblasts
		(ii)	decrease in (partial pressure of) oxygen ✓	1	**ALLOW** O_2 for 'oxygen'
	(b)	(i)	measure number of, red blood cells / RBCs /erythrocytes ✓ high number of RBCs indicates use of rhEPO✓ use of (fluorescent) antibodies to detect rhEPO ✓	2 max	**ALLOW** use flow cytometry **ALLOW** use of ELISA / immunoassay, to detect rhEPO
		(ii)	rhEPO is identical to the normal EPO ✓ normal EPO concentrations vary (so difficult to know when rhEPO is added)✓	2	**ALLOW** cannot tell difference between types of EPO **ALLOW** difficult to establish normal EPO concentration
	(c)	(i)	EPO stimulates production of red blood cells ✓	1	**ALLOW** RBCs / erythrocytes
		(ii)	(damaged) kidney no longer produces (sufficient) EPO ✓ (so) fewer red blood cells are produced ✓ blood loss in haemodialysis ✓ red blood cells (maybe) filtered into the urine ✓	2max	**ALLOW** RBCs / erythrocytes **ALLOW** RBCs / erythrocytes

Question			Answer	Marks	Guidance
		(iii)	(kidney disease causes) increased production of renin ✓ renin catalyses conversion of angiotensinogen to angiotensin ✓ increases blood pressure /causes hypertension ✓ (increased blood pressure) damages endothelium in arteries / causes atherosclerosis ✓	3max	
	(c)	(iv)	*Selection of correct data* 4.8-5.2 for darbepoetin alfa **AND** 1.5-1.8 for rhEPO ✓ *Incorrect because* (only) 2.6-3.4 (x more darbepoetin alfa than rhEPO) ✓	2	**IGNORE** % values **ALLOW** calculated figure (lower than 5) **AND** stated as less than '5x more'
	(d)		(have more accurate) match to, antigens on red blood cells / MHC ✓ use patients' own stem cells ✓ (which will) differentiate into kidney cells ✓ (not rejected because) genetically identical / seen as 'self' ✓ (could use) induced pluripotent stem cells / iPSCs ✓ (these are examples of) therapeutic cloning ✓	3 max	**ALLOW** more accurate blood grouping **IGNORE** growing kidneys

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