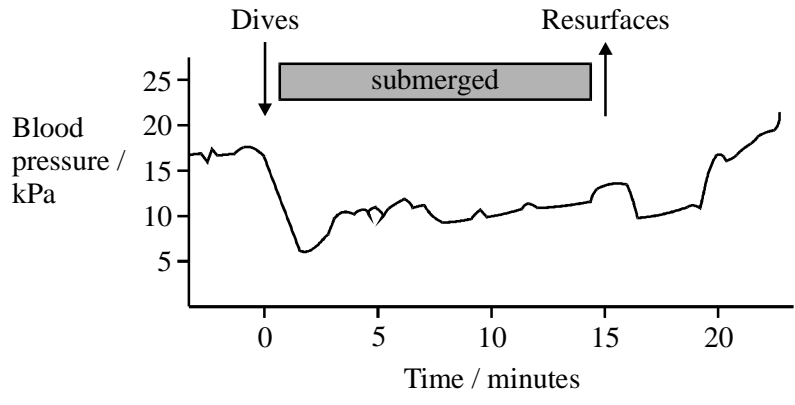


1. In diving mammals, such as seals, there may be a shortage of oxygen in the tissues when the mammals are underwater. Diving mammals have adaptations of their breathing and blood systems that ensure effective use of the oxygen that is available.

(a) **Graph 2** shows the changes in the blood pressure in an arteriole in a flipper when a seal dives, is submerged and then resurfaces.



Graph 2

(i) Describe the pattern of changes in arteriole blood pressure and relate these to the stages of the dive.

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(2)

(ii) Explain how the structure of arterioles enables the regulation of blood flow to different parts of the body.

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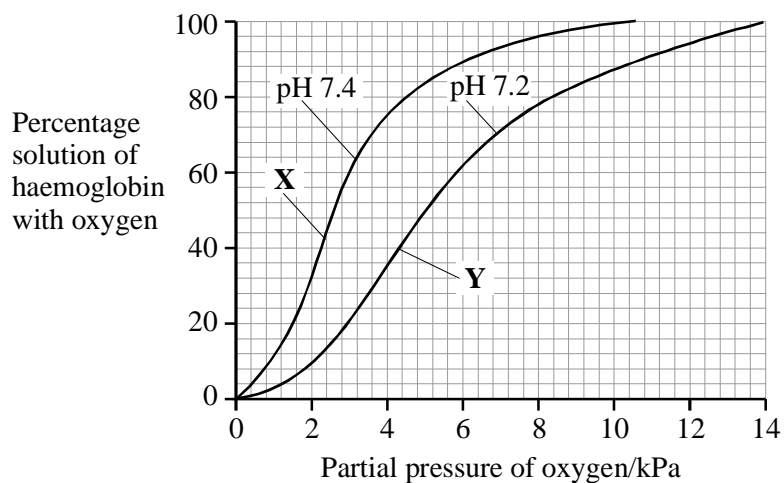
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(2)

(b) **Graph 3** shows the dissociation curves of a seal's haemoglobin at pH 7.2 and 7.4.



Graph 3

(i) Use the graph to find the difference in percentage saturation of haemoglobin at 4 kPa between pH 7.2 and 7.4.

Answer.....%

(1)

(ii) Explain how an increase in the rate of respiration could lead to a change in the shape of the dissociation curve such as that from curve X to curve Y.

.....

(2)

(iii) Explain the advantage to the seal of this change.

.....

(2)

(c) Myoglobin is a respiratory pigment similar to haemoglobin. It has a high affinity for oxygen. There is a lot of myoglobin in the muscles of seals. Suggest how submerged seals benefit from the presence of myoglobin in their muscles.

.....

(2)

(Total 11 marks)

2. The table shows the relative rate of diffusion of oxygen through three different media.

Medium	Relative rate of diffusion
Air	11.0
Water	3.4×10^{-5}
Muscle tissue	1.4×10^{-5}

(a) The measurements in the table were all made at the same temperature. Explain how an increase in temperature affects the rate of diffusion.

.....

(2)

(b) The lung alveoli have a moist surface.

(i) It is sometimes suggested that this moist surface makes gas exchange more efficient. Use the information in the table to explain why this suggestion is incorrect.

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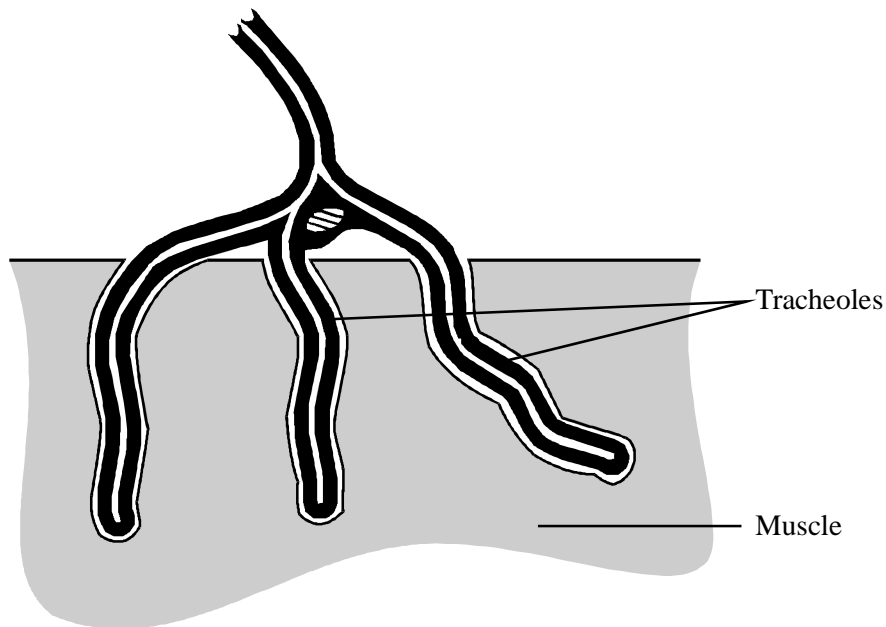
(1)

(ii) Explain how diffusion results in the alveoli having a moist surface.

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(2)

(c) The diagram shows the position of the tracheoles which supply oxygen to the muscles of an insect.



This insect has more than 1.5 million tracheoles. The distance between the ends of the tracheoles in the muscle is approximately 4 μm . Explain how these features allow efficient oxygen supply.

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(3)
(Total 8 marks)

3. (a) Give **two** features common to the gas exchange surfaces of bony fish and of mammals, and explain how each feature allows rapid and efficient uptake of oxygen.

Feature 1

Explanation

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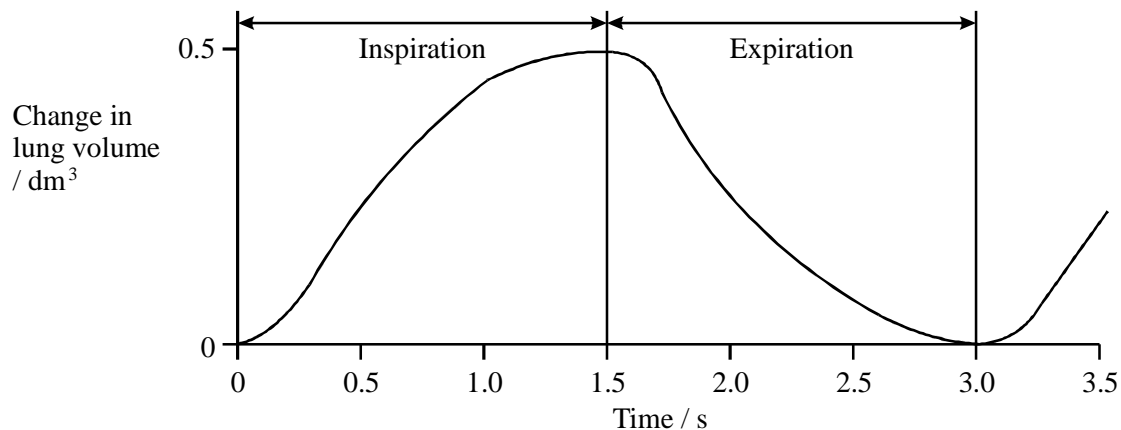
Feature 2

Explanation

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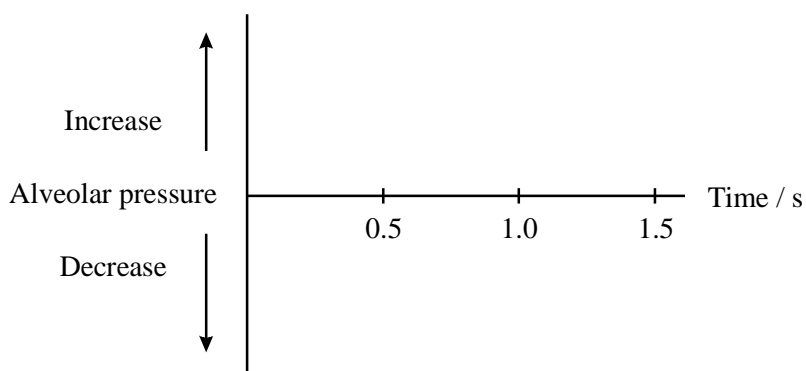
(2)

(b) **Graph 1** shows how lung volume of a human changes during inspiration and expiration.



Graph 1

(i) Sketch, on **Graph 2**, a curve to show the changes in alveolar pressure during inspiration.



Graph 2

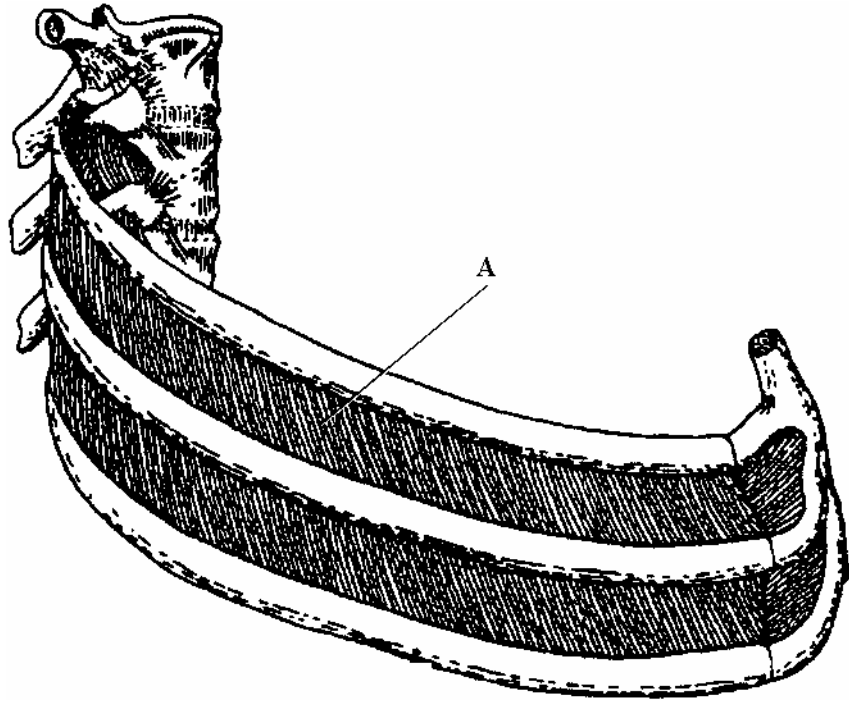
(2)

(ii) Use **Graph 1** to calculate the rate of breathing in breaths per minute.

Answer breaths per minute

(1)
(Total 5 marks)

4. The drawing shows some of the structures involved in ventilating human lungs.



(a) Name structure A

(1)

(b) (i) Describe the role of structure A in inspiration.

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(3)

(ii) Explain how ventilation increases the rate of gas exchange in the alveoli.

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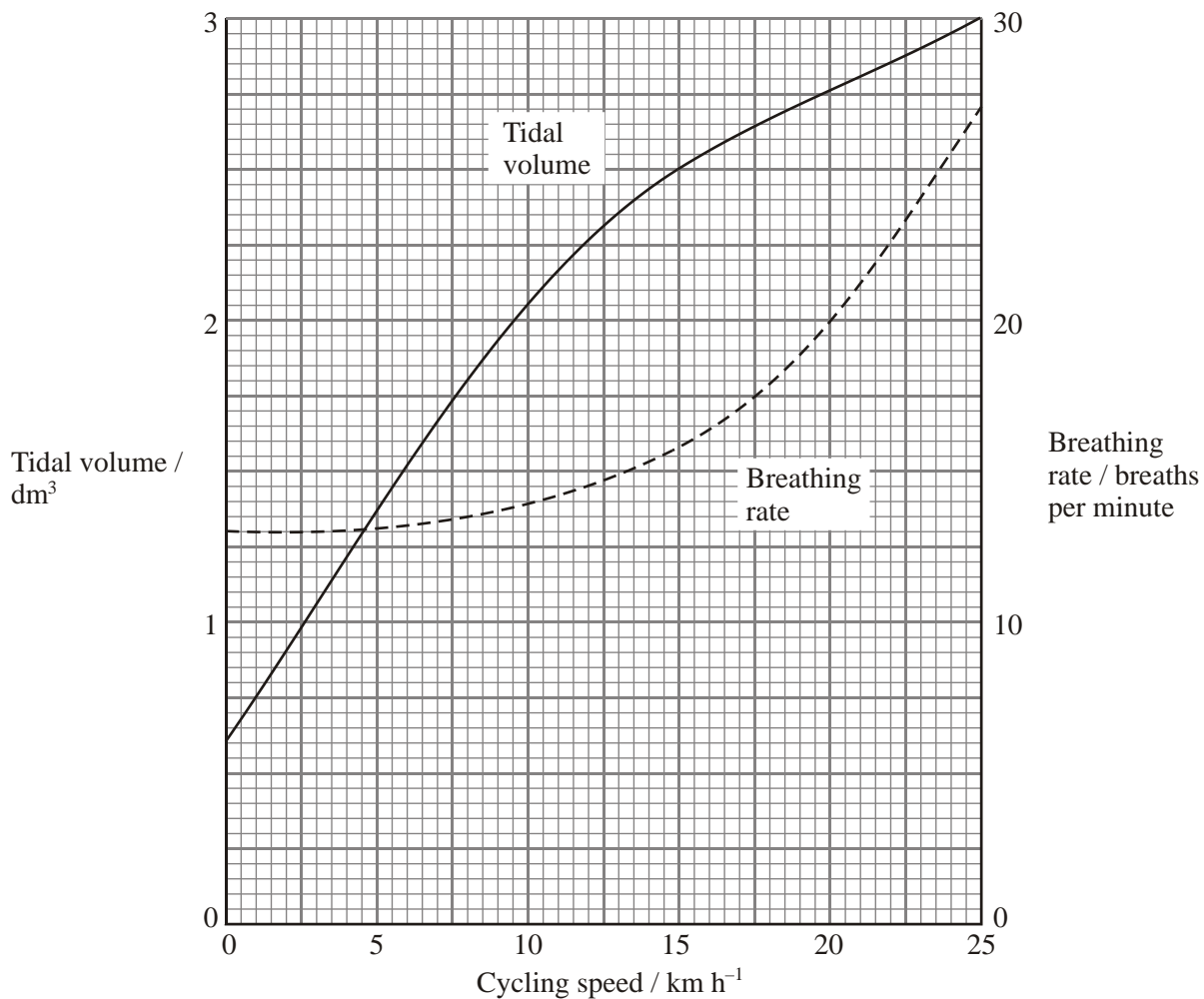
(2)
(Total 6 marks)

5. (a) Describe how air is taken into the lungs.

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(3)

The volume of air breathed in and out of the lungs during each breath is called the tidal volume. The breathing rate and tidal volume were measured for a cyclist pedalling at different speeds. The graph shows the results.



(b) Describe the **two** curves.

(i) Tidal volume

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(ii) Breathing rate

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- (c) Calculate the total volume of air breathed in and out per minute when the cyclist is cycling at 20 km h^{-1} . Show your working.

..... dm^3

(2)

(Total 7 marks)

- 6. (a) Tuberculosis is caused by the bacterium, *Mycobacterium tuberculosis*. Describe how *Mycobacterium tuberculosis* enters the human body.

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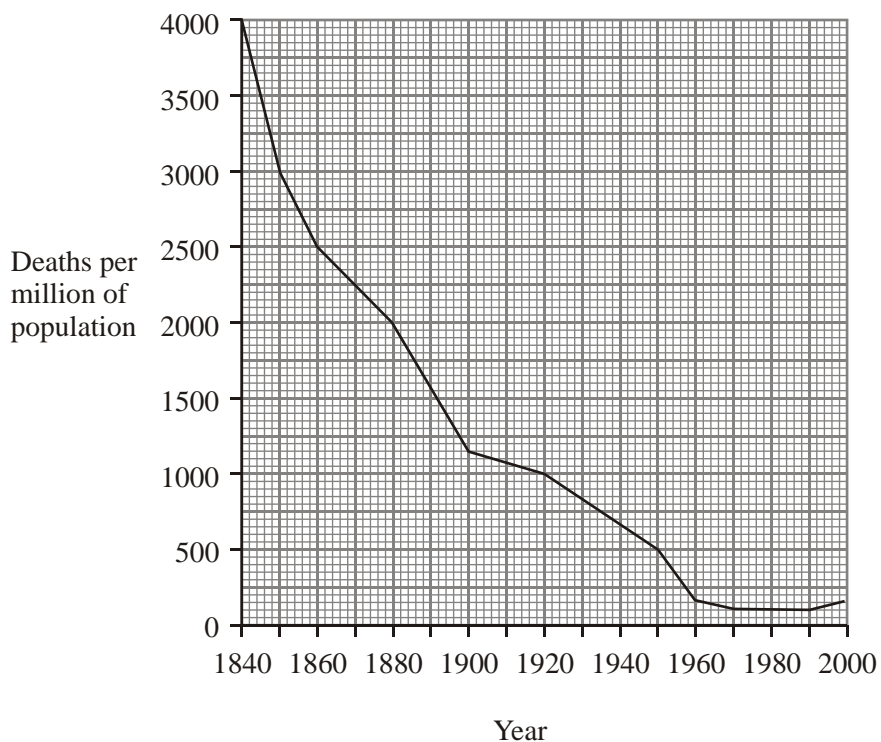
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(2)

The graph shows the death rate from tuberculosis in England and Wales.



- (b) The population of England and Wales in 1860 was 20 066 000. Calculate the number of people who died of tuberculosis that year. Show your working.

Answer

(2)

(Total 4 marks)