

3.2 ORGANISMS AND SUBSTANCE EXCHANGE – GAS EXCHANGE (2) – MARK SCHEMES

Q1.

- (a) 235–240;;
(one mark for an answer between 200-300 based on 2 - 3 stomata in 0.01mm^2
Alternatively, one mark for calculating the area of the rectangle correctly as $0.016 - 0.017\text{mm}^2$)

2

- (b) grows in arid / dry conditions;
less surface area;
(rate of) transpiration / water loss would be reduced;

3

[5]

Q2.

- (a) Active transport against / facilitated down with concentration gradient;
Accept answers in terms of water potentials

Active transport uses ATP/energy, /facilitated doesn't;
Reject along/across gradient

Active uses carrier (proteins), / facilitated (often) uses channel (proteins);

2 max

- (b) Lipid/fatty acid part of membrane is non-polar/hydrophobic;
Accept lipid/fatty acid bilayer

Oxygen and carbon dioxide small/ non-polar (molecules);

Oxygen/carbon dioxide can diffuse through/dissolve in/
get between molecules in this layer;

Down a concentration gradient;

2 max

- (c) Brings more oxygen/removes carbon dioxide;

Maintains diffusion/concentration gradients;

Between alveoli and blood/capillaries;

Reject references to surface area

2 max

[6]

Q3.

- (a) (i) Changes shape of antitrypsin;
Reference to hydrogen/ionic/disulfide bonds;
No longer attaches to/interacts/ reacts with trypsin;
Accept protease

2

- (ii) Higher the concentration of hydrogen peroxide, more amino acids/

proteins affected;
More antitrypsin molecules change shape;

2

- (b) (Longterm smokers) inhale a lot of hydrogen peroxide;
Smokers have more active enzyme that damages lung tissue;
Reducing gas exchange surface;

2 max

[6]

Q4.

- (a) exchange / diffusion across body surface / skin;
short diffusion pathway / distance / large SA:V ratio;
- (b) large numbers of lamellae so large SA;
lamellae thin so short (diffusion) pathway to blood / capillaries;
high rate of oxygen uptake for respiration / energy release;
(accept more oxygen)

2

3

[5]

Q5.

- (a) (explanation must be linked to structures to gain second mark for each linked pair)

filaments / lamellae ;	large SA;
gill plates or secondary lamellae;	
large number of capillaries;	to remove oxygen / to maintain a gradient;
thin epithelium;	short diffusion pathway;
pressure changes;	to bring in more water / to maintain gradient;
countercurrent flow (or description);	exchange / diffusion along whole length / concentration gradient maintained / equilibrium not achieved / blood always meets water with higher oxygen concentration;

6

- (b) (i) requires 20 cm³ of oxygen / extracts 7.2 cm³ of oxygen /
reject if referring to volume of water

$$\frac{20}{7.2};$$

2.7 / 2.8 (dm³h⁻¹);
(correct answer award 2 marks)

2

- (ii) high (relative) density / heavy;
requires large input of energy as difficult to push back out;

2

- (c) (for each pair second point must be linked to first)
to provide same amount of oxygen;

need to have more water flowing over gills;
OR
metabolic rate / respiration increases (with increase in temperature);
so more oxygen required;

2 max

[12]

QWC 1

Q6.

- (a) 1. mouth opens, operculum / opercular valve shuts;
2. floor of mouth lowered;
3. water enters due to decreased pressure / increased volume;
4. mouth closes, operculum / opercular valve opens;
5. floor raised results in increased pressure / decreased volume;
6. high / increased pressure forces / pushes water over gills;

4 max

- (b) 1. alveoli provide a large surface area;
2. walls of alveoli thin to provide a short diffusion pathway;
3. walls of capillary thin / close to alveoli provides a short diffusion pathway;
4. walls (of capillaries / alveoli) have flattened cells;
5. cell membrane permeable to gases;
6. many blood capillaries provide a large surface area;
7. intercostal / chest muscles / diaphragm muscles / to ventilate lungs / maintain a diffusion / concentration gradient;
8. wide trachea / branching of bronchi / bronchioles for efficient flow of air;
9. cartilage rings keep airways open;
(*reject moist and thin membranes*)

6 max

[10]

Q7.

- (a) contraction of (diaphragm) muscles flattens diaphragm;
contraction of intercostal muscles raises ribcage;
increase in volume decreases pressure;

3

- (b) (i) tidal volume increases steeply, then increase slows down after 10 to 15 km h⁻¹;

1

- (ii) breathing rate increases slowly then steeply after 10 to 15 km h⁻¹;
(*max 1 if no reference to speed where change occurs in either (i) or (ii)*)

1

- (c) $20 \times 2.75 = 55 \text{ dm}^2$;

(*award 1 mark for correct method i.e. tidal volume \times rate*);

2

[7]

Q8.

- (a) (i) one feature;
then linked Explanation;

(many) filaments / lamellae / secondary lamellae;
so large surface area;

large number of capillaries; (NOT "good blood supply")
maintains a diffusion gradient / removes oxygen;

thin epithelium / lamellae wall;
short diffusion pathway;

2

(ii) maintains diffusion / concentration gradient / equilibrium
not reached;
diffusion occurs across whole length (of lamellae / gill);

2

(b) less energy needed / continuous flow of water or O₂;

1

[5]

Q9.

(a) (gills have) lamellae on filaments;
lots of both;

2

(b) (i) all 3 go up;

Accept converse

1

(ii) more oxygen can be supplied;
for more respiration;

Accept answer relating to CO₂

2

[5]

Q10.

(a) (diffusion) gradient will be maintained all the way along the gill / the amount of
oxygen in the water is always higher than in the blood / the numbers in the water are
always higher than in the blood;
more oxygen will diffuse into the blood;

2

(b) 100 cycles per minute;

(principle of 60 / x or 0.6 seen gains one mark)

2

[4]

Q11.

(i) (waxy so) impermeable to water / waterproof / stops water
passing through;

1

(ii) reference to hairs / position of stomata (sunken stomata /
stomata in pits)

LINKED to reduced air movement / trap layer of air /
trap water vapour (*reject water*) / maintains humidity;

reduces diffusion gradient / concentration gradient of water /

water potential gradient;

OR

stoma can close;

reduces area for evaporation or transpiration;

2

[3]

Q12.

(a) Immediate / rapid increase, steady rise and plateau clearly identified;
Ignore references to rest period if clearly identified as such

1

(b) Find value of pulmonary ventilation from graph / 26-28;
Divide by breathing rate / 20;

2

(c) Air is from nose / trachea / bronchi / not been in alveoli / dead space;
Gas exchange / diffusion only in alveoli / not in these structures;

2

[5]

Q13.

(a) Epithelium of alveolus, capillary wall / epithelium / endothelium, plasma;

1

(b) Cell wall;
Capsule;
Flagellum;
Mesosomes;
Plasmid;
Genetic material / DNA / nucleoid;
Ribosomes;

Accept references to size only if some idea of range is given

max 2

(c) Large (surface) area;
For diffusion;
or
Short distance to centre of cell / to all haemoglobin;
For diffusion;

2

(d) (i) Correct answer of approximately 7800 / 8000 = 2 marks
Incorrect answer but clearly derived by
dividing diameter of cell A by 7 = 1 mark

2

(ii) Idea of cut through maximum diameter / middle;

1

[8]

Q14.

(a) (Small alveoli with) large surface area;
For diffusion;

2

- (b) (i) Epithelium / epithelial / squamous / pavement cells;
Reject endothelium. 1
- (ii) 0.11 μm ; 1
- (c) (i) Less oxygen / more carbon dioxide / more water vapour;
Two differences required, but only one mark for this part of the question. 1
- (ii) Gas exchange takes place in alveoli / does not take place in trachea; 1
- (d) (i) Pulmonary artery; 1
- (ii) Concentrations reach equilibrium / become equal;
Diffusion occurs when there is a concentration gradient (so some will remain in blood);
OR
Lung cells / vessel cells respire;
Add / produce carbon dioxide; 2

[9]

Q15.

- (i) Because there are big differences;
any correct named example e.g. lung cancer / bronchitis much lower in women than in men; 2
- (ii) easier to compare if sample size effectively the same;
different numbers of people in each group; 2

[4]

Q16.

- (a) Diaphragm (muscle) contracts;
Flattens / Increases volume of chest;
Reduced pressure allows air to enter; 3
- (b) Allows comparison;
As organs differ in size / as larger organs will need more blood; 2
- (c) 2 marks for 40.91 / 40.9 / 41
1 mark for 59.09 / 59.1 / 59 2
- (d) (i) Some oxygen still in lungs (which will enter the blood) /
removal of carbon dioxide (from blood); 1
- (ii) More blood available for other organs;
Supplying oxygen / glucose / removing carbon dioxide;

OR
Diaphragm muscles not contracting (as not breathing);
Will not require (as much) oxygen / glucose;

2

[10]

Q17.

- (a) Muscles (associated with breathing) relax;
- (b) Produces lower pressure (and air moves in down pressure gradient);

1

1

[2]

Q18.

- (a) (i) high / higher CO₂ concentration / lack of oxygen;
- (ii) CO₂ asphyxiates / is toxic;
lack of oxygen for (aerobic) respiration;
OR
lack of energy / ATP (for pumping movements);
reduced muscle function / muscle fatigue
- (b) removal of (excess) CO₂ / oxygen to break down lactate / to repay oxygen debt / to enable aerobic respiration;

1

2 max

1

[4]

Q19.

(a) $\frac{10}{20} \times \text{measurement} / \frac{1}{2} \times \text{measurement}$;

= 1.25 to 1.5;

allow 1 mark if correct working shown

max 2

- (b) Maintains concentration gradient (over whole length of gill) / diffusion can occur over whole gill;
More oxygen enters blood (/ more CO₂ leaves);
More (aerobic) respiration / more energy release in muscle / for swimming; 'more' needed *ONCE* only

3

[5]

Q20.

- (a) increasing carbon dioxide concentration / partial pressure;
(*decrease in oxygen negates*)
- (b) (oxygen is used in) respiration therefore diffuses (from tracheae) to tissues;
oxygen unable to enter organism;

1

2

- (c) spiracles not open all the time;
therefore there is less water loss
(by diffusion through spiracles);

2

[5]

Q21.

- (a) (i) less at **A** / more at **B**;
(accept inspiration and expiration as equivalent to A and B)

1

- (ii) carbon dioxide diffuses / passes / into alveoli / from blood;
as higher concentration in blood / low concentration in alveolus;
(first mark for site and direction, second for cause)

2

- (b) curve increases;
(reject if decreases)
then levels out;

2

- (c) (i) contract;
ribs move upwards / out;
increasing volume / decreasing pressure in chest / thorax / lungs;

3

- (ii) intercostal muscles relax;
(if you can ignore ref to internal contracting, do so)

1

[9]

