The gas exchange system and Smoking

Question Paper 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Gas exchange and smoking
Sub Topic	The gas exchange system and Smoking
Booklet	Theory
Paper Type	Question Paper 3

Time Allowed : **74 minutes**

Score : **/ 61**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Almost 40% of adults with cystic fibrosis (CF) develop a form of diabetes known as cystic fibrosis-related diabetes (CFRD). This is thought to happen because the build-up of thick secretions in the pancreas destroys β cells.

(a) Explain how the destruction of β cells causes diabetes.

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(b) The bacterium *Pseudomonas aeruginosa* can cause chronic (long-lasting) lung infections. A person with CFRD is likely to have poorer lung function and a greater likelihood of having a chronic lung infection than a person who has CF but does **not** have CFRD.

An investigation was carried out to find out if the severity of damage to lung function in a person with CFRD is affected by

- their gender
- whether or not they have a chronic *P. aeruginosa* infection.

The investigators measured lung function by recording the maximum volume of air that can be expelled from the lungs in the first one second of a forced expiration. This is known as FEV_1. The lower the median FEV_1, the poorer the lung function.

Table 4.1 summarises the results of this investigation. All the 812 people in the study had cystic fibrosis.

Table 4.1

	without chronic *P. aeruginosa* infection				**with chronic *P. aeruginosa* infection**			
	male		**female**		**male**		**female**	
	with CFRD	**without CFRD**	**with CFRD**	**without CFRD**	**with CFRD**	**without CFRD**	**with CRFD**	**without CFRD**
number of people	44	110	52	93	106	166	121	120
FEV_1	71.1	71.4	53.6	73.6	49.0	59.0	42.0	61.0

With reference to Table 4.1

(i) discuss whether or not there appears to be a positive correlation between having a chronic *P. aeruginosa* infection and having CFRD

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..... [2]

(ii) calculate the percentage difference between the FEV_1 of males and females without CFRD and without *P. aeruginosa* infection.

Show your working

answer ..... % [2]

(iii) outline the conclusions that can be drawn concerning the relationship between gender and the severity of lung damage in a person with CFRD and with *P. aeruginosa* infection.

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(c) In a person with CF, damage to lung function and the increased likelihood of chronic infections are the result of the secretion of thick mucus.

Explain why thick mucus is secreted in the lungs of a person with CF.

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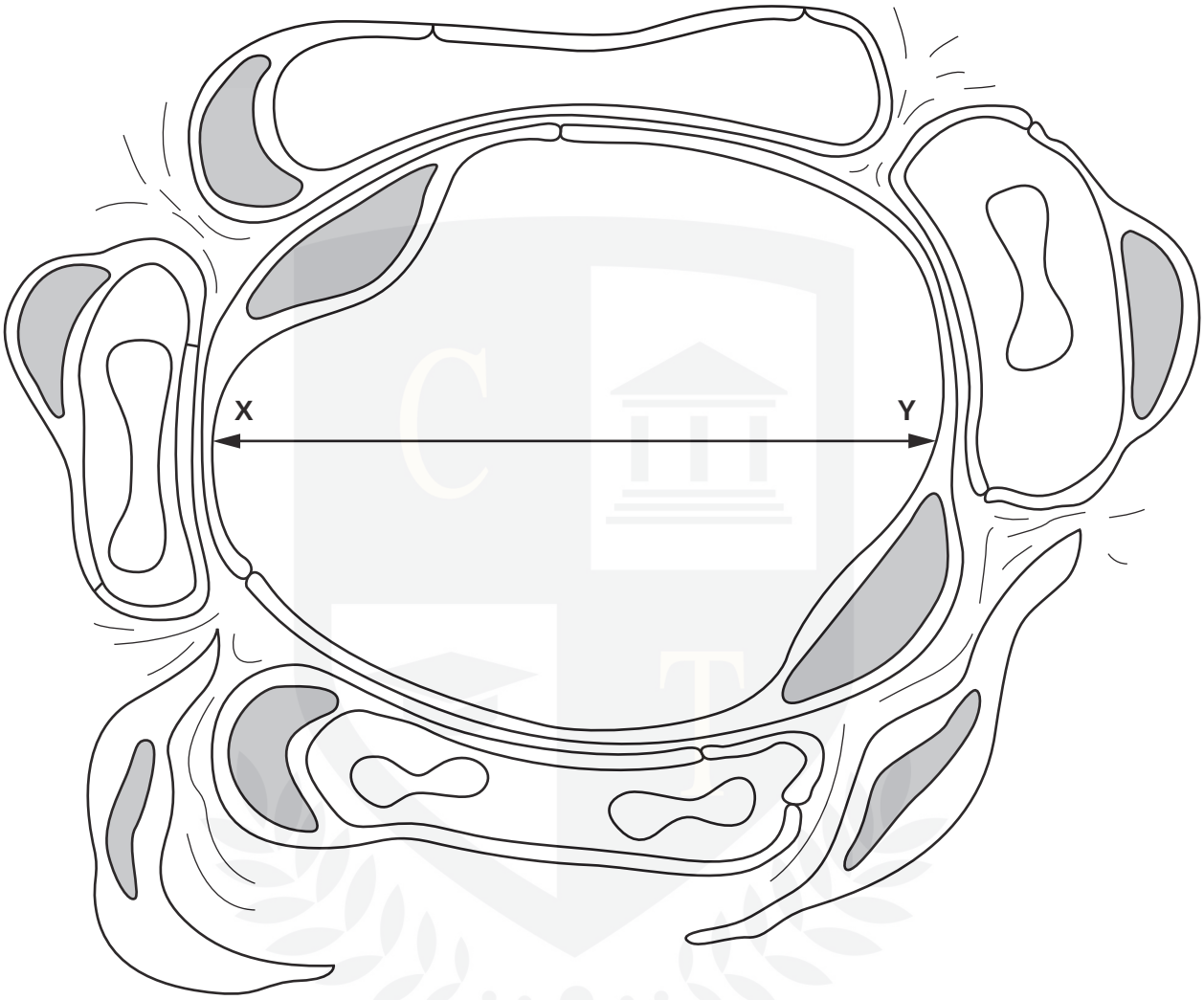
..... [4]

[Total: 15]

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



magnification × 3500

Fig. 2.1

(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 = ... µm [2]

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

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.....[2]

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

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

- chronic bronchitis
- emp ysema.

(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. .....

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2. .....

.....[2]

[Total: 12]

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

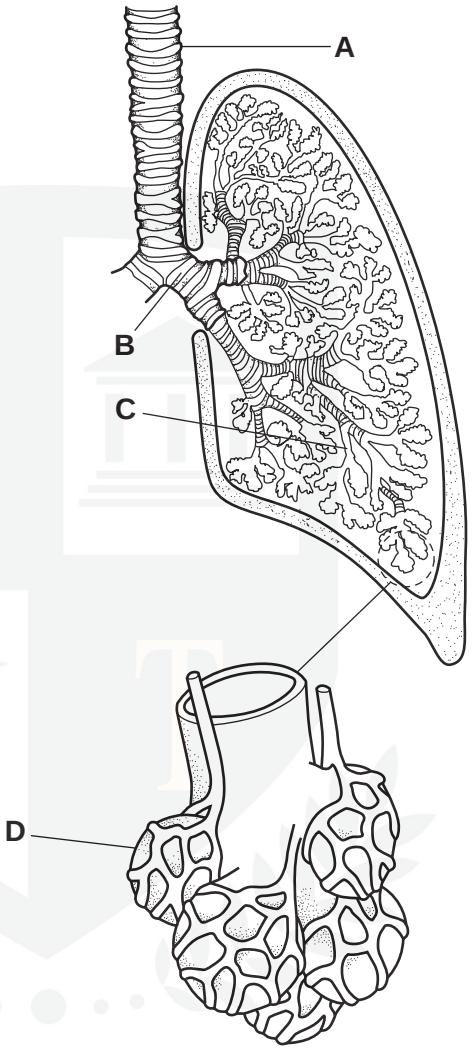

Fig. 5.1

(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 (✗) 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
A		✓		✓	
B			✓		
C				✓	✓
D	✗				✗

[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]

4 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 ✗ 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			✗	
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. .....

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2. .....

.....[2]

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

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

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.....[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. .....

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2. .....

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3. .....

.....[3]

[Total: 11]

5 Fig. 1.1 shows the outline of a ciliated cell from the human gas exchange system.

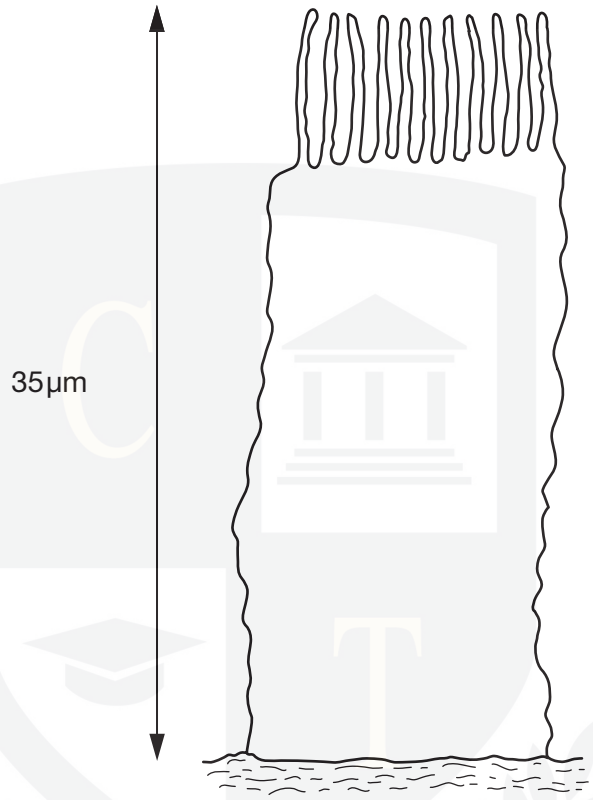

Fig. 1.1

(a) (i) Inside the ciliated cell in Fig. 1.1, draw the nuclear envelope and a mitochondrion as they would be seen with an electron microscope.

Label these structures. [3]

(ii) Calculate the magnification of the ciliated cell in Fig. 1.1.

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

magnification = ... [2]

Fig. 1.2 is a drawing of *Mycobacterium tuberculosis*.

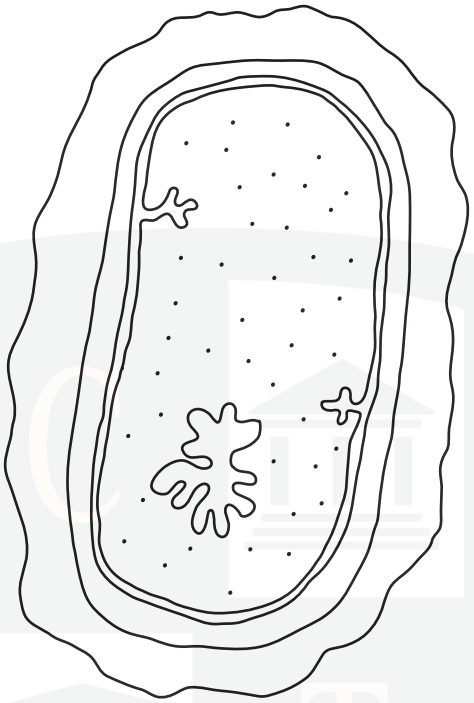

Fig. 1.2

(b) State three structural features that are found in **both** *M. tuberculosis* and animal cells, such as the ciliated cell in Fig. 1.1.

1. .....

2. .....

3. .....[3]

(c) Describe how *M. tuberculosis* is transmitted from an infected person to an uninfected person.

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.....[2]

Table 1.1 shows the numbers of new cases of tuberculosis (TB) and the death rates from TB in selected countries in 2005. The fatality ratio is the number of deaths as a proportion of the number of new cases.

Table 1.1

country	number of new cases per 100 000 people	number of deaths per 100 000 people	fatality ratio
China	100	16	0.16
Pakistan	181	37	0.20
South Africa	600	71	0.12
Uganda	369	91	
United Kingdom	14	1	0.07
United States of America	5	0	0.00

(d) Complete Table 1.1 by calculating the fatality ratio for Uganda.

Enter your result in Table 1.1. [1]

(ii) Suggest why fatality ratios are higher in some of the countries shown in Table 1.1 than in others.

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..... [4]

[Total: 15]