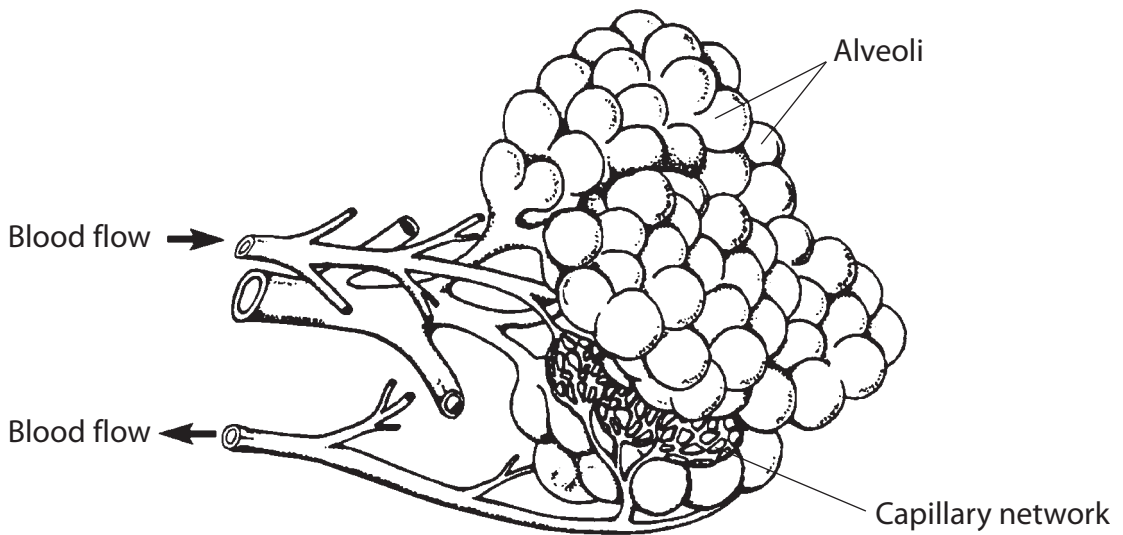


1 The lungs in a mammal are adapted for efficient gas exchange.

(a) The diagram below illustrates a small part of the lung responsible for gas exchange.



(i) On the diagram, add a line labelled P to a branch of the pulmonary vein.

(1)

(ii) Give **one** difference between the structure of a capillary and the structure of a vein.

(1)

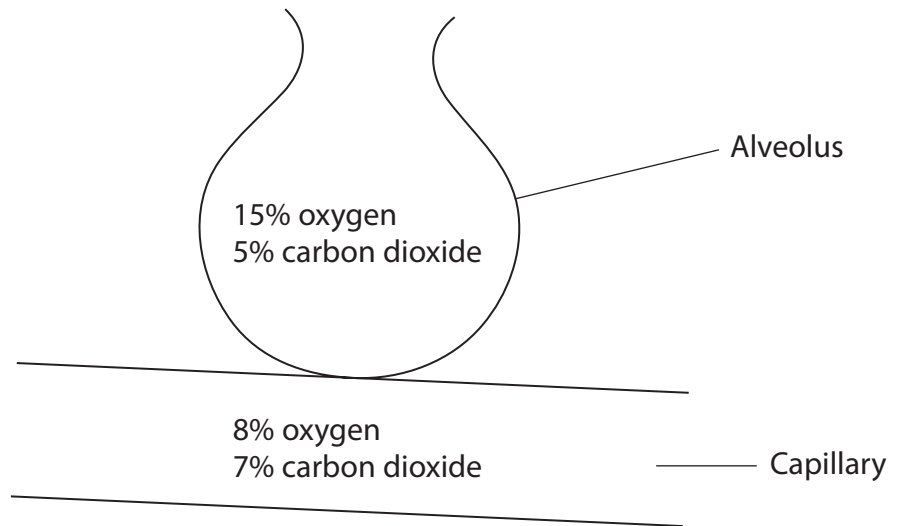
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(b) The diagram below represents the approximate concentrations of oxygen and carbon dioxide inside an alveolus and a capillary in the lungs.

These gases will diffuse at different rates.



Using the information in the diagram, explain the difference in the rate of diffusion of these gases.

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(c) Fick's law of diffusion states that the rate of diffusion is proportional to the surface area, the difference in concentration and the length of the diffusion pathway.

This law is represented by the following formula.

$$\text{Rate of diffusion is proportional to } \frac{\text{surface area} \times \text{difference in concentration}}{\text{length of diffusion pathway}}$$

\*Using the information given in the question and your own knowledge, explain how rapid gaseous exchange takes place in a mammal.

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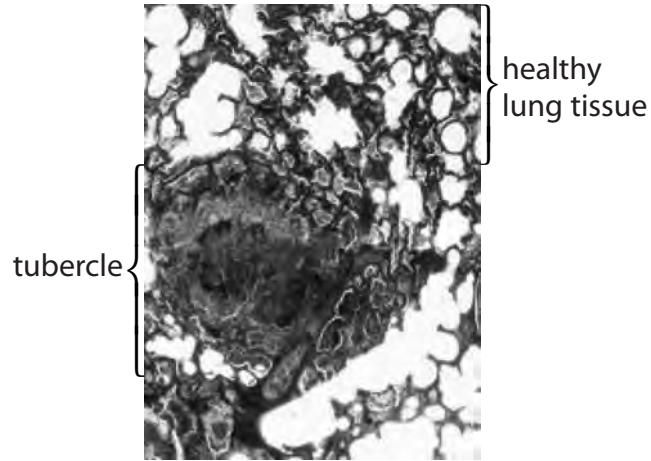
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(Total for Question 1 = 9 marks)

2 Infection of the lungs with *Mycobacterium tuberculosis* can result in a range of symptoms. These symptoms can include severe breathing problems, a persistent cough and coughing up blood.

(a) The photograph below shows a tubercle in part of a lung infected with *Mycobacterium tuberculosis*, as seen using a light microscope.

A tubercle is a solid mass of dead tissue, macrophages and bacteria.



©John Burbidge/Science Photo Library

Magnification  $\times 50$

Using the information in the photograph and your knowledge of gas exchange surfaces, suggest why this infection can result in these symptoms.

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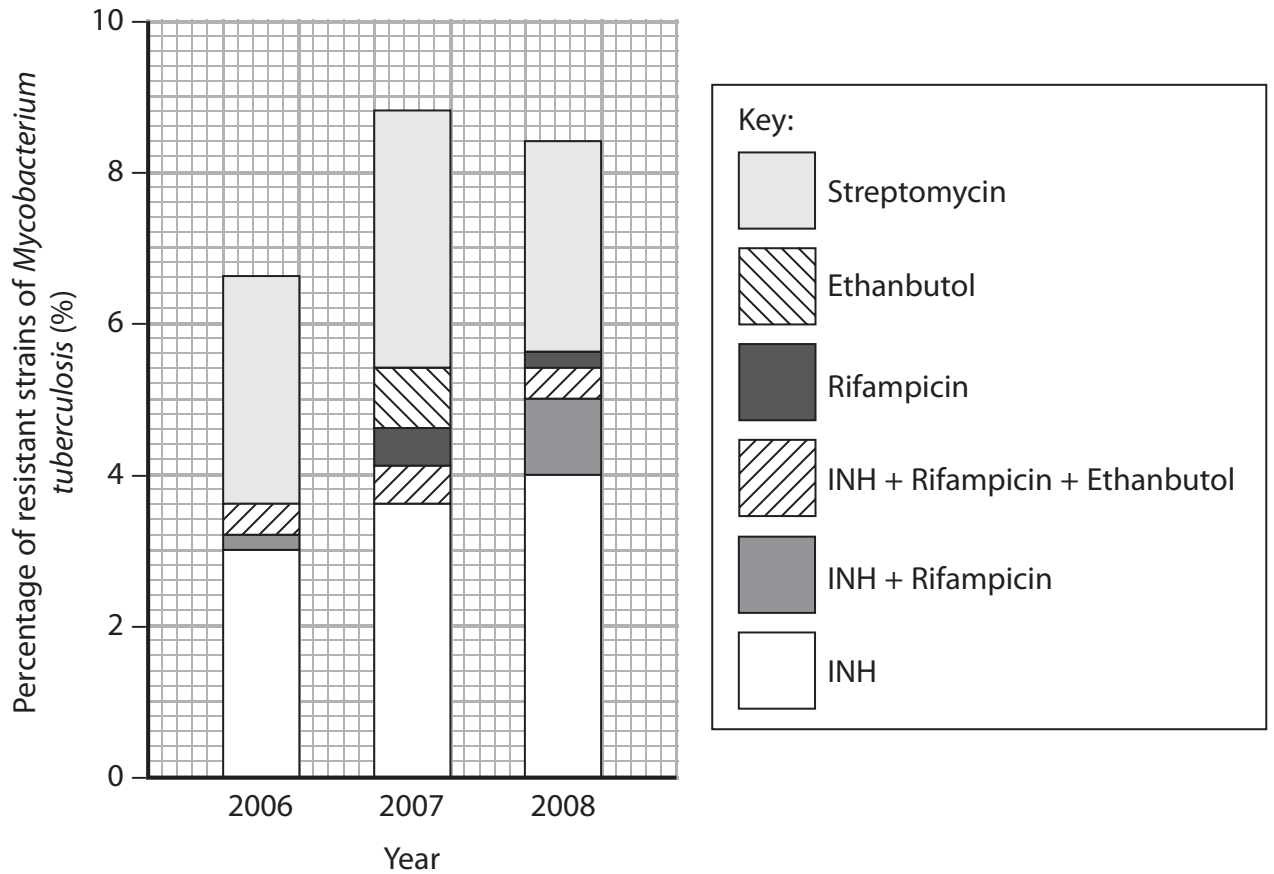
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(b) Treating *Mycobacterium tuberculosis* infections can be a problem, as the bacteria are resistant to many antibiotics.

There are many strains of *Mycobacterium tuberculosis*. Different strains are resistant to different antibiotics or combinations of antibiotics.

The chart below shows the percentage of resistant strains of *Mycobacterium tuberculosis* to six different antibiotics, or combinations of antibiotics, in 2006, 2007 and 2008.



(i) Using the information in the graph, compare the types of antibiotics and combinations of antibiotics that the *Mycobacterium tuberculosis* are resistant to in 2006 with 2007.

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(ii) The percentage of strains of *Mycobacterium tuberculosis* resistant to the antibiotic INH has increased during these three years.

Suggest how natural selection could have resulted in this increase.

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(iii) Suggest how hospitals could prevent an increase in the percentage of strains of *Mycobacterium tuberculosis* resistant to antibiotics.

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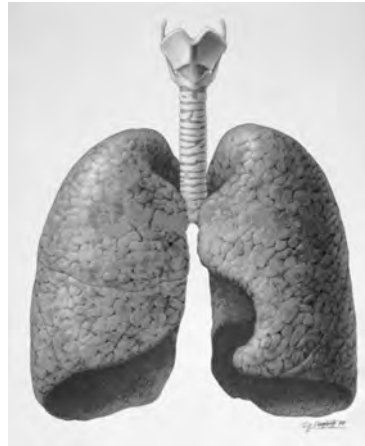
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**(Total for Question 2 = 12 marks)**

3 Many animals have specialised organs for gas exchange and transport.

\*(a) The diagram below shows the lungs of a mammal.



Describe and explain how the lungs of a mammal are adapted for rapid gas exchange.

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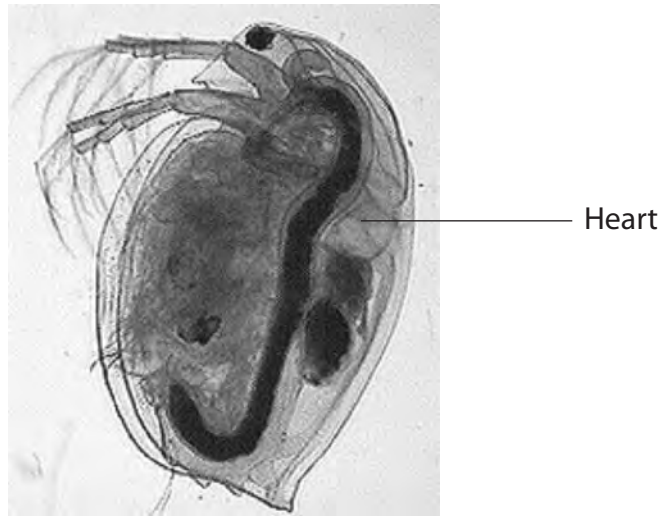
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- (b) *Daphnia* have a circulatory system with a heart that pumps blood into cavities surrounding their organs.

The photograph below shows the location of the heart in a *Daphnia*.



Magnification  $\times 25$

- (i) Suggest how the heart of a *Daphnia* enables organs to carry out effective gas exchange.

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(ii) In mammals, blood passes through the heart twice for each circulation of the body.

Suggest how this type of circulation enables mammals to carry out effective gas exchange.

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**(Total for Question 3 = 10 marks)**

**4** Cystic fibrosis is an inherited condition.

(a) Read through the following passage about cystic fibrosis then write on the dotted lines the most appropriate word or words to complete the sentences.

(4)

Cystic fibrosis is a disorder caused by one of a number of gene mutations.

The symptoms of the disorder are seen only in an individual who is

..... for the recessive allele. The gene codes for

a ..... protein called CFTR. This protein is responsible for the

movement of ..... ions across the cell membranes. Cystic fibrosis

impairs the functions of the gaseous exchange, digestive and .....

systems in the body.

(b) Explain why people with cystic fibrosis can have breathing difficulties.

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(c) Cystic fibrosis can be detected using prenatal genetic testing.

(i) Describe how **one** named method of **prenatal** genetic testing can be carried out.

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(ii) Explain **either** one ethical issue **or** one social issue relating to the use of prenatal genetic testing.

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**(Total for Question 4 = 13 marks)**