PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 4: EXCHANGE AND TRANSPORT

GAS EXCHANGE

SCORE	PERCENTAGE
/92	%

STEMUP

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Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
(i)	A calculation that shows the following stages • use manipulation of units to mm (1) • calculation of volume of cylinder (1) • rate per minute calculated to 2sf (1)	Example of calculation: eg mean is 64 (mm) 4.522 / 4.524 (this gets mp1 and 2 if 64 not seen) 45.2 is correct value if 6.4 is used 0.90 Correct answer with no working gains 3 marks 0.9 gets 2 marks (not 2sf) 0.09 gets 2 marks (if 6.4 is used for distance) 18 gets 2 marks (if diameter is used) 4.5 gets 2 marks (2sf if they do not divide by 5)	**Exp (3)**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that includes three of the following • {water uptake / transpiration} is fastest in moving air in the light (1) • {water uptake / transpiration} {is very slow / stops / decreases} in the dark as stomata close (1) • {water uptake / transpiration} is faster in moving air (than still air) as the diffusion gradient is {maintained / steeper} (1) • comment on decline in rate (of transpiration / water uptake) as trials continue in darkness with explanation (1) • effect of light is greater than effect of moving air (1)	Accept {water uptake / transpiration} is slowest in still air in the dark Not converse Accept concentration gradient / water potential gradient / diffusion shells around stomata or leaf Accept converse Accept stomata do not close completely until trial 3	**Exp (3)**

Question Number	Answer	Additional Guidance	Mark
(iv)	A description that includes four of the following: • cover one surface of leaves with vaseline / petroleum jelly / clear tape (to prevent transpiration) • measure {rate / distance moved in 5 mins / volume of water taken up in 5 mins} (1) • ensure that covering is fully removed or use another shoot with same surface area (1) • repeat for other surface of leaves (and compare results) (1) • **method of control of** one named variable / monitoring named variable which cannot be controlled (1) • repeats for each set up and calculate standarc deviation (1)	Accept clear nail varnish / clingfilm Accept other times Accept time how long it takes to move a set distance Accept same number of leaves / similar surface area Accept calculate rate of water loss per unit area Piece together Accept eg. temperature – AC room / room temperature humidity - clear bag over plant light intensity – distance from lamp air movement - distance from fan Accept repeat and carry out appropriate stats test eg t-test, 95% confidence limits, Mann Whitney U test	**Exp (4)**

Q2.

Question Number	Indicative content
*	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. Indicative content Descriptions (D) • A, B increase Carrico index / alveolar expansion • A and B together gives the highest level of improvement in Carrico index / more than natural surfactant • Both compounds A and B together are best to treat ARDS / increase the Carrico index • A alone is least effective • B increases Carrico index more than A • in all cases, the improvement is rapid and persists from 30 to 120 minutes Analysis (A) • valid comparison with natural surfactant / control • B has similar increase in Carrico index as natural surfactant / control • A has lower increase compared to natural surfactant / control • positive correlation between alveoli expansion and Carrico index • improving alveoli expansion results in improvement in blood oxygenation which improves Carrico index • the artificial surfactants allow alveoli to expand, increasing surface area and oxygen diffusion into blood • unaffected baby has index of 67 which is what A and B reach Potential use (P) • rabbits may not respond in the same way as humans to the compounds • may not be safe in humans • small sample size • no comparison has been made with no surfactant

Level	Marks	
0	0	No awardable content
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding **Only D**
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure. **D + A or D+ P**
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. **D+A+P**

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	• data correctly substituted into equation 14 / 14.1 / 14.07	Example of calculation (67 x 0.21 =) 14	**1**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • less oxygen in blood / capillaries / lower partial pressure of oxygen in blood (1) • because alveoli have less surface area (1) • because (lack of surfactant) prevents expansion (1) • less air / oxygen inhaled (1)	**ACCEPT** more likely to collapse	**4**

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	D ATP is broken down into ADP and phosphate ions by a hydrolysis reaction	A is incorrect because ATP is broken down B is incorrect because ATP is broken down C is incorrect because condensation reactions form bonds	

Question Number	Answer	Additional Guidance	Mark
(ii)	A malate lowers the water potential of the cytoplasm	B is incorrect because increase in solute concentration raises water potential so water would leave the cells C is incorrect because starch has no osmotic effect D is incorrect because starch has no osmotic effect	

Question Number	Answer	Additional Guidance	Mark
(iii)	D The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall	A is incorrect because entry of water would make the cell more larger B is incorrect because entry of water would make the cell more larger C is incorrect because the stoma would not form if the inner wall was flexible	

Q5.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to four of the following: • because 30 °C is an appropriate temperature for one species and provides enough oxygen for the other species **(1)** • because if the temperature was above {30 / 40} °C there would be less oxygen dissolved in it **(1)** • so there would not be enough oxygen for {respiration / metabolism / ATP production} **(1)** • because if the temperature was above {25 / 30} °C the enzymes would be denaturing **(1)** • because the temperature was below {25 / 30} °C the enzymes would not have enough {kinetic energy / collisions / enzyme substrate complexes} **(1)**	**Accept** because 30 °C satisfies the requirements of both fish **Do not accept** start to denature **Accept for 1 mark** 30 °C is close to the optimum temperature for the enzymes	**(4)**

Q6.

Question Number	Answer	Additional Guidance	Mark
(i)	• total blood volume in one seal (1)	Example of calculation: 400 x 207 = 82800 cm^3 **Accept** calculation of total haemoglobin per cm^3 kg^{-1} blood: 207 × 216 = 44712 **Accept** calculation of concentration of haemoglobin in one seal: 216 × 400 = 86400	
	• conversion of g dm^{-3} to g cm^{-3} (1)	216 ÷ 1000 = 0.216 g cm^{-3}	
	• total mass of haemoglobin (concentration of haemoglobin x volume of blood in a seal) (1)	0.216 x 82800 = 17885 g Correct answer with no working gains full marks **Accept** for two marks a correct answer with no units / wrong units **Accept** for three marks: 17884.8 g / 17880 g / 17890 g / 17900/ 18000 g / 17.8848 kg / 17.885 kg / 17.89 kg / 17.9 kg / 18 kg	**(3)**

Question Number	Indicative content
(ii) *	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. <u>A: Depth and diving</u>: • positive correlation between maximum depth and maximum time holding breath • weak positive correlation between mass of animal and depth • weak correlation between maximum time holding breath and mass of mammal • because diving deeper requires larger oxygen storage as can't breathe underwater • aerobic respiration requires oxygen to release energy <u>B: Blood and muscle:</u> • positive correlation between volume of oxygen in body and maximum depth • positive correlation between concentration of haemoglobin in blood and maximum depth • no correlation between oxygen stored in muscle and maximum depth • all the mammals must possess myoglobin acting as an oxygen store in muscle • bottlenose dolphin and harbour seal have more oxygen stored in lungs / Weddell seal and Northern elephant seal have less oxygen stored in lungs • oxygen stored in lungs results in more buoyancy so deeper diving mammals have less stored in lungs • combined effect of high blood volume and haemoglobin concentration results in very high blood oxygen storage • more oxygen stored in blood so higher haemoglobin concentration and blood volume in animals that dive deeper • all have similar proportions of oxygen stored in muscle <u>Quantitative analysis</u> • Q1: quoting of data to support explanation • Q2: manipulation of data to support explanation, for example, determining total haemoglobin concentrations in mammals.

Level	Marks	
0	0	No awardable content
1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. **Level 1: Description of some patterns from at least one of A or B**
2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. The discussion shows some linkages and lines of scientific reasoning with some structure. **Level 2: Description of patterns with explanation from at least one of A or B**
3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. **Level 3: Detailed description and explanation of patterns from both A and B with quantitative analysis (Q)**

Q7.

Question Number	Answer	Mark
(i)	The only correct answer is C hydrogen *A is incorrect because covalent bonds do not form between neighbouring water molecules* *B is incorrect because ionic bonds to not form between neighbouring water molecules* *D is not correct because hydrophobic bonds do not form between neighbouring water molecules*	**1**

Question Number	Answer	Mark
(ii)	The only correct answer is C three *A is incorrect because there are three components* *B is incorrect because there are three components* *D is incorrect because amino acids are not a component*	**1**

Q8.

Question Number	Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • large surface area (to volume ratio) for diffusion (1) • thin for shorter diffusion distance (1) • {blood flow / countercurrent} to maintain {diffusion gradient / concentration gradient} (1)	**DO NOT ACCEPT** thin membranes	**(3)**

Q9.

Question Number	Answer	Mark
	An explanation that makes reference to three of the following: • less {evaporation / transpiration / diffusion} (1) • because {leaf is curled / small gap / hairs / sunken stomata / stomata in pits / waxy cuticle} (1) • trap water vapour / reduce {diffusion / concentration / water potential} gradient (1)	**(3)**

Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	• 7.776×10^6 / 7.78×10^6 / 7.8×10^6 / 8×10^6		(1) GRAD

Question Number	Indicative content		Mark
* (ii)	Indicative content Gill filaments: • active fish (generally) have a greater number of gill filaments than inactive fish • the exception is the heaviest inactive fish, *Tinca* • maybe a weak correlation between number of filaments and mass of active fish Lamellae: • active fish (generally) have more lamellae on each filament • but this does not correlate with the mass of the fish • *Tinca* is the inactive fish with the highest total number of gill filaments • 1.9×10^6 • which is way lower than *Thunnus* • and only slightly above the active fish with the least number Surface area: • active fish (generally) have a greater surface are of gills than inactive fish of similar mass • but no correlation with mass Diffusion distance: • very little data on diffusion distance • active fish seem to hoave a smaller diffusion distance • but no obvious correlation with activity or mass Explanations: • higher {number of filaments / lamellae / surface area} increases gas exchange • a smaller diffusion increases gas exchange	**Level 1:** 1 mark = one gill aspect commented on 2 marks = two gill aspects commented on **Level 2:** 3 marks = two gill aspects commented on with an explanation 4 marks = three gill aspects commented on with an explanation **Level 3:** 5 marks = four gill aspects commented on, with an explanation 6 marks = four gill aspects commented on, with an explanation linking to muscle contraction	6 EXP

	• so more oxygen available for aerobic respiration • therefore more ATP can be generated • for the contraction of muscles (of the active fish) • more energy needed for movement of heavier fish		

Q11.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to five of the following: • carbon dioxide is absorbed through the stomata andwater is lost (1) • recognition of two patterns of stomatal distribution(1) Trees (beech, oak, sycamore) plus pea & sunflower • plants {with leaves lying flat / have most stomata onthe lower surface} to reduce water loss from direct sunlight (1) Frogbit • {upper surface in contact with air, lower surface with water / (therefore the) frogbit has all the stomata on the upper surface because it is not short of water} (1) Daffodil & maize • leaves are {upright / exposed to equal amounts oflight} so have stomata on both surfaces (1)	Allow {more on upper / more on lower /equal distribution} Allow stomata on lower surface allow {carbon dioxide to enter / gas exchange} Allow it needs to absorb carbon dioxidefrom the air	**(5)**

Q12.

Question Number	Answer	Additional Guidance	Mark
(i)	An answer that makes reference to the following: • rate at low light intensity and high light intensity estimated (1) • percentage increase calculated (1)	Acceptable range of rates 1.2 to 1.5 4.5 to 5.5 Acceptable range = 200 – 358% Correct answer with no working gains full marks	(2)
(ii)	An explanation that makes reference to the following: • temperature because it affects the rate of transpiration (1) • humidity because it affects the rate of transpiration (1)	accept other relevant factors eg. windspeed availability of water	(2)

Q13.

Question Number	Answer	Additional Guidance	Mark
(i)	**The only correct answer is B** **A** is incorrect because respiration takes place in the root **C** is incorrect because photosynthesis does not take place in the root **D** is incorrect because respiration takes place in the root		(1) COMP

Question Number	Answer	Additional Guidance	Mark
(ii)	**The only correct answer is A** **B** is incorrect because pits are in the xylem **C** is incorrect because plasmodesmata are between cells **D** is incorrect because stomata are in the leaves		(1) COMP

Q14.

Question Number	Answer	Additional Guidance	Mark
	A description that makes reference to the following: • enters through spiracles (1) • diffusion {in tracheae / in tracheoles / into cells} (1) • down concentration gradient (1)		**(3)**

Q15.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to the following: • locust has a smaller surface area to volume ratio than *Paramecium* (1) • therefore has { tracheae / tracheoles } to provide greater surface area (for gas exchange / diffusion) (1)	Allow converse statements	**(2)**

Question Number	Indicative content		
(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. • in human exhaled air abdominal pumping movements rise, but since exhaled air is warmer / more moist, contains more carbon dioxide and less oxygen than atmospheric air no conclusion can be reached from this result • in the presence of pure oxygen the number of abdominal pumping movements is lower than when in atmospheric air • in the presence of pure carbon dioxide the number of abdominal pumping movements is higher than when in atmospheric air • in atmospheric air there is some residual effect of previous gas exposure		
Level	Mark	Descriptor	
	0	No awardable content	
1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information with a focus on mainly just one piece of scientific information. The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.	
2	3-4	An explanation will be given with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning with some structure.	
3	5-6	An explanation is made which is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning which is clear and logically structured.	

Q16.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following: • {supply / store of / reservoir of} oxygen (1) • so respiration can occur in {large / active} locusts (1)		**(2)**

Q17.

Question Number	Answer	Additional Guidance	Mark
(i)	• insect weighed before and after investigation and the difference calculated (1)		(1) GRAD

Question Number	Answer	Additional Guidance	Mark
(ii)	• 42.86 (%)	**DO NOT ACCEPT** 42.860 or any other numbers	(1) CLER

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to two of the following: • as a standard for comparison (1) • to prevent {water loss / dehydration} (before the start of the investigation) (1) • as this is the highest humidity {they could tolerate / that could be produced} (1)	**ACCEPT** a description e.g. so that the effects of lower humidities can be seen **ACCEPT** reduce water loss so there will be water in the tracheoles **IGNORE** water enters spiracles **ACCEPT** higher humidities might be harmful	(2) EXP

Question Number	Answer	Additional Guidance	Mark
(iv)	An explanation that makes reference to three of the following: • water loss increases with decrease in humidity as there is more room for water molecules (1) • less water loss at {low / 20% / 0%} humidity in air because spiracles close (1) • water loss is greater in air with higher levels of carbon dioxide as ventilation rate is faster (1) • and the spiracles stay open (1)	**ACCEPT** converse where appropriate **ACCEPT** fewer water molecules in air / down a (water vapour) concentration gradient (into air) **ACCEPT** breathing rate / gas exchange	(3) EXP

Q18.

Question Number	Answer	Mark
(i)	**The only correct answer is B** ***A*** *is not correct because chi squared test compares expected result to the actual result* ***C*** *is not correct because standard deviation measures scatter about the mean* ***D*** *is not correct because Student's t test compares the means of two sets of data*	**(1)**

Question Number	Answer	Additional Guidance	Mark
(ii)	• $6\sum d^2$ calculated **(1)** • $n(n^2-1)$ calculated **(1)** • correct r_s value given **(1)**	Example of calculation 6 × 108 = 648 7(49-1) =336 1 - (648 ÷ 336) = -0.93 / 0.93 / -0.929 / 0.929 **Accept** ecf from $6\sum d^2$ and $n(n^2-1)$ calculations **Correct answer gains full marks, with no working shown**	**(3)**

Question Number	Answer	Additional Guidance	Mark
(iii)	An explanation that makes reference to the following: • critical value found at {p = 0.05 / 95% level confidence level / 5% significance level} **(1)** • because if {calculated / r_s} value is greater than critical value there is a {strong / significant} {relationship / correlation} **(1)**	**Accept** 0.01 / 99 % **Accept** converse	**(2)**

Q19.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to three of the following: **Similarities:** • large surface area (1) • thin exchange surface / small diffusion distances (1) **Differences:** • nymphs have gills and adults have trachea / spiracles (1) • the nymph has external system and the adult has internal system (1)	**DO NOT PIECE TOGETHER** **ACCEPT** both have tracheoles if not awarded as a difference **ACCEPT** tracheoles if not awarded as a similarity **ACCEPT** gills on the outside and {spiracles / trachea / tracheoles} are on the inside	**(3)**