

**Q.1.**

**6** The following statements apply to the effects of drugs on the body.

- S** acts as a stimulant
- T** increases the heart rate
- U** acts as a painkiller
- V** if taken in excess, may lead to cirrhosis
- W** mimics natural neurotransmitter chemicals in the nervous system
- X** leads to constriction of peripheral blood vessels
- Y** acts as a depressant
- Z** raises blood pressure

**(a)** Complete the table by putting **two** letters in each column of the table. Choose letters for the statements that most closely match each of the four drugs.

You may use each letter once, more than once or not at all.

alcohol	caffeine	nicotine	heroin
.....	.....	.....	.....

[4]

**(b)** Explain the term *drug tolerance*.

.....

.....

.....

.....

.....

.....[2]

(c) Some medicinal drugs act as non-competitive inhibitors of enzymes.

Explain how a non-competitive inhibitor acts on an enzyme to prevent it catalysing a reaction.

You may use an annotated diagram to illustrate your answer if you wish.

.....  
.....  
.....  
.....  
.....

[3]

[Total : 9]

**Q.2.**

(b) Nicotine is the drug in tobacco smoke.

State **two** effects of nicotine on the cardiovascular system.

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

**13**

Table 6.1 shows information on smoking and lung cancer in six countries.

Table 6.1 shows:

- the percentage of male and female adults who smoke regularly in each country;
- the death rates from lung cancer expressed as deaths per 100 000 of the population of each country.

**Table 6.1**

country	percentage of the population who smoke		deaths from lung cancer / deaths per 100 000	
	males	females	males	females
China	53.4	4.0	22.7	10.5
France	33.0	21.0	73.3	14.4
Malaysia	49.2	3.5	5.6	2.3
New Zealand	25.1	24.8	47.3	29.2
South Africa	43.8	11.7	13.8	5.4
Trinidad and Tobago	42.1	8.0	12.3	4.2

(c) Explain whether or not there is any evidence in Table 6.1 to support the following statements.

Use the data in the table to support your answer.

Men are more at risk of dying from lung cancer than women.

.....

.....

.....

Countries where a high percentage of the population smoke have high death rates from lung cancer.

.....

.....

..... [3]

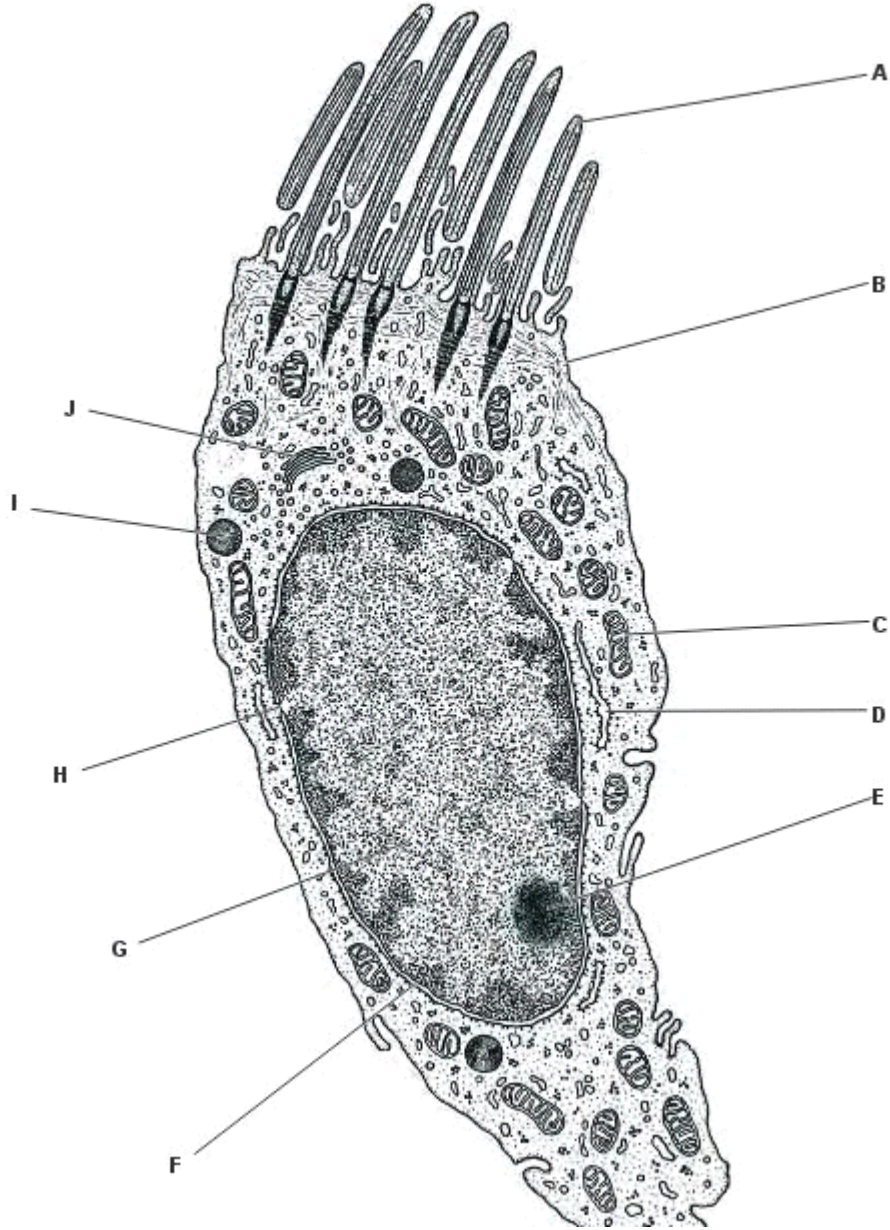
- (d) Table 6.1 shows that a larger percentage of men in some countries, such as Malaysia, smoke compared with New Zealand. It also shows that the death rate from lung cancer for men in Malaysia is much lower.

Suggest **two other** pieces of information about men who smoke that would be useful in evaluating the risks of developing lung cancer.

- 1 .....
- .....
- 2 .....
- ..... [2]

**Q.3.**

- 1 Fig. 1.1 is a drawing made from an electron micrograph of a cell from the ciliated epithelium of the bronchus.



- (a) Complete the table below by writing the appropriate letter from Fig. 1.1 to indicate the structure that carries out each of the functions listed. The first one has been completed for you.

function	structure
facilitated diffusion of glucose	<b>B</b>
creates a current to move mucus	
aerobic respiration	
makes ribosomes	
a site of transcription	
packages proteins into lysosomes	

[5]

- (b) The alveoli in the lungs are lined by a squamous epithelium.

Explain why gas exchange occurs in alveoli and not in the bronchus.

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.....

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.....[3]

- (c) Describe the likely appearance of the lining of the bronchus in a person who has been a heavy smoker for many years.

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.....[3]

[Total: 11]

**Q.4.**

- (c) Some components of tobacco smoke are absorbed into the blood stream and affect the cardiovascular system.

Describe the effects of nicotine and carbon monoxide on the cardiovascular system.

nicotine .....

.....

.....

.....

carbon monoxide .....

.....

.....

..... [4]

**Q.5.**

- 4 Scientists at the Tibet Institute of Medical Sciences in Lhasa investigated differences between adult Tibetans who had lived in Lhasa (altitude 3658 m) all their lives and adult Han Chinese residents who had lived there for about 8 years. The Tibetans and the Han Chinese exercised at maximum effort and various aspects of their breathing were measured.

Some of the results are shown in Table 4.1.

**Table 4.1**

feature	Tibetans	Han Chinese
minute volume / dm <sup>3</sup> min <sup>-1</sup>	149	126
oxygen uptake / cm <sup>3</sup> kg <sup>-1</sup> min <sup>-1</sup>	51.0	46.0

- Minute volume. This is the volume of air breathed in during one minute.
- Oxygen uptake. This is the volume of oxygen absorbed into the blood during one minute. It is expressed per kg of body mass.

The researchers observed that

- the greater minute volume of the native Tibetans resulted from a greater tidal volume
- the tidal volumes of the Tibetans showed a positive correlation with their vital capacity measurements
- the Han Chinese had lower values for both tidal volume and vital capacity.

(a) State what is meant by the term *tidal volume*.

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

(b) Suggest why the researchers also measured the *vital capacity* of the people in the study.

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

(c) Explain how the minute volume **at rest** would be determined.

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

(d) Suggest two differences in the **structure** of the lungs that may account for the greater oxygen uptake by the Tibetans shown in Table 4.1.

1 .....  
.....  
2 .....  
..... [2]



- (e) When people who have lived all their lives at low altitude go to a place at high altitude, such as Lhasa, they are often breathless, lack energy and suffer from altitude sickness. However, with time, they often acclimatise to the high altitude.

In another study, researchers found that the red blood cell count increases in such people by about 30% over several weeks.

Explain why the red blood cell count increases so much when people visit places at high altitude.

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..... [2]

[Total: 9]

**Q.6.**

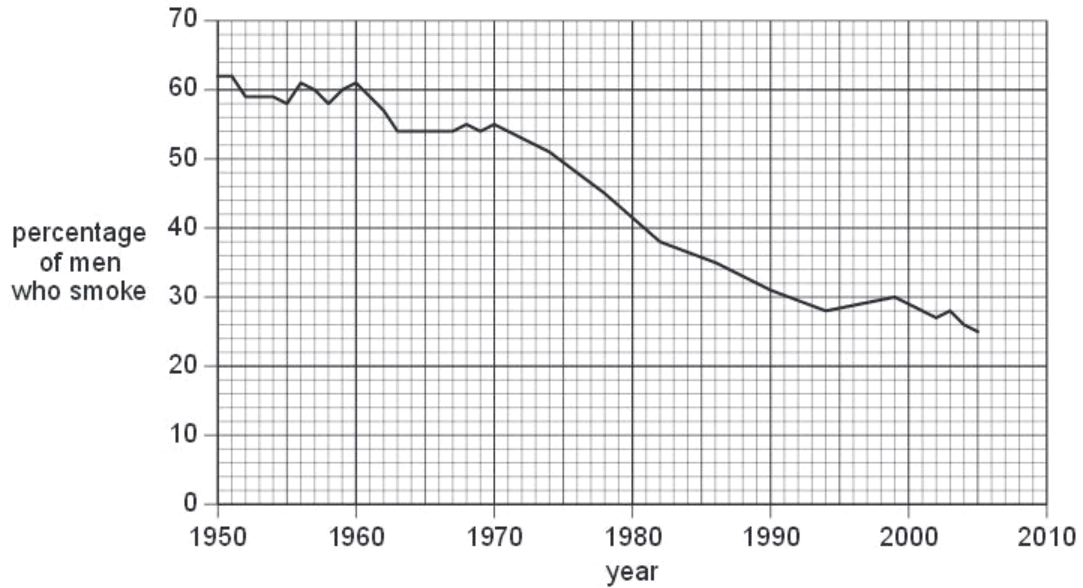
- (b) People who have smoked cigarettes for many years are at risk of developing lung cancer.

Describe how cigarette smoke is responsible for the development of lung cancer.

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..... [4]

(c) Fig. 6.2 shows the change in the percentage of smokers in the male population of the UK between 1950 and 2005.

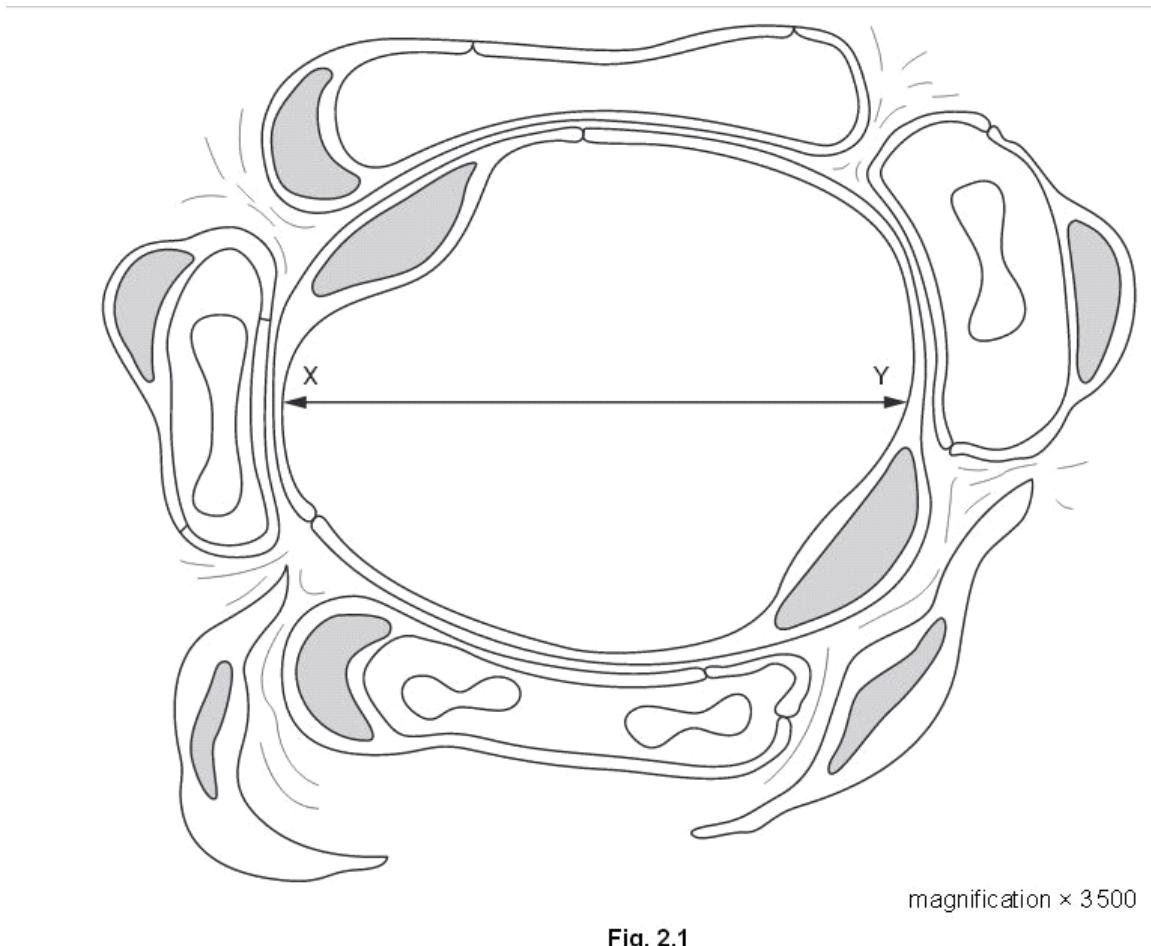
Fig. 6.3 shows the change in mortality rate in the UK in men aged 75 to 84 between 1950 and 2005.



**Fig. 6.2**



2 Fig. 2.1 is a section of an alveolus and surrounding tissue.



- (a) Calculate the actual diameter of the alveolus along the line X–Y.

Show your working and give your answer to the nearest micrometre.

Answer = .....  $\mu\text{m}$  [2]

- (b) (i) Describe the role of elastic fibres in the wall of the alveolus.

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

- (ii) With reference to Fig. 2.1, explain how alveoli are adapted for gas exchange.

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

(c) Chronic obstructive pulmonary disease (COPD) is a progressive disease that develops in many smokers. COPD refers to two conditions:

- chronic bronchitis
- emphysema.

(i) State two ways in which the lung tissue of someone with emphysema differs from the lung tissue of someone with healthy lungs.

1. ....

2. .... [2]

(ii) State two symptoms of emphysema.

1. ....

.....

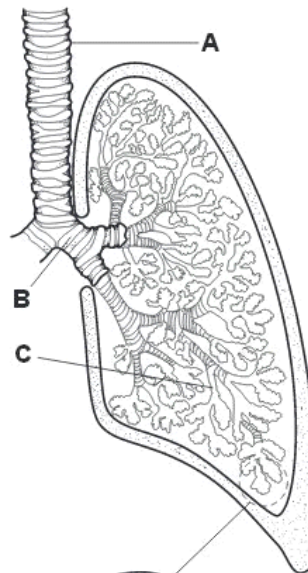
2. ....

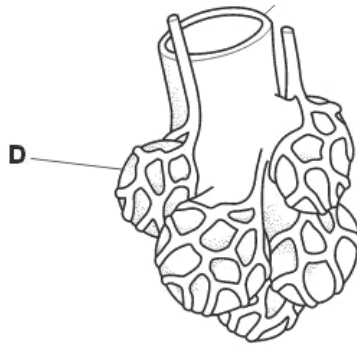
..... [2]

[Total: 12]

**Q.8.**

5 Fig. 5.1 is a diagram of part of the human gas exchange system.





**Fig. 5.1**

(a) Complete the table to show the distribution of the structural features within the parts of the gas exchange system, **A** to **D**, shown in Fig. 5.1.

Use a tick (✓) if the feature is present and a cross (X) if the feature is absent. Some of the boxes have been completed for you.

structure	features				
	cartilage	ciliated epithelium	elastic fibres	goblet cells	smooth muscle
<b>A</b>		✓		✓	
<b>B</b>			✓		
<b>C</b>				✓	✓
<b>D</b>	X				X

[4]

- (b) Explain the role of goblet cells and cilia in the maintenance of a healthy gas exchange system.

*goblet cells* .....

.....

.....

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.....

.....

*cilia* .....

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[4]

[Total: 8]

**Q.9.**

- 6 Various structures in the human gas exchange system are adapted in different ways to perform their specific functions.

- (a) Complete the table below using a tick ✓ or cross X in each box to show whether or not the structure shows the particular feature.

Two boxes have been completed for you.

	lined with cilia	reinforced with cartilage	site of gas exchange	contains smooth muscle
trachea			X	
bronchus				
bronchiole				✓
alveolus				

[4]



(b) State the two ways in which the concentration gradients of oxygen and carbon dioxide are maintained for efficient gas exchange.

1. ....  
.....
2. ....  
.....[2]

(c) The alveoli in the lungs have elastic fibres in their walls.

(i) State **one** function of the elastic fibres.

- .....  
.....[1]

(ii) Name the medical condition caused by breakdown of the elastic fibres.

- .....[1]

(d) Cigarette smoke contains tar, a substance which has several harmful effects on **the cells** lining the gas exchange system.

Outline three of these effects.

1. ....  
.....
2. ....  
.....
3. ....  
.....[3]

[Total: 11]

**Q.10.**

1 Fig. 1.1 is an electron micrograph of cells from the ciliated epithelium of the trachea.



(a) Calculate the magnification of the electron micrograph in Fig. 1.1.

Show your working and express your answer to the nearest whole number.

magnification × .....[2]

**(b)** Explain how the cells labelled **A** and the structures labelled **B** in Fig. 1.1 protect the lining of the trachea.

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

**(c)** Cells, such as **C**, at the base of the epithelium of the trachea divide by mitosis.  
Describe the changes that occur within the cell between the beginning of prophase and the end of metaphase.

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

[Total: 11]

**Q.11.**

6 Leaves of tobacco plants, *Nicotiana spp.*, have a high concentration of nicotine, the addictive component of tobacco smoke. Scientists are continually seeking ways to produce tobacco plants that have reduced nicotine content.

(a) Describe **and** explain the effects of nicotine on the cardiovascular system that can contribute to a person developing **coronary heart disease**.

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

(b) The production of low-nicotine cigarettes and cigars is considered a strategy that may reduce the harmful effects of smoking.

Explain whether or not you agree with this statement.

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

[Total: 5]

**Q.12.**

(b) Describe the experimental evidence that shows that smoking causes lung cancer.

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..... [3]

(c) Fig. 6.1 shows the changes in mortality rates for lung cancer in five countries between 1950 and 2006 for males.

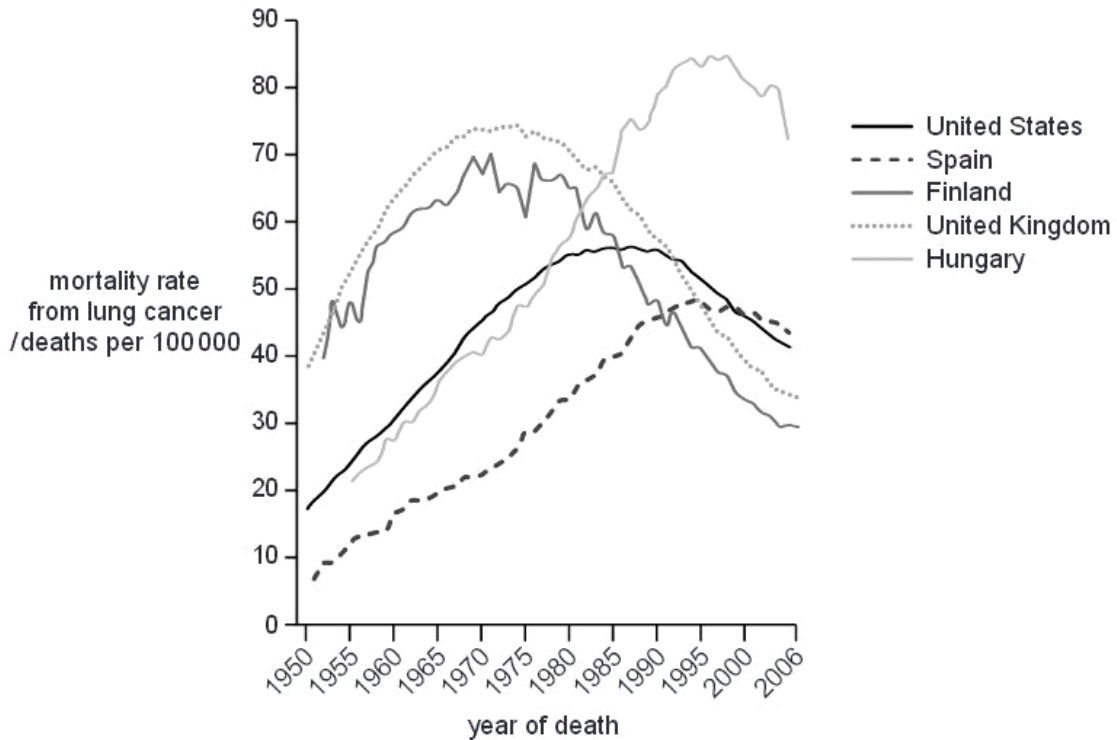


Fig. 6.1

With reference to Fig. 6.1, describe the similarities **and** differences in the trends in mortality rates in the countries shown.

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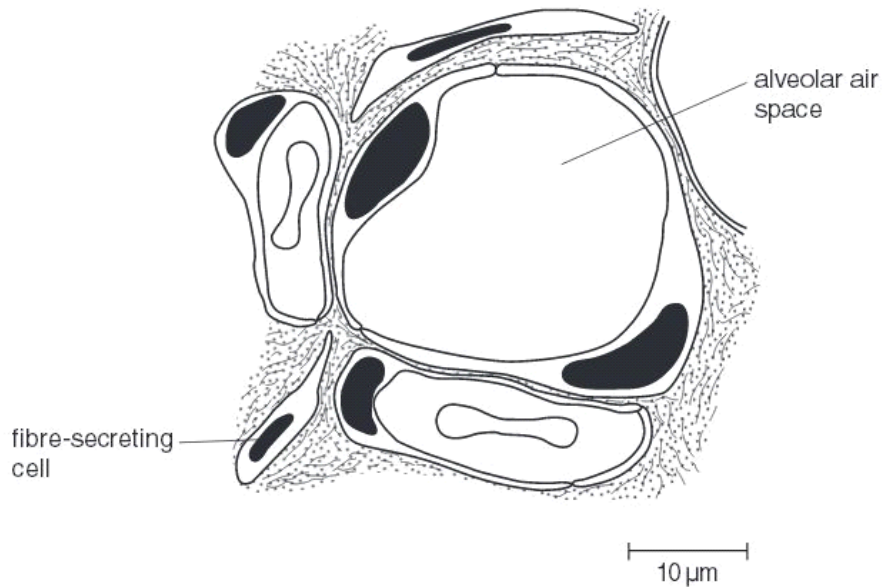
.....

.....

[3]  
[Total: 9]

**Q.13.**

- 1 Fig. 1.1 is a drawing made from an electron micrograph showing a cross-section of an alveolus and two adjacent capillaries.



**Fig. 1.1**

- (a) Calculate the magnification of Fig. 1.1. Show your working and express your answer to the nearest whole number.

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

- (b) With reference to Fig. 1.1, describe the process of gaseous exchange in the alveolus.

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

Allergies, such as asthma, are the result of an over reaction by the immune system to a harmless antigen. When people suffer from an asthma attack, their immune systems respond to the presence of a specific antigen by producing antibodies. These antibodies attach to the surface of mast cells in the airways causing these cells to release histamine. This hormone-like chemical stimulates inflammation in the lining of the airways, which then makes breathing very difficult.

- (c) State the name of the cells of the immune system that secrete antibodies.

.....[1]

- (d) Describe the changes that occur in airways, such as the bronchioles, during an asthma attack that make breathing difficult.

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

[Total : 10]

**Q.14.**

6 Complete the following passage.

During strenuous exercise, muscles often do not receive sufficient oxygen to support aerobic respiration. As a result, muscles carry out .....  
respiration and produce ....., which diffuses into the blood.  
Most is then absorbed by the ....., which respire it to form  
carbon dioxide and water or uses it to form glucose. The volume of oxygen absorbed by  
the lungs does not return to normal immediately after strenuous exercise because the  
body has to repay an oxygen .....

Exercise that uses the cardiovascular and gaseous exchange systems is termed  
..... exercise. Improvements in fitness of the cardiovascular  
system can be followed by measuring the decrease in the .....  
pulse rate. [6]

[Total : 6]

**Q.15.**

(c) Describe the effect of tar from cigarettes on the lining of the gaseous exchange system.

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

**Q.16.**



- 6 An athlete exercised for eight minutes. The athlete's oxygen consumption was measured before, during and after the exercise. The results are shown in Fig. 6.1.

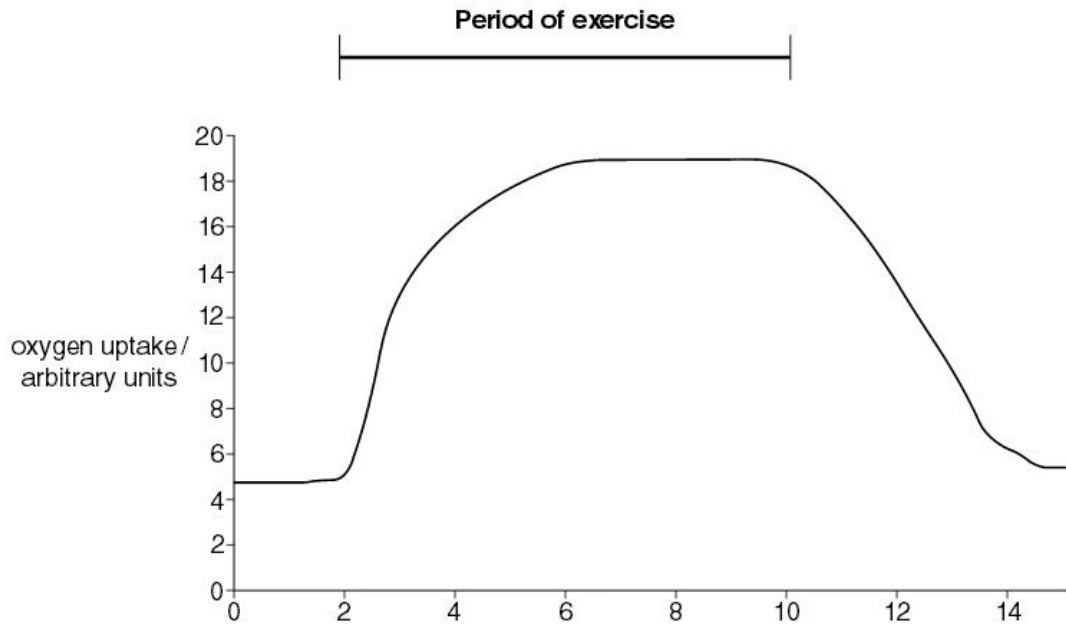


Fig. 6.1

- (a) Explain why the athlete's oxygen consumption increased between two minutes and six minutes.

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.....

.....

.....[2]

(b) Explain why the athlete's oxygen consumption took more than four minutes to decrease to resting values after the end of exercise.

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

(c) Heart transplants and coronary by-pass surgery are used in the treatment of heart disease.

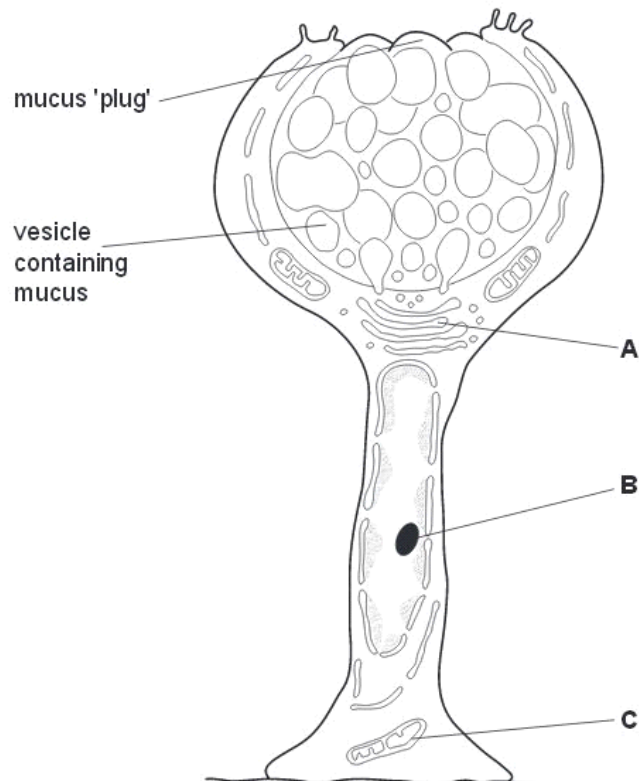
State two reasons why heart transplants are much less common than coronary by-pass surgery in the treatment of heart disease.

1 .....  
.....  
2 .....  
.....[2]

[Total: 8]

Q.17.

- 1 Fig. 1.1 is a drawing made from an electron micrograph of a goblet cell from the epithelium of the gas exchange system.



- (a) Name A to C.

A .....

B .....

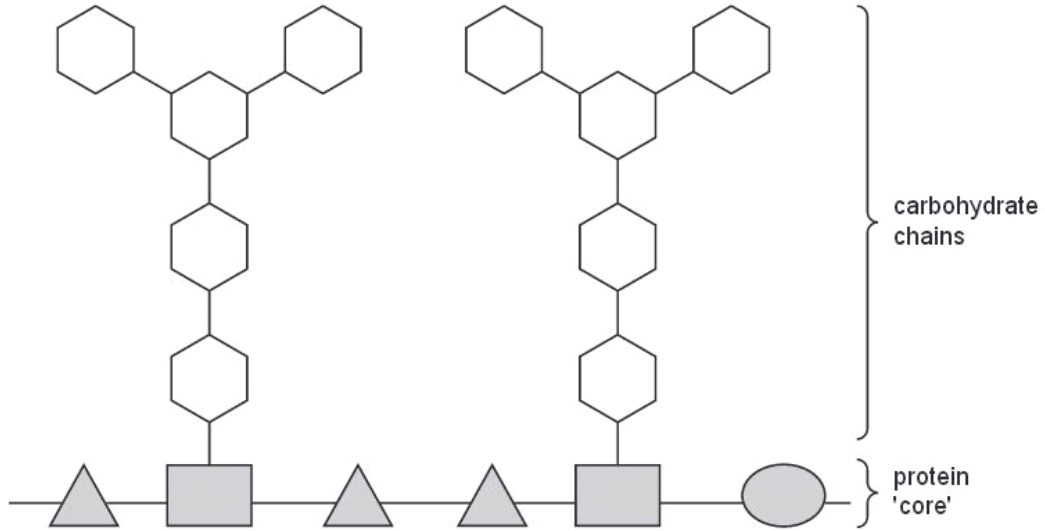
C .....[3]

- (b) State two places in the gas exchange system where goblet cells are found.

1. ....

2. ....[1]

Mucus contains a number of different glycoproteins, called mucins. These have a protein 'core' that is formed by repeated sequences of amino acids, some of which have carbohydrates attached to their side chains (R groups). A part of one of these repeated units is shown diagrammatically in Fig. 1.2.



**Fig. 1.2**

(c) Use label lines and the letters **P** and **G** to indicate on Fig. 1.2 the positions of:  
**P** – a peptide bond;  
**G** – a glycosidic bond. [2]

(d) Describe the role of mucus in the gas exchange system.

.....

.....

.....

.....

.....

.....

.....[3]

(e) Glycoproteins are found in cell surface membranes.

State **one** function of these glycoproteins.

.....

.....[1]

[Total: 10]

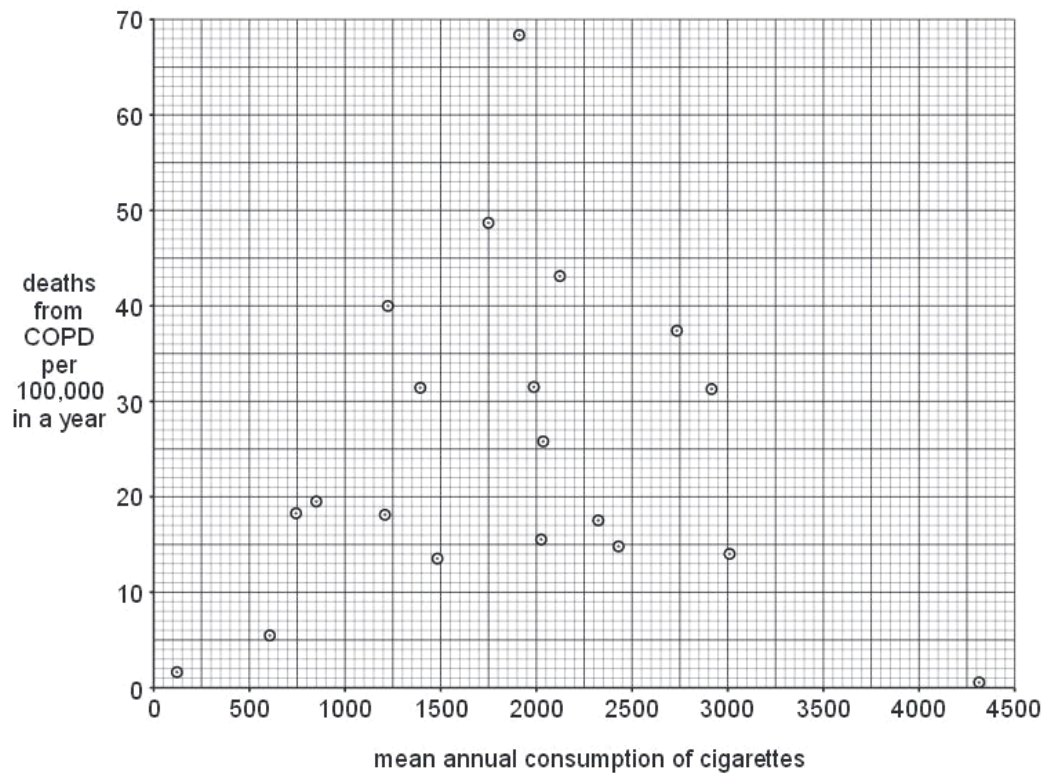
**Q.18.**

- 3** Fig. 3.1 shows some cells from the lining of the bronchus from a person who has never smoked.  
Fig. 3.2 shows cells from the same area in a heavy smoker who suffers from chronic bronchitis.



- (c) Chronic obstructive pulmonary disease (COPD) includes chronic bronchitis and emphysema.

A student used the World Health Organisation database to investigate the link between cigarette smoking and deaths from COPD. Fig. 3.3 shows deaths from COPD plotted against the mean annual consumption of cigarettes in 20 countries for the period 1997 to 2002.



**Fig. 3.3**

The student concluded that there was no link between cigarette consumption and deaths from COPD.

Use the information in Fig. 3.3 to discuss the student's conclusion.

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

[Total: 9]

**Q.19.**

- (b) When tobacco leaf fragments in cigarettes are burnt, substances that are hazardous to health are released.

Name three of these hazardous substances and for each describe **one** effect on the body.

*substance* .....

*effect* .....

*substance* .....

*effect* .....

*substance* .....

*effect* .....

.....[3]

**Q.20.**



- 2 (a) Table 2.1 shows some of the structures in different parts of the gas exchange system.

Complete Table 2.1 by indicating with a tick (✓) if the structure is present in each part of the gas exchange system or a cross (X) if it is not.

**Table 2.1**

structure	trachea	bronchus	bronchiole	alveolus
ciliated epithelium				
goblet cells				
cartilage				
smooth muscle				

[4]

- (b) An exercise physiologist investigated aspects of breathing in an athlete.

The minute volume is the volume of air breathed in during one minute.

The data recorded is in Table 2.2.

**Table 2.2**

vital capacity /dm <sup>3</sup>	breathing rate at rest /breaths min <sup>-1</sup>	minute volume /dm <sup>3</sup>
5.8	11	5.5

- (i) Explain how the physiologist would determine the vital capacity of the athlete.

.....

.....

.....

.....

.....

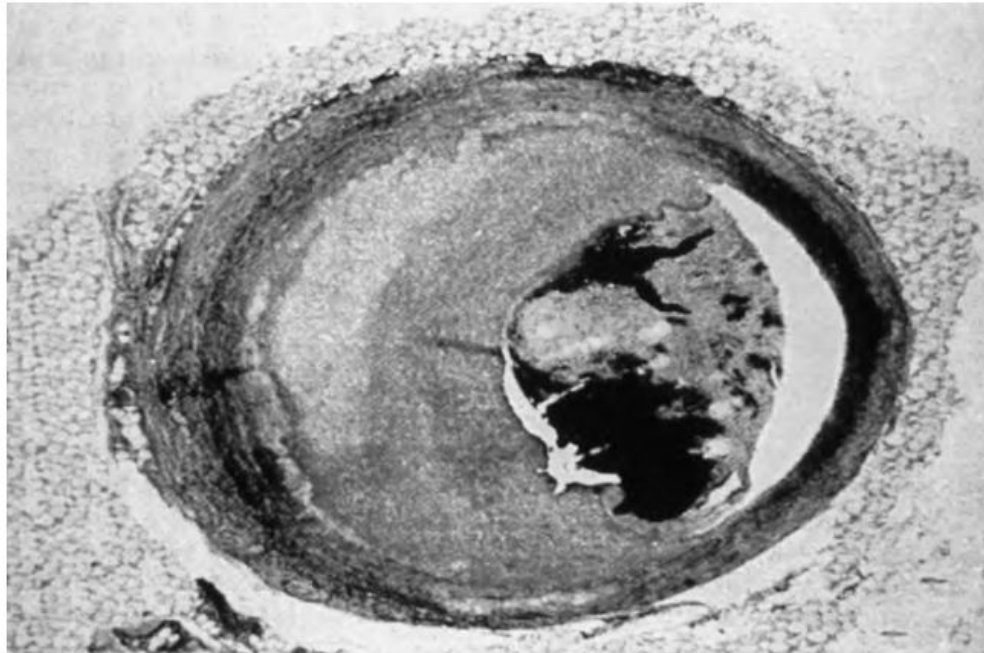
.....

[2]

(ii) Calculate the athlete's tidal volume.

Answer = .....[1]

(c) Fig. 2.1 shows a cross section of a coronary artery partially blocked by plaque causing atherosclerosis.



**Fig. 2.1**

Explain why atherosclerosis in coronary arteries may limit the ability of people to take vigorous exercise.

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

(d) Describe the effects of nicotine and carbon monoxide in cigarette smoke on the cardiovascular system.

*nicotine* .....

.....  
.....  
.....  
.....  
.....

*carbon monoxide* .....

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

[Total: 13]

Q.21.

6 Fig. 6.1 is a section through lung tissue showing an alveolus and its blood supply.

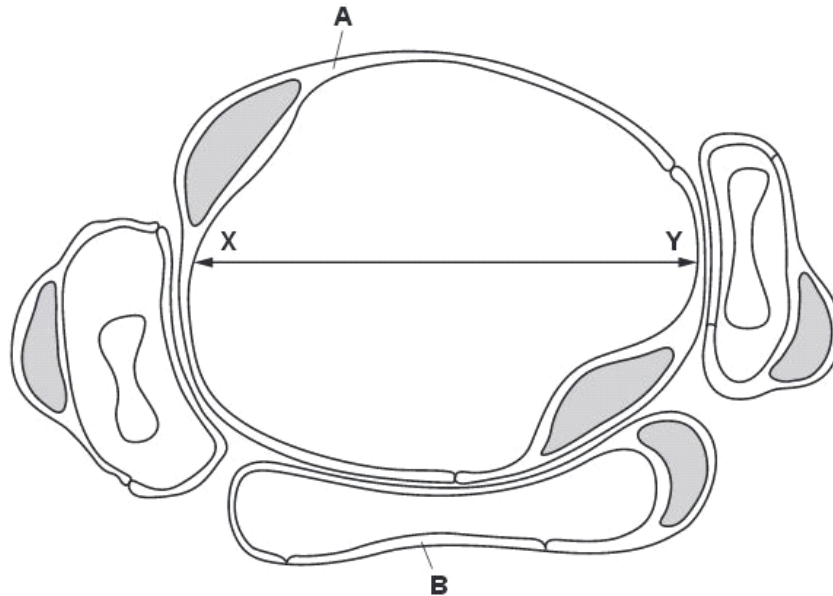


Fig. 6.1

(a) (i) Name the type of epithelial cell shown by label lines **A** and **B**.

..... [1]

(ii) Describe how the elastic fibres of the alveoli contribute to the healthy functioning of the lungs.

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

(b) The actual diameter of the alveolus along the line X–Y is 220 micrometres ( $\mu\text{m}$ ). Calculate the magnification of Fig. 6.1.

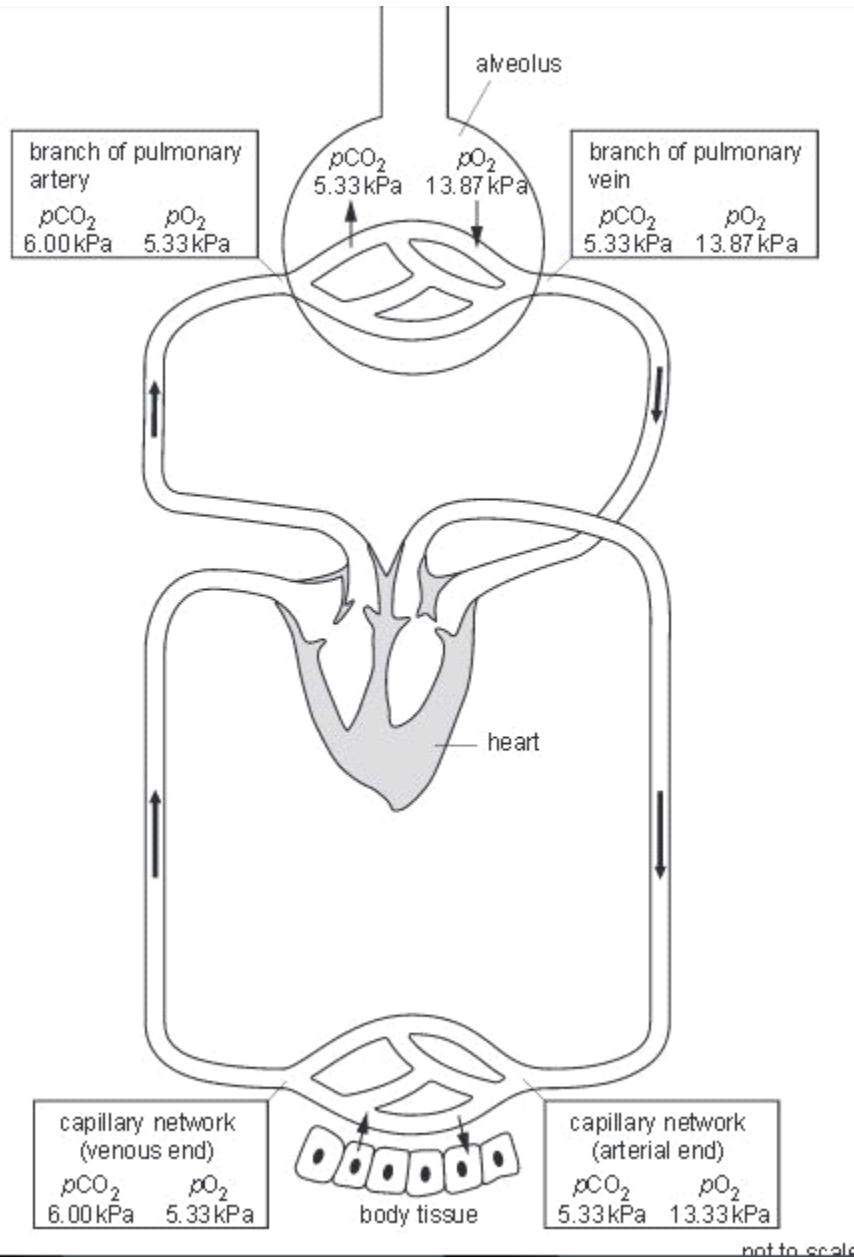
Show your working and give your answer to the nearest whole number.

answer  $\times$  ..... [2]

(c) Outline two features of a gas exchange surface **that are shown on Fig. 6.1.**

1. ....  
.....
2. ....  
..... [2]

(d) Fig. 6.2 is a simplified diagram of the circulatory system of a human, showing gas exchange in the lungs and in respiring tissue. The partial pressures of oxygen ( $pO_2$ ) and carbon dioxide ( $pCO_2$ ) at four locations are also shown.

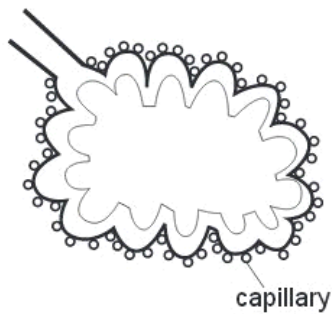




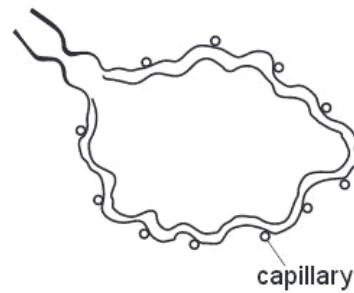
5 (a) Describe and explain how the structure of alveoli is adapted for efficient gas exchange.

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

Fig. 5.1 shows a cross-section of normal human alveoli and Fig. 5.2 shows a cross-section of alveoli from a person suffering from emphysema.



**Fig. 5.1**



**Fig. 5.2**

(b) (i) State the most common cause of emphysema.

.....[1]

(ii) With reference to changes visible in Fig. 5.1 and Fig. 5.2, state and explain the effect of emphysema on the alveoli and on gas exchange.

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



(c) State three symptoms of emphysema.

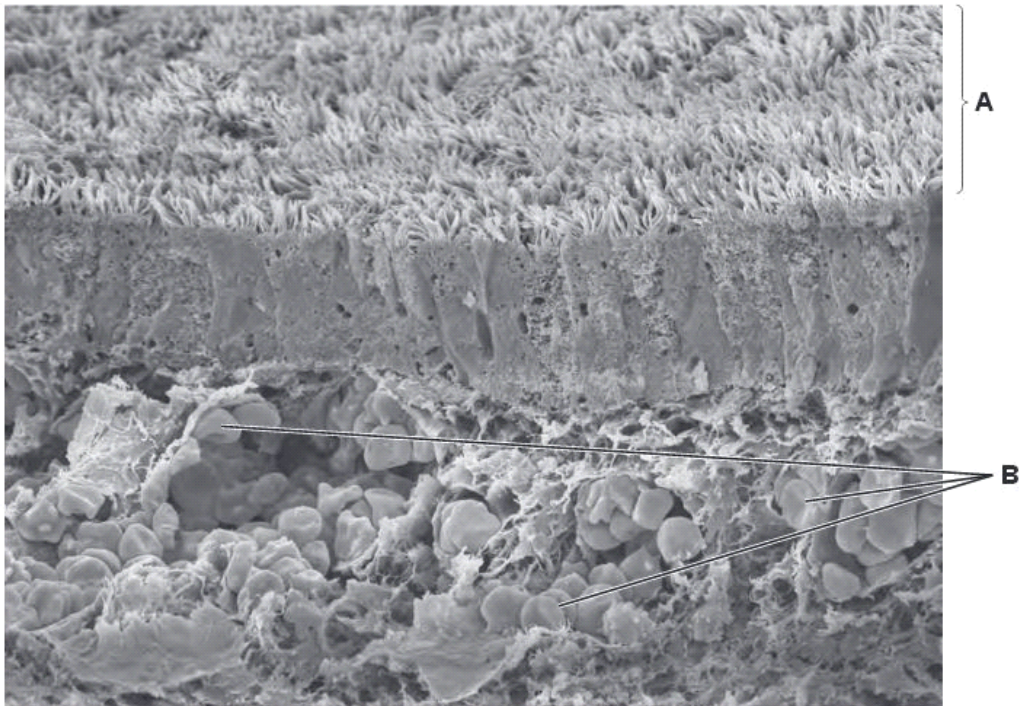
1. ....  
.....
2. ....  
.....
3. ....  
.....

[3]

[Total: 9]

**Q.23.**

- 1 Fig. 1.1 is a scanning electron micrograph of part of the wall of the bronchus of a healthy human.



**Fig. 1.1**

**(a) (i)** Name the structures labelled **A**.

.....[1]

**(ii)** State the function of the cells labelled **B**.

.....[1]

**(b)** Name two tissues found in the wall of the bronchus that are not visible in Fig. 1.1.

1. ....

2. ....[2]

Chronic bronchitis is one of the conditions that contributes to chronic obstructive pulmonary disease (COPD).

**(c)** State the name of the other condition that contributes to COPD.

.....[1]

**(d)** Describe the appearance of a section through the **wall** of a bronchus in a person with chronic bronchitis.

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

- (e) Suggest why a person with chronic bronchitis is more likely than a healthy person to suffer from infectious diseases of the gas exchange system.

.....

.....

.....

.....[2]

[Total: 11]

**Q.24.**

- 5 In 1954, an article was published in the British Medical Journal entitled, *The mortality of doctors in relation to their smoking habits*.

One aspect of the investigation studied a very large number of male doctors in the UK aged 35 years and older. A survey established the quantity of tobacco smoked per day.

Twenty-nine months later, the cause of any deaths in the study group was recorded.

Table 5.1 summarises the results obtained.

**Table 5.1**

cause of death	number of deaths	death rate per year per 1000 men in the study			
		non-smokers	smokers, tobacco smoked / g day <sup>-1</sup>		
			1-14	15-24	25 and above
coronary thrombosis (heart attack)	235	3.89	3.91	4.71	5.15
other cardiovascular diseases	126	2.23	2.07	1.58	2.78
lung cancer	36	0.00	0.48	0.67	1.14
other diseases of the gas exchange system	54	0.86	0.88	1.01	0.77

(a) State which group in the study is most at risk from dying of lung cancer.  
.....[1]

(b) Using information from Table 5.1 to support your answer, discuss the evidence linking tobacco smoking to disease and early death.  
.....  
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.....  
.....  
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.....  
.....  
.....  
.....  
.....  
.....[4]

[Total: 5]

**Q.25.**

- 3 A study was carried out on a large number of people, some of whom were smokers. The study investigated the link between percentage of deaths due to lung cancer in smokers and their smoking habits. The age at which they started smoking and the number of cigarettes smoked per day were recorded. The results of the study are shown in Fig. 3.1.



**(b)** Tobacco smoke contains many substances which are harmful to the body.

Outline the harmful effects on the cardiovascular system of:

**(i)** carbon monoxide

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

**(ii)** nicotine.

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

**(iii)** Describe briefly the effects of tar on the goblet cells and cilia of the trachea.

*goblet cells* .....

.....  
.....  
.....

*cilia* .....

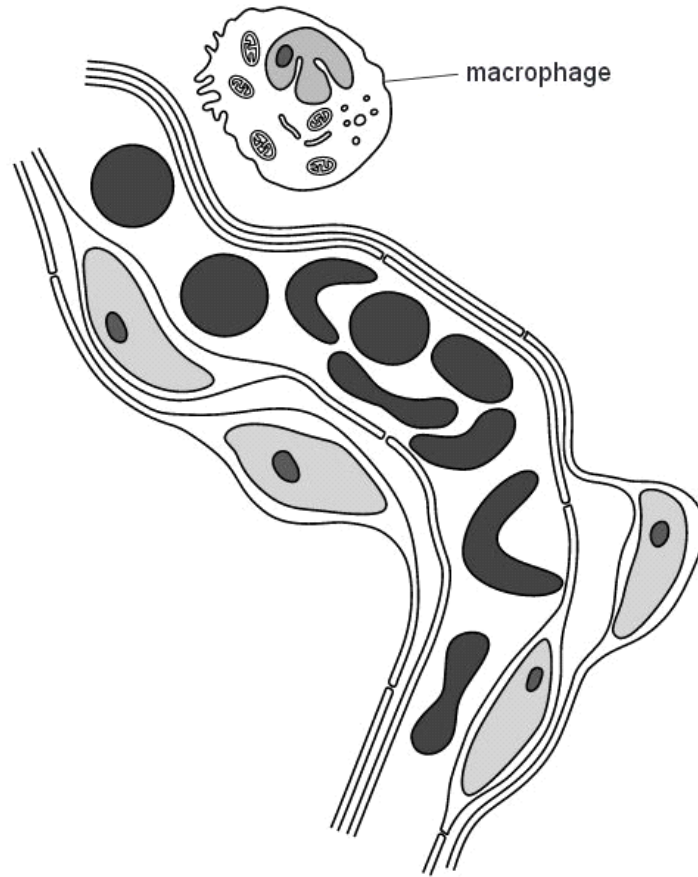
.....  
.....  
..... [4]

[Total: 12]

Q.26.

Macrophages are large phagocytic cells that are found in many tissues including alveolar tissue in the lungs. They provide the main means of defence against pathogens in this tissue.

Fig. 3.1 is a drawing made from an electron micrograph showing part of a capillary and two alveoli, with a macrophage.



**(b)** With reference to Fig. 3.1, explain:

**(i)** how alveoli are adapted for gaseous exchange

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

**(ii)** how macrophages function to protect the lungs from becoming infected.

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



- (c) Phagocytes release enzymes that digest proteins. In smokers, this may lead to the large-scale destruction of alveolar walls.

Outline the effects of this destruction on a person's health.

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..... [3]

**Q.27.**

- (c) Describe **and** explain how the structure of the human **gas exchange surface** is adapted for maximum efficiency.

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..... [4]

**Q.28.**

- (b) Nicotine has an effect on the cardiovascular system, such as making platelets sticky, so causing blood to clot. This increases the risk of thrombosis and reduces blood flow.

Outline **other** effects of nicotine on the cardiovascular system.

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

**Q.29.**

- 1 Name as precisely as you can the structure described in each of the following statements.

- (a) The blood vessel that transports deoxygenated blood from the heart.  
..... [1]
- (b) The cell that ingests and digests cell debris and bacteria in the lungs.  
..... [1]
- (c) The cell that secretes antibodies.  
..... [1]
- (d) The epithelial cell that secretes mucus in the trachea.  
..... [1]
- (e) The tissue that prevents the collapse of the trachea during inhalation.  
..... [1]

[Total: 5]







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