OCR
Oxford Cambridge and RSA

GCE

Biology A

Unit **H420A/01:** Biological purposes

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 ✓	1	
2			C ✓	1	
3			A ✓	1	
4			B ✓	1	
5			D ✓	1	
6			D ✓	1	
7			B ✓	1	
8			C ✓	1	
9			B ✓	1	
10			C ✓	1	
11			A ✓	1	
12			A ✓	1	
13			C ✓	1	
14			D ✓	1	
15			A ✓	1	
			Total	**15**	

Question			Answer	Marks	Guidance
16	(a)	(i)	scales and hair help to reduce heat loss ✓ generate heat from , respiration / metabolism ✓	1max	 **ALLOW** generate heat internally **IGNORE** temperature
	(a)	(ii)	(insects are smaller and) have a , large(r) / AW , surface area to volume ratio ✓ (insects have) greater rate of heat loss ✓ mammals and birds have , more effective / thicker , insulation ✓ *ref to a method* of more precise control of body temperature in birds and mammals ✓	2 max	**Mps 1 and 2 ALLOW** ora for mammals (must be comparative) **ALLOW** SA:V / surface area relative to volume **ALLOW** lose heat more , quickly / easily **ALLOW** have fat under skin **ALLOW** ora for insects (must be comparative) e.g. thermoregulatory centre / heat gain / heat loss centre e.g. vasodilation / vasoconstriction e.g. sweating / shivering / hairs standing up
16	(b)	(i)	spiracle (s) ✓	1	**ALLOW** stigma(ta) **DO NOT ALLOW** stomata
	(b)	(ii)	trachea(l) (fluid) ✓	1	**IGNORE** haemolymph **IGNORE** tracheole

Question			Answer	Marks	Guidance
16	(c)			3 max	*give credit to examples used in the correct context*
			high metabolic , demands / rate ✓		**ALLOW** high rate of respiration
			need , large oxygen / rapid oxygen , supply ✓		
			diffusion , not sufficient / too slow / distance too far ✓		**IGNORE** not efficient
			(to) maintain , steep / AW , concentration / diffusion , gradient(s) ✓		
			surface area to volume ratio is (usually) low ✓		**ALLOW** SA:V / surface area relative to volume
			(named) metabolite(s) needed by cells / (named) waste(s) removed from cells ✓		**ALLOW** nutrients / hormones **IGNORE** oxygen **ALLOW** toxins

Question			Answer		Marks	Guidance
16	(d)				2 max	***IGNORE*** *numbered lines and mark as prose* ***IGNORE*** *references to detail of diagram*
			1	large size / at least 50% of available space ✓		
			2	title / heading ✓		
			3	labels outside diagram ✓		
			4	label lines should not cross over others ✓		
			5	continuous lines ✓		**ALLOW once only** no , sketching / feathering for **either** mp5 **or** mp6
			6	no shading ✓		
			7	use plain paper ✓		
			8	state magnification ✓		
			9	correct proportions ✓		
				Total	**10**	

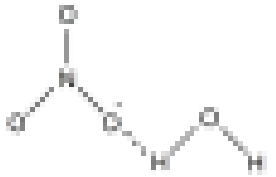
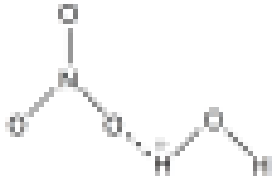
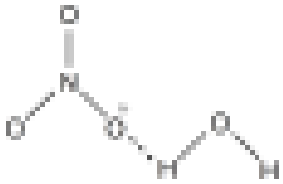
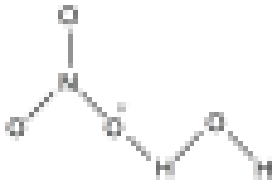
Question			Answer	Marks	Guidance
17	(a)	(i)	10^8 **OR** 1×10^8 **OR** 100 000 000 ✓✓	2	**If answer is incorrect ALLOW one mark** *For evidence of correct working* i.e.$10^9 \div 10^1$
	(a)	(ii)	liver has , large / good / AW , blood supply ✓ released / secreted / AW , into bile ✓	2	**IGNORE** reference to C-reactive protein and copeptin throughout **ALLOW** liver has sinusoids
17	(b)	(i)	3157 $\underline{\mu m^3}$ / 3.157 x10^3 $\underline{\mu m^3}$ **OR** 3155 $\underline{\mu m^3}$ / 3.155 x10^3 $\underline{\mu m^3}$ *(3.14 used for value of π)* **OR** 3158 $\underline{\mu m^3}$ / 3.158 x10^3 $\underline{\mu m^3}$ *(22/7 used for value of π)* **OR** 3.157 / 3.155 / 3.158 , $\times10^{-15}$ $\underline{m^3}$ *(answer using SI units)* ✓✓✓	3	**ALLOW for two marks** *correctly calculated value not given to 4SF* e.g. 3156.55 μm^3 3157.82 μm^3 (22/7used) 3154.95 μm^3 (3.14 used) **OR** *correctly calculated value without units* e.g. 3157 / 3.157 **OR** *correctly calculated value with inappropriate units* e.g. $3.157\text{x}10^{-6}$ mm^3 $3.157\text{x}10^{-9}$ cm^3 ***If two or three marks were not awarded for the correct answer or calculated value:*** *for **one mark** look for evidence of use of the formula:* $(4/3) \times \pi \times r^3$

Question			Answer	Marks	Guidance
17	(b)	(ii)	(transmission) electron (microscope) ✓ **AND ONE** of the following: 2D image ✓ internal details visible ✓ (named) organelles / ultrastructures , visible ✓ high <u>magnification</u> ✓ high <u>resolution</u> ✓	**2 max**	**ALLOW** TEM **DO NOT ALLOW** scanning electron microscope / SEM **IGNORE** black and white / colour e.g. mitochondria **IGNORE** nucleus (as visible under a light microscope)
			Total	**9**	

Question			Answer	Marks	Guidance
18	(a)		the factor that will , determine / limit / AW , the rate ✓ when at , low(er) / sub-optimal / AW , level ✓	2	**Both marks can be gained from a correctly described example** e.g. when CO_2 (concentration) is in short supply, it prevents the rate of photosynthesis increasing **DO NOT ALLOW** inhibits / reduces **ALLOW** prevents rate from increasing / slows down rate of increase / stops rate from increasing / causes rate to plateau **ALLOW** when in short (est) supply
18	(b)	(i)	increased volume of water added (to seedlings) , leads to lower survival (of seedlings) ✓ larger decrease in survival for added water , above / from , 30 (cm^3) ✓ volume of water has no effect on number (of seedlings) surviving up to the first 3 days / AW ✓ quote data points / calculation(s) used , to support any point ✓	3 max	**ALLOW** the more water the faster they die **ALLOW** ora e.g. less / little , decrease in survival for 30(cm^3) and below **DO NOT ALLOW** at 30cm^3 minimum one pair of readings quoted for two water volumes (no units needed)

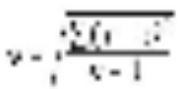
18	(b)	(ii) *	Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance. Using a 'best-fit' approach based on the science content of the answer, first decide which set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. **The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. **In summary:** • **The science content determines the level.** • **The communication statement determines the mark within a level.** **Level 3 (5–6 marks)** A detailed scientific statement about aerobic respiration **AND a** detailed scientific statement about anaerobic respiration **AND** more than one scientific consequence for the plant of overwatering	6	**Indicative scientific points may include…** **Aerobic respiration (A)** *Statement* **(S)** *The scientific statement can be implied by giving good scientific detail* • (No oxygen so) no aerobic respiration occurs *Further detail* **(D)** • No , link reaction / Kreb's cycle / ETC / oxidative phosphorylation • No oxygen to act as the final , electron / hydrogen acceptor **Anaerobic respiration (An)**

			There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. **Level 2 (3–4 marks)** A detailed scientific statement about either aerobic or anaerobic respiration **AND** a scientific consequence for the plant of overwatering *There is a line of reasoning presented with some structure. The information presented in the most part relevant and supported by some evidence.* **Level 1 (1–2 marks)** A statement about either aerobic or anaerobic respiration **AND** a scientific consequence for the plant of overwatering *There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant and correct.* **0 marks** No response or no response worthy of credit.		*Statement* **(S)** *The scientific statement can be implied by giving good scientific detail* • (Plant has to) switch to anaerobic respiration / only anaerobic respiration can occur *Further detail* **(D)** • Only glycolysis occurs • Alcoholic fermentation occurs • NAD regenerated (for glycolysis) • Pyruvate to ethanal to ethanol • Named enzyme e.g. pyruvate decarboxylase • (Only) 2 ATP **Scientific consequences for the plant (C)** • ethanol is toxic • (alcoholic fermentation) is irreversible • Less ATP produced / only 2 ATP from glycolysis • Less / no , active transport • (root hair cells) cannot take up mineral ions (by active transport) • so (plant) cannot make , proteins / amino acids / DNA / chlorophyll etc • cannot generate water potential gradient (into roots) / water potential (in root hair cells) is too high • water cannot be absorbed (so cells cannot remain turgid) • less / no , photosynthesis

Question			Answer	Marks	Guidance
18	(c)	(i)	water is (a) polar (molecule) ✓ nitrate (ion) / NO_3^- , is , charged / negative ✓ (hydrogen bonds form) between H on water and O on nitrate ✓	2 max	*Read answer first; if two marks from written response, **IGNORE** diagram. If two marks not awarded refer to diagram to find additional mark(s).* **DO NOT ALLOW** water is charged **ALLOW** water has slightly positive / δ^+ , H **IGNORE** 'δ^- O' if describing water **IGNORE** 'δ^- O' if describing nitrate or on diagram **DO NOT ALLOW** nitrate is polar **IGNORE** solid line for H bond on diagram **NOTE** 'delta plus of water is attracted to negative charge of nitrate' = 2 marks (MP1 and 2) **NOTE** the following examples  = 2 marks (MP 2 & 3)  = 2 marks (MP 1 & 3)  = 1 mark (MP3)  = 0 mark

Question			Answer	Marks	Guidance
18	(c)	(ii)	solutes / ions / named ion , enter , against concentration gradient / by active transport ✓ reduces water potential of (endodermal) cell(s) ✓ water , moves / diffuses , by osmosis / down water potential gradient ✓	2 max	**ALLOW** Ψ for water potential throughout **DO NOT ALLOW** ref to concentration of water in mps 2 or 3 **ALLOW** 'pumped' as AW for active transport **ALLOW** water potential of cell(s) becomes more negative **ALLOW** from high to low water potential
18	(d)		*organ is* collection / AW , of tissues ✓ perform / carry out / adapted to , function / role ✓ *leaves have* **two** from: epidermis / spongy mesophyll / palisade mesophyll / vascular / phloem / xylem , (tissues) ✓ (to carry out) photosynthesis / gaseous exchange ✓	4	**IGNORE** cells throughout **ALLOW** working together **IGNORE** mesophyll (unqualified) **IGNORE** stomata
			Total	19	

Question			Answer	Marks	Guidance
19	(a)		**B** ✓ **C** ✓ **B** ✓	3	*If two or more letters given, 0 mark*
19	(b)		nucleotide ✓ phosphate ✓ pentose ✓ strands ✓	4	*If two or more words are given for each gap do not accept contradictory responses* **ALLOW** two
19	(c)	(i)	**U** matrix ✓ **W** crista(e) / inner (mitochondrial) membrane ✓ **Z** inter-membrane space ✓	3	 **IGNORE** ETC / ATP synthase / cytochromes **ALLOW** inter-membranal space
	(c)	(ii)	cyanide , prevents / AW , aerobic respiration **AND** fluoride , prevents / AW , anaerobic respiration (which also prevents aerobic respiration) ✓	1	*BOTH statements required for one mark* **IGNORE** 'affects' throughout **ALLOW** link reaction / Krebs cycle / ETC / oxidative phosphorylation instead of aerobic respiration **ALLOW** cyanide allows , glycolysis / anaerobic respiration **ALLOW** prevents , all respiration / both stages of respiration **IGNORE** lactate fermentation
			Total	11	

Question			Answer	Marks	Guidance
20	(a)		5 ✓✓✓	3	*If no definitive answer given in Table 20, look in space above for working and/or answer.* **ALLOW** 3, 4, 5 **OR** 6 to correct SF for **3 marks** **ALLOW** 3, 4, 5 **OR** 6 to incorrect SF for **2 marks** **ALLOW** 2 **OR** 7 to correct SF for **2 marks** **ALLOW** 2 **OR** 7 to incorrect SF for **1 mark** **ALLOW** any other figure to correct SF for **1 mark** any other figure to incorrect SF = **0 marks** If no marks awarded from above, look for the following evidence of working for **1 mark** mean / $\bar{x}$ = 30 **OR** Σ = 228 **OR**  **OR** 

Question			Answer	Marks	Guidance
20	(b)		SD bars plotted correctly for the first four yeast species above and below the mean. ✓✓	2	*A correctly plotted SD bar is an accurately drawn vertical line. If the top and bottom of the line are capped, accept only the following symbols* —, X , ⊙ **IGNORE** *A. pullulans* (both columns) **ALLOW** one complete SD bar incorrect **For one mark** Four, five or six complete correct SD bars
20	(c)		61.54 (%) **OR** 70.20 (%) *(calculated from Table 20)* ✓✓✓	3	**IGNORE** + or - signs **ALLOW for two marks** *correctly calculated answer not to 4 SF* e.g. 61.538 / 61.5 e.g. 70.198 / 70.2 **ALLOW for one mark** *evidence of a correct calculation* e.g.  ×100 **OR**  ×100
20	(d)	(i)	**1** *incorrect because* *A. pullulans* / one yeast (species) , produced more CO_2 in anaerobic conditions ✓ **2** *incorrect because* error bars / standard deviations , overlap ✓	2	**ALLOW** no *t*-test carried out **DO NOT ALLOW** range bars

Question			Answer	Marks	Guidance
20	(d)	(ii)	random error (because) some (experiments / yeast species / columns on chart with) large SDs / error bars ✓	1	**DO NOT ALLOW** standard error **DO NOT ALLOW** range bars
20	(e)		ribosome(s) ✓	1	**ALLOW** rough endoplasmic reticulum / RER
			Total	12	

21	**(a) ***	Read through the whole answer from start to finish, concentrating on features that make it a stronger or weaker answer using the indicative scientific content as guidance. The indicative scientific content indicates the expected parameters for candidates' answers, but 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 set of level descriptors, Level 1, Level 2 or Level 3, best describes the overall quality of the answer using the guidelines described in the level descriptors in the mark scheme. Once the level is located, award the higher or lower mark. **The higher mark** should be awarded where the level descriptor has been evidenced and all aspects of the communication statement (in italics) have been met. **The lower mark** should be awarded where the level descriptor has been evidenced but aspects of the communication statement (in italics) are missing. **In summary:** • **The science content determines the level.** • **The communication statement determines the mark within a level.** **Level 3 (5–6 marks)** A statement in support of the claim **AND** a statement against the claim **AND** more than one comment on the validity of the claim **OR** A statement in support of the claim **AND** more than one statement against the claim **AND** a comment on the validity of the claim *There is a well-developed line of reasoning which is clear and*	**6**	**Indicative scientific points may include…** *Supporting firm's claim (F):* • As the volume of Diatin increases the mass of seedless fruit (harvested) increases *Against firm's claim (A):* • no , scale / units / numerical value , on graph axes • labels of graph axes are the wrong way round • no , error bars / standard deviation / mean / (named) statistical test • should be percentage increase in mass • correlation is not evidence of causation • risk of bias / lack of objectivity (as company is selling product based on claims)

		logically structured. The information presented is relevant and substantiated. **Level 2 (3–4 marks)** A statement in support of the claim **AND** a statement against the claim **AND** a comment on the validity of the claim **OR** A statement in support of the claim **AND** more than one statement against the claim **OR** A statement in support of the claim **AND** more than one comment on the validity of the claim **OR** A statement against the claim **AND** more than one comment on the validity of the claim *There is a line of reasoning presented with some structure. The information presented is in the most-part relevant and supported by some evidence.* **Level 1 (1–2 marks)** A statement in support of the claim **AND** a statement against the claim **OR** A statement in support of the claim **and** a comment on the validity of the claim **OR** A statement against the claim **and** a comment on the validity of the claim **OR** More than one statement against the claim **OR** More than one comment on the validity of the claim *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.		• Zeatin is more productive (than Diatin) *Issues with validity (V):* • no method given • species / type of plant is not named • no control variables given • concentration of hormone not specified • temperature control not specified • carbon dioxide concentration not specified • location not specified (e.g. could be outside vs greenhouse) • mineral availability / soil type , not specified • water availability not specified • light intensity not specified • presence of pollinators not specified • presence of , pests / weeds / pesticide / herbicide , not specified • no control group (to compare results) • no evidence of repeats • no consideration of the interaction with other hormones or processes

Question			Answer	Marks	Guidance
21	(b)		***related to light (L)*** **L1** light intensity / brightness , is not , controlled / specified **OR** size of hole in box not specified ✓ **L2** different , light intensities / brightness , could lead to variation in , phototropism / bending ✓ **L3** *idea that* light intensity / brightness , stays the same ✓ ***related to selection of seedlings (S)*** **S1** no method for , selecting / AW , (20) seedlings ✓ **S2** could lead to biased results ✓ **S3** *idea of* random selection ✓ ***related to measuring bend of seedlings (B)***	**6 max**	*Mark limitation, explanation and improvement as continuous prose within each numbered prompt.* *If marks come from more than one letter within either numbered prompt, award that which gives the highest mark* **IGNORE** reference to any other variables **ALLOW** wavelength / colour instead of intensity throughout (***L)*** *For L3 if statement not used other examples may include* e.g. use of , light meter / photo sensor e.g. use lamps of same bulb wattage e.g. use same distance from lamp e.g. use same , wavelength / coloured bulb *For S1* **IGNORE** only 20 seedlings selected *For S3* **ALLOW** count , all / more / 50 , seedlings **ALLOW** reasonable method of selection e.g. photograph and allocate numbers e.g. mini grid then select random numbers

			B1 degree of bending (of seedlings) not considered ✓ **B2** *idea of* a (reproducible) comparison is not possible **OR** could lead to biased results ✓ **B3** measure angle of bend ✓ ***related to replicates (R)*** **R1** experiment / trial , was not repeated ✓ **R2** cannot , calculate mean / identify anomalies / carry out statistical analysis ✓ **R3** repeat (experiment at least) twice **OR** carry out (at least) three trials ✓ ***related to size of dish (D)*** **D1** size of petri dish not , controlled / specified ✓ **D2** different sized dishes could affect , spacing of seeds / access to light ✓ **D3** specify , size / volume / diameter , of petri dish ✓		*For B1* **ALLOW** bending judgement **,** not quantitative / is subjective *For B3* **ALLOW** descriptions of method e.g. use of protractor e.g. use a , standard / model (for comparison) *For R2* **IGNORE** reference to , fair test / accuracy / reliability *For D3* **ALLOW** use the same sized dish
			Total	**12**	

Question			Answer	Marks	Guidance
22	(a)	(i)	**A** ✓	1	*mark the first letter only* **IGNORE** name unless contradicts a stated letter
	(a)	(ii)	**B** , **D** ✓	1	*If more than two letters given, 0 mark* **IGNORE** names unless contradicts a stated letter
22	(b)	(i)	*similarities* **S1** both use <u>active transport</u> ✓ **S2** both involve , co-transport / described ✓ **S3** both involve <u>selective</u> reabsorption ✓ **S4** both involve use of , sodium ions / Na^+ ✓ *differences* **D1** DCT involves use of , calcium ions / Ca^{2+} ✓ **D2** (co-transport in) DCT involves ions only ✓ **D3** PCT involves ions and (named) molecules ✓	3 max	*maximum two marks for similarities or differences* **IGNORE** sodium / Na **IGNORE** calcium / Ca **e.g.** glucose / amino acid(s)
	(b)	(ii)	*symptom* high volume of / excess , urine **OR** always thirsty / AW ✓ *explanation* fewer / AW , aquaporins in the (plasma) membrane (of collecting duct cells) ✓	2	**ALLOW** large amount / lots , of urine **IGNORE** reference to , dilute urine / water potential / frequency of urination **ALLOW** <u>protein</u> water channels for aquaporins

Question			Answer	Marks	Guidance
22	(c)	(i)	**1** have already / are , differentiated / specialised (so cannot divide) ✓ **2** are in , G_0 (phase of cell cycle) / resting phase ✓ **3** *idea that* shape is (too) , irregular / asymmetrical (so cannot divide) ✓ **4** cytoskeleton cannot function / spindle (fibres) cannot form✓ **5** (if mitosis occurred) it would alter , number / size , of the , gaps / fenestrations ✓ **6** *idea that it* would alter an aspect of ultrafiltration ✓	**3 max**	**ALLOW** cannot pass G1 checkpoint / cannot go into S phase / remains in G_1 e.g. (podocyte) has projections (so cannot divide) **ALLOW** for aspect of ultrafiltration e.g. different sized molecules can pass through e.g. no / less , ultrafiltration e.g. changes rate of ultrafiltration e.g. changes composition of filtrate
	(c)	(ii)	(adult stem cells) are <u>multipotent</u> ✓ (differentiate to) become any <u>cell</u> type within , kidney / nephron (tissue) ✓	**2**	**DO NOT ALLOW** totipotent / pluripotent **ALLOW** (adult stem cells) can , differentiate / specialise
			Total	**12**	

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