



Gas exchange: practice questions

6 questions · 17 marks · mark scheme at the back

For IB Diploma Biology SL undefined. **HL only** is additional higher level content, for HL students only.

Name

Total / 17

1 PAPER 1A STYLE [1 mark]

Which change happens as an organism of the same shape increases in size?

- A. ☐ Surface area increases and the surface area-to-volume ratio increases
- B. ☐ Surface area increases and the surface area-to-volume ratio decreases
- C. ☐ Volume decreases relative to surface area
- D. ☐ The distance from the centre to the exterior decreases

2 PAPER 1A STYLE [1 mark]

What is the role of surfactant in the alveoli of mammalian lungs?

- A. ☐ It dissolves oxygen so that it can diffuse into the blood
- B. ☐ It kills bacteria that enter the alveoli with inhaled air
- C. ☐ It reduces surface tension so that the alveoli do not collapse
- D. ☐ It increases the thickness of the alveolus wall to prevent damage

3 PAPER 2A STYLE [3 marks]

Outline how concentration gradients are maintained at the gas-exchange surface of a mammal.

4 PAPER 1B STYLE

[5 marks]

A student measured her lung volumes with a spirometer at rest. The values are practice data. (a) Calculate her vital capacity. (b) Calculate her total lung volume. (c) State which value in the table cannot be measured with a spirometer and explain why. (d) Explain how contraction of the external intercostal muscles and diaphragm causes inspiration.

Lung volumes of one student at rest (practice data)	
Volume	Value / dm ³
Tidal volume	0.5
Inspiratory reserve volume	2.6
Expiratory reserve volume	1.0
Residual volume	1.2

Answer =

5 PAPER 2A STYLE

[3 marks]

Explain why plants cannot avoid losing water by transpiration.

Leaf casts were made of the lower epidermis of two species. Stomata were counted in five fields of view at $\times 400$. The field of view diameter was 0.45 mm. (a) Calculate the mean stomatal density of species X. Give your answer in stomata per mm^2 . (b) Suggest why five fields of view were counted. (c) Species Y lives in a hot, dry habitat. Suggest how its stomatal density helps it survive.

Number of stomata per field of view (practice data)					
Species	Count 1	Count 2	Count 3	Count 4	Count 5
X	31	35	29	33	32
Y	12	15	11	14	13

Answer =

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Mark scheme

One mark for each point unless a maximum is given. Words in brackets are not needed for the mark.

1. [1]

B B [1]

2. [1]

C C [1]

3. [3]

- dense network of capillaries close to the alveoli [1]
- continuous blood flow carries oxygenated blood away / brings deoxygenated blood [1]
- ventilation replaces air in alveoli / brings fresh air with high O₂ concentration and removes CO₂ [1]
- keeps O₂ concentration higher in alveoli than in blood / CO₂ higher in blood than in alveoli [1]
- max 3

4. [5]

- (a) $0.5 + 2.6 + 1.0 = 4.1 \text{ dm}^3$ [1]
- (b) $4.1 + 1.2 = 5.3 \text{ dm}^3$ [1] ECF from (a)
- (c) residual volume, because this air always remains in the lungs / cannot be breathed out into the spirometer [1]
- (d) ribs move up and out and diaphragm flattens/moves down, so thorax volume increases [1]
- (d) pressure in the thorax/lungs falls below atmospheric so air flows in [1]

5. [3]

- stomata must be open to allow CO₂ to enter for photosynthesis [1]
- water evaporates from (moist) mesophyll cell walls into air spaces [1]
- water vapour diffuses out through open stomata down a concentration gradient [1]
- gas exchange surface must be moist/permeable so water is lost from it [1]
- max 3

6. [4]

- (a) mean count = $160 \div 5 = 32$ [1]
- (a) area = $\pi \times 0.225^2 = 0.159 \text{ mm}^2$; density = $32 \div 0.159 = 201$ stomata per mm^2 (accept 200-202) [1]
- (b) stomatal number varies across the leaf/biological variability, so replicates give a reliable mean [1]
- (c) fewer stomata so less water vapour lost by transpiration [1]