PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 4: EXCHANGE AND TRANSPORT

TRANSPORT OF GASES IN THE BLOOD

SCORE	PERCENTAGE
/59	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions and mark schemes in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question or mark scheme material in this pack. Pearson has not endorsed, approved or been involved in the production of it. Pearson, Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson publishes its past papers and mark schemes free of charge. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Mark Scheme

Q1.

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)**

Q2.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • as the length of the dive increases and the depth of the dive increases, the percentage decreases (1) • appropriate conclusion about percentage and length of dive (1) • no information about how long the longest dive lasts (1) • appropriate conclusion about depth of dive (1) • no information on the length of time that dives at different depths last (1)	**NB** piece together **e.g.** most dives last less than 16 to 20 minutessome dives can last as long an hour **e.g.** most dives are up to 100 to 200 metres some dives may be as deep as 600 metres	(4)

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	**The only correct answer is A** ***B*** *is incorrect because the haemoglobinwould have a higher affinity for oxygen* ***C*** *is incorrect because the curve would beto the left* ***D*** *is incorrect because the curve would beto the left*		(1)

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 genericmark 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** • less oxygen stored in seal's lungs • so that more is delivered to the body • reduces buoyancy • cannot be replenished as diving • lungs of seal must be able to diffuse oxygen into blood faster • therefore {larger surface area / faster blood flow} • blood of seal carries more oxygen • because their haemoglobin has a higher affinity for oxygen • blood of seal carries more oxygen because they release erythrocytes from the spleen • therefore can supply more oxygen to muscles for aerobic respiration • to release ATP for muscle contraction • muscles of seal have more myoglobin • therefore can store more oxygen until oxygen tensions are very low • so that aerobic respiration can take place • to release ATP for muscle contraction • anaerobic respiration would not supply enough ATP for muscle contraction	**Level 1:** 1 mark = 1 comparison 2 marks = 3 comparisons **Level 2:** 3 marks = 1 set of data simplyexplained 4 marks = 2 sets of data simplyexplained **Level 3:** 5 marks = 3 sets of data explained with links to diving and muscles 6 marks = 4 sets of data explained with links to diving and muscles

	• body fluids store the same level of oxygen • because they do not have a role in storing oxygen • small concentrations in body fluids, as oxygen is dissolved in it for diffusion into cells	

Q4.

Question Number	Correct Answer	Additional guidance	Mark
	An explanation that makes reference to the following: • malarial {parasite/merozoite} {invades/destroys} red blood cells (1) • therefore reduced haemoglobin {red cell count} which causes anaemia (1)		**(2)**

Q5.

Question Number	Answer	Mark
(i)	An explanation that makes reference the following: • anaerobic respiration takes place (1) • therefore {lactic acid / lactate} is produced (1) • because pyruvate reduced / NADH oxidised / NADH converted to NAD^+ / NADH donates H^+ or proton or e^- (1)	**(3)**

Question Number	Indicative content
*(ii)	Answers will be credited according to candidate's deployment of knowledge and understanding of 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. **Description: D** shape of curve is sigmoid / S-shaped tadpole curves are steeper tadpole curves are further to the left than frog curves lower pH moves curve to left in tadpole lower pH moves curve to the right in frog tadpole curves are closer together than frog curves reference to correct comparative % ONCE **Explanation: E** at higher ppO_2 blood more saturated / as ppO_2 increases saturation increases at lower ppO_2 blood less saturated / as ppO_2 decreases saturation decreases tadpole is more saturated at lower ppO_2 tadpole more dissociation with change in $pp0_2$ tadpole has higher % saturation than frog tadpole blood has greater affinity than blood movement lowers pH in blood Bohr shift in frog conformational change makes binding easier steep part of curve means small change in ppO_2 causes large change in percentage saturation top part of curve represents situation in gills or lungs bottom part of curve represents situation in tissues **Habitat: H** less oxygen in water than in air / ppO_2 in water lower than ppO_2 in air (lowering pH) tadpole is more able to obtain oxygen from polluted water (lowering pH) frog more able to release oxygen to tissues during exercise / activity / movement adaptations allow tadpole / frog to survive harder to move in water than on land

Level	Marks	
0	**0**	No awardable content
1	**1-3**	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made. Vague statements related to consequences are made with limited linkage to a range of scientific ideas, processes, techniques and procedures. The discussion will contain basic information with some attempt made to link knowledge and understanding to the given context. **1 to 3 from D, E or H**
2	**4-6**	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts. Consequences are discussed which are occasionally supported through linkage to a range of scientific ideas, processes, techniques and procedures. The discussion shows some linkages and lines of scientific reasoning with some structure. **1H and 4 to 6 in total**
3	**7-9**	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts.
		Consequences are discussed which are supported throughout by sustained linkage to a range of scientific ideas, processes, techniques or procedures. The discussion shows a well-developed and sustained line of scientific reasoning which is clear and logically structured. **2H and 7 to 9 plus in total**

Q6.

Question Number	Correct Answer	Additional guidance	Mark
(a)	56 - 36 = 20 (1)		**(1)**

Question Number	Indicative content	
(b)*	Answers will be credited according to the 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. • Dissociation curve for mouse haemoglobin is to the right of the curve for elephant haemoglobin • Mouse haemoglobin has a lower affinity for oxygen • Mouse haemoglobin allows more dissociation • Mouse has bigger surface area to volume ratio • Mouse loses more heat / needs to regenerate more heat • Maintenance of body temperature • Mouse has higher metabolic rate • Mouse needs more oxygen • Accept converse answers for elephant	
Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	Demonstrates isolated elements of biological knowledge and understanding to the given context with generalised comments made The explanation will contain basic information with some attempt made to link knowledge and understanding to the given context.
Level 2	3-4	Demonstrates adequate knowledge and understanding by selecting and applying some relevant biological facts/concepts to provide the explanation being presented. Lines of argument occasionally supported through the application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows some linkages and lines of reasoning with some structure.
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting and applying relevant knowledge of biological facts/concepts to provide the explanation being presented. Line(s) of argument supported throughout by sustained application of relevant evidence (scientific ideas, processes, techniques and procedures). The explanation shows a well-developed and sustained line of reasoning which is clear, coherent and logically structured.

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	• correct value from graph (1) • correct calculation of oxygen in 1 g of haemoglobin (1) • correct calculation of oxygen in 100 cm^3 of blood (1)	72 % 72 / 100 X 1.36 = 0.9792 1.47 / 1.469 / 1.4688 cm^3 Correct answer gains full marks	3

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • myoglobin (is on the left because) has a higher affinity for oxygen / binds more tightly to oxygen (1) • therefore it acts as a store for oxygen / only releases oxygen when oxygen is low (1) • haemoglobin is sigmoidal / S shaped / myoglobin is not S shaped (1) • as oxygen binds cooperatively (1) • so that the affinity varies depending on how much oxygen is bound (1)	**Accept** converse for oxygen e.g. haemoglobin releases oxygen more easily **Accept** correct description	4

Q8.

Question Number	Answer	Additional Guidance	Mark
(i)	An explanation that makes reference to three of the following points: • (leghaemoglobin / myoglobin) is not S shaped / is linear / is a straight line (1) • because (leghaemoglobin / myoglobin) affinity for oxygen does not alter (1) • because (with leghaemoglobin) there is no cooperative binding (1) • (leghaemoglobin) binds to one molecule (of oxygen) (1)	**Accept** converse for haemoglobin **Accept** converse for haemoglobin **Accept** converse for haemoglobin **Accept** shape change to subunits / conformation change **Accept** (leghaemoglobin / myoglobin) has only one oxygen binding site **Accept** haemoglobin has four binding sites / binds to four molecules of oxygen	**3 exp**

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following points: • (waterlogged soil has) little / low / less / no oxygen (1) • (leghaemoglobin) provides oxygen for **respiration** (1) • which enables active uptake of mineral ions / named mineral ion (1) • such as (calcium) to make calcium pectate / (nitrate) to make amino acids / (magnesium) to make chlorophyll (1)	**Accept** binds to / stores oxygen for respiration **Accept** other correct active processes e.g. synthesis of amino acids / protein synthesis / mitosis **Accept** other correct examples of minerals with functions	**3 exp**

Q9.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to four of the following: • the (Tibetan haemoglobin) has a higher affinity for oxygen (1) • so that it is more saturated at lower pressures of oxygen (1) • with high carbon dioxide, the Tibetan haemoglobin has a lower affinity for oxygen (than Europeans) (1) • because it has a {more pronounced / bigger} Bohr shift / shift to the right (1) • so that it will release oxygen more easily (1)	**Accept** converse **Accept** oxygen concentrations **Accept** can bind oxygen at low pressures /can bind oxygen when at altitude where there is less partial pressure of oxygen **Accept** with higher carbon dioxide, Tibetan haemoglobin is less saturated (than European haemoglobin)	**4**

Q10.

Question Number	Answer	Additional Guidance	Mark
	The only correct answer is **B** (X,Z,Y) **A** is not correct because adult haemoglobin is Z, not Y and fetal haemoglobin is Y, not Z **C** is not correct because myoglobin is X, not Y and fetal haemoglobin is Y, not X **D** is not correct because myoglobin is X, not Z, and adult haemoglobin is Z, not X		**(1)**