

PEARSON EDEXCEL A-LEVEL BIOLOGY B • 9B10

# BIOLOGY



## EXAM QUESTION PACK

TOPIC 4: EXCHANGE AND TRANSPORT  
SURFACE AREA TO VOLUME RATIO

SCORE

/20

PERCENTAGE

%

STEMUP

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Q1.

A scientist investigated the oxygen consumption of four different mammals.

The table shows the results of this investigation.

| Mammal   | Body mass<br>/ kg | Oxygen<br>consumption<br>/ $\text{dm}^3 \text{ h}^{-1}$ | Oxygen<br>consumption<br>/ $\text{dm}^3 \text{ kg}^{-1} \text{ h}^{-1}$ |
|----------|-------------------|---------------------------------------------------------|-------------------------------------------------------------------------|
| Shrew    | 0.002             | 0.0216                                                  | $1.08 \times 10^1$                                                      |
| Cat      | 3                 | 1.5                                                     | $5.00 \times 10^{-1}$                                                   |
| Human    | 80                | 24                                                      | $3.00 \times 10^{-1}$                                                   |
| Elephant | 4000              | 50                                                      |                                                                         |

(i) Calculate the oxygen consumption of the elephant.

Convert your answer into standard form.

(2)

Answer .....  $\text{dm}^3 \text{ kg}^{-1} \text{ h}^{-1}$

(ii) Explain the relationship between body mass and oxygen consumption in these mammals.

(4)

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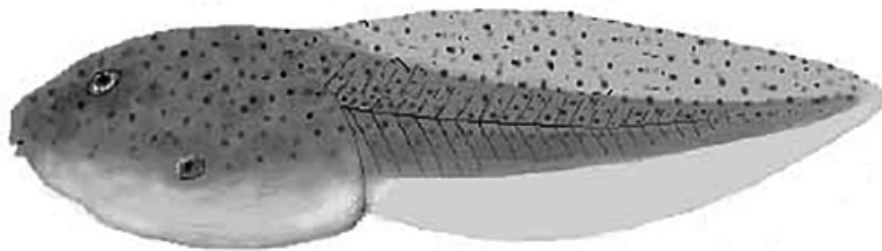
Q2.

The adult American bullfrog, *Rana catesbeiana*, can live in water or on land.

Adult frogs lay eggs in water where they are fertilised.

The fertilised eggs develop into tadpoles that live only in water.

The photograph shows a tadpole.



Adult frogs use lungs for gas exchange but tadpoles use gills.

Explain how gills are adapted for gas exchange.

(3)

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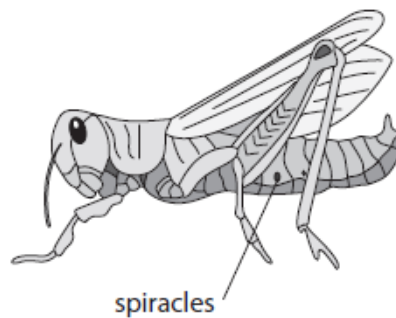
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Q3.

Insects such as locusts do not breathe through the mouth.

The gas exchange system of a locust includes air sacs, tracheae and tracheoles.

The diagram shows a locust before dissection.



Locusts have a complex gas exchange system because they are multicellular organisms.

Explain why single-celled organisms do not have a gas exchange system.

(2)

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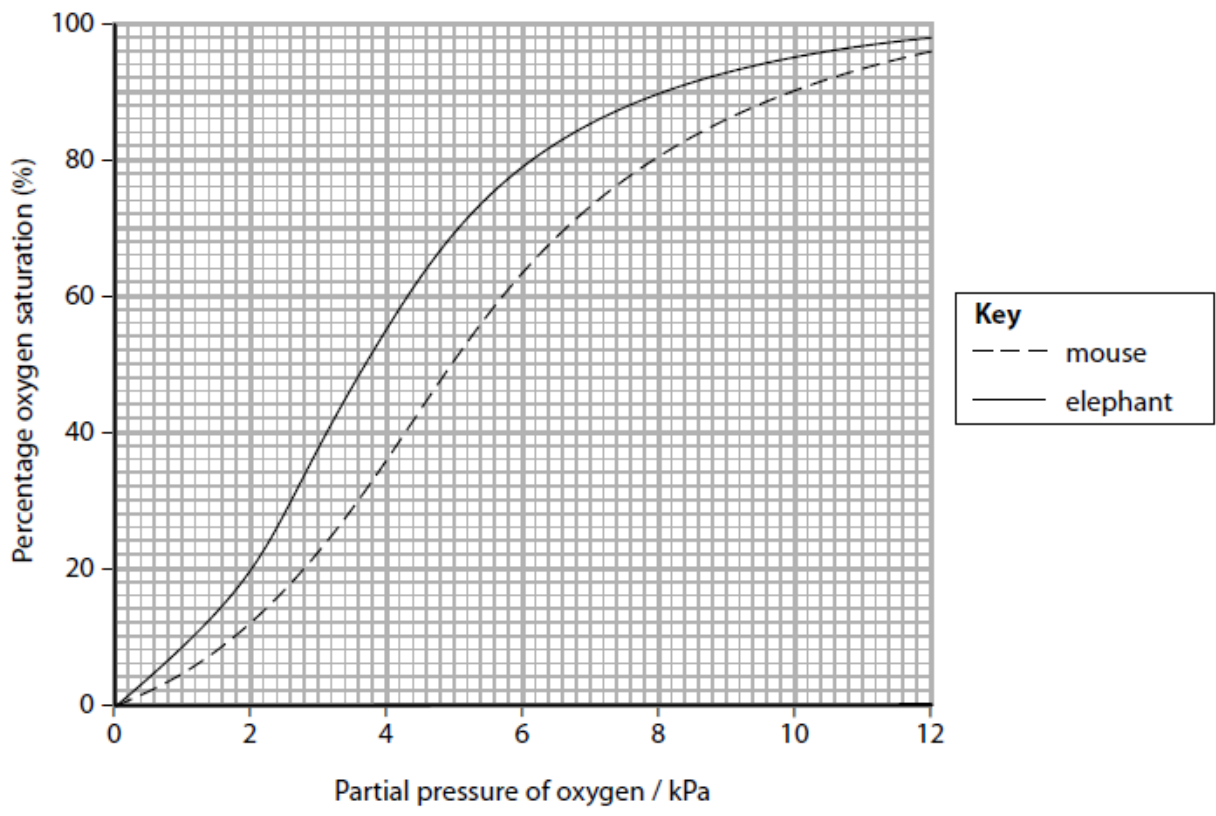
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**(Total for question = 2 marks)**

Q4.

The graph below shows the oxygen haemoglobin dissociation curves for a blood sample from an elephant and a mouse.



(a) Use the information in the graph to determine the difference in percentage saturation between elephant haemoglobin and mouse haemoglobin at a partial pressure of oxygen of 4 kPa.

(1)

Answer .....

\*(b) Explain the effect that body size has on the metabolic rate of these two mammals.

(6)

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**(Total for question = 7 marks)**

Q5.

Water is needed for the transport of mineral ions through a plant.

Farmyard manure contains many mineral ions.

(i) Calcium ions in manure promote the growth of plants by increasing

**(1)**

- ☐ **A** amino acid synthesis
- ☐ **B** the production of chlorophyll
- ☐ **C** the strength of the middle lamella between cells
- ☐ **D** water loss by the leaves

(ii) Which of the following is the mechanism by which these calcium ions are transported from soil water into plants?

**(1)**

- ☐ **A** active transport
- ☐ **B** exocytosis
- ☐ **C** osmosis
- ☐ **D** transpiration

## **Mark Scheme**

Q1.

| Question Number | Answer                                                                                                                                    | Additional Guidance                                                                                                                                                                                                                        | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| (i)             | <ul style="list-style-type: none"> <li>divide oxygen consumption by body mass (1)</li> <li>express answer in standard form (1)</li> </ul> | <p><u>Example of calculation</u></p> <p><math>50 \div 4\,000 = 0.0125</math></p> <p><math>1.25 \times 10^{-2}</math></p> <p>Correct answer gains full marks, with no working shown</p> <p><b>ACCEPT</b> one mark in working for 0.0125</p> | (2)  |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                   | Additional Guidance                                                                                                                                        | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| (ii)            | <p>An explanation that makes reference to four of the following:</p> <ul style="list-style-type: none"> <li>{small(er) mammals / small(er) body mass} consume more oxygen (per kg) (1)</li> <li>mammals are endotherms / maintain body temperature / regulate body temperature (1)</li> <li>small mammals have larger surface area to volume ratio (1)</li> <li>therefore lose more heat (1)</li> <li>heat by respiration (1)</li> </ul> | <p><b>ACCEPT</b> large(r) mammals consume more oxygen in <math>\text{dm}^3 \text{h}^{-1}</math></p> <p><b>ACCEPT</b> converse for Mps 1, 3 and 4 and 5</p> | (4)  |

Q2.

| Question Number | Answer                                                                                                                                                                                                                                                                                                                            | Additional guidance                        | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------|
|                 | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• large surface area (to volume ratio) for diffusion (1)</li> <li>• thin for shorter diffusion distance (1)</li> <li>• {blood flow / countercurrent} to maintain {diffusion gradient / concentration gradient} (1)</li> </ul> | <p><b>DO NOT ACCEPT</b> thin membranes</p> | (3)  |

Q3.

| Question Number | Answer                                                                                                                                                                                                               | Additional Guidance                           | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------|
|                 | <p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• they have a large surface area to volume ratio (1)</li> <li>• therefore diffusion is sufficient (1)</li> </ul> | <p><b>Accept</b> short diffusion distance</p> | (2)  |

Q4.

| Question Number | Correct Answer   | Additional guidance | Mark       |
|-----------------|------------------|---------------------|------------|
| <b>(a)</b>      | 56 - 36 = 20 (1) |                     | <b>(1)</b> |

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

Q5.

| Question Number | Answer                                               | Additional guidance | Mark       |
|-----------------|------------------------------------------------------|---------------------|------------|
| <b>(i)</b>      | C (the strength of the middle lamella between cells) |                     | <b>(1)</b> |

| Question Number | Answer               | Additional guidance | Mark       |
|-----------------|----------------------|---------------------|------------|
| <b>(ii)</b>     | A (active transport) |                     | <b>(1)</b> |