Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Respiration and gas exchange

Time allowed: 1 hour 35 minutes

Subject code **0610**

Biology

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 96

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 96 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 Choose words from the list to complete the sentences about respiration.

Each word may be used once, more than once or not at all.

alcohol **carbon dioxide** **glucose**

glycerol **lactic acid** **oxygen** **water**

During exercise muscle cells can respire anaerobically and convert ..... to ..... .

When yeast cells respire anaerobically they produce ..... and ..... .

[4]

[Total: 4]

Aerobic and anaerobic respiration Click for more variations

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1	glucose ; lactic acid ; alcohol ; carbon dioxide ;	**4**	

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2 Inhaled air differs in composition from exhaled air.

Table 3.1 shows some of these differences.

Table 3.1

	inhaled air	exhaled air
temperature	varies	body temperature
oxygen	higher	lower
carbon dioxide		
water vapour		

(a) Complete Table 3.1, to show the difference in composition of inhaled and exhaled air for carbon dioxide **and** water vapour.

Write your answers in Table 3.1. [2]

(b) Describe how you could test for the presence of:

(i) carbon dioxide;

test .....

result ..... [2]

(ii) water vapour.

test .....

result ..... [2]

[Total: 6]

Gas exchange and breathing Click for more variations

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2 **(a)**	*carbon dioxide* – 0.04% / lower and 4.0% / higher; *water* – varies due to humidity of surroundings / AW and more / saturated;	[2]	
(b) (i)	*test* – limewater ; *results* – clear / colourless / transparent to cloudy;	[2]	**A.** hydrogen carbonate solution – red to yellow. initial colour must be given
(ii)	*test* – (anhydrous) copper sulphate / cobalt chloride; *results* – white to blue for copper sulphate blue to pink for cobalt chloride;	[2]	
		[Total: 6]	

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3 **(a)** Fig. 5.1 is a diagram of the human gas exchange system.

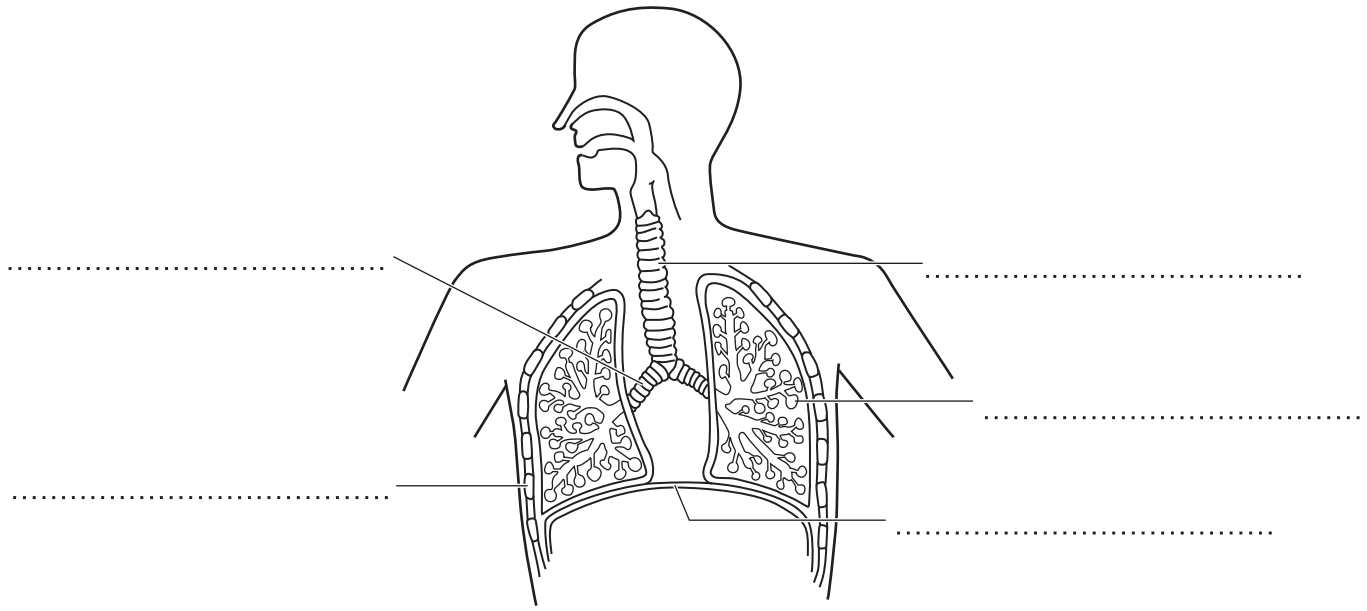


Fig. 5.1

The list shows the names of some of the parts of the human gas exchange system.

alveolus **bronchiole** **bronchus** **diaphragm**

larynx **rib** **trachea**

Use the words from the list to label Fig. 5.1.

You do not need to use every word.

Write your answers on the answer lines provided in Fig. 5.1. [5]

(b) State the name of the part of the body through which air enters and leaves.

..... [1]

(c) Complete the sentences about the differences between inspired and expired air.

Inspired air contains ..... oxygen than expired air.

Inspired air contains ..... carbon dioxide than expired air.

The concentration of water ..... in inspired and expired air varies. [3]

(d) Carbon dioxide is one of the components of inspired and expired air.

State the name of the chemical used to test for the presence of carbon dioxide.

..... [1]

[Total: 10]

Gas exchange and breathing Click for more variations

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3(a)	*diagram correctly labelled clockwise from top right:* trachea ; alveolus ; diaphragm ; rib ; bronchus ;	5	
3(b)	mouth / nose ;	1	
3(c)	more ; less ; vapour / molecules ;	3	
3(d)	limewater ;	1	

4 **(a)** Fig. 5.1 is a diagram of a cell carrying out one type of respiration.

The arrows show the direction of movement of the substances involved in respiration in this type of cell.

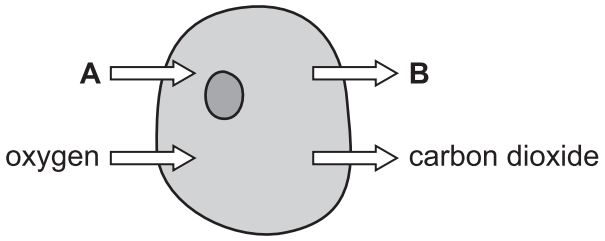


Fig. 5.1

(i) State the type of respiration shown by Fig. 5.1.

..... [1]

(ii) Identify the substances involved in respiration that are represented by the letters **A** and **B** in Fig. 5.1.

A .....

B .....
[2]

(iii) State the process by which oxygen moves into the cell.

..... [1]

(b) State **three** processes that require energy from respiration.

1 .....

2 .....

3 .....
[3]

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(c) Some students investigated the effect of temperature on respiration in yeast.

- The students put a beaker containing 20 cm^3 of a yeast suspension into a water-bath at different temperatures.
- They collected the gas released by the yeast cells in a gas syringe.
- They recorded the volume of gas released after 15 minutes.

Table 5.1 shows the results.

Table 5.1

temperature / °C	volume of gas collected in 15 minutes / cm^3
0	0.5
10	2.8
20	5.6
30	9.2
40	18.2
50	16.3
60	10.4
70	0.3
80	0.1
90	0.1

Using the data in Table 5.1, describe the effect of temperature on the rate of respiration in yeast.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

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Aerobic and anaerobic respiration Click for more variations

4(a)(i)	aerobic ;	**1**	
4(a)(ii)	**A** glucose ; **B** water ;	**2**	
4(a)(iii)	diffusion ;	**1**	
4(b)	*any three from:* active transport ; cell division ; growth ; maintain body temperature ; muscle contraction ; passage of nerve impulses ; protein synthesis ; AVP ;;	**3**	
4(c)	*any three from:* rate of respiration increases then decreases as temperature increases ; peak rate / optimum, at 40°C ; rate / gas production, very low / AW, after 60°C ; rate / gas production, the same / 0.1 at 80°C and 90°C ; data manipulation ;	**3**	e.g. rate doubles from 10°C to 20°C

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5 **(a)** Use words from the list to complete the definition of ***anaerobic*** *respiration*.

Each word may be used once, more than once or not at all.

carbon dioxide **cells** **chemical** **chloroplasts** **energy**

nucleus **nutrient** **oxygen** **physical**

The ..... reactions in ..... that break down .....

molecules to release energy without using ..... . [4]

(b) 100 g of glucose releases 1600 kJ of energy during aerobic respiration.

The energy released during anaerobic respiration is only 5% of the energy released during aerobic respiration.

(i) Calculate the energy released from 100 g of glucose during **anaerobic** respiration.

Show your working.

..... kJ
[2]

(ii) State **two** substances made by **aerobic** respiration.

1 .....

2 .....
[2]

(iii) State **three** uses of the energy released by respiration in the body.

1 .....

2 .....

3 .....
[3]

(c) State **one** way anaerobic respiration in muscles during vigorous exercise differs from the anaerobic respiration that occurs in yeast.

.....

.....

.....[1]

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(d) State **one** industrial process that uses anaerobic respiration in yeast.

.....

.....[1]

[Total: 13]

Aerobic and anaerobic respiration Click for more variations

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5(a)	chemical ; cells ; nutrient ; oxygen ;	**4**	
5(b)(i)	80 (kJ) ;;	**2**	1 mark for correct working if answer wrong 1600 x 0.05 or equivalent calculation
5(b)(ii)	carbon dioxide ; water ;	**2**	either order
5(b)(iii)	muscle contraction / muscle doing work / (muscle) movement ; metabolism / enzyme reactions / chemical reactions / digestion; protein synthesis ; cell division / cell repair; active transport ; growth ; passage of nerve impulses ; maintenance of a constant body temperature ; excretion;	**3**	**I** exercise **A** reproduction **A** shivering / keep warm / homeostasis
5(c)	(muscle produces) lactic acid ; **ora** **or** (muscle) does not produce carbon dioxide / ethanol / alcohol ; **ora**	**1**	**A ora** only if yeast stated
5(d)	brewing / making alcoholic drinks / making beer / bread-making / biofuels / making ethanol / making carbon dioxide ;	**1**	**A** fermentation

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

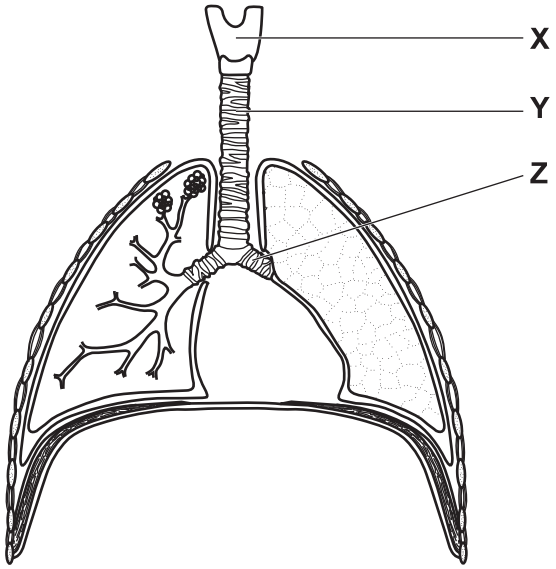


Fig. 5.1

(a) (i) Identify the parts of the gas exchange system labelled **X**, **Y** and **Z** in Fig. 5.1.

X .....

Y .....

Z .....

[3]

(ii) State the name of the tissue that prevents the collapse of **Y** and **Z** during breathing.

..... [1]

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(b) Breathing involves the movement of the ribs and the diaphragm.

Describe the process of **inspiration**.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(c) State the name of the gas exchange surface in the lungs.

..... [1]

[Total: 9]

Gas exchange and breathing Click for more variations

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6(a)(i)	**X** – larynx ; **Y** – trachea ; **Z** – bronchus ;	**3**	
6(a)(ii)	cartilage ;	**1**	
6(b)	*any four from:* **1** external intercostal muscles contract (and internal intercostal muscles relax) ; **2** lifts ribs, upwards / outwards; **3** diaphragm, contracts / flattens; **4** volume of, thorax, increases ; **5** pressure in, thorax, decreases ; **6** causing air to flow, down a pressure gradient / into the lungs / lungs inflate ; **7** equalising pressure between atmosphere and lungs ;	**4**	
6(c)	alveoli / alveolus ;	**1**	

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7 The ribcage and diaphragm are involved in the breathing mechanism to ventilate the lungs.

Fig. 3.1 is a flow chart that shows the changes that take place when breathing in.

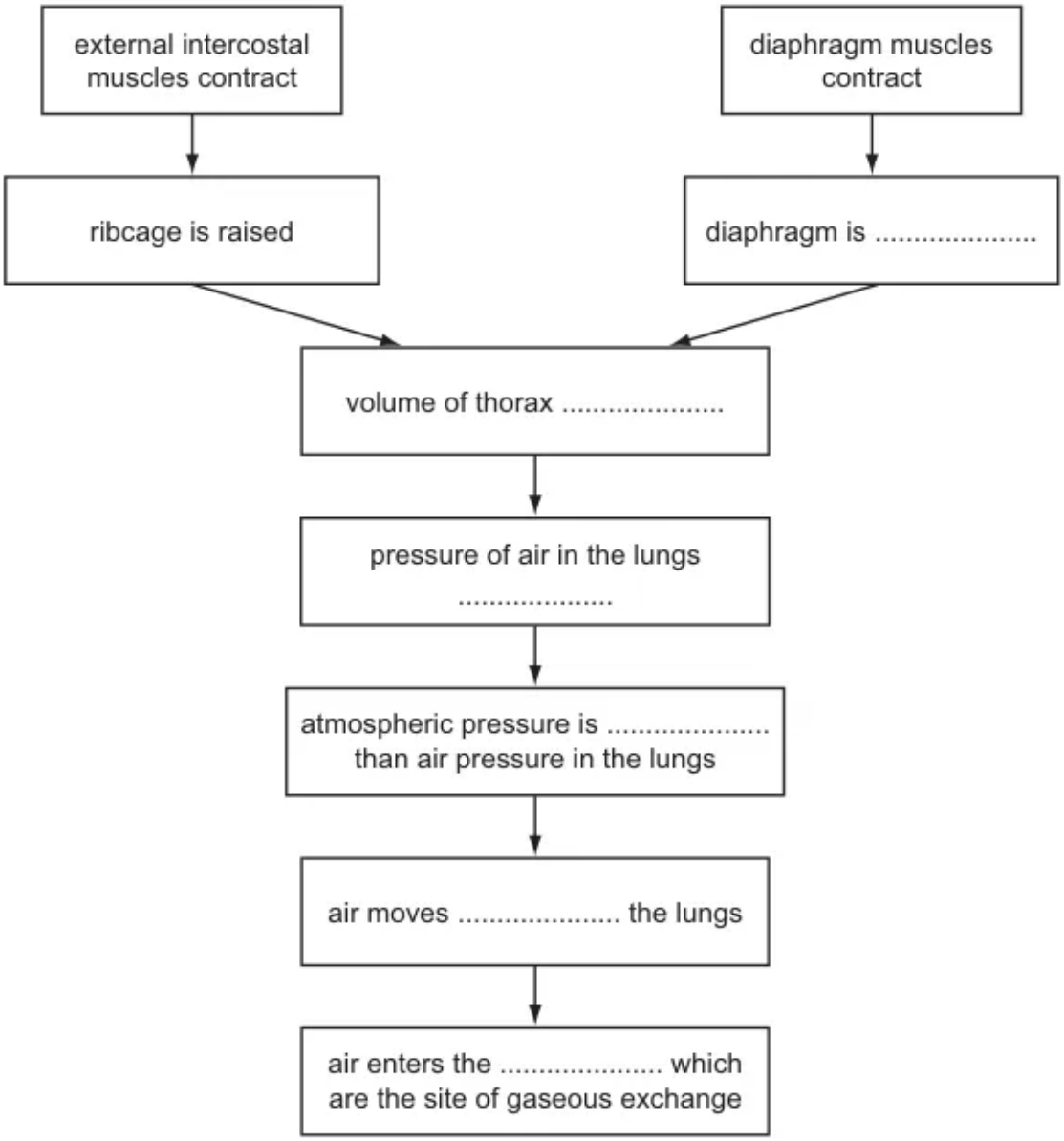


Fig. 3.1

(a) Complete Fig. 3.1 by writing appropriate words in the spaces provided. [6]

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(b) Fig. 3.2 shows part of the epithelium that lines the trachea.

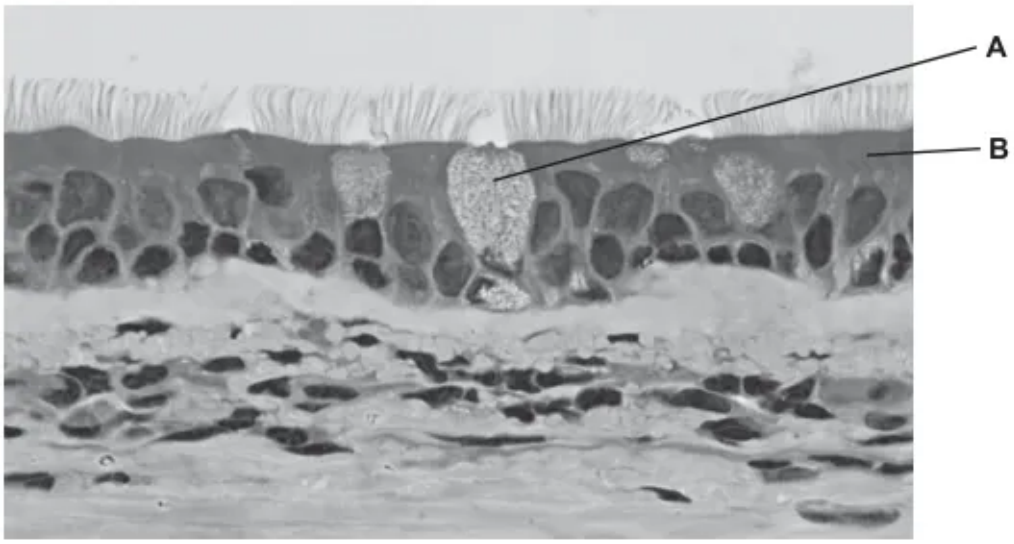


Fig. 3.2

Explain how the cells labelled **A** and **B** in Fig. 3.2 protect the gas exchange system.

A .....

.....

.....

.....

B .....

.....

.....

..... [4]

[Total: 10]

Gas exchange and breathing Click for more variations

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7	**(a)**	lowered / flattened / AW ; increases / AW ; decreases / AW ; higher / greater / more ; into / inside; alveoli ;	6	
	(b)	(**A** / goblet cell) secretes / produces, mucus ; sticky ; collects / traps, particles (in the air) ; cilia, move / beat / waft; mucus moves / removes, away from alveoli / out of trachea / towards larynx / towards mouth / AW ;	max 4	***ignore*** hairs direction needed
			[Total: 10]	

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8 **(a)** Fig. 1.1 shows the human head, neck and thorax.

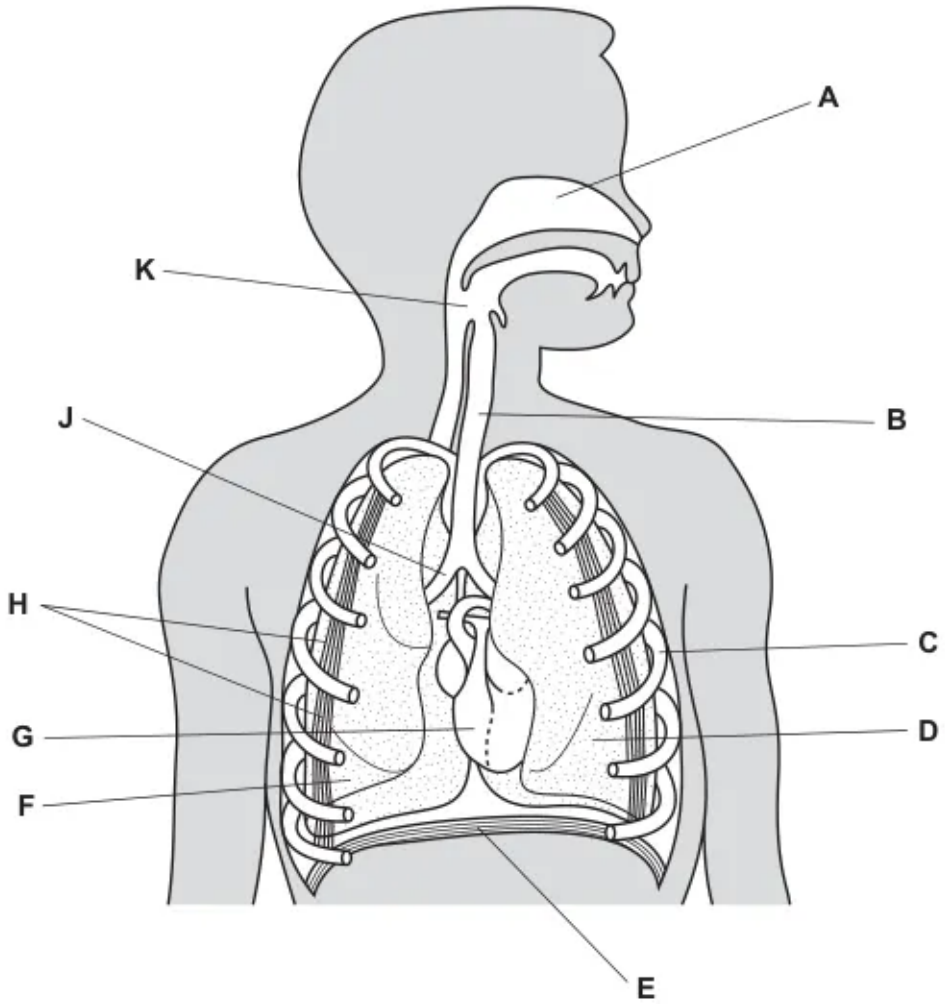


Fig. 1.1

Complete Table 1.1 by writing **one** letter from Fig. 1.1 to identify the named structures.

The first one has been done for you.

Table 1.1

structure	letter from Fig. 1.1
left lung	**D**
bronchus	
diaphragm	
intercostal muscle	
rib	
trachea	

[5]

(b) In an investigation, a student breathed in and out of the apparatus shown in Fig. 1.2.

Valve **X** opens to allow atmospheric air in while valve **Y** is closed.

When the student breathes out, valve **X** is closed and valve **Y** opens to allow breathed out air into the bag.

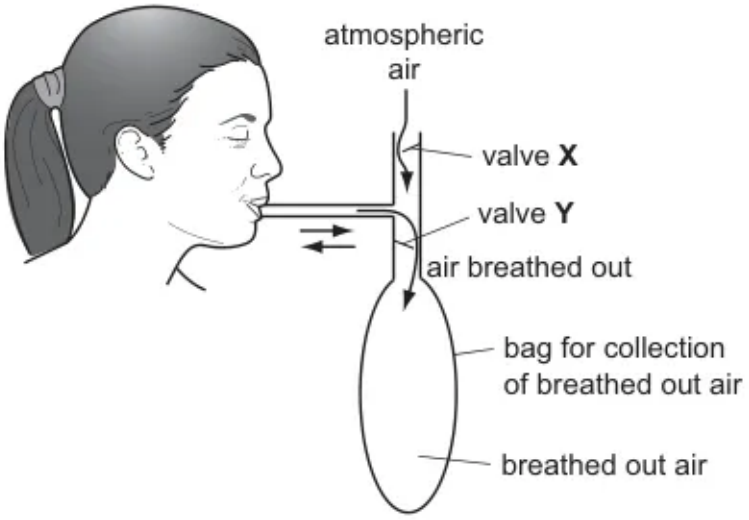


Fig. 1.2

The student breathed in and out **four times**. The bag was sealed and the volume of air inside the bag was measured.

A sample of air from the bag was analysed for the percentage composition of oxygen, carbon dioxide and nitrogen.

The student then did some vigorous exercise for five minutes. After the exercise, the student repeated the procedure.

The results of the investigation are shown in Table 1.2.

Table 1.2

	sample of breathed out air	
	before exercise	after exercise
total volume of air collected in bag / cm^3	2000	15000
mean volume of air per breath / cm^3	500	
percentage of oxygen / %	17.2	15.3
percentage of carbon dioxide / %	3.6	5.5
percentage of nitrogen / %	74.9	74.7

(i) Calculate the mean volume of air per breath after exercise.

Write your answer in Table 1.2.

Show your working.

[1]

(ii) Suggest **one** way, **not shown** in **Table 1.2**, in which the student's breathing changed after exercise.

.....

..... [1]

(iii) The figures in Table 1.2 for the percentage composition of air in each sample do not add up to 100 %.

Name **one** other gas that would be present in **both** samples of air.

..... [1]

(iv) The results for oxygen and carbon dioxide in the samples of breathed out air taken before and after exercise are different.

Describe **and** explain these differences.

.....

.....

.....

.....

.....

..... [3]

[Total: 11]

Gas exchange and breathing Click for more variations

STEM | Exa

8 (a)

structure	letter from Fig. 1.1
left lung	**D**
bronchus	**J**
diaphragm	**E**
intercostal muscle	**H**
rib	**C**
trachea	**B**

[5]

Only one letter per box; if more than one letter no mark

If letter crossed out but not rewritten mark it

JEHCB

(b) (i) 3750 ; *no mark for working alone* [1]

if the answer is not in the table look for it in the space for working

(ii) number of breaths (per minute) / different rate of breathing ;
exhaled breath has a higher temperature ; [max 1]

A faster, slower, change in frequency
ignore depth (as in the table) / heavier

(iii) water vapour / H_2O / any **named** rare *or* inert gas *or* pollutant ; [1]

names, correct symbols or formulae for any of the following: H_2, Ar, He, Xe, Ne, Rn, Kr, SO_2, O_3, CO, NO_2, N_2O, CH_4, NH_3, I_2

(iv)

in breathed out air

1 after exercise less oxygen and more carbon dioxide / ora ;
2 use of data with % to quantify (for either oxygen or carbon dioxide) ;

explanation in terms of the following increasing

3 more oxygen, absorbed / is needed / used up ;
4 more carbon dioxide, produced ;
5 more gas exchange ;
6 more respiration ; **R** more anaerobic respiration
7 more energy required ;
8 repaying / AW, oxygen debt ; [max 3]

MP2
oxygen – 17.2 to 15.3% / 1.9%
carbon dioxide – 3.6 to 5.5% / 1.9%

R inhaled
R exhaled
R produce energy

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9 **(a)** State the balanced chemical equation for aerobic respiration.

.....[2]

(b) Researchers in the Czech Republic investigated oxygen consumption in horses. They measured the oxygen consumption of the horses while they were exercising at four different paces: walking, trotting, cantering and galloping.

The results are shown in Fig. 5.1.

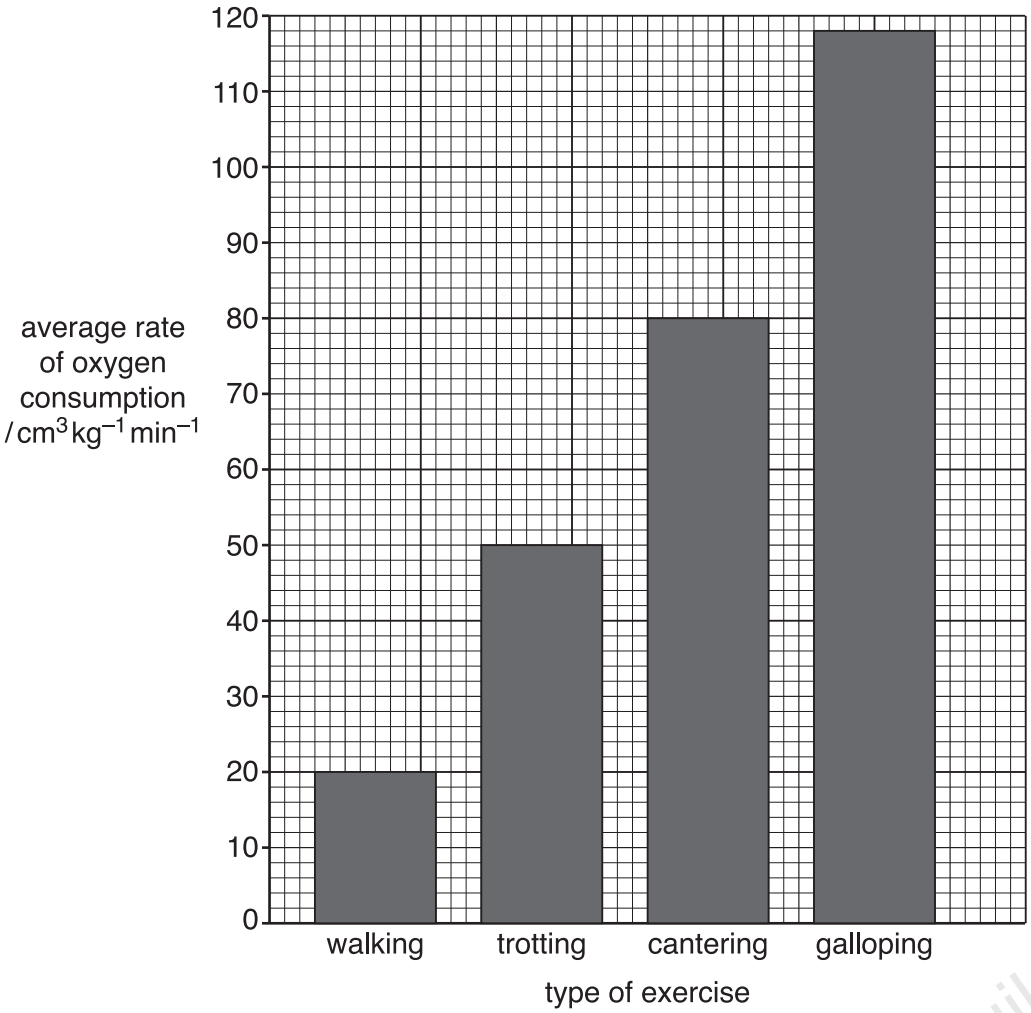


Fig. 5.1

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Calculate the percentage increase in the average rate of oxygen consumption as the horses change from walking to trotting.

Show your working.

..... %
[2]

(c) The researchers also calculated the oxygen debt for each type of exercise.

They found that the horses developed a larger oxygen debt when they exercised by galloping and cantering rather than when they walked.

Explain why the horses developed an oxygen debt when they exercised.

.....

.....

.....

.....

.....

.....

.....

.....[3]

(d) Describe how the horses would recover from an oxygen debt when they stop exercising.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

[Total:11]

Aerobic and anaerobic respiration Click for more variations

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9(a)	$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ energy released) ;;	**2**	one mark for correct symbols one mark for correct balancing
9(b)	150(%) ;;	**2**	one mark for correct working if answer wrong
9(c)	demand for, energy / oxygen, increases ; (rate of) respiration increases ; limited supply of oxygen to muscle (tissue) ; *idea that* heart / pulse / breathing, rate not increased enough ; muscles respire anaerobically ; lactic acid is produced ;	**3**	
9(d)	horses continue to breathe, at high rate / deeper ; continue with a high, heart / pulse, rate ; to provide, enough / AW, oxygen (to 'pay-off' the debt) ; lactic acid, moves / diffuses / AW, (from muscle) into blood ; lactic acid transported to the liver ; (in the liver) lactic acid is, broken down / oxidised / respired (aerobically) ;	**4**	

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10 **(a)** An athlete monitored their heart rate and breathing rate before, during and after vigorous exercise.

Fig. 6.1 shows the results.

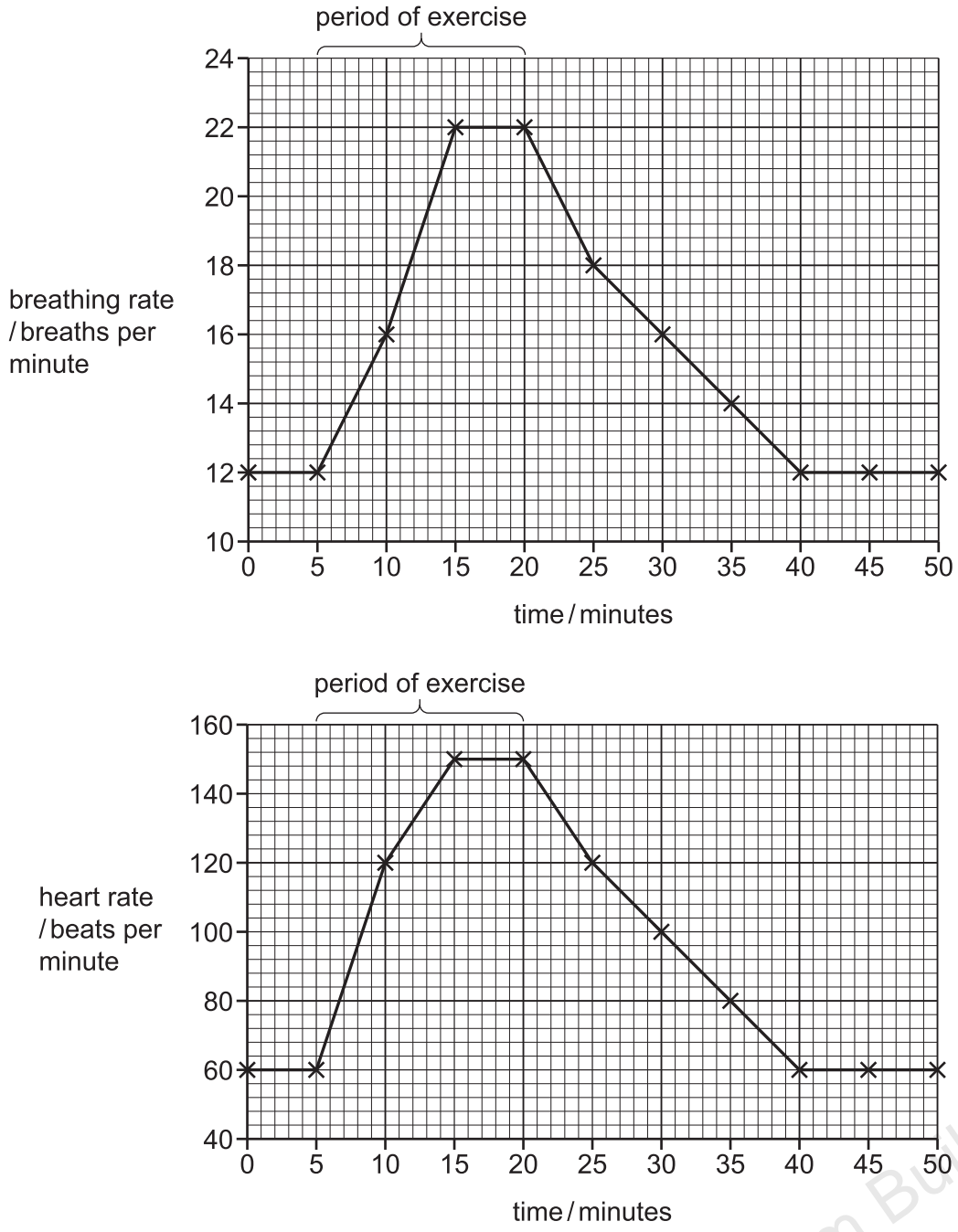


Fig. 6.1

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Complete the sentences to describe **and** explain the results shown in Fig. 6.1.

After exercise, it takes ..... minutes for the athlete's breathing rate to return to its resting rate.

The heart rate decreases by ..... beats per minute between 20 and 40 minutes.

The heart rate and breathing rate do not immediately return to their resting rates because anaerobic respiration has occurred.

Lactic acid has built up in ..... causing an oxygen ..... .

The heart rate remains high to transport lactic acid to the ..... .

The breathing rate remains high to supply ..... for the ..... respiration of lactic acid.

[7]

(b) The carbon dioxide produced during exercise is excreted. Urea is another substance that is excreted.

(i) State the name of the organ that produces urea.

..... [1]

(ii) State the name of the organ that excretes urea.

..... [1]

(c) State the balanced chemical equation for anaerobic respiration in yeast.

..... [2]

(d) State **one** food product that is made using anaerobic respiration in yeast.

..... [1]

[Total: 12]

Aerobic and anaerobic respiration Click for more variations

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10(a)	20 ; 90 ; muscles / blood ; debt ; liver ; oxygen ; aerobic ;	**7**	
10(b)(i)	liver ;	**1**	
10(b)(ii)	kidney ;	**1**	
10(c)	$C_6H_{12}O_6 \rightarrow$; $2C_2H_5OH + 2CO_2$;	**2**	products in either order
10(d)	bread / **AVP** ;	**1**	

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