Chapter 11

Gas exchange in humans

01. 0610_s20_qp_41 Q: 1

The gas exchange system is one of the organ systems of the human body.

Fig. 1.1 shows parts of the gas exchange system during breathing in and breathing out.

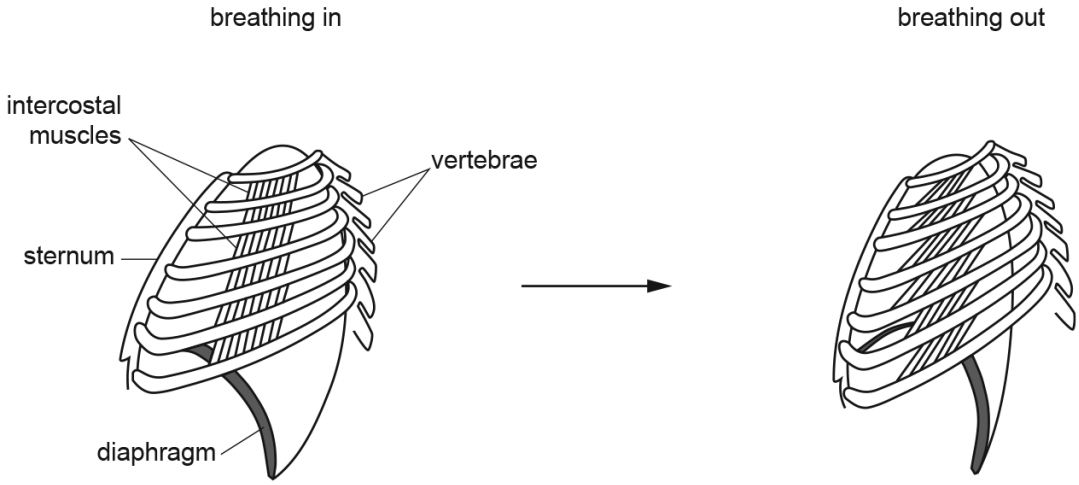

Fig. 1.1

(a) Complete Table 1.1 to show:

- the functions of the diaphragm and the intercostal muscles during breathing in and breathing out
- the pressure changes in the thorax.

Use these words:

contract
relax
increases
decreases.

Table 1.1

	diaphragm	intercostal muscles		pressure change in the thorax
		internal	external	
breathing in				
breathing out				

[4]

Fig. 1.2 shows part of the gas exchange surface of a human.

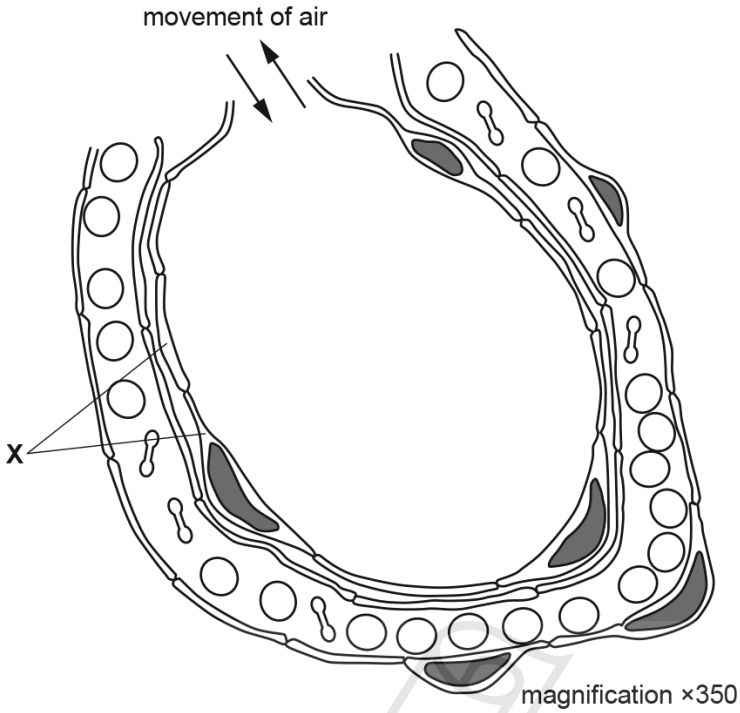

Fig. 1.2

(b) State **two** features of the gas exchange surface that are **visible** in Fig. 1.2.

1 .....

2 .....

[2]

(c) The cells labelled **X** on Fig. 1.2 form a tissue.

(i) Define the term *tissue*.

.....

.....

.....

.....

..... [2]

(ii) Cartilage is another tissue found in the gas exchange system.

State the functions of cartilage in the gas exchange system.

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..... [2]

[Total: 10]

02. 0610_s17_qp_42 Q: 3

Heart rate is influenced by electrical impulses from the brain.

(a) State the name of the type of cell that conducts electrical impulses to the heart.

.....[1]

(b) The electrical activity of the heart can be recorded on an ECG.

Fig. 3.1 shows an ECG of one heartbeat.

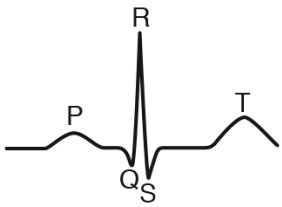

Fig. 3.1

(i) Table 3.1 shows how the electrical activity, during one heartbeat, corresponds to the opening and closing of the valves in the heart.

Complete Table 3.1 using the words 'open' and 'closed'.

Table 3.1

part of the ECG shown in Fig. 3.1	result of electrical activity	atrioventricular valves	semilunar valves
P	atria contract		
QRS	ventricles contract		
T	atria and ventricles relax		

[3]

(ii) State the function of heart valves.

.....

.....[1]

(c) Fig. 3.2 shows the ECG of an athlete before and during exercise.

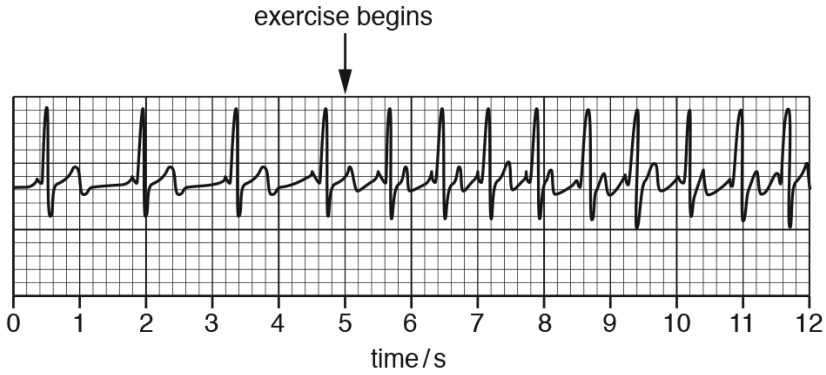

Fig. 3.2

(i) Calculate the heart rate, in beats per minute, **before** exercise begins.

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

.....beats per minute
[2]

(ii) Using Fig. 3.2, describe how the electrical activity of the heart during exercise differs from the electrical activity before exercise begins.

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.....

.....[3]

(iii) Describe how the ventilation of the lungs will change while the athlete exercises.

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.....[2]

[Total: 12]

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03. 0610_w17_qp_41 Q: 2

A group of students planned an investigation to determine the effects of physical activity on breathing rate.

(a) Describe how the students could measure their breathing rates.

.....

.....

.....[2]

(b) The students measured their breathing rates before physical activity and every minute for five minutes after cycling around the school field.

Write a hypothesis for their investigation.

.....

.....

.....[2]

(c) Fig. 2.1 shows a woman on a stationary bicycle. The mask fitted over her nose and mouth measures the composition of the air she breathes out.

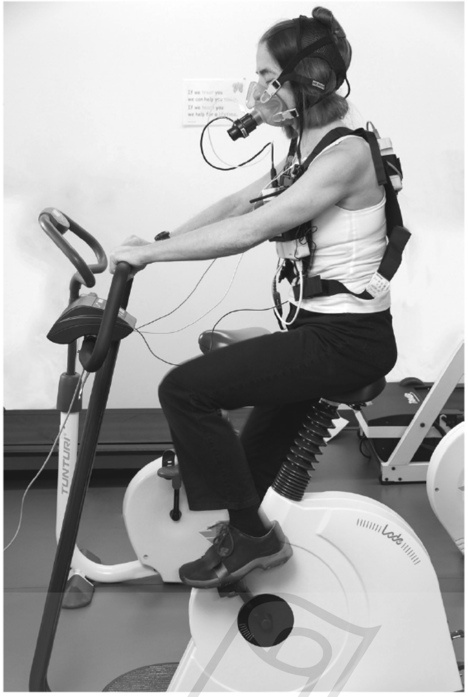

Fig. 2.1

Fig. 2.2 shows the concentration of carbon dioxide in the air expired by the woman in the five minutes after she stopped exercising.

The dashed line on the graph shows the concentration of carbon dioxide in her expired air when she was at rest, before she began to exercise.

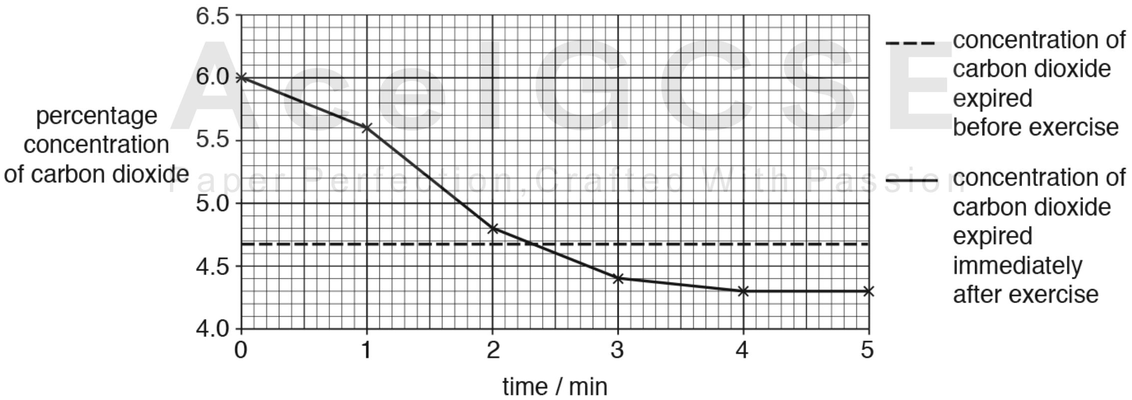

Fig. 2.2

Describe **and** explain the results of the investigation shown in Fig. 2.2.

Use the data in Fig. 2.2 in your answer.

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.....[6]

(d) Before starting the investigation, the researchers confirmed that the woman did not have coronary heart disease.

(i) Suggest why.

.....

.....[1]

(ii) Explain why exercise is recommended for people with a high risk of developing coronary heart disease.

.....

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.....

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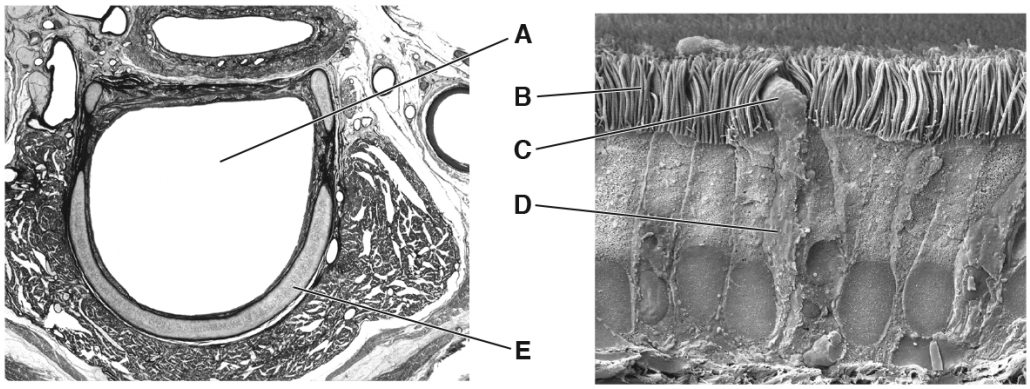
.....[3]

[Total: 14]

04. 0610_w17_qp_43 Q: 1

Fig. 1.1 shows two photomicrographs of a cross-section of trachea.



low magnification high magnification

Fig. 1.1

(a) The open space at the centre of the trachea is labelled **A** in Fig. 1.1.

Air travels into and out of the trachea through this open space.

State a gas that is at a higher concentration in expired air than in inspired air.

.....[1]

(b) Describe **and** explain the functions of the structures or substances labelled **B** to **E** in Fig. 1.1.

Use the letters in Fig. 1.1 in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(c) Fig. 1.2 shows some events during inspiration.

P	pressure in the thorax decreases
Q	air travels down the trachea
R	air enters the bronchi
S	air travels through the larynx
T	air enters the nose
U	the ribcage moves upwards and outwards
V	air enters the alveoli

Fig. 1.2

(i) Put the events shown in Fig. 1.2 into the correct sequence. Two have been done for you.

		T				**V**

[2]

(ii) Suggest why alveoli have thin walls.

.....

.....

.....

.....[2]

(d) Sickle-cell anaemia is a disease that reduces the delivery of oxygen to tissues.

Explain why.

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.....

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.....

.....

.....[3]

[Total: 12]

05. 0610_s16_qp_43 Q: 1

(a) Fig. 1.1 shows the human gas exchange system. The functions of the parts of the gas exchange system are given in Table 1.1.

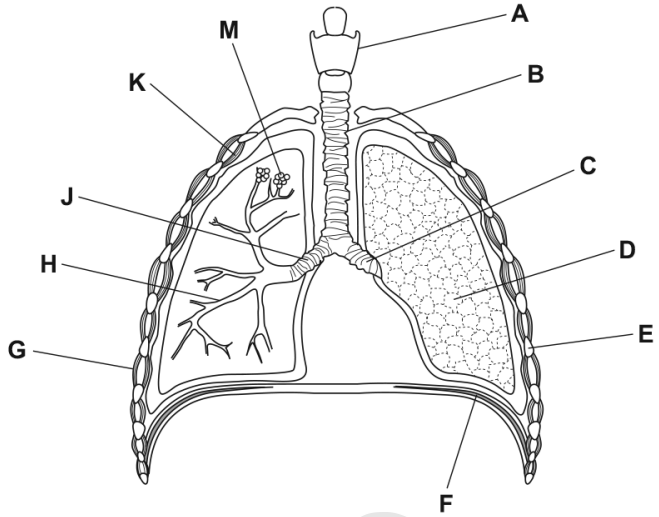

Fig. 1.1

Complete Table 1.1. One row has been done for you.

Table 1.1

function	letter on Fig. 1.1	name
structure that makes sounds	**A**	larynx
bone that provides protection for the lungs		
airway that allows passage of air only into the right lung		
airway that allows passage of air into both lungs		
contracts to increase volume of thorax		
muscle that contracts to lower the ribcage		
site of gas exchange		

[6]

(b) The gas exchange system contains cartilage.

Describe the function of cartilage in the gas exchange system.

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.....

..... [2]

(c) Soon after starting physical activity the concentration of carbon dioxide in the blood increases.

(i) Name the process inside cells that produces carbon dioxide.

.....

..... [1]

(ii) State the effect on breathing of an increase in carbon dioxide concentration in the blood.

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.....

..... [1]

(iii) Explain how this effect on breathing is coordinated.

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.....

.....

..... [3]

[Total: 13]

01. 0610_s20_MS_41 Q: 1

<table>
<tr><td>(a)</td><td>one mark for each column:
<table>
<tr><th></th><th rowspan="2">diaphragm</th><th colspan="2">intercostal muscles</th><th rowspan="2">pressure change in the thorax</th></tr>
<tr><th>internal</th><th>external</th></tr>
<tr><td>breathing in</td><td>contract</td><td>relax</td><td>contract</td><td>decreases (A increases)</td></tr>
<tr><td>breathing out</td><td>relax</td><td>contract / relax</td><td>relax</td><td>increases (A decreases)</td></tr>
</table>;;;;</td><td>4</td></tr>
<tr><td>(b)</td><td>any two from:
thin / short distance (for diffusion) ;
well supplied by blood / surrounded by capillaries / AW ;
good ventilation with air ;</td><td>2</td></tr>
<tr><td>(c)(i)</td><td>a group of cells with similar structures ;
working together to perform a shared function ;</td><td>2</td></tr>
<tr><td>(c)(ii)</td><td>any two from:
forms incomplete rings around, trachea / bronchi ;
keeps (named) airways open ;
reduces resistance to movement of air ;
protects (named) airways ;
sound production in larynx ;</td><td>2</td></tr>
</table>

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02. 0610_s17_MS_42 Q: 3

<table>
<tr><th></th><th>Answer</th><th>Mark</th><th>Partial Marks</th></tr>
<tr><td>(a)</td><td>(motor / effector) neuron(e) / nerve (cell) ;</td><td>1</td><td>R relay / sensory / SAN / pacemaker</td></tr>
<tr><td>(b)(i)</td><td><table>
<tr><th>position on Fig. 3.1</th><th>result of electric activity</th><th>atrioventricular valves</th><th>semilunar valves</th></tr>
<tr><td>P</td><td>atria contract</td><td>open</td><td>closed ;</td></tr>
<tr><td>QRS</td><td>ventricles contract</td><td>closed</td><td>open ;</td></tr>
<tr><td>T</td><td>atria and ventricles relaxed</td><td>open</td><td>closed ;</td></tr>
</table></td><td>3</td><td>one mark per row</td></tr>
<tr><td>(b)(ii)</td><td>to prevent backflow / AW ;
ensures one-way flow of blood (through the heart) ;</td><td>1</td><td>I pressure changes</td></tr>
<tr><td>(c)(i)</td><td>43 ;;
OR
48 ;;</td><td>2</td><td>one mark for correct working if value incorrect</td></tr>
<tr><td>(c)(ii)</td><td>1 increased electrical activity during exercise ; ora
2 comparative data before ;
3 no / small, difference in, height of peak / amplitude ;
4 waves closer together during exercise / S–T interval is shorter ;</td><td>3</td><td></td></tr>
<tr><td>(c)(iii)</td><td>deeper (breaths) / increased volume (of lung) ;
faster (rate) ;
AVP ;</td><td>2</td><td></td></tr>
</table>

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03. 0610_w17_MS_41 Q: 2

	Answer	Mark	Partial Marks
(a)	watch chest / abdomen, rise and fall / use a spirometer ; ref. to time / in one minute ;	2	
(b)	exercise will increase breathing rate ; after exercise the breathing rate, will start decreasing / levels off ;	2	
(c)	*description* carbon dioxide constant / at 4.7% , before exercise ; carbon dioxide highest / higher, at 6.0% / (immediately) after exercise ; decreases; falls below resting level / AW ; comparative data quote ; *explanation* removal of excess carbon dioxide ; more energy used during exercise means higher rates of respiration ; aerobic respiration releases carbon dioxide ; oxygen not supplied fast enough (from lung / heart) / more oxygen required by muscles ; oxygen debt ; anaerobic respiration (in muscles) ; (produces) lactic acid / lactate; lactic acid is, broken down / respired / converted to glucose / converted to carbon dioxide ;	6	**A** 4.6%.
(d)(i)	safety risk (not to over exercise) ; CHD could change the expected result (for healthy people) ; she does not show (named) risk factor ;	1	**A** suitable suggestion related to CHD **I** 'danger' unqualified
(d)(ii)	prevents blocked arteries / prevents thrombus formation ; lowers blood pressure ; lowers cholesterol / lowers fats / reduces risk of atheroma ; weight loss / using fats / avoids obesity ; lowers stress ; (heart) muscle stronger / lower (resting) pulse ;	3	**A** increased stroke volume

04. 0610_w17_MS_43 Q: 1

	Answer	Mark	Partial Marks
(a)	carbon dioxide / CO_2 ; water (vapour) ;	1	
(b)	1 **B** are cilia ; 2 **C** is mucus ; 3 **C / D**, are goblet cells ; 4 **E** is cartilage ; 5 **B** / cilia, waft / beat, mucus / **C** (up / out of, the airway) ; 6 **C / D** / goblet cells, secrete, mucus / **C** ; 7 **C** / mucus, traps, particles / pathogens ; 8 **B / C / D** / AW, prevent infections ; 9 **E** / cartilage, keeps the, airway / trachea, open ;	6	max 2 marks for labels **A** prevent collapse
(c)(i)	**U** **P ;** **T** **S** **Q** **R ;** **V**	2	
(c)(ii)	1 for, gas exchange / diffusion / movement of CO_2 and O_2 ; 2 short distance (for diffusion / gas exchange) ; 3 fast (gas exchange / diffusion) ;	2	
(d)	1 haemoglobin is, abnormal / rigid / AW ; 2 abnormal haemoglobin carries less oxygen (than normal haemoglobin) ; **ora** 3 red blood cells are, sickle shaped / AW ; 4 (sickle cells) stick together / clot (in blood vessels) ; 5 fewer red blood cells ;	3	**A** abnormal haemoglobin does not carry O_2 **A** not biconcave **A** blocked vessels / stuck / more red blood cells broken down

<table>
<tr><th></th><th>Answer</th><th>Mark</th><th>Partial Marks</th></tr>
<tr><td>(a)</td><td>
<table>
<tr><th>function</th><th>letter</th><th>name</th></tr>
<tr><td>structure that makes sounds</td><td>A</td><td>larynx</td></tr>
<tr><td>bone that provides protection for the lungs</td><td>E</td><td>rib;</td></tr>
<tr><td>airway that allows passage of air only into the right lung</td><td>J</td><td>bronchus ;</td></tr>
<tr><td>airway that allows passage of air into both lungs</td><td>B</td><td>trachea ;</td></tr>
<tr><td>contracts to increase the volume of the thorax</td><td>F/G</td><td>(F) diaphragm/ (G) external intercostal muscle ;</td></tr>
<tr><td>muscle that contracts to lower the ribcage</td><td>K</td><td>internal intercostal muscles ;</td></tr>
<tr><td>site of gas exchange</td><td>M</td><td>alveoli ;</td></tr>
</table>
</td><td>[6]</td><td></td></tr>
<tr><td>(b)</td><td>keeps, airways/trachea/bronchi, open;
allows (free flow of) air into (the lungs);
allows flexibility/can breathe even when, bent/swallowing/AW ;
AVP;</td><td>[max 2]</td><td>I protection</td></tr>
<tr><td>(c) (i)</td><td>(aerobic) respiration;</td><td>[1]</td><td>R anaerobic respiration</td></tr>
<tr><td>(ii)</td><td>rate (of breathing) increases;</td><td>[1]</td><td>R it increase
A it's faster / deeper</td></tr>
<tr><td>(iii)</td><td>stimulus (is CO_2); A acidic/pH, of blood decreases;
(CO_2 / pH) detected by the brain ;
by a receptor;
ref to (named) neurone in context ;
brain sends impulses to, (intercostal) muscles/diaphragm/effectors ;
(intercostal) muscles/diaphragm/effectors, contract more (frequently) ;
negative feedback/homeostasis;
reflex/automatic/involuntary;</td><td>[max 3]</td><td></td></tr>
<tr><td></td><td></td><td>[Total: 13]</td><td></td></tr>
</table>