



## Organisms (Form and function) practice questions

11 questions • 35 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 ..... / 35

### Gas exchange **Spec B3.1**

**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.

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**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 <sup>3</sup> |
| Tidal volume                                        | 0.5                     |
| Inspiratory reserve volume                          | 2.6                     |
| Expiratory reserve volume                           | 1.0                     |
| Residual volume                                     | 1.2                     |

Answer = .....

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**5 PAPER 2A STYLE**

**[3 marks]**

Explain why plants cannot avoid losing water by transpiration.

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**6** PAPER 1B STYLE

[4 marks]

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  $\text{mm}^2$ . (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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## Transport Spec B3.2

**7** PAPER 1A STYLE

[1 mark]

Fenestrated capillaries are found in the glomerulus of the kidney. What is the advantage of fenestrations?

- A. ☐ They prevent blood cells from leaving the capillary
- B. ☐ They allow particularly rapid exchange of fluid and solutes
- C. ☐ They increase blood pressure in the capillary
- D. ☐ They prevent backflow of blood

**8** PAPER 2A STYLE

[4 marks]

Distinguish between the structure of arteries and veins, relating each difference to function.

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**9** PAPER 2A STYLE

[2 marks]

A student counted her radial pulse for 20 s three times and got 24, 26 and 25 beats. Calculate her mean heart rate in beats per minute and state why she should use her fingertips rather than her thumb.

Answer = .....

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**10** PAPER 1B STYLE

[5 marks]

A study recorded mean daily saturated fat intake and deaths from coronary heart disease (CHD) in six populations. The correlation coefficient was  $r = +0.98$ . (a) Describe the relationship shown. (b) Explain how a high saturated fat intake could lead to occlusion of a coronary artery. (c) Evaluate whether the data show that saturated fat causes CHD.

**Saturated fat intake and CHD deaths (practice data)**

| Population | Saturated fat / % of energy intake | CHD deaths per 100 000 per year |
|------------|------------------------------------|---------------------------------|
| 1          | 7                                  | 60                              |
| 2          | 9                                  | 95                              |
| 3          | 11                                 | 140                             |
| 4          | 13                                 | 150                             |
| 5          | 15                                 | 230                             |
| 6          | 17                                 | 240                             |

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Explain how water is transported from the roots to the leaves of a plant during transpiration.

[illegible]

## 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 O<sub>2</sub> concentration and removes CO<sub>2</sub> [1]
- keeps O<sub>2</sub> concentration higher in alveoli than in blood / CO<sub>2</sub> 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 CO<sub>2</sub> 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<sup>2</sup> (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]

7. [1]

B B [1]

8. [4]

- arteries have thicker walls relative to the lumen / veins thinner walls [1]
- artery walls withstand high pressure [1]
- arteries have more elastic fibres which stretch and recoil to maintain pressure/even out flow [1]
- arteries have more smooth muscle to narrow the lumen/maintain pressure [1]
- veins have valves to prevent backflow at low pressure [1]
- veins have wider lumen / flexible walls compressed by skeletal muscle to push blood to heart [1]
- max 4

**9. [2]**

- mean = 25 beats per 20 s, so  $25 \times 3 = 75$  beats per minute [1]
- the thumb has its own pulse, which could be counted by mistake [1]

**10. [5]**

- (a) positive correlation: as saturated fat intake increases, CHD deaths increase [1]
- (a) strong correlation, as  $r$  is close to +1 [1]
- (b) raises blood cholesterol which forms fatty deposits/plaque in coronary artery walls, narrowing lumen [1]
- (b) plaque rupture leads to a blood clot that blocks the artery [1]
- (c) correlation does not prove causation [1]
- (c) other factors could differ between populations, e.g. smoking, exercise, genetics, age / only six populations [1]
- max 5

**11. [6]**

- water evaporates from (spongy mesophyll) cell walls and diffuses out through stomata [1]
- water drawn from xylem/through cell walls by capillary action/adhesion to cellulose [1]
- generates tension/negative pressure potential in xylem [1]
- tension pulls water up xylem [1]
- cohesion between water molecules due to hydrogen bonding [1]
- keeps a continuous column of water [1]
- adhesion of water to xylem walls [1]
- xylem has no cell contents/end walls so flow is unimpeded [1]
- lignified walls prevent collapse under tension [1]
- pits allow water to enter/leave xylem [1]
- passive process / energy from evaporation (sun), not ATP [1]
- max 6