Mark schemes

Q1.

(a) Mark in pairs: 1 **and** 2 OR 3 **and** 4

1. Flattened cells

OR

Single layer of cells;
Reject thin cell wall/membrane
Accept thin cells
Accept 'one cell thick'

2. Reduces diffusion distance/pathway;

3. Permeable;

4. Allows diffusion of oxygen/carbon dioxide;
Ignore gas exchange

2

(b) Correct answer for 2 marks = 1.10–1.15;;

Accept for 1 mark,

0.6(1) : 1 (correct FEV_1 : FEC ratio)

2

(c) 1. Less carbon dioxide exhaled/moves out (of lung)

OR

More carbon dioxide remains (in lung);

2. (So) reduced diffusion/concentration gradient (between blood and alveoli);

3. Less/slower movement of carbon dioxide out of blood

OR

More carbon dioxide stays in blood;

3

[7]

Q2.

(c) 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

(d) 1. Blood and water flow in opposite directions;

2. Diffusion/concentration gradient (maintained) along (length of) lamella/filament;

Accept for 2 marks, suitably labelled diagram

2

Q3.

(a) 1. Diaphragm (muscle) contracts **and** external intercostal muscles contract;

Ignore ribs move up and out

2. (Causes volume increase and) pressure decrease;

3. Air moves down a pressure gradient

Ignore along

OR

Air enters from higher atmospheric pressure;

3

(b) K = Bronchiole **and**

L = artery/arteriole/vein/venule;

Reject capillary

Ignore pulmonary

1

(c) 1. This/animal/lung tissue does not contain starch;

Accept cell(s) for 'tissue'

2. (Makes) nucleus visible;

OR

Nucleus contains DNA;

2

(d) **In support**

1. (Link/risk with asthma and) living with cat or dog is (statistically) significant;

2. (Link with) obesity is most/highly significant;

Reject 'results are significant'

Not supported

3. (Link/risk with asthma and) burned wood (indoors) is not (statistically) significant;

Accept 'due to chance' for 'not significant' and converse

3

[9]

Q4.

(a) 1. Reduced surface area;

2. Increased distance for diffusion;

Accept description of efficient gas exchange in healthy alveolar epithelium as long as reference made to the damaged tissue changing this.

3. Reduced **rate** of gas exchange;

3

(b) (No)

EITHER

1. 9 (percent per 5 μg cm^{-3});

2. 1.42/1.8 (percent per 5 μg cm^{-3});

Accept any number of significant figures as long as rounding correct, full answer for mp2 is 1.42105263.

OR

3. 1.8 (percent per 1 μg cm^{-3});

4. 0.28/0.36 (percent per 1 μg cm^{-3});

Accept any number of significant figures as long as rounding correct, full answer for mp4 is 0.28421053.

OR

5. 9% **and** 36/27% increase here;

6. (To be linear) 100 (μg cm^{-3}) would be 180/171% (increase)

OR

(To be linear) 5 (μg cm^{-3}) would be 1.8% (increase)

OR

% increase is x4 (0-5 μg cm^{-3} compared with 0-100 μg cm^{-3}) but 5-100 is more than x4

OR

% increase is x3 (0-5 μg cm^{-3} compared with 5-100 μg cm^{-3}) but 5-100 is more than x3;

OR

7. (Using y = mx + c) at 5 (μg cm^{-3}) m = 1.8;

8. (Using y = mx + c) at 100 (μg cm^{-3}) m = 0.36;

9. At 100 (μg cm^{-3}) y would be 186%;

10. At 5 (μg cm^{-3}) y would be 7.8%;;

If no correct answers accept for one mark

Evidence of incorrect graph reading but division by 19

OR

Evidence of incorrect graph reading but division by 95

Accept 1 and 2 OR 3 and 4
OR 5 and 6
OR 7 and 8
OR 7 and 9
OR 8 and 10

2

[5]

Q5.

(a) F = Filament **and**
G = (Secondary) lamella(e) / (gill) plate;

Reject gill arch
Accept primary lamella(e) for F

1

(b) 1. Water **and** blood flow in opposite directions;

2. Maintains diffusion/concentration gradient of oxygen

Accept: converse for carbon dioxide
Accept: equilibrium not reached

OR

Oxygen concentration always higher (in water);

3. (Diffusion) along length of lamellae/filament/gill/capillary;

Accept: all/whole of lamellae/filament//gill/capillary

3

[4]

Q6.

(d) **EITHER**

1. Low/slow growth;

2. Due to smaller number/area of stomata (for gas exchange);

OR

3. Growth may continue at lower water potentials;

4. (Due to) adaptations in enzymes involved in photosynthesis/metabolic reactions;

*Mark as pair – 1 and 2 **OR** 3 and 4.*

Reference to stomata must not relate only to water loss.

2 max

(e) 1. Stomata close;

2. Less carbon dioxide (uptake) for less photosynthesis/glucose production;

'Less' only required once.

Reject 'no photosynthesis' but accept 'carbon dioxide can't enter so less photosynthesis'.

Ignore oxygen for respiration but reject oxygen for photosynthesis.

Ignore less water for photosynthesis.

Accept only correct chemical formulae.

For 'glucose' accept named product of photosynthesis eg triose phosphate, TP, amino acid, lipid.

2

Q7.

(a) 1. (Across) alveolar epithelium;

2. Endothelium / epithelium of capillary;

Incorrect sequence = maximum of 1 mark

2

(b) 1. (The alveolar epithelium) is one cell thick;

Reject thin membrane

2. Creating a short diffusion pathway / reduces the diffusion distance;

2 max

(c) **For**

1. Significantly higher concentrations of CO (compared with no smoking) with closed window (as no overlap in 2 × SD);

Accept higher concentrations of CO with closed window are not due to chance

Idea of higher is required, not just difference

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);
Idea of higher is required, not just difference

Against

4. No idea if (roughly) 5ppm is 'deadly';

5. No significant difference with open window (as 2 × SD overlaps);
Accept difference with open window could be due to chance

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

[8]

Q8.

(a) 1. Named structures – trachea, bronchi, bronchioles, alveoli;
Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

2. Above structures named in correct order
OR
Above structures labelled in correct positions on a diagram;
Reject mp1 if structures from other physiological systems are named but award mp2 if the correct structures are in the correct order.

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);
For thoracic cavity accept 'lungs' or 'thorax'.
Reference to 'thoracic cavity' only required once.

5. Breathing out - Diaphragm relaxes **and** internal intercostal muscles contract;
*Accept diaphragm relaxes **and** (external) intercostal muscles relax **and** lung tissue elastic (so recoils).*

6. (Causes) volume decrease and pressure increase in thoracic cavity (to above atmospheric, resulting in air moving out);

For thoracic cavity accept 'lungs' or 'thorax'.

Reference to 'thoracic cavity' only required once.

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

6

Q9.

(a)
1. Tracheoles have thin walls **so** short diffusion distance to cells;
2. Highly branched / large number of tracheoles **so** short diffusion distance to cells;
3. Highly branched / large number of tracheoles **so** large surface area (for gas exchange);
4. Tracheae provide tubes full of air **so** fast diffusion (into insect tissues);
5. Fluid in the end of the tracheoles that moves out (into tissues) during exercise **so** faster diffusion through the air to the gas exchange surface;
   OR
   Fluid in the end of the tracheoles that moves out (into tissues) during exercise **so** larger surface area (for gas exchange);
6. Body can be moved (by muscles) to move air **so** maintains diffusion / concentration gradient for oxygen / carbon dioxide;

1. Do not accept unqualified references to thin membranes.

Max 2 if any reference to blood

Ignore references to spiracles

5. Accept 'water' for fluid.

Accept 'cells' and 'tissues' as interchangeable words.

3 max

(b)
1. Damselfly larvae has high(er) metabolic / respiratory (rate);
2. (So) uses more oxygen (per unit time / per unit mass);

Idea of 'more / high' is needed for both mark points.

2. Accept 'needs' for 'uses'

2. Ignore references to absorbing / obtaining / uptake of more oxygen

2

(c) Mean SA = 9.85 $\underline{mm^2}$ / 9.9 $\underline{mm^2}$;
Percentage uncertainty of SA = 18.5 / 18.7 / 19;

If both answers incorrect 1 mark for

Percentage uncertainty of dimensions 11.8 / 12 and 6.70 / 6.7
Surface area correctly calculated with correct units but not rounded to appropriate sf (9.8532 $\underline{mm^2}$)
Surface area correct (with appropriate sf) but no / incorrect unit given

Both answers correct = 3 marks

1 answer correct only = 2

Both answers incorrect = max 1

3 max

Q10.

(a) 1. Many lamellae / filaments so large surface area;

2. Thin (surface) so short diffusion pathway;

1 & 2 must each have a feature and a consequence

2

(b) 1. Water and blood flow in opposite directions;

Allow diagram showing counter-flow

2. Blood always passing water with a higher oxygen concentration;

3. Diffusion gradient maintained throughout length (of gill)
OR
Diffusion occurs throughout length of gill
OR
If water and blood flowed in same direction equilibrium would be reached;

3

[5]