Gas Exchange: AQA A Level Biology Exam Questions by Topic

18 questions · 52 marks · about 68 minutes. Answer in the spaces, then check the mark schemes at the end.

Question 1 · AS Paper 1 · June 2023 · Q05.5 · 3 marks

0 5 . 5 Describe how gas exchange occurs in single-celled organisms **and** explain why this method cannot be used by large, multicellular organisms.

[3 marks]

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Question 2 · AS Paper 2 · June 2022 · Q09.1 · 5 marks

0 9 . 1 Describe how the structure of the insect gas exchange system:

- provides cells with sufficient oxygen
- limits water loss.

Explain your answers.

[5 marks]

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Question 3 · A level Paper 3 · June 2024 · Q03.4 · 1 mark

0 3 . 4 Name **two** structural features of the gills of a fish that increase their surface area.

[1 mark]

1 _____

_____

2 _____

_____

Question 4 · AS Paper 1 · June 2019 · Q06.2 · 3 marks

0 6 . 2 Describe and explain the advantage of the counter-current principle in gas exchange across a fish gill.

[3 marks]

_____

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Question 5 · information from earlier in the question

0 9 Scientists dissected gills from several species of fish. They recorded:

- the mass of the whole fish
- the total number of gill filaments
- the mean length of one filament
- the mean number of lamellae per mm
- the mean surface area of one lamella.

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0 9 . 3 **Table 5** shows the scientists' data for two species of fish.

Table 5

Fish species	Mean fish mass / g	Mean total surface area of the gills / mm^2
Opsanus tau	305	46 100
Trachurus trachurus	250	252 500

One of these fish spends most of its time not moving, waiting to catch passing prey. The other species is very active, hunting mobile prey.

Suggest which of the species in **Table 5** is the very active fish species.

Explain your answer.

[2 marks]

Very active fish species _____

Explanation _____

_____

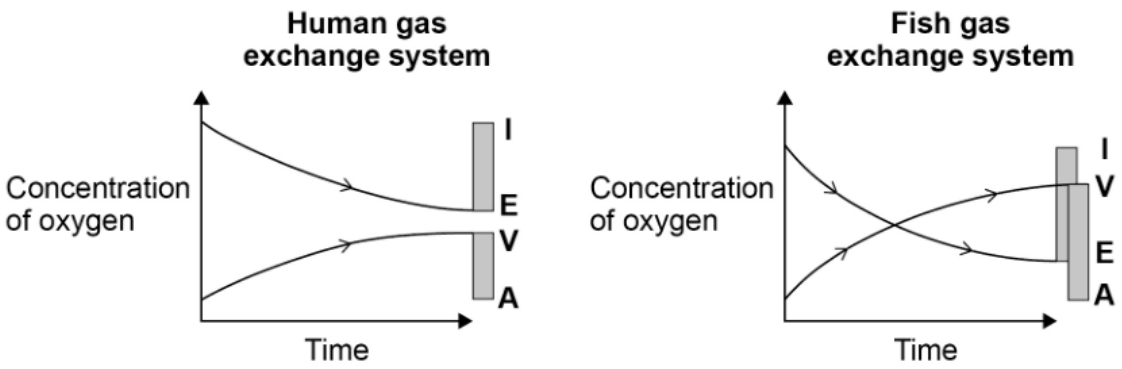
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0 2 . 3 **Figure 3** shows changes in concentration of oxygen in two gas exchange systems.

Figure 3



Key

I Air/water entering the gas exchange system

E Air/water leaving the gas exchange system

A Arterial blood entering the gas exchange system

V Venous blood leaving the gas exchange system

A student studied **Figure 3** and concluded that the fish gas exchange system is more efficient than the human gas exchange system.

Use **Figure 3** to justify this conclusion.

[2 marks]

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Question 7 · A level Paper 1 · June 2025 · Q10.2 · 4 marks

1 0 . 2 Describe **and** explain the adaptations of leaves that maximise gas exchange.

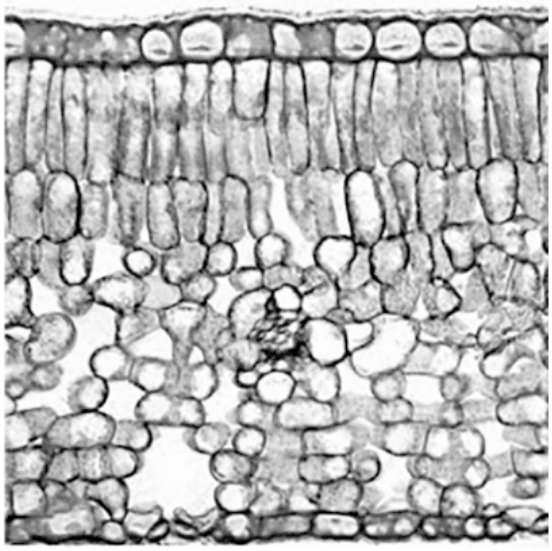
Do **not** refer to organelles in your answer.

[4 marks]

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0 7 **Figure 8** is a photograph of a vertical section through a leaf observed using an optical microscope.

Figure 8



0 7 . 1 In the box below:

- produce a scientific drawing of the arrangement of tissues shown in **Figure 8**
- label **one** of the tissues in your drawing

Do **not** draw individual cells.

[3 marks]

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Question 9 · AS Paper 2 · June 2016 · Q02.4 · 2 marks

0 2 . 4 One of the two plant species used by the student in this investigation was a xerophyte.

Other than the distribution of stomata, suggest and explain **two** xerophytic features the leaves of this plant might have.

[2 marks]

1 _____

_____

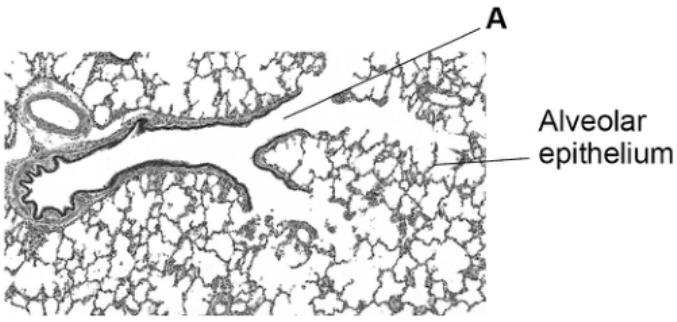
2 _____

_____

Question 10 · A level Paper 1 · June 2024 · Q03.3 · 1 mark

0 3 . 3 **Figure 2** is an image of the lung tissue observed using an optical microscope.

Figure 2



Identify the tube labelled **A**.

[1 mark]

A _____

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Question 11 · A level Paper 1 · June 2018 · Q10.1 · 6 marks

1 0 . 1 Describe the gross structure of the human gas exchange system and how we breathe in and out.

[6 marks]

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Question 12 · AS Paper 1 · June 2018 · Q09.1 · 2 marks

0 9 . 1 Describe the pathway taken by an oxygen molecule from an alveolus to the blood.

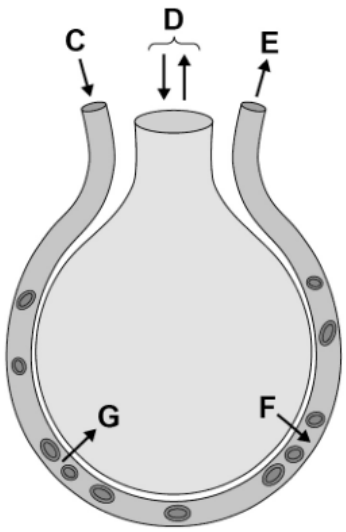
[2 marks]

Question 13 · information from earlier in the question

0 1 . 2 **Figure 2** is a diagram of an alveolus and a blood vessel associated with the alveolus.

The direction of the movement of substances is shown by the arrows labelled **C**, **D**, **E**, **F** and **G**.

Figure 2



Complete **Table 1** by writing the correct letter, **C**, **D**, **E**, **F** or **G**, in the box next to each statement. You may use each letter once, more than once or not at all.

[2 marks]

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Question 13 · AS Paper 1 · June 2024 · Q01.3 · 2 marks

0 1 . 3 Describe and explain **one** adaptation of a **single** alveolus for gas exchange.

[2 marks]

Question 14 · information from earlier in the question

0 6 A scientist investigated the effect of the lung disease emphysema on lung function.

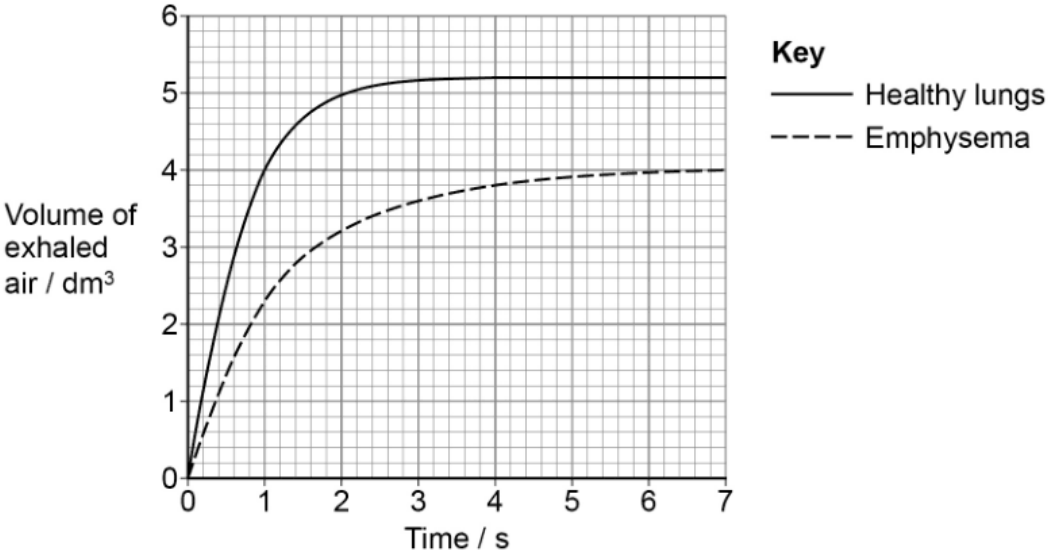
They investigated lung function in:
- a person with emphysema
- a person with healthy lungs.

The scientist told each person:
- to breathe in fully
- then breathe out fully and as quickly as possible.

The scientist measured the volume of air exhaled in one breath.

Figure 7 shows the scientist's results.

Figure 7



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Question 14 · AS Paper 1 · June 2025 · Q06.3 · 3 marks

0 6 . 3 The main effects of emphysema on the lungs are the breakdown of:

- the walls of the alveoli
- the elastic tissue in the lungs.

Use this information and the data in **Figure 7** to suggest why gas exchange is reduced in a person with emphysema.

[3 marks]

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Question 15 · A level Paper 1 · November 2020 · Q06.1 · 3 marks

0 6 . 1 Particulate matter is solid particles and liquid particles suspended in air. Polluted air contains more particulate matter than clean air.

A high concentration of particulate matter results in the death of some alveolar epithelium cells. If alveolar epithelium cells die inside the human body they are replaced by non-specialised, thickened tissue.

Explain why death of alveolar epithelium cells reduces gas exchange in human lungs.

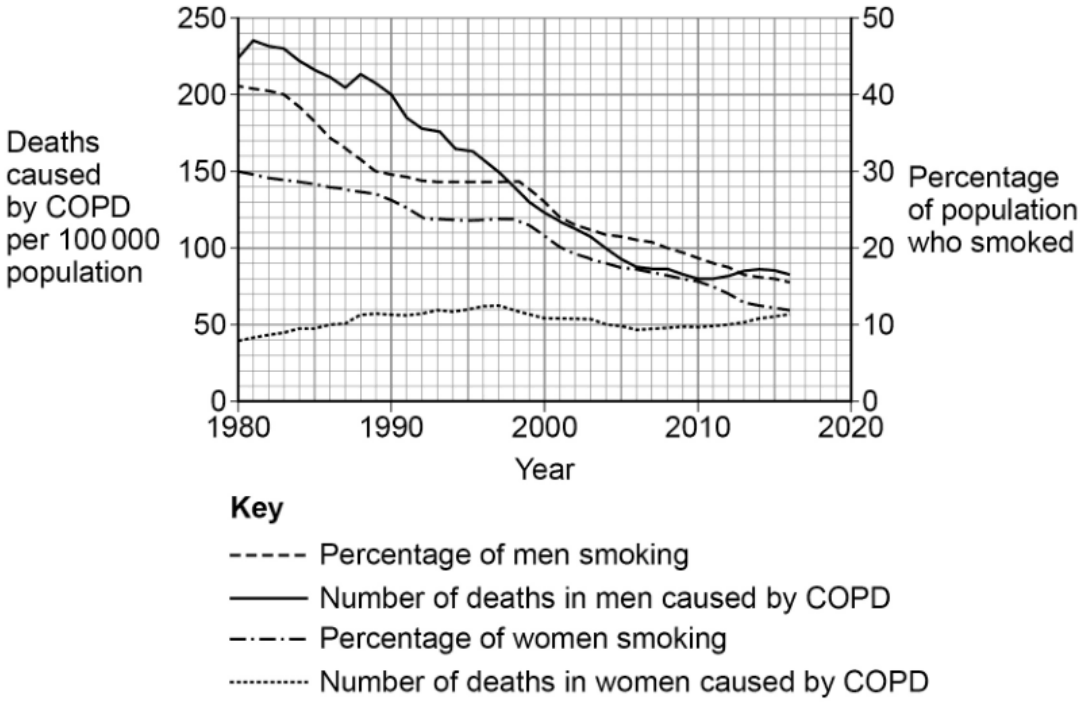
[3 marks]

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0 6 . 4 Chronic obstructive pulmonary disease (COPD) is the name for a group of lung diseases that cause breathing difficulties. This includes emphysema.

Figure 8 shows the number of deaths caused by COPD from 1980–2016. It also shows the percentage of the population who smoked, for the same time period.

Figure 8



A journalist looked at the data in **Figure 8** and concluded that smoking is a cause of COPD.

Evaluate this conclusion.

[3 marks]

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0 5 . 4 Scientists investigated the link between the lung disease asthma and three risk factors. They studied a large number of people. They recorded if the people had asthma and if they:

- were obese
- burned wood indoors as a fuel
- lived in a house with a cat or dog.

The scientists used a statistical test to calculate the probability of the link between asthma and each risk factor being due to chance.

Table 2 shows their results.

Table 2

Risk Factor	Probability (P value)
Obese	< 0.001
Burned wood indoors	= 0.06
Lived with a cat or dog	< 0.05

A student who looked at these results concluded that all three risk factors are linked with asthma. Evaluate this conclusion.

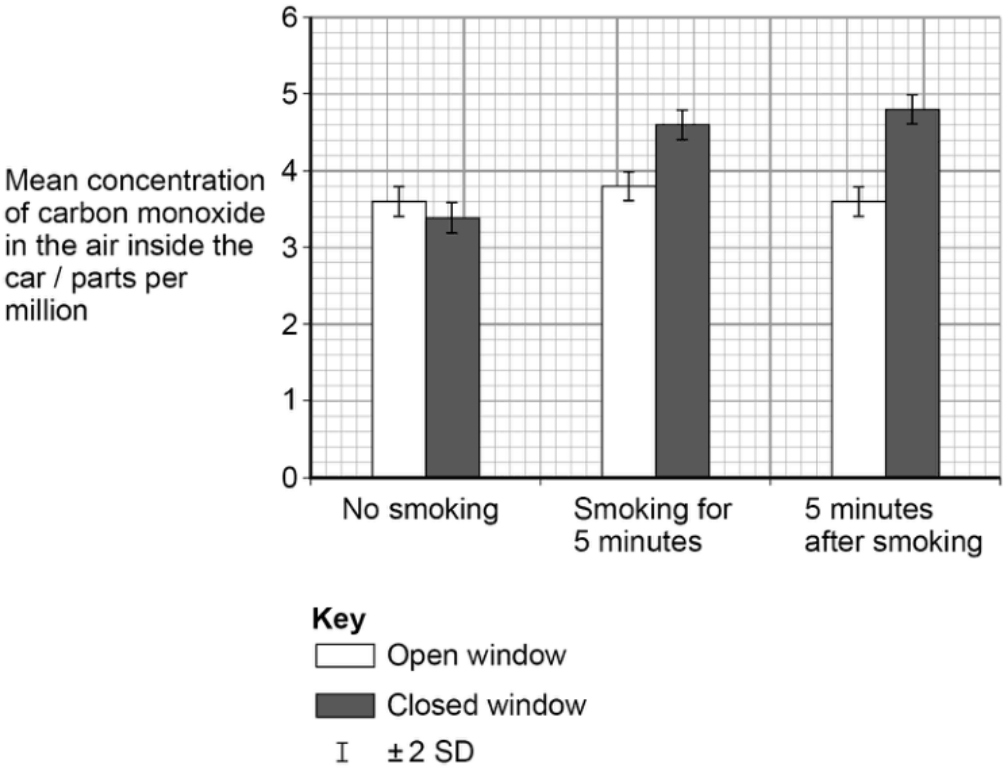
[3 marks]

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Carbon monoxide is a poisonous gas that is present in cigarette smoke. This carbon monoxide can be absorbed into the blood where it binds with haemoglobin.

Scientists investigated the concentration of carbon monoxide in cars in which people were smoking or not smoking. They measured the concentration with the car windows open and closed. **Figure 7** shows the scientists' results as they presented them. A value of ± 2 standard deviations from the mean includes over 95% of the data.

Figure 7



0 9 . 3 In England, in October 2015, a law was introduced making it illegal to smoke in a car carrying someone who is under the age of 18.

Following the introduction of the law, a politician stated:

'It is dangerous to smoke when a child is in the car. Higher levels of deadly toxins can build up, even on short journeys, and children breathe faster than adults, meaning they inhale more of the deadly toxins.'

Use the information provided **and** the data in **Figure 7** to evaluate the politician's statements.

[4 marks]

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Mark schemes

Question 1 · AS Paper 1 · June 2023 · Q05.5 · 3 marks

05.5	1. Diffusion (across the cell surface membrane); 2. Large organisms have small(er) sa : vol ratio **OR** Single-celled organisms have a large(r) sa : vol ratio; 3. Diffusion pathway would be too long **OR** (Rate of) Diffusion too slow;	3 max (3 x AO1)	3. Must be in the context of larger organisms

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09.1	1. Spiracles, tracheae, tracheoles; 2. Spiracles allow <u>diffusion</u> (of oxygen) **OR** (Oxygen) <u>diffusion</u> through tracheae/tracheoles; 3. Tracheoles are highly branched so large surface area (for exchange); 4. Tracheole (walls) thin so short diffusion distance (to cells) **OR** Highly branched tracheoles so short diffusion distance (to cells) **OR** Tracheoles enter cells so short diffusion distance; 5. Tracheole permeable to oxygen/air; 6. Cuticle/chitin/exoskeleton (impermeable) so reduce water loss; 7. Spiracles (can) close so no/less water loss **OR** Spiracles have valves so no/less water loss; 8. Hairs around spiracles reduce water loss;	5 max (5 x AO1)

Reference to these 3 structures anywhere in answer = 1mark

If whole answer refers to MPs 1–5 only, award MAX 4 marks

3. Accept 'network' or 'large number' for highly branched

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Question 3 · A level Paper 3 · June 2024 · Q03.4 · 1 mark

03.4	(Gill) lamella(e) **and** (gill) filament(s);	1 (1x AO1)	Accept primary **and** secondary lamellae Ignore (gill) arch **and** (gill) rakers

Question 4 · AS Paper 1 · June 2019 · Q06.2 · 3 marks

06.2	1. Water **and** blood flow in opposite directions; 2. Maintains diffusion/concentration gradient of oxygen **OR** Oxygen concentration always higher (in water); 3. (Diffusion) along length of lamellae/filament/gill/capillary;

3	2. Accept: converse for carbon dioxide 2. Accept: equilibrium not reached 3. Accept: all/whole of lamellae/filament//gill/capillary

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Question 5 · AS Paper 2 · June 2023 · Q09.3 · 2 marks

09.3	(*Trachurus trachurus*) – **no mark** 1. More oxygen uptake/diffusion **OR** More gas exchange; 2. More energy/ATP from respiration;	2 (2 x AO2)	Incorrect fish name = zero Accept just 'Trachurus' or 'trachurus' 'More' required once only

Question 6 · A level Paper 1 · November 2021 · Q02.3 · 2 marks

02.3	1. In fish, blood leaving (V) has more oxygen than water leaving (E); 2. (But) in humans, blood leaving (V) has less oxygen than air leaving (E); 3. Difference in oxygen (concentration) between artery and vein is greater in fish than in humans; 4. (So) fish remove a greater proportion from the oxygen they take in;	2 max

Question 7 · A level Paper 1 · June 2025 · Q10.2 · 4 marks

10.2	1. Many <u>stomata</u>; 2. Stomata allow (gas) diffusion; 3. Air spaces in <u>mesophyll</u>; 4. Large surface area of cells/cell membranes for (rapid) diffusion; 5. Large (leaf) surface area to volume ratio **so** high/increases diffusion (rate); 6. Thin (leaves) **so** short diffusion distance/ pathway;	4 max (4 x AO1)	Ignore moist membranes

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Question 8 · AS Paper 2 · June 2022 · Q07.1 · 3 marks

07.1	1. Four bands (upper epidermis, palisade, spongy, lower epidermis); 2. Band widths must look similar to photograph; 3. Correct label of one tissue;	3 (3 x AO2)

1. and 2. ignore waxy cuticle and vascular bundle/xylem/phloem

Give benefit of doubt for use of printed box as borderlines of drawing bands.

2. Reject if cells drawn

2. Reject if lines are overlapping **OR** sketched

2. Ignore stomata and air spaces

2. Must be at least 3 bands shown

3. Accept (upper/lower) epidermis/palisade mesophyll/spongy mesophyll/ vascular bundle/ xylem/phloem

3. Accept cells for mesophyll

3. Reject stoma

3. Reject waxy cuticle

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Question 9 · AS Paper 2 · June 2016 · Q02.4 · 2 marks

02.4	1. Hairs **so** 'trap' water vapour and water potential gradient decreased; 2. Stomata in pits/grooves **so** 'trap' water vapour and water potential gradient decreased; 3. Thick (cuticle/waxy) layer **so** increases diffusion distance; 4. Waxy layer/cuticle **so** reduces evaporation/transpiration. 5. Rolled/folded/curled leaves **so** 'trap' water vapour and water potential gradient decreased; 6. Spines/needles **so** reduces surface area to volume ratio;	2 max	1, 2 and 5. Accept: humid/moist air as 'water vapour' but **not** water/moisture on its own. 1, 2 and 5. Accept: diffusion gradient as equivalent to water potential gradient. 1, 2 and 5. Accept: less exposed to air as an alternative to water potential gradient. 6. Accept: spines/needles s**o** 'reduce area'.

Question 10 · A level Paper 1 · June 2024 · Q03.3 · 1 mark

03.3	Bronchiole(s);	1 (1 x AO1)	Accept broncheole(s) **OR** bronchiol(les) **OR** broncheol(les) **OR** bronkiol(les) **OR** bronkeol(les) **OR** brochiol(les) **OR** brocheol(les) Reject bronchiolus **OR** broncheolus **OR** **OR** branchiol(les) **OR** brancheol(les) **OR** bronchus **OR** bronchi

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10.1	1. Named structures – trachea, bronchi, bronchioles, alveoli; 2. Above structures named in correct order OR Above structures labelled in correct positions on a diagram; 3. Breathing in – diaphragm contracts **and** external intercostal muscles contract; 4. (Causes) volume increase and pressure decrease in thoracic cavity (to below atmospheric, resulting in air moving in); 5. Breathing out - Diaphragm relaxes **and** internal intercostal muscles contract; 6. (Causes) volume decrease and pressure increase in thoracic cavity (to above atmospheric, resulting in air moving out);	6

1, 2. Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

4. and 6. For thoracic cavity accept 'lungs' or 'thorax'.

4. and 6. Reference to 'thoracic cavity' only required once.

If idea of thoracic cavity is missing or incorrect, allow ECF for mark point 6.

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Question 12 · AS Paper 1 · June 2018 · Q09.1 · 2 marks

09.1	1. (Across) alveolar epithelium; 2. Endothelium / epithelium of capillary;	2	Incorrect sequence = maximum of 1 mark

Question 13 · AS Paper 1 · June 2024 · Q01.3 · 2 marks

01.3	1. (Epithelium is) single cell layer **OR** (Epithelium contains) thin/flat cells **OR** Epithelium is thin; 2. (So) short diffusion pathway/distance;	2 (2 x AO1)	Ignore reference to surface area 1. Accept one cell thick 1. Accept "has squamous epithelium"

Question 14 · AS Paper 1 · June 2025 · Q06.3 · 3 marks

06.3	1. Low FEV1/Figure 7 shows less air exhaled; 2. (Destruction of alveoli walls means) decrease in surface area (for gas exchange); **OR** (Destruction of alveoli walls may) increase diffusion distance (due to scar tissue); 3. Lack of (elastic) recoil/tissue makes exhalation more difficult **OR** Lack of (elastic) recoil/tissue reduces concentration gradient (between alveoli and blood);	3 (1 x AO1, 2 x AO2)

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Question 15 · A level Paper 1 · November 2020 · Q06.1 · 3 marks

06.1	1. Reduced surface area; 2. Increased distance for <u>diffusion</u>; 3. Reduced **rate** of gas exchange;	3	1 and 2. Accept description of efficient gas exchange in healthy alveolar epithelium as long as reference made to the damaged tissue changing this.

Question 16 · AS Paper 1 · June 2025 · Q06.4 · 3 marks

06.4	1. **Positive** correlation between smoking and COPD deaths in men; 2. **No** correlation shown between smoking and COPD deaths in women; 3. Named/other factors not taken into consideration;	3 (3 x AO3)

1 and 2. Accept description of correlation

2. Accept '(slight) negative correlation' for 'no correlation'

3. Other factors include e.g. passive smoking, occupational exposure, medical improvements

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Question 17 · AS Paper 1 · November 2020 · Q05.4 · 3 marks

05.4	**In support** 1. (Link/risk with asthma and) living with cat or dog is (statistically) significant; 2. (Link with) obesity is most/highly significant; **Not supported** 3. (Link/risk with asthma and) burned wood (indoors) is not (statistically) significant;	3	Reject 'results are significant' Accept 'due to chance' for 'not significant' and converse
TOTAL		**9**	

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09.3	**For** 1. Significantly higher concentrations of CO (compared with no smoking) with closed window (as no overlap in 2 x SD); 2. Any increase in CO could be dangerous; **OR** CO causes less oxygen to be carried / provided (which could be deadly in children); 3. (significantly) higher levels after (just) 5 minutes (with closed windows supporting short journey statement); **Against** 4. No idea if (roughly) 5ppm is 'deadly'; 5. No significant difference with open window (as 2 x SD overlaps); 6. No data on child breathing rates; **OR** Idea that children breathe faster but have smaller lung volume, **so** overall volume of CO inhaled could be similar;

4 max	1. Accept higher concentrations of CO with closed window are not due to chance

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