OCR A-LEVEL BIOLOGY A · H420

BIOLOGY



EXAM QUESTION PACK

3.1.1 EXCHANGE SURFACES

SCORE	PERCENTAGE
/97	%

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1(a). Many teachers use models to demonstrate and explain breathing and lung function in mammals.

Fig. 2.1 is a model of the mammalian chest.

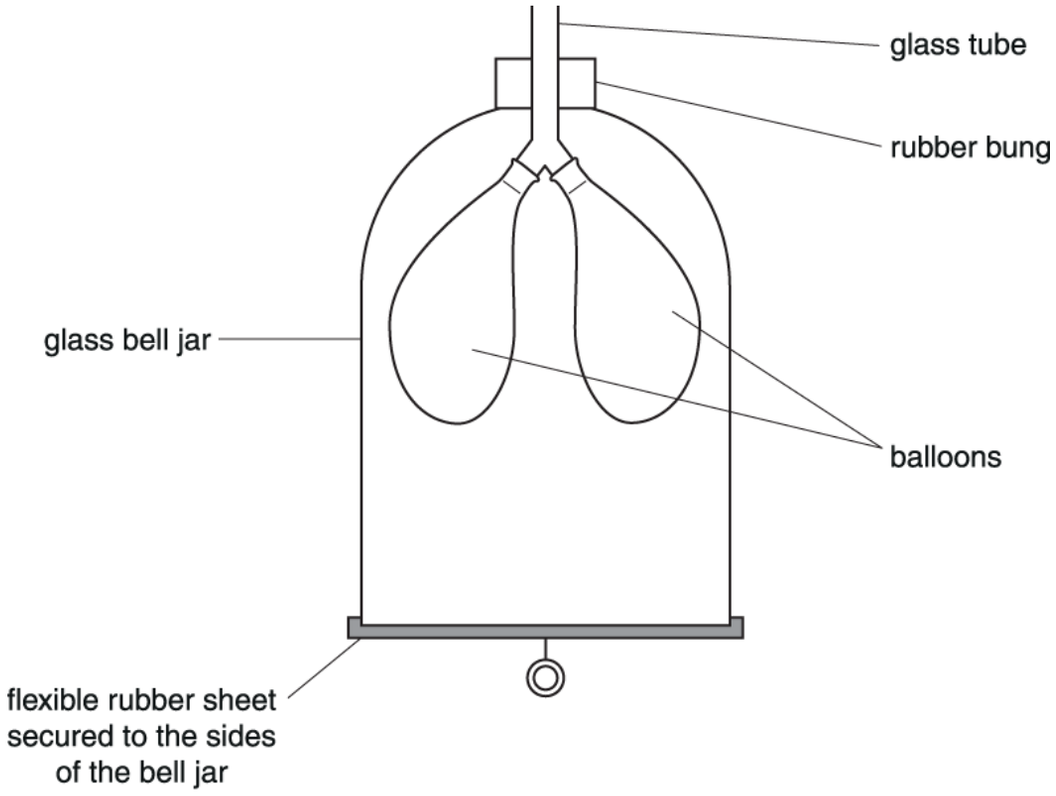


Fig. 2.1

When the rubber sheet is pulled down the balloons expand.

Explain why the balloons expand.

---

[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.*

---**[2]**

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

---**[2]**

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

---**[2]**

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

---**[1]**

2. State the correct term for the following definition.

The bulk transport of materials out of a cell.

---**[1]**

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3. The graph in Fig. 8.1 shows a normal spirometer trace.

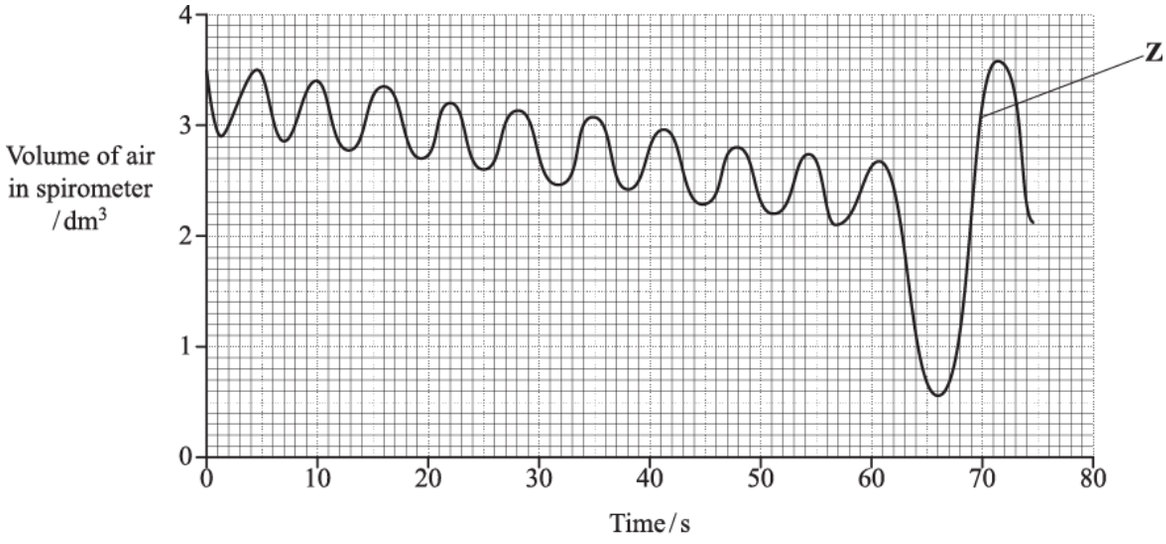


Fig. 8.1

Which option correctly describes what is happening at point **Z**?

A pressure inside lungs is low
B volume of thorax is large
C diaphragm is contracted
D internal intercostal muscles are contracted

Your answer ☐

[1]

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4. Emphysema is a chronic respiratory disease where elastase is produced by phagocytes in the lungs, which breaks down lung tissue. This means that a person with emphysema cannot fully exhale.

Fig. 15.1 is a diagram of a small section of a healthy lung.

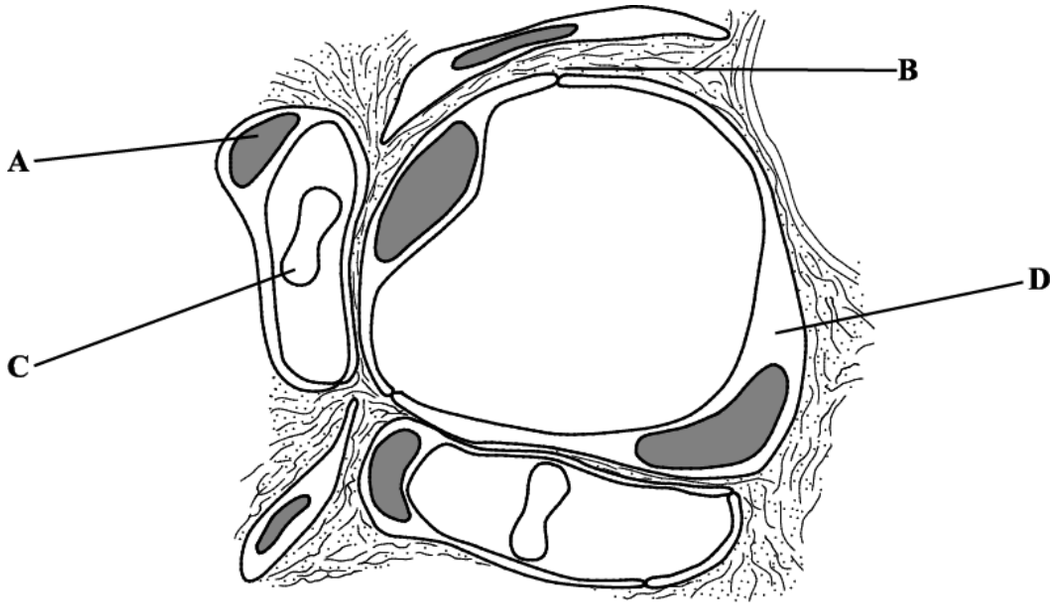


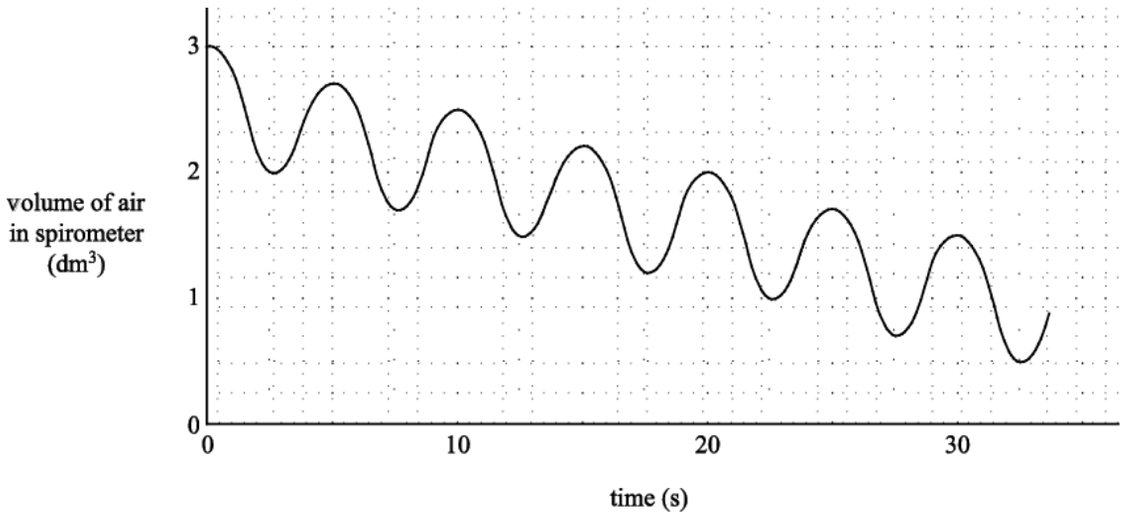
Fig. 15.1

Which label shows the area of lung tissue that is broken down by elastase?

Your answer ☐

[1]

5. The following spirometer trace shows the results of an experiment. Soda lime was used to extract carbon dioxide from exhaled air.



What is the rate of oxygen consumption in the experiment?

A 1.0 dm^3

B 3.0 dm^3 min^{-1}

C 5.0 dm^3 min^{-1}

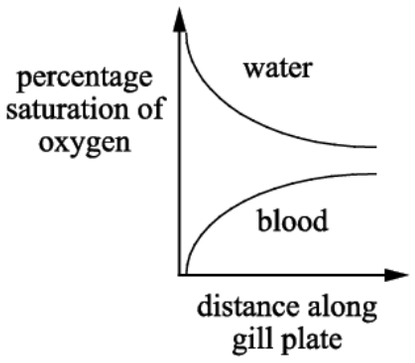
D 12 breaths min^{-1}

Your answer ☐

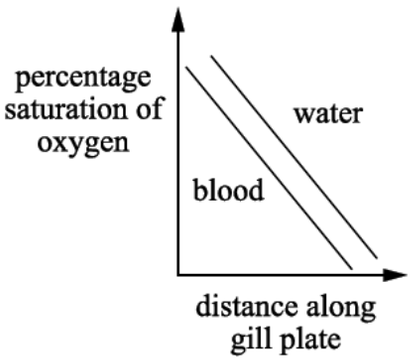
[1]

6. Which graph represents the counter-current exchange system in fish gills?

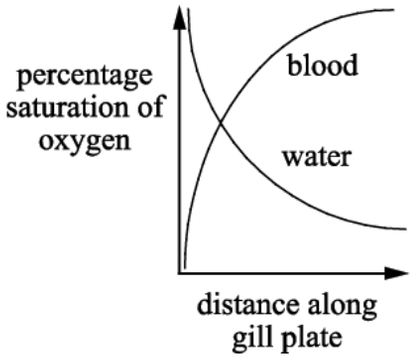
A



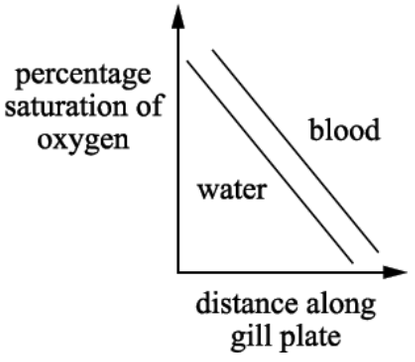
B



C



D



Your answer

[1]

7(a). **Fig. 1.1** shows a microscopic image of part of a fish gill.

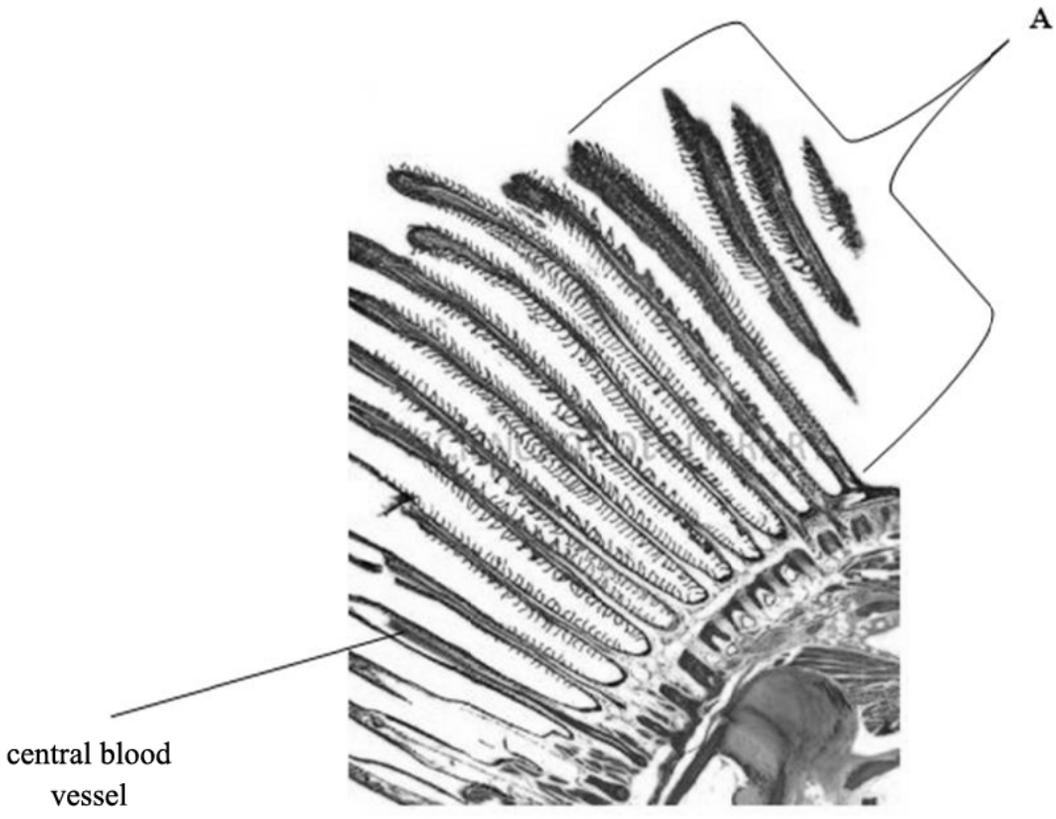


Fig. 1.1

Name structure **A**.

---------- **[1]**

(b). Explain how **Fig. 1.1** shows that gills are adapted for efficient gas exchange.

---------- **[4]**

(c). Each gill is supported by a gill arch made of bone. Bone tissue is made of living cells, collagen and an inorganic component.

Explain why bone is described as a tissue and gills are described as organs.

---

[3]

8(a). Termites are highly social insects. They are thought to have evolved from earlier forms of insect at least 150 million years ago, in the Jurassic geological period. They are related to cockroaches.

(i) How might scientists a century ago have known that termites evolved in the Jurassic geological period?

---

[1]

(ii) What new source of evidence might help today's scientists to find out how closely related termites are to cockroaches?

---

[1]

(b). **Fig. 5.1** shows a termite mound, the nest of approximately one million individuals. The photograph was taken in Queensland Australia, about 3000 kilometres south of the equator.

(i) **Fig. 5.1** shows that the interior of the termite mound is full of interconnecting chambers. At the top of the mound some of these chambers open to the air outside.

Worker termites spend all their time working in brood chambers low in the mound, where eggs and larvae develop.

Explain how carbon dioxide produced in the respiring body cells of worker termites is removed to the air outside the termite mound.

---

[4]

(ii) In Africa, closer to the equator, the mounds built by some species of termite are blade-shaped, with the long axis pointing North–South. **Fig. 5.2** shows an example of a termite mound in Africa.

Suggest why the African termites need to build mounds in this shape and orientation.

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[2]

Fig. 5.1



Fig. 5.2



9. Ventilation involves various parts of the mammalian respiratory system.

Which of the following statements, **A** to **D**, describes **inhalation**?

A ribcage moves upwards and outwards; external intercostal muscles relax; diaphragm relaxes
B ribcage moves downwards and inwards; external intercostal muscles relax; diaphragm relaxes
C ribcage moves upwards and outwards; external intercostal muscles contract; diaphragm contracts
D ribcage moves downwards and inwards; external intercostal muscles contract; diaphragm contracts

Your answer [ ]

[1]

10(a). Fig. 1.1 is a diagram that represents inspiration and expiration in a human.

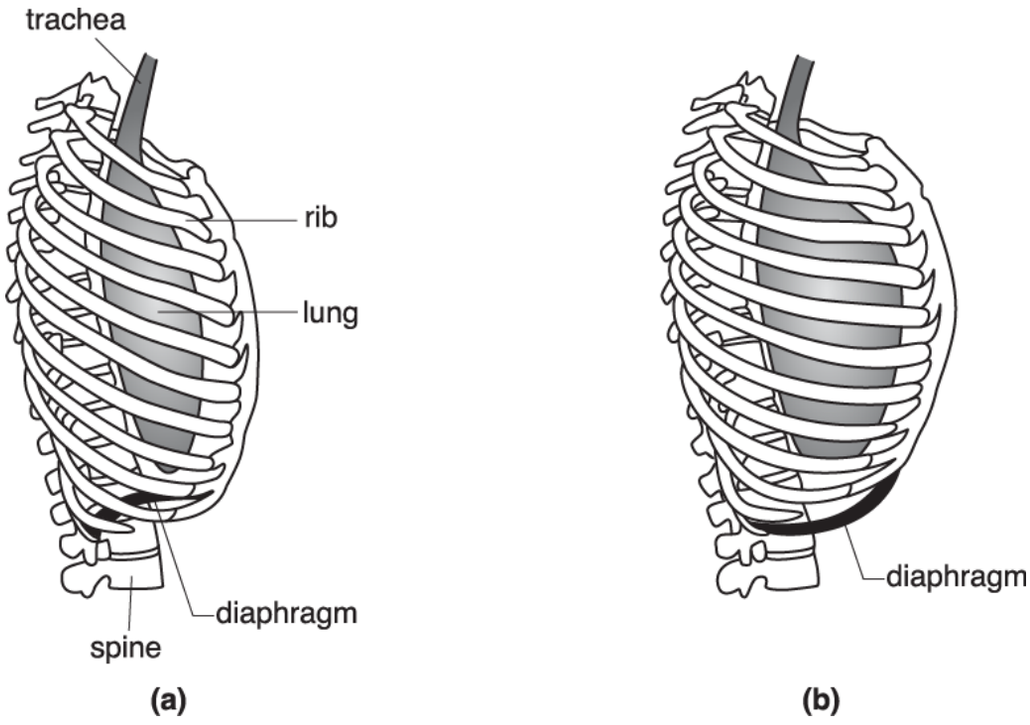


Fig. 1.1

(i) Which of the two diagrams, **(a)** or **(b)**, represents the body **immediately after** expiration?

Describe how this diagram justifies your choice.

---**[2]**

(ii) Why can expiration be a passive process?

---**[1]**

(iii) Some chemicals can act as allergens. If these allergens are inhaled, they can cause breathing problems. Allergens cause the smooth muscle in the walls of the airways to contract.

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Suggest the effects that this muscle contraction has on ventilation.

---

[2]

(b). Fig. 1.2 represents the volume changes in the lung of a human.

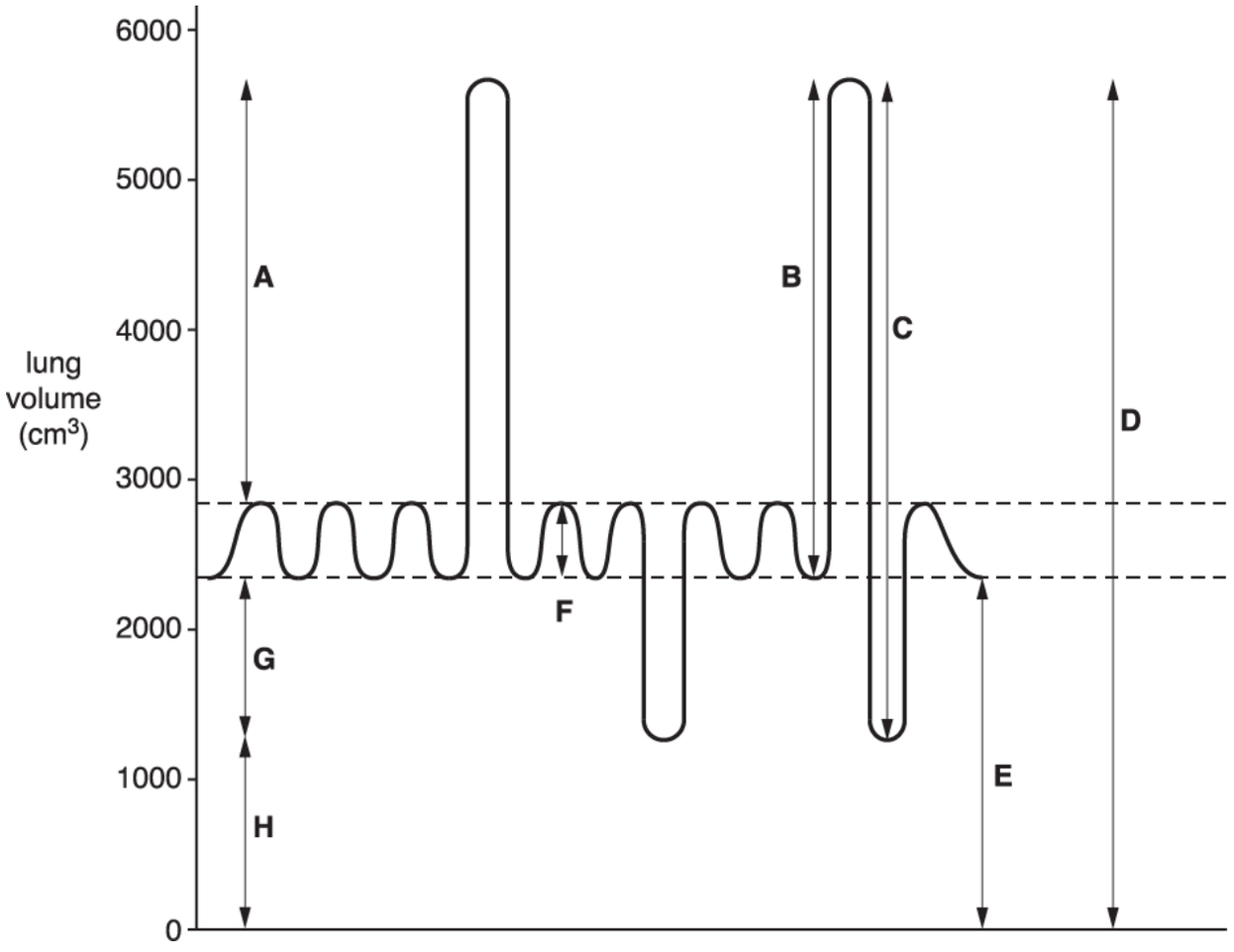


Fig. 1.2

(i) Select the letter, **A** to **H**, that corresponds to each of the following lung volumes.

The first one has been done for you.

Lung volume	Letter
Inspiratory reserve volume	***A***
Residual volume	
Total lung capacity	
Tidal volume	
Vital capacity	

[4]

(ii) Volume **C** can be measured using an instrument such as a spirometer.

What **breathing** instructions would be given to a person whose volume **C** was being measured?

---

[2]

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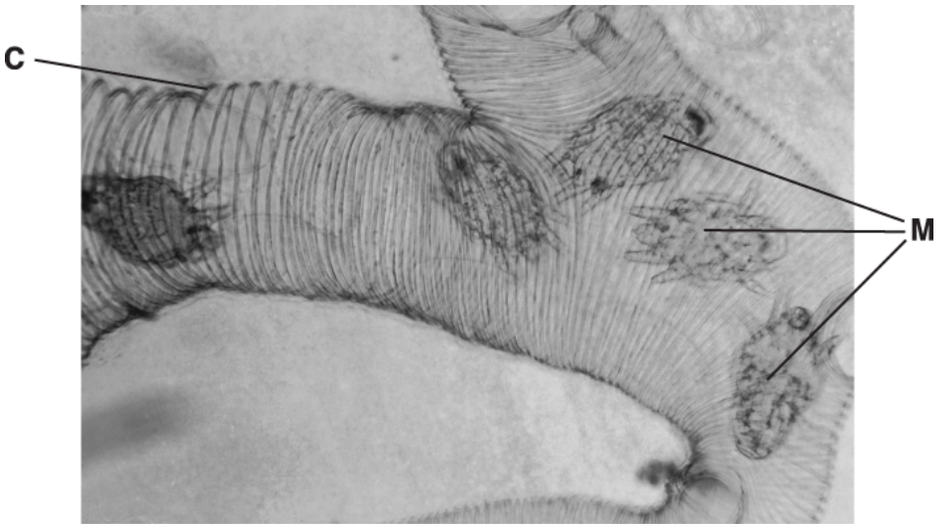
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11. The figure is a photomicrograph of the trachea of a honeybee, *Apis mellifera.*

The trachea of this honeybee is infected with honeybee tracheal mites, *Acarapis woodi.* Some of these mites are labelled **M** on the figure.

The trachea and tracheoles of insects have circular bands of chitin. One of these bands is labelled **C** on the figure.



(i) What is the function of the circular bands of chitin labelled **C**?

--- **[1]**

(ii) The mites use their mouthparts to bite through the walls of the trachea. They then feed off the haemolymph, the blood-like liquid that bathes the cells and organs of the honeybee.

Suggest **one** other way in which the presence of the mites might affect the honeybee.

--- **[1]**

12. *Amoeba proteus* is a single-celled organism that lives in freshwater habitats. Fig. 1.1 is a drawing of *A. proteus*.

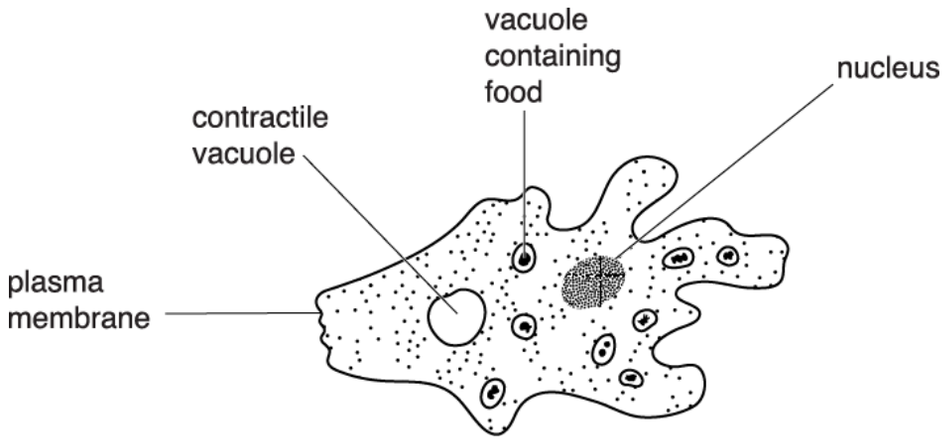


Fig. 1.1

Explain why an *Amoeba* does **not** need a specialised surface for gaseous exchange.

---

[2]

13. Table 2.1 lists a number of specialised cells found in the gaseous exchange system of a mammal.

Complete the table to describe the function of each type of specialised cell.

Specialised cells	Function of cells in the gaseous exchange system
Ciliated cells	_____ _____ _____
Goblet cells	_____ _____ _____
Smooth muscle cells	_____ _____ _____

	_ _
Squamous epithelial cells	_ _

Table 2.1

_ _

[4]

14(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.

---

[5]

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(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]**

(ii) Fig. 3.1 shows a trace recorded from this apparatus.

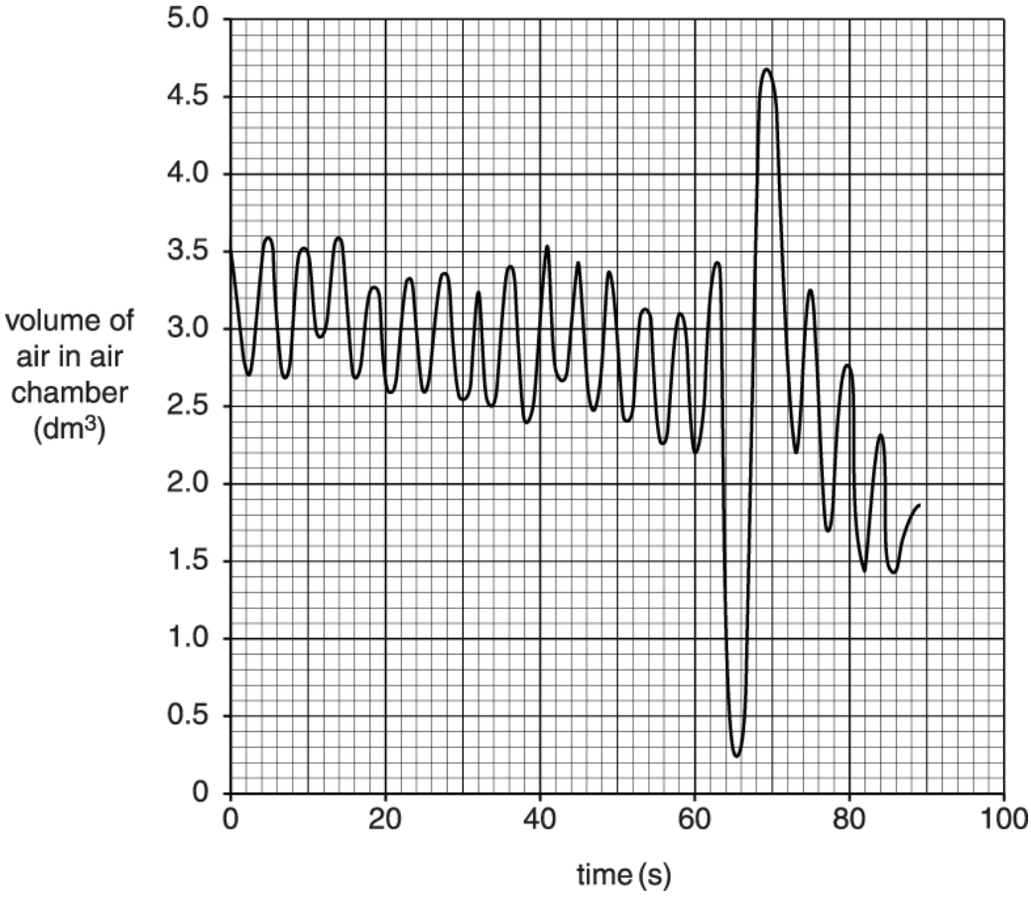


Fig. 3.1

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.

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Show your working.

answer = _____ $dm^3\ min^{-1}$

[2]

15. Describe how the components of tobacco smoke can affect the **cardiovascular system** of smokers.



In your answer you should link the chemicals in tobacco smoke to their effects on the cardiovascular system.

[7]

16. Gene sequencing can help us to understand how an individual's genome affects their body's response to drugs.

One research study has looked at the effectiveness of drugs used to treat asthma in children. Asthma is a condition in which the bronchioles become reduced in diameter. This results in the child finding it difficult to breathe.

(i) Using your knowledge of the structure of bronchioles, suggest how their diameter might become reduced.

---**[2]**

(ii) Explain why it is difficult to expel air from the lungs if the bronchioles become reduced in diameter.

---**[1]**

17. Nicotine is a toxic chemical. Smokers take in low doses of nicotine that are not toxic in the short term, but these low doses affect cardiovascular health in the longer term.

Nicotine increases blood pressure and increases the likelihood of a thrombosis (formation of a blood clot). Either of these effects can lead to a stroke, which is when cells in part of the brain die, leading to loss of function.

(i) Suggest how each of these stated effects of nicotine could contribute to cell death in the brain.

increased blood pressure _____

_____

_____

_____

thrombosis _____

_____

_____

_____ **[4]**

(ii) It is important that the correct treatment is given when a stroke is suspected.

Research has led to the ability to identify whether a stroke has resulted from a thrombosis or from increased blood pressure.

The standard emergency treatment for a suspected stroke is to give a drug that will counteract a thrombosis. If, however, the cause of the stroke is found to be high blood pressure, an alternative treatment would be more appropriate.

Explain why.

_____

_____

_____

_____ **[1]**

(iii) The effects of a stroke will depend on which part of the brain has been affected.

Some possible effects of a stroke are listed below.

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- Problems with coordination of movement.
- Loss of memory and speech.
- Paralysis of the body below the neck.

With reference to named parts of the brain, explain how each of these specific effects is caused.

---

[4]

18. Which structure, **A** to **D**, is **not** an example of a surface that is specialised for the purpose of gas exchange?

A alveolus of a mammal
B plasma membrane of a unicellular protoctista
C leaf of a tobacco plant
D trachea of an insect

Your answer ☐

[1]

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19(a). A student investigated the relationship between height and vital capacity.

The student used a spirometer to measure vital capacity of 10 boys and 10 girls in their year group at school.

List two variables the student should control to ensure validity in this investigation?

1

2

---

[2]

(b). Fig. 16 is a graph of the student's results.

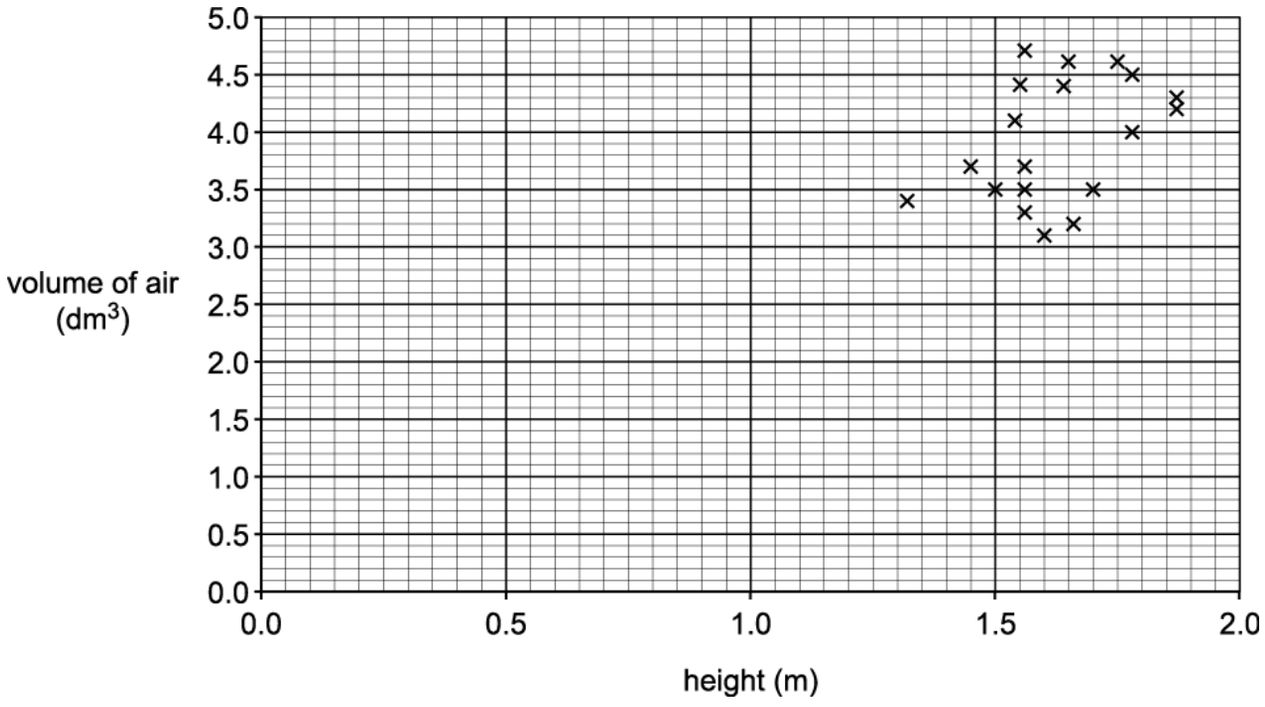


Fig. 16

The student made the following comment about their results:

I think there is no relationship between height and vital capacity.

(i) Using Fig. 16, explain whether you agree with the conclusion the student made.

---

[2]

(ii) The student planned to measure tidal volume for the **same 20 students**.

Circle a region **on Fig. 16** where you would see these data if the student plotted them on the same graph.

[Answer on Fig. 16]

[2]

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(c). *Outline the structures involved in the mammalian gaseous exchange system.

For each structure, explain how it increases the efficiency of gaseous exchange.

[6]

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20. Adult flies have a very different body structure from that of maggots.

- Flies have complex and well-developed exchange surfaces and transport systems.
- Maggots have only a small number of tracheae and a small volume of tracheal fluid.

Suggest why maggots do not need such well-developed exchange surfaces and transport systems.

---

[3]

END OF QUESTION PAPER

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Question			Answer/Indicative content	Marks	Guidance
1	a				**DO NOT ALLOW** marks for use of just 'oxygen' in place of 'air' throughout question 2
			1 volume, inside / of, jar increases ;	3 max	**IGNORE** references to chest / lungs
			2 pressure inside, jar / balloons, decreases ;		
			3 to below pressure in atmosphere ;		**CREDIT** idea of creating a pressure gradient (between balloon and exterior) **IGNORE** hydrostatic **Note:** 'makes pressure in jar lower than atmosphere' = 2 marks
			4 (therefore) air, moves / pushed / forced, into, balloons / glass tube ;		**ACCEPT** flows / enter / fills **DO NOT CREDIT** suction / drawn / pulled in / diffuse in / taken in **IGNORE** *just* into bell jar **Examiner's Comments** Candidates were asked to explain why the balloons expand when the rubber sheet is pulled down. This question is answered by very simple physics. Many candidates were able to score all three marks within two lines of clear succinct text. Other candidates clearly need to gain a better understanding of the simple physics and consider their response before starting to write. Some candidates described how air is inhaled into the lungs rather than applying their knowledge to the model. These candidates must be encouraged to read the question carefully.

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Question			Answer/Indicative content	Marks	Guidance
	b	i	volume of air, inhaled / exhaled ; in, one / each, breath ; during, steady / regular, breathing ;	2 max	**ACCEPT** breathed / moved, in (and / or out of lungs) **IGNORE** amount **ACCEPT** at rest / during steady exercise / normal / quiet breathing **Examiner's Comments** Candidates were asked to explain the term tidal volume. Most candidates successfully scored one or two marks. Sometimes these marks were achieved for the idea that this volume is measured 'at rest' or that it is the volume 'in one breath' rather than for the idea that the tidal volume is a 'volume of air inhaled or exhaled'. Candidates must try to be more specific with their terminology and use the term 'volume' rather than 'amount'. Weaker candidates should also move away from the idea that oxygen is inhaled and carbon dioxide is exhaled.
		ii	up / down, movements (of rubber sheet / band) ; *idea of:* small / steady / regular, movements (of rubber sheet) ;	2	**ACCEPT** pull / push on rubber sheet / band **ACCEPT** pull / push and let go **ACCEPT** rhythmically / in time with breathing / repetitively **IGNORE** gently **Note:** pulled down slightly = 2 marks **Examiner's Comments** Candidates who were familiar with this model were able to describe how it was used by the teacher to demonstrate tidal volume. Those who had not seen the model before suggested blowing into the glass tube or attaching it to a spirometer to measure the volume of the air.

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Question			Answer/Indicative content	Marks	Guidance
		iii	the maximum volume of air ; inhaled / exhaled, in one breath ;	2	**ACCEPT** tidal volume + inspiratory reserve + expiratory reserve = 2 **ACCEPT** total lung capacity – residual volume = 1 mark **IGNORE** total volume **ACCEPT** breathed, in / out, in one breath **DO NOT CREDIT** held in lungs or max vol in lungs **DO NOT CREDIT** breathed in **and** out in one breath **Examiner's Comments** Candidates were asked to explain the term vital capacity, and many were able to score marks successfully. Again, the use of inappropriate terms meant that some responses were not sufficiently focussed to gain full marks.
		iv	***idea that*** pulled down on rubber, sheet / band, as far as possible **and** pushed up as far as possible ;	1	**ACCEPT** pull / push in either order **ACCEPT** pull **and** push as hard as possible **Examiner's Comments** When asked how the teacher could demonstrate vital capacity most candidates described how to demonstrate taking a deep breath. Pulling the rubber sheet down as far as possible (taking a deep breath) must be followed by pushing it up as far as possible to expel as much air as possible.
			Total	**10**	

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Question			Answer/Indicative content	Marks	Guidance
2			exocytosis ;	1	**DO NOT CREDIT** endocytosis / mass flow **IGNORE** bulk flow **Mark the first answer for each question part.** If the answer is correct and a further answer is given that is incorrect or contradicts the correct answer then = **0 marks** **Examiner's Comments** This term was well known to the majority of candidates.
			Total	**1**	
3			D	1	
			Total	**1**	
4			B	1	
			Total	**1**	
5			B	1	
			Total	**1**	
6			B	1	
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
7	a		lamella	1	**ALLOW** lamellae.
	b		*three from* many / AW, lamellae / structure A, provide large surface area (1) (presence of) secondary lamellae on main lamellae provide large surface area (1) short distance between blood and, water / outside (1) idea that blood maintains diffusion gradient (1) *any of above linked to* faster diffusion (of oxygen, carbon dioxide) (1)	4	**ALLOW** only if linked to another marking point. **IGNORE** refs to squamous cells as not visible on Fig. 1.1.
	c		*three from* tissue has, one / few, types of cell **and** performs, one / few, functions (1) *idea that* bone has, one / few, types of cell **or** *idea that* bone performs, one / few, functions (1) organs consist of several tissues (1) gills contain two or more **named** tissues (1)	3	**ALLOW** bone, blood, epithelial, connective.
			Total	**8**	

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Question			Answer/Indicative content	Marks	Guidance
8	a	i	fossils in, known-age / Jurassic, strata / rocks	1	
		ii	DNA / cytochrome c	1	
	b	i	carbon dioxide diffuses down concentration gradient out of the respiring cell (1) carried through body from cell (to tracheoles) by blood passing out via tracheoles / trachea / spiracles (1) respiration generates heat (1) hot gases expand and are less dense so rise up by convection through the mound to vents at mound-top (1)	4	
		ii	*shape,* large or increased surface area to volume ratio (1) smallest area exposed to greatest heat (1)	2	Response **must** be linked to context of avoiding overheating / needing to get rid of heat.
			Total	**8**	
9			C	1	**Examiner's Comments** This question was also quite straightforward and answered correctly by many candidates. For those who could be confused with the intercostal muscles, the movement of the ribcage and contraction of the diaphragm should have been sufficient to choose the correct answer.
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
10	a	i	*two from* ***(a)*** *because* 1 lung(s) are, deflated / less inflated / small(er) / volume decreased ☐ 2 diaphragm is, domed / curved up / arched / not flat / relaxed ☐ 3 rib cage is / ribs are, in lowered position / not raised ☐	2	**Only credit answers that refer to (a) as the chosen option** **DO NOT CREDIT** if the 'a' is not clear enough **Indicate that (a) has been chosen by using the green dot** ● 1 **ACCEPT** 'thorax has smaller volume' **IGNORE** ref to chest volume 2 **ACCEPT** higher / moves up **IGNORE** pushed up 3 **ACCEPT** 'rib cage moves down' **IGNORE** ref to intercostal muscles **Examiner's Comments** Generally this was very well-answered. Most candidates know the position of ribs and diaphragm in expiration but some described inspiration or muddled relaxing and contracting. A small minority of candidates failed to gain marks as they either didn't state the letter of the correct diagram (A) or answered incorrectly with B. A number incorrectly referred to the lungs 'relaxing' and some talked about the lungs being completely empty of air.

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Question			Answer/Indicative content	Marks	Guidance
		ii	it does not use muscle contraction / muscles (just) relax **or** rib cage, falls / drops (due to gravity) **or** lungs (elastic so) will recoil □	1	**IGNORE** ref to energy / ATP **IGNORE** ref to pressure, changes / gradients **IGNORE** ref to intercostal muscles contracting during expiration as Q refers to a passive process **ACCEPT** 'diaphragm relaxes' **IGNORE** 'rib cage moves down' as this could involve muscle contraction **Examiner's Comments** This was moderately well-answered. Most correct answers referred to muscles relaxing. Very few candidates mentioned elastic recoil or the rib cage falling or dropping under the influence of gravity. The most common answers not worthy of credit were a reference to energy / ATP not being needed or pressure differences. Many candidates do not appreciate what passive means in this context, confusing it with subconscious or part of autonomic nervous system. Many of those who correctly recognise passive as not requiring energy then did not connect that to why it doesn't require energy.

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Question			Answer/Indicative content	Marks	Guidance
		iii	*two from* (*as lumen of airways decrease*) 1 reduction in (lumen) diameter of, bronchi / bronchioles ☐ 2 harder to exhale / more resistance to exhalation / less air can be exhaled ☐ 3 more air remains in the lungs ☐ 4 harder to inhale / more resistance to inhalation / less air can be inhaled ☐ 5 harder to ventilate / more resistance to ventilation / increased breathing rate / gasping ☐	2	**IGNORE** ref to contraction of muscle (as in Q) 1 **ACCEPT** ref to 'narrowing' for 'reduced diameter' **IGNORE** ref to blocking / size **DO NOT CREDIT** ref to trachea 2 **ACCEPT** ref to 'breathing out' for 'exhale' **IGNORE** ref to air leaving / air moving out 4 **ACCEPT** ref to 'breathing in' for 'inhale' **IGNORE** ref to air entering / air moving in 5 **IGNORE** 'hard to breath' 'struggles to get breath' 'short of breath' wheezing ventilation rate **Examiner's Comments** Most answers referred to airways being narrowed and gases (air / oxygen / carbon dioxide) entering, passing, moving in or flowing. Candidates demonstrated lack of scientific language, just referring to air 'moving in / out' rather than inhalation and exhalation. Key terms should be reinforced whilst teaching. The misconception that smooth muscle was present in the trachea was common. Some candidates referred to smooth muscle contraction in artery walls while others thought the muscle contraction would prevent any air from entering or was used to expel air from the lungs. A small number of candidates described the processes of inhalation and exhalation but failed to address the question.

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Question			Answer/Indicative content	Marks	Guidance
	b	i	**H** ☐ **D** ☐ **F** ☐ **C** ☐	4	**Mark the first answer in each cell.** If an additional answer is given that is incorrect then = **0 marks** **IGNORE** correct combinations of letters that correspond to D (e.g. A + F + G + H) **IGNORE** correct combinations of letters that correspond to C (e.g. A + F + G or B + G) **Examiner's Comments** It was good to see so many correct responses for this question. It provided a useful scaffold with letter A provided (to emphasise the direction of the trace) but, nonetheless, the candidates did show a good grasp of the features displayed via the spirometer trace. It was interesting to note that a common error was to select E (the expiratory reserve volume) instead of the correct choice H for the residual volume. Total lung capacity was most frequently correct. Several candidates confused F and C.

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Question			Answer/Indicative content	Marks	Guidance
		ii	1 breathe in as deeply as possible / AW ☐ 2 (and) then force as much air out as possible ☐	2	**IGNORE** ref to using nose clip If they have the deepest breath out before the deepest breath in, then **max 1** (for correct mp 2) 1 e.g. 'breathe in as much as possible' 'inhale as much as you can' 'inhale to maximum' 'breathe in all the air that you can' 2. e.g.'breathe out as hard as possible' 'exhale as much as you can' 'exhale to maximum' 'breathe out all the air that you can' **DO NOT CREDIT** *all* of the air pushed out of lungs **Examiner's Comments** This question was generally answered really well. It demonstrates the emphasis on practical work and the fact that its assessment is now embedded in the question papers. Those with experience were better equipped to describe the process. However, a large minority struggled to link the 'as much as possible' idea to both inhalation and exhalation in terms of quality of expression. Unfortunately, some candidates described breathing out before breathing in and this limited their overall score to 1 mark for this question.
			Total	**11**	

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Question			Answer/Indicative content	Marks	Guidance
11		i	support **or** prevents the trachea(e) from collapsing / keeps the airways open □	1	**IGNORE** protection / structure / shape / squashed / strength / stability **Examiner's Comments** Most recognised the role of chitin in support, although some only mentioned properties of chitin such as strength or structure which were not credited.
		ii	*idea that* (their presence) restricts the airflow in the trachea / blocks the airways **or** (leakage of haemolymph) deprives the, tissues / cells, of, oxygen / O_2 / nutrients **or** use of, oxygen / O_2 / nutrients, by mites **or** disease transmission **or** (mites) release toxins □	1	**IGNORE** statements that simply refer to the mites feeding on the haemolymph (as given in Q) **ACCEPT** causes the trachea to collapse **IGNORE** 'affects airflow' unqualified **IGNORE** ref to 'difficult to breathe' **ACCEPT** ref to inflammatory / immune, response **Examiner's Comments** Candidates generally recognised that the mites would obstruct the airways. References to oxygen frequently neglected to mention that the cells or tissues of the honey bee would receive less. Despite the gas exchange system of an insect being on the specification, a significant number of candidates referred to less oxygen reaching the bee's lungs. Other suitable suggestions included disease transmission or toxin production.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
12			(cell) very small **OR** large surface area to volume ratio; short diffusion pathway; *idea that* diffusion sufficient / fast enough, to supply (all) needs;	max 2	**IGNORE** low, activity / metabolic rate **IGNORE** not very big / small (unless qualified) **ACCEPT** microscopic **ACCEPT** larger SA:Vol (ratio) **Examiner's Comments** Generally well answered with nearly all candidates scoring at least one mark. The vast majority of candidates knew that the Amoeba had a large surface area to volume ratio and many also understood that diffusion would be sufficient to meet all needs, however, some candidates were unable to express this clearly.
			Total	**2**	

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Question			Answer/Indicative content	Marks	Guidance
13				4	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
			move / waft / sweep, mucus;		
			produce / release / secrete, mucus;		**DO NOT CREDIT** excrete
			constrict the (named) airways;		**CREDIT** narrows lumen / reduces diameter of airway **IGNORE** controls, diameter / air flow
			provide, thin barrier / short diffusion distance;		**IGNORE** smooth lining / *reduces* diffusion distance **IGNORE** thin, surface / cells, for diffusion
					Examiner's Comments A familiar question in which many candidates performed well. It was a little disappointing to see that the common errors were the same as those that have been reported on in the past. There was some confusion for weaker candidates over the role of the smooth muscle with 'provides a smooth surface for the blood vessels/airways' and 'contracting or relaxing the airways' being common responses that were not awarded credit. Squamous epithelium 'reducing the diffusion pathway' was also considered too vague as it did not make clear that the diffusion pathway is short.
			Total	**4**	

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Question			Answer/Indicative content	Marks	Guidance
14	a	i	columnar / ciliated; squamous / pavement;	2	**Mark the first two answers.** **IGNORE** 'cilia cells' **Examiner's Comments** Candidates were asked to name two types of epithelial tissue found in the lungs and airways. The most common responses were 'squamous' and 'ciliated' and the majority of candidates scored both marks. The most common incorrect response was to write 'ciliated' and 'goblet'.

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Question	Answer/Indicative content	Marks	Guidance
ii		5 max	Mp 1 & 2 the phrase 'for short(er) diffusion distance' only needs to be stated once to gain both marks **IGNORE** ref to rate of diffusion
	1 wall is <u>one</u> <u>cell</u> thick for short(er) **diffusion**, distance / pathway;		**ACCEPT** 'alveolus / epithelium one cell thick' **DO NOT CREDIT** 'membrane / cell wall, one cell thick'
	2 **squamous**, cells / epithelium , provide short diffusion distance / pathway;		**ACCEPT** pavement / thin / flat for squamous **IGNORE** thin wall
	3 **elastic** so, **recoil**/ expel air / helps **ventilation**;		**ACCEPT** gas for air **IGNORE** CO_2 / O_2
	4 create / maintain, **concentration gradient** / described;		**IGNORE** diffusion gradient Take care not to confuse mp 5 & 6
	5 large number (of alveoli) provide large(r) **surface area**;		**DO NOT CREDIT** large in number so large SA:Vol **DO NOT CREDIT** small so provide large surface area
	6 small size (of alveoli) provide large(r) **surface area to volume ratio** ;		**CREDIT** SA:Vol
	7 (cells secrete) surfactant to maintain surface area;		**ACCEPT** surfactant to prevent collapse Any **two** technical terms from the list below used appropriately and spelled correctly :
	max 4		**concentration gradient squamous surface area to volume ratio ventilation elastic recoil** **surface area** (note: do not allow as part of 'surface area to volume ratio') **diffusion** (note: do not allow as part of 'diffusion gradient')
	QWC; max1		**Examiner's Comments** Candidates were asked to explain how the alveoli create a surface for efficient gaseous exchange. To award a mark Examiners were looking for the description

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Question			Answer/Indicative content	Marks	Guidance
					of a feature accompanied by an explanation of how this feature improves gaseous exchange. For example, 'alveoli have a wall that is one cell thick' needed to be combined with 'to create a short diffusion pathway' in order to achieve a mark. This question differentiated well as there were good responses from those who really understood the significance of the question and planned their points carefully to gain full credit. However, many responses displayed evidence of rote learning with full descriptions of the features that make a good exchange surface that were not accompanied by an explanation of how this improved exchange. It was clear that many candidates still do not fully understand the concepts of surface area and surface area to volume ratio. Many candidates thought it enough to say 'Alveoli have a big surface area' without any mention of the presence of many alveoli. Many candidates simply stated that 'alveoli have a large surface area to volume ratio' without mentioning that this is achieved because they are so small. Some candidates simply used the two terms in the same sentence as if they are synonymous. Many candidates wrote detailed descriptions of the capillary network despite the question being specific to alveoli. There is still a widespread belief that gas exchange surfaces must be moist to allow efficient diffusion, with the gases needing to dissolve in water before they can diffuse. Candidates should be aware that gases such as oxygen and carbon dioxide can dissolve in the phospholipid bilayer and diffuse across without first dissolving in water. The mark for use of terms was usually awarded as most candidates referred to '*surface area*' and '*diffusion*'. However, these terms were occasionally used in the wrong context such as referring to 'small alveoli have a large surface area'.

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Question			Answer/Indicative content	Marks	Guidance
	b	i	spirometer;	1	**DO NOT CREDIT** respirometer **IGNORE** trace **Examiner's Comments** Candidates were asked to name the apparatus used to record air movements created by ventilation. The majority gave the correct answer 'spirometer' but incorrect responses included 'potometer', 'oxygen chamber', 'ventilator' and even 'apparatus to record air movements'.
		ii	13.5;	1	**ACCEPT** 13 or 14 **Examiner's Comments** The majority of candidates were able to count the number of peaks or troughs on the trace to state the rate of breathing correctly as 13 (measured by counting peaks) or 14 (measured by counting troughs). 13.5 was also accepted as the most accurate response.

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Question			Answer/Indicative content	Marks	Guidance
		iii	0.5;;	2	Correct answer = 2 marks If answer incorrect allow one mark for: either 3.6– 3.1 (measured from peaks) OR 2.7 – 2.2 (measured from troughs) **ECF** one mark for final answer if candidate has used 3.5 as the initial reading (3.5 – 3.1 = 0.4 for 1 mark) **For candidates who have measured over less than a minute and divided by number of seconds:** **ACCEPT for two marks** 0.56 if measured peaks 0.52 if measured troughs **ACCEPT** working (3.6 – 3.1) × 60 / 54 for peaks OR (2. 7 – 2.2) × 60 /58 for troughs **Examiner's Comments** Candidates were asked to calculate the rate of oxygen consumption over the first minute from the trace. Surprisingly few candidates were able to give the correct answer (0.5) to this simple calculation. The calculation required the subtraction of one value from another, both identified from the trace. Candidates could measure from the peaks (3.6 – 3.1) or from the troughs (2.7 – 2.2) to gain the correct answer. Many of those who failed to score a mark measured from the first peak to the last trough (3.6 – 2.2 = 1.4). A number of candidates either left the space blank or wrote a wide range of inaccurate figures in the space provided. With the emphasis on mathematics in science becoming increasingly important it is essential that Centres put greater emphasis on this type of topic.
			Total	**11**	

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Question			Answer/Indicative content	Marks	Guidance
15				6 max	***N** marking points*
			N1 nicotine;		**N1 DO NOT CREDIT** if any **N** mark is associated with a chemical other than nicotine
			N2 increases stickiness of platelets;		**N2 ACCEPT** makes platelets sticky
			N3 thrombosis / formation of blood clot; **N4** causes release of adrenaline;		**N3 ACCEPT** thrombus formation
			N5 causes constriction of, <u>arterioles</u> / small arteries;		**N5 IGNORE** narrowing of lumen
			N6 reduced, blood flow / oxygen supply, <u>to (named) extremities</u>;		
					***C** marking points*
			C7 carbon monoxide / CO;		**C7 DO NOT CREDIT** if any **C** mark is associated with a chemical other than carbon monoxide
			C8 combines (permanently) with haemoglobin / forms carboxyhaemoglobin;		**C8 IGNORE** carbamino
			C9 reduced oxygen carrying capacity of blood;		**C9 ACCEPT** reduced amount of oxygen in blood **C9 IGNORE** 'less oxygenated blood is delivered to tissues' as this could imply reduced cardiac output
			10 increased, heart rate / blood pressure;		**10 IGNORE** heart must work harder
			11 damage to, lining / endothelium, (of blood vessels);		**11 ACCEPT** epithelium
			12 <u>atherosclerosis</u> / <u>atheroma</u>;		**12 IGNORE** plaques
			13 coronary heart disease / CHD / heart attack / stroke / myocardial infarction / MI / angina;		**13 IGNORE** conary / chronic / part of heart dying / cardiac arrest / heart failure

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Question			Answer/Indicative content	Marks	Guidance
			QWC - N1 and C7 plus another **N** mark or **C** mark **and no** discussion of tar	1	**DO NOT AWARD** QWC if candidate discusses a lung disease or any non-cardiovascular effects **DO NOT AWARD** QWC tar is *discussed* at all **IGNORE** nicotine is addictive **IGNORE** 'tar' if it appears as a list of chemicals **Examiner's Comments** Most candidates were very comfortable with the topic and wrote lengthy answers which often gained 6 of the 7 available marks. Responses that discussed nicotine and carbon monoxide in the context of only the cardiovascular system often got full marks. The QWC mark was frequently not awarded because candidates discussed effects on the respiratory system.
			Total	**7**	

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Question			Answer/Indicative content	Marks	Guidance
16		i	contraction of smooth muscle; circular (muscle); extra mucus production; inflammation;	2 max	**ACCEPT** involuntary muscle / non-striated muscle **ACCEPT** blocked by mucus / build-up of mucus **ACCEPT** swelling / oedema **IGNORE** scarring **Examiner's Comments** Generally, a two mark question would involve identifying two distinct marking points, but very few candidates did this. Many gained 1 mark for correctly stating that smooth muscle contracts. However, a common misconception was talking about the muscles constricting, which gained no credit. Few candidates mentioned inflammation or excess mucus production for a second mark. A significant number talked about the long term effects of smoking or bronchitis on the bronchioles, and had clearly not read the question properly, since it was asking about the effects of asthma on bronchioles in children.
		ii	(reduced diameter means) increased, resistance to air flow / friction; *idea that* exhalation is passive / no (muscular) force behind exhalation / requires additional, force / pressure, to exhale;	1 max	**ACCEPT** 'breathes harder' **Examiner's Comments** Very few candidates were awarded this mark. Most candidates merely rephrased the question stating 'that a decreased diameter reduced the volume of air expelled'. Examiners were looking for the idea that the reduced diameter increased resistance to air flow, and that this means additional force is required to exhale, but this was rarely seen.
			Total	**3**	

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Question			Answer/Indicative content	Marks	Guidance
17		i	*increased blood pressure* **B1** (small) blood vessels / capillaries, burst / break; **B2** bleeding causes (localised) build up of pressure (leading to cell death) **or** blood / oxygen, supply, reduced / stopped; **B3** cells cannot <u>respire</u> (leading to cell death); *thrombosis* **T1** thrombus / clot, interrupts / reduces, blood flow; **T2** (cells) deprived of, oxygen / glucose; **T3** cells cannot <u>respire</u> (leading to cell death);	4 max	**B1 CREDIT** haemorrhage / aneurism / arterioles / arteries **B1 IGNORE** veins / venules **B1 IGNORE** destroys / damages blood vessels **B2** e.g. bleeding leads to cell compression **B2 ACCEPT** brain deprived of, oxygen / glucose **B3 DO NOT ACCEPT** <u>respire</u> less 'Clot results in less oxygenated blood to cells' = **T1** and **T2** **T2 ACCEPT** brain deprived of, oxygen / glucose **T3 DO NOT ACCEPT** <u>respire</u> less **Examiner's Comments** This question was generally well answered by candidates, with the effects of thrombosis being best understood. A number of candidates did not link high blood pressure to a burst blood vessel in the brain, yet some of these were still able to gain marks by discussing atherosclerosis. Candidates most often lost marks by not including each logical step in their explanations (e.g. for thrombosis: blood clot – lack of blood flow – lack of oxygen – no respiration). Thrombosis (a process) was also incorrectly substituted for a thrombus / clot (a noun). Unusually in this question candidates could state the same things in both parts of the question and get maximum marks.

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Question			Answer/Indicative content	Marks	Guidance
		ii	*idea that* (if the stroke has been caused by a bleed) then the drug will, increase the bleeding / be ineffective as a treatment (to prevent bleeding);	1	e.g. 'the drug makes the problem worse' **DO NOT CREDIT** 'not effective in reduction of blood pressure' **Examiner's Comments** Few candidates were able to explain that the drug for counteracting thrombosis would increase bleeding or would be ineffective in treating the cause of the stroke. Many confused answers were seen describing the drug thinning the blood, with this being linked to an increase in blood pressure.

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Question			Answer/Indicative content	Marks	Guidance
		iii	*idea of* disruption of, oxygen / glucose, supply (to brain cells) for <u>aerobic respiration</u>; *lack of oxygen / glucose / blood / damage to* <u>cerebellum</u> resulting in problems with coordination / movement; <u>cerebrum</u> / <u>cerebral</u> <u>hemisphere(s)</u> / <u>cerebral</u> <u>cortex</u>, resulting in loss of, memory / speech; <u>medulla</u> (oblongata) / <u>cerebrum</u> / <u>cerebellum</u>, resulting in paralysis (of body below the neck);	4	**Can be awarded at any point in the answer**. **Effect must be correctly linked to the part of the brain responsible.** **ACCEPT** Broca's / Wernicke's, area / hippocampus **ACCEPT** cerebral hemisphere(s) / cerebral cortex / corpus callosum **Examiner's Comments** Many candidates were able to correctly describe the functions of different parts of the brain and understand the consequence of damage to each of these areas. However, several candidates simply stated these functions, and struggled to write an answer that was in the correct context. Cerebrum and cerebellum were sometimes confused. Both candidates and teachers need to focus their study of the brain on those anatomical structures named in the OCR specification. Attempts at detailed answers sometimes achieved no marks as smaller structures were named (e.g. frontal lobe, association area) with no link to the correct named parts. By far the majority of candidates focussed their answers on named parts of the brain and did not give the overview required by marking point 1.
			Total	**9**	
18			B □	1	
			Total	**1**	

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Question			Answer/Indicative content	Marks	Guidance
19	a		fitness ☐ mass / weight ☐ *idea of* respiratory health ☐ build ☐	2 max	**DO NOT ALLOW** age (because they are in the same school year) **ALLOW** level of exercise **ALLOW** colds / asthma / allergies **ALLOW** named build types e.g. ectomorph / endomorph
	b	i	*correct because:* no (clear) correlation from the graph ☐ figures to support **with units** ☐ *incorrect because:* sample size (20) too small to make valid conclusion ☐ students all the similar age so not representative ☐	2 max	**ALLOW** only if two pairs of data are provided
		ii	area circled between 1.32 ± 0.02 and 1.88 ± 0.02 on *x*-axis ☐ area circled between 0.3 ± 0.1 and 0.7 0.1 ± on *y*-axis ☐	2	

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Question			Answer/Indicative content	Marks	Guidance
	c		***Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question.*** *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best–fit' approach based on the science content of the answer, first decide which of the level descriptors,* ***Level 1****,* ***Level 2*** *or* ***Level 3****, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the* ***Communication Statement*** *(shown in italics):* • *award the higher mark where the Communication Statement has been met.* • *award the lower mark where aspects of the Communication Statement have been missed.* ***In summary:*** • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.***	1	
			Level 3 (5–6 marks) Full and detailed description and explanation of the features of the mammalian respiratory system. Candidate demonstrates a detailed understanding of the different features and explains the adaptations of each one to maximise the efficiency of gaseous exchange. *There is a well-developed description and explanation of the majority of relevant features. The information presented is relevant and clearly explained.* **Level 2 (3–4 marks)**	6	**Indicative scientific points may include:** *Nasal cavity* • large surface area and good blood supply, warms air • mucus secreting cells, trap dust and microbes • moist surfaces, increase humidity and reduce evaporation from surfaces in lung *Trachea*

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Question			Answer/Indicative content	Marks	Guidance
			Clear description and explanation of the features of the mammalian respiratory system. Candidate demonstrates a reasonable understanding of most of the different features and includes explanations of the adaptations that maximise the efficiency of gaseous exchange. *There is a well-developed description and explanation of some of the relevant features. The information presented is relevant and for the most part clearly explained.* **Level 1 (1–2 marks)** An attempt at description and explanation of a limited number of the features of the mammalian respiratory system. Candidate demonstrates a limited understanding of the different features with some explanation of the adaptations that maximise the efficiency of gaseous exchange. *There is a logical structure to the answer. The explanations, though basic, are clear.* **0 marks** No response or no response worthy of credit.		• cartilage rings, stop it from collapsing • ciliated epithelium and goblet cells secrete mucus, trap dust and microbes and move them towards stomach *Bronchi / bronchioles* • smooth muscle, allows air to move in and out and maintains high concentration gradient of O_2 / CO_2 *Alveoli* • thin (epithelial) wall, reduces diffusion distance • collagen / elastic fibres, elastic recoil to help squeeze air out during exhalation • large number / provide large surface area, to increase rate of diffusion • good blood supply / capillaries, maintains high concentration gradient • surfactant, allows gases to dissolve *Diaphragm / intercostal muscles* • contract to increase volume in lungs, reduce pressure and cause inspiration *NB: Many of the features listed above are common to more than one structure and should be credited where appropriate.*
			Total	**12**	

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Question			Answer/Indicative content	Marks	Guidance
20			maggots are smaller so have greater <u>surface area to volume ratio</u> (than adult flies) ☐ shorter diffusion distance ☐ *idea that* maggots less active so lower metabolic demand for O_2 ☐ no (hard) exoskeleton so can absorb oxygen by diffusion through, skin / cuticle ☐	3	**ALLOW** ORA throughout **ALLOW** SA:V ratio
			Total	**3**	

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