1 **(a)** **(i)** Name the **two** types of epithelial tissue found in the lungs and airways.

.....

..... **[2]**

(ii) The epithelial cells in the lungs are arranged into structures called alveoli.

Explain how the alveoli create a surface for efficient gaseous exchange.

In your answer you should use appropriate technical terms, spelled correctly.

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..... **[5]**

(b) To improve gaseous exchange, the air in the alveoli is refreshed by ventilation. The air movement created by ventilation can be recorded using suitable apparatus.

(i) Name the apparatus used to record these air movements.

..... **[1]**

Fig. 3.1 shows a trace recorded from this apparatus.

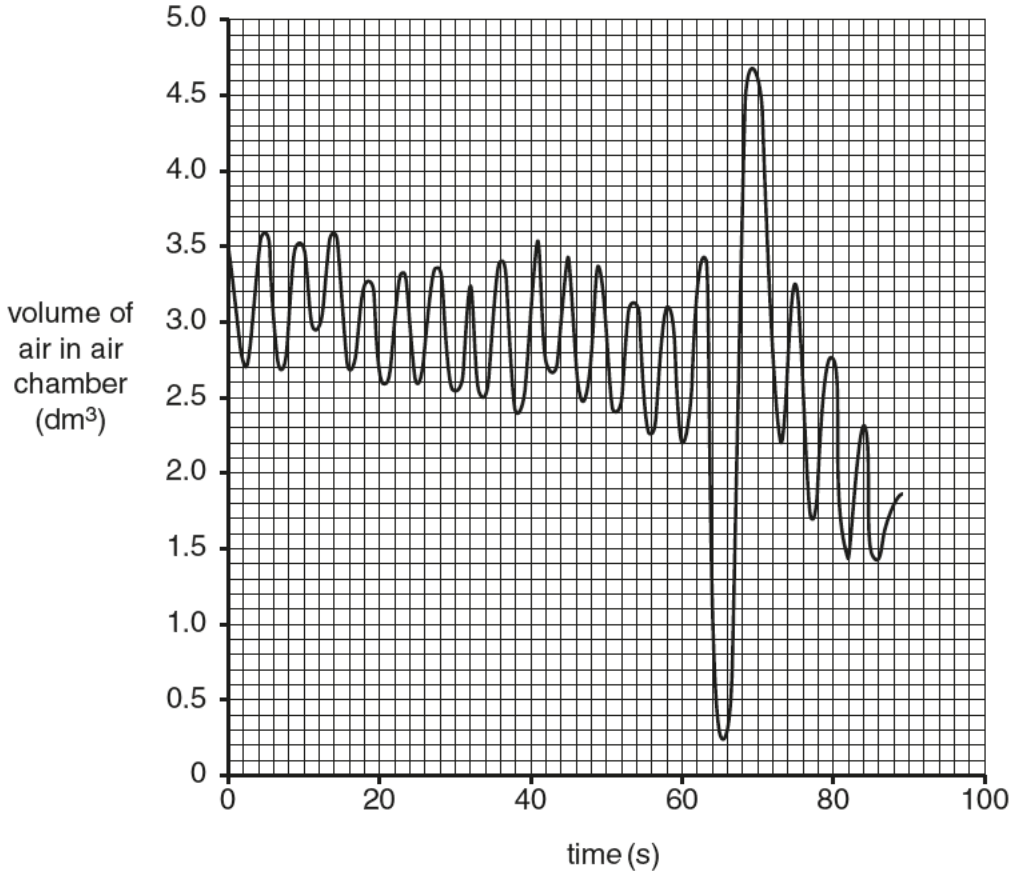


Fig. 3.1

(ii) Calculate the rate of breathing over the first minute from the trace.

answer = ... breaths per minute **[1]**

(iii) Using the trace, calculate the rate of oxygen consumption over the first minute.

Show your working.

answer = ... $dm^3\ min^{-1}$ **[2]**

[Total: 11]

2 Many teachers use models to demonstrate and explain breathing and lung function in mammals.

Fig. 2.1 is a model of the mammalian chest.

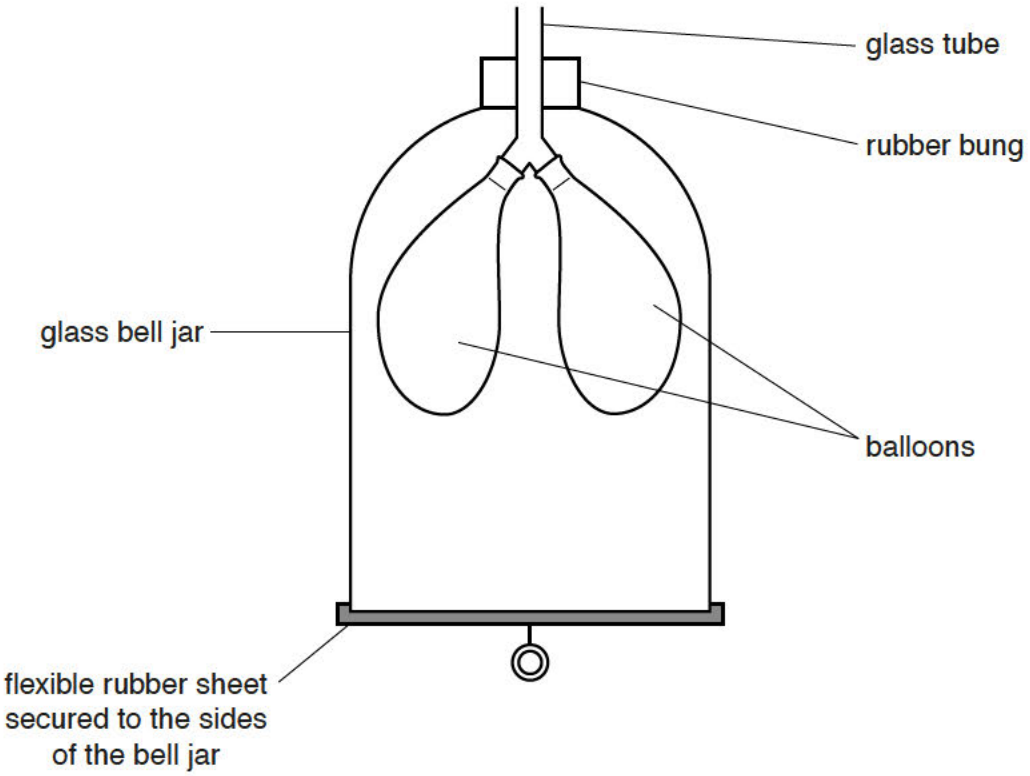


Fig. 2.1

(a) When the rubber sheet is pulled down the balloons expand.

Explain why the balloons expand.

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..... **[3]**

(b) A teacher used the model in Fig. 2.1 to demonstrate the difference between tidal volume and vital capacity.

(i) Explain the meaning of the term *tidal volume*.

.....

.....

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..... **[2]**

(ii) Suggest how the teacher may have used the model to demonstrate tidal volume.

.....

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..... **[2]**

(iii) Explain the meaning of the term *vital capacity*.

.....

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..... **[2]**

(iv) Suggest how the teacher may have used the model to demonstrate vital capacity.

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..... **[1]**

[Total: 10]

3 In an experiment to measure the rate of diffusion, a student placed cubes of agar jelly containing an indicator into dilute hydrochloric acid. The indicator changes from pink to colourless in acidic conditions.

The student used cubes of different sizes and recorded the time taken for the pink colour of each cube to disappear completely.

The student's results are recorded in Table 2.1.

Length of side of cube (mm)	Surface area of cube (mm^2)	Volume of cube (mm^3)	Surface area to volume ratio	Time taken for pink colour to disappear (s)	Rate of diffusion ($mm\,s^{-1}$)
2	24	8	3.0:1	50	0.020
5	150	125	1.2:1	120	0.021
10	600	1000		300	0.017
20	2400	8000	0.3:1	700	0.014
30	5400	27000	0.2:1	1200	0.013

Table 2.1

(a) (i) Calculate the surface area to volume ratio of the cube with 10 mm sides.

Show your working.

Answer = ... **[2]**

(ii) **Using the data in Table 2.1**, describe the relationship between the rate of diffusion and the surface area to volume ratio.

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..... **[2]**

(iii) Explain the significance of the relationship between rate of diffusion and the surface area to volume ratio for large plants.

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..... **[2]**

(b) Another student used the same raw data obtained in the experiment but calculated a different rate of diffusion for each cube. This student's results are shown in Table 2.2.

Length of side of cube (mm)	Time taken for pink colour to disappear (s)	Rate of diffusion ($mm\,s^{-1}$)
2	50	0.040
5	120	0.042
10	300	0.033
20	700	0.029
30	1200	0.025

Table 2.2

In this student's table, the calculation of the rate of diffusion is incorrect.

(i) Suggest the method used to calculate the rate of diffusion in Table 2.2.

.....

..... **[1]**

(ii) State why the method in **(b)(i)** is **not** correct.

.....

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..... **[1]**

(c) In mammals, the lungs are adapted to enable efficient gaseous exchange.

The table below lists some of the adaptations of the lungs.

Complete the table explaining how each adaptation improves efficiency of gaseous exchange.

Adaptation	How this adaptation improves efficiency of gaseous exchange
squamous epithelium	....
large number of alveoli	....
good blood supply	....
good ventilation	....

[4]

[Total: 12]

4 **(a)** List **three** reasons why a large, multicellular animal, such as a mammal, needs a transport system.

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..... **[3]**

Fig. 1.1, **on the insert**, shows the nervous pathways that coordinate heart action.

Above the diagram is a trace showing the electrical activity associated with one heart beat.

(b) **(i)** State the full name given to a trace showing the electrical activity of the heart.

..... **[1]**

(ii) Identify the components of the heart labelled **A** and **B** on Fig. 1.1.

A .....

B .....

[2]

(c) **(i)** During the electrical stimulation of the heart, there is a short delay between the excitation of the atria and excitation of the ventricles.

Explain why this delay is essential.

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..... **[2]**

(ii) The Purkyne tissue carries the excitation wave down the septum to the apex of the heart.

Explain why the excitation wave is carried to the apex.

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..... **[2]**

[Total: 10]

5 Fig. 5.1 shows the changes in the volume of air in the lungs of a student at rest during one breath.

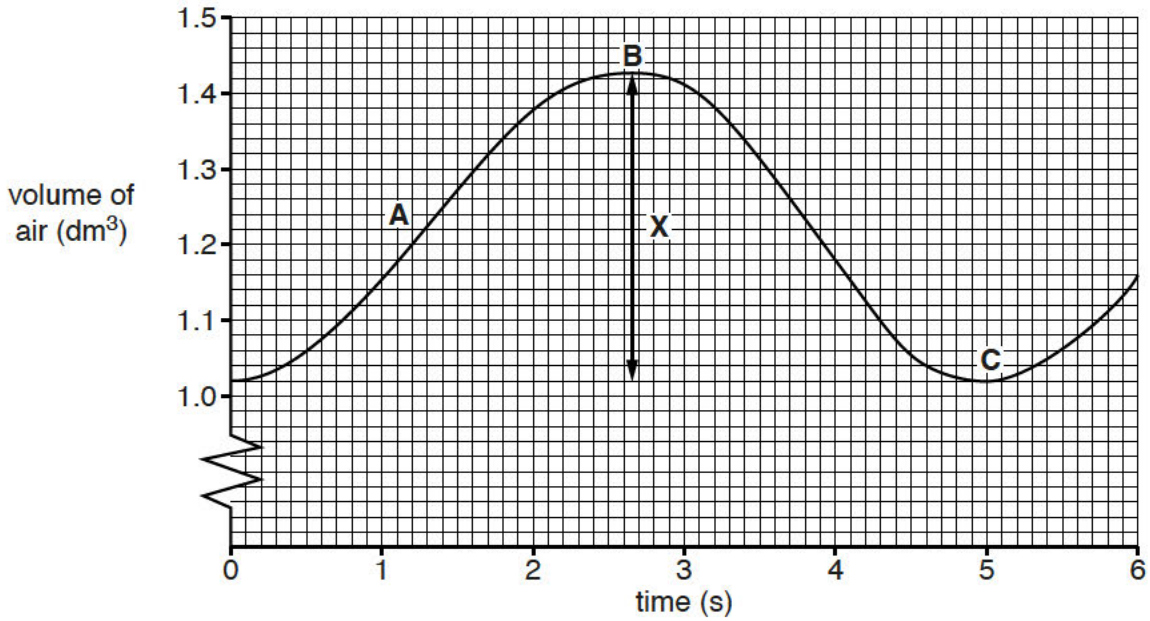


Fig. 5.1

(a) (i) Name the measurement represented by the line **X**.

..... **[1]**

(ii) What is happening to the elastic fibres in the walls of the alveoli at point **A**?

..... **[1]**

(b) Explain what causes the change in the volume of air between points **B** and **C** on Fig. 5.1.



In your answer you should use appropriate technical terms, spelt correctly.

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..... **[4]**

(c) Using Fig. 5.1, calculate the breathing rate of this student in breaths per minute.

Answer = ... breaths per minute **[2]**

(d) About 1 dm^3 of air cannot be expelled from the lungs. This is known as the residual volume.

Suggest why it is **not** possible to expel all the air from the lungs.

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..... **[2]**

[Total: 10]