Exchange Surfaces

Model Answers 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Exchange and transport
Topic	Exchange Surfaces
Booklet	Model Answers 1

Time allowed: **42 minutes**

Score: **/31**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E
>69%	56%	50%	42%	34%	26%

Question 1

Bony fish and insects have different gas exchange systems. Both can be observed by dissection.

(a) Describe how you would carry out the dissection to display maximum detail of either gas exchange system. **[2]**

- Remove the operculum or remove the exoskeleton
- To display the gills or the tracheoles

(b) Insects, such as beetles, obtain oxygen by drawing air in through holes in their exoskeleton, called spiracles. Pairs of spiracles on each abdominal segment connect to air tubes that take the air deep into the tissues of the insect for gas exchange.

Diving beetles live in ponds. They carry an air bubble under their wing when they swim underwater. The bubble supplies air to the spiracles. When the bubble has been used up, the beetle comes to the surface to collect a new bubble.

A student carried out an investigation into the effect of temperature on three diving beetles.

- Three beetles (A, B and C) from the same species were used in the investigation.
- They were placed in thermostatically controlled water baths at 10 °C, 20 °C and 30 °C respectively.
- They were observed for one hour.
- The number of times the beetle surfaced to renew its air bubble was recorded.
- Mean values for each temperature were calculated and recorded to the nearest whole number.
- The results are shown in Table 3.

Temperature (°C)	Number of times beetle resurfaced in one hour			
	Beetle A	Beetle B	Beetle C	Mean
10	10	12	8	10
20	18	22	18	20
30	44	48	38	43

• 19

Table 3

The student made an error in their working.

(i) Put a ring around the error in **Table 3** and write the correct answer next to it. Use the space below to show your working. **[2]**

(ii) Fig. 3 shows a diagram of part of the gas exchange system of an insect.

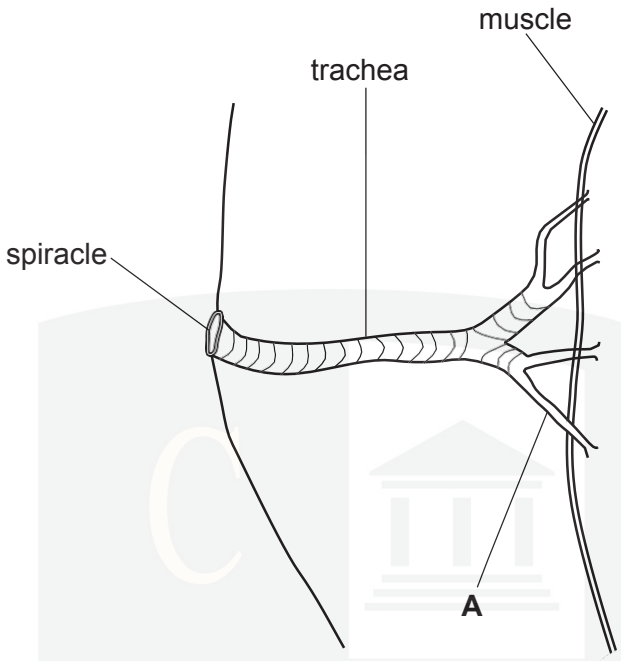


Fig. 3

Name the structure labelled **A**. . **[1]**

tracheole

(iii) Describe how the trachea of a mammal is different from the trachea shown in Fig. 3. **[2]**

In this answer the first response refers to the mammal and the second refers to the insect

- No chitin/ has cartilage has chitin/no cartilage
- Cartilage is C shaped chitin is spiral
- Lumen is wider lumen is narrower
- One trachea several trachea
- Longer shorter
- Has smooth muscle/goblet cells no goblet cells/no smooth muscle

The role of cartilage and chitin is to support the trachea in mammals and insects because when they breathe in the pressure inside falls and the tube has to be prevented from collapsing

(c)* Alveoli are located in the lungs of mammals.

Explain how **alveoli** are adapted for efficient gas exchange. **[6]**

- Large numbers of alveoli create a large surface area : so more space for molecules to pass across
- They have elastic fibres : so they can stretch and recoil making exhalation passive
- They have a surfactant : to reduce surface tension in alveoli so the alveoli don't collapse
- Alveoli are one cell thick/squamous epithelium/capillaries close : short pathway for **rapid** diffusion
- They are ventilated so oxygen is replaced & carbon dioxide removed : to maintain diffusion gradients
- Good blood supply and capillaries very close to maintain diffusion gradients and rapid diffusion path

The marks awarded for this question depend upon scientific content and relevant explanations. You cannot just list features without stating how this helps gas exchange.

[Total: 13]

Question 2

Many organisms have evolved specialised gas exchange surfaces. One feature of these structures is their large surface area to volume ratio.

(a) (i) Describe how the structures of the insect tracheal system and fish gills provide a large surface area for gas exchange.

[2]

- Insects have many branched tracheae / tracheoles
- Fish have many filaments/lamellae/gill plates

(ii) The lugworm, *Arenicola marina*, is a species of segmented worm that lives in burrows in damp sand. They have hair-like external gills that increase the surface area available for gas exchange.

Many other species of segmented worm do not have external gills.

Suggest why lugworms have evolved external gills **[1]**

- Lugworms are large so their surface area : volume ratio is low
- The rate of diffusion is too small to meet the demands of the organism
- Lugworms have a fast metabolic rate
- Oxygen is in short supply in the damp sand

The first two marking points are standard theory that you should have revised, so refer to surface area etc. Then look at the information they've given you. 'They live in damp sand'.

(b) Mammals use lungs for gas exchange. The following passage describes how gases are moved in and out of the lungs.

Complete the passage using the most appropriate words or phrases.

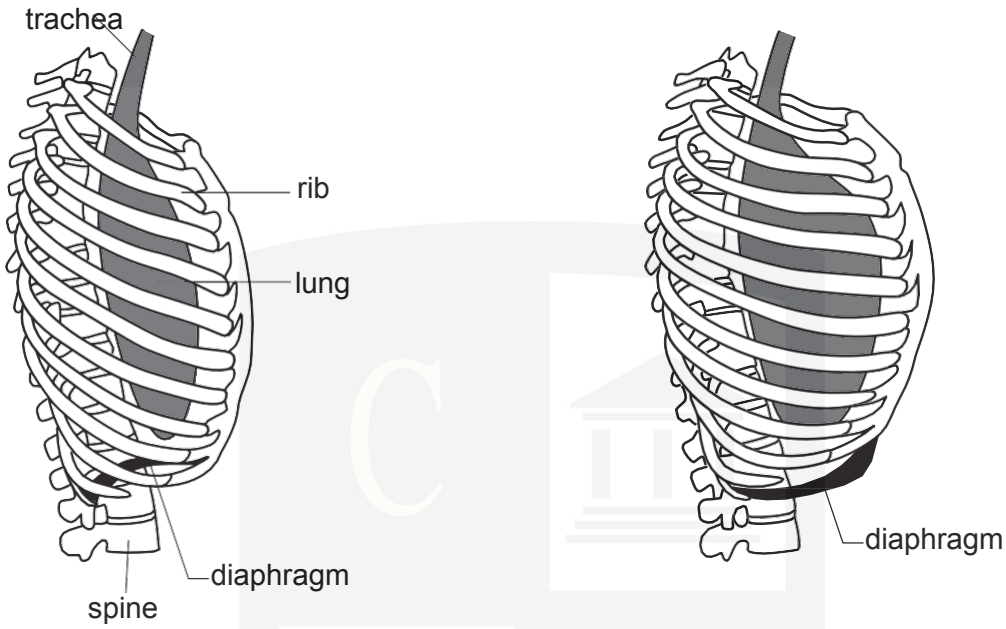
When air enters the trachea, mucus secreted by .....goblet cells..... cells traps dust and microorganisms. Air diffuses through the bronchi and the bronchioles. Smooth muscle in the bronchioles relaxes during the 'fight or flight' response. This response is produced by the sympathetic nervous system, which contains neurones that secrete the neurotransmitter .....noradrenaline..... . During inspiration, both the .....diaphragm..... and external intercostal muscles contract. The internal intercostal muscles only contract when expiration is .....forced/active..... .

[4]

[Total: 7]

Question 3

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



(a) **Fig. 1.1** **(b)**

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

Describe how this diagram justifies your choice. **[2]**

- A because the volume of the lungs / thorax is smaller
- The diaphragm is dome shaped / relaxed
- Ribs are lowered

(ii) Why can expiration be a passive process? **[1]**

- The muscles don't contract, the lungs recoil and gravity returns the rib cage

The external intercostal muscles contract to raise the rib cage whereas the internal intercostal muscles only contract when air is forced out of the lungs. The elastic tissue that surrounds the alveoli recoils to help the lungs return to their original position

(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.

Suggest the effects that this muscle contraction has on ventilation. **[2]**

- It reduces the diameter of the bronchi / bronchioles
- Less air can be exhaled as the resistance to air flow increases
- More air stays in the lungs
- It's harder to inhale as the resistance to air flowing in is greater
- Breathing rate increases / breathing becomes shallower

When you reduce the diameter of a tube its resistance to flow increases, these would be the symptoms of an asthma attack

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

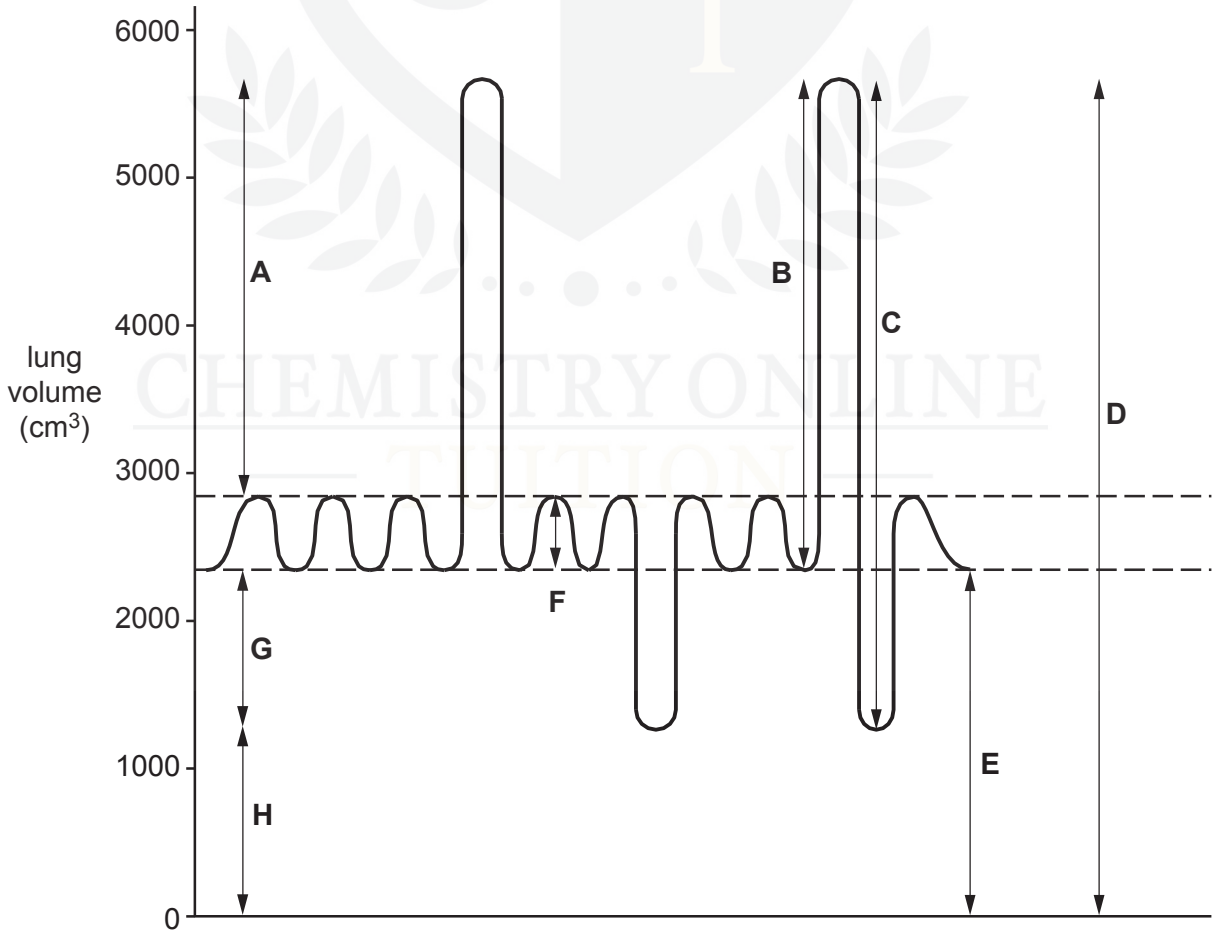


Fig. 1.2

(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	H
Total lung capacity	D
Tidal volume	F
Vital capacity	C

[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]**

- Breathe in as deeply as possible
- Force as much air out as possible

As the curve goes up, the volume of air in the lungs increases, so this is breathing in. The person has breathed as much air in as they can, then they breathe out as much as they can. This is known as the vital capacity.

[Total: 11]