Mark schemes

Q1.

(a) 1. (**A**) Trachea;
Accept cartilage

2. (**B**) External intercostal (muscle);

2

(b) 3 correct = **2 marks**;;

2 correct = **1 mark**;

1 correct = **0 marks**

Box	Statement
F	represents the diffusion of oxygen
D	represents the transport of a gas mixture
C	represents blood moving at the highest pressure

2

(c) 1. (Epithelium is) single cell layer

OR

(Epithelium contains) thin/flat cells

OR

Epithelium is thin;
Ignore reference to surface area
Accept one cell thick
Accept "has squamous epithelium"

2. (So) short diffusion pathway/distance;

2

[6]

Q2.

(a) 1. Diaphragm (muscle) contracts pulling diaphragm down;

*Accept flattening **OR** moves down for 'pulling diaphragm down'*

2. External intercostal muscles contract pulling/moving ribs upwards/outwards;

Accept ribs lifted for 'pulling ribs upwards'

3. (Causes) volume increase **and** pressure decrease in thoracic cavity;

*Accept thorax **OR** lung(s) for thoracic cavity*

3

(b) 1. (Create a) single/few layer(s) of cells/tissue;

Accept to avoid overlapping cells

2. (So) light can pass through;

2

(c) Bronchiole(s);

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*

1

(d) Correct answer for 2 marks, 75 (µm);;

Accept for 1 mark, evidence of

$$\textit{Real/actual} = \frac{\textit{Image}}{\textit{Mag(nification)}}$$

(correct rearranged magnitude word equation)

OR

÷ 40 (correct denominator from equation)

OR

3000 (µm) (correct mean diameter)

OR

× 1000 (correct conversion of mm to µm)

OR

0.075 (correct calculation with incorrect units (mm))

OR

Answer shows correct number but incorrect number of decimal places eg 0.75 / 7.5 / 750

2

(e) 1. (Uncertainty ±) 1 (mm);

2. (Percentage error) 25 (%);

Accept, if incorrect uncertainty
÷ 4 and multiplied by 100
***OR** – for example*
50% (if uncertainty is 2)
OR
12.5% (if uncertainty is 0.5)
OR
2.5% (if uncertainty is 0.1)

2

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Q3.

(a) 1. Random samples;

Allow in context of fish or gills

2. Large sample size;

If a specified number is given, it must be 10 or more.

Accept 'many'/ 'multiple' for large sample but ignore 'several'

2

(b) Correct answer of 18 000/1.8 × 10^4 = **2 marks**;;

1 mark for

Correct answers not given to 2sf (17 969.952)

OR

Evidence of 1701.7 (total length of filaments)

OR

27 227.2 – 27370 (total number of lamellae)

Accept 17970/17969.9

2

(c) (*Trachurus trachurus*) – **no mark**

1. More oxygen uptake/diffusion

OR

More gas exchange;

2. More energy/ATP from respiration;

Incorrect fish name = zero

Accept just 'Trachurus' or 'trachurus'

'More' required once only

2

(d) **1 mark** for first column

1 mark for 2nd and 3rd column all correct

Kingdom	**Animalia**	Animalia
Phylum/Phyla	Chordata	**Chordata**
Class	Actinopterygii	Actinopterygii
Order	Batrachoidiformes	Carangiformes
Family	Batrachoididae	Carangidae
Genus	**Opsanus**	**Trachurus**
Species	*tau*	*trachurus*

2

[8]

Q4.

(a) 1. Less (oxygen) loaded at high pO_2 (compared with no CO)

OR

Maximum Hb saturation is 50% (oxygen);

Accept 'in lungs' for 'high pO_2'

Accept 'levels (off)' OR 'plateau at 50%' for maximum

Accept 'only 50%' for 'maximum (of) 50%'

2. (At low pO_2) Hb has higher affinity (for oxygen);

3. Hb has more oxygen at low pO_2

OR

Hb unloads less oxygen at low pO_2;

Ignore references to 'binding sites occupied by CO'

Accept 'in (respiring) cells/tissues' for 'low pO_2/cells'

Ignore 'more loading of oxygen at low pO_2'

Accept 'less readily' for less

3

(b) *Award 3 max only if answer contains MP1 OR MP2*

(For scientists' suggestion)

1. Children exposed (to CO) for 8 hours;

(Against scientists' suggestion)

2. Children exposed (to CO) for 1 hour

OR

Adults exposed (to CO) for 1 hour **and** 8 hours;

(But)

3. Maths model may not be accurate

OR

Maths model did not use people;

Accept '(based on) invalid assumptions' for 'may not be accurate'

Accept test OR experiment OR investigation for 'maths model'

4. (Recommendation for people) only at rest

OR

Unknown effects of exercise (on CO uptake);

5. (People vary in) size/age/ethnicity

OR

Different sex;

Accept gender

6. No statistical test to show if differences are significant;

Accept no SDs to show if differences are significant

7. Unknown effects on CO exposure for people with respiratory disease

OR

Unknown effects on CO exposure for smokers;

Accept any named respiratory disorder; eg asthma OR coronary heart disease

8. Might not be able to reduce CO (concentration) in air below 10(mg m^{-3});

3 max

[6]

Q5.

(a) 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);

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

If tracheae/tracheoles confused, penalise once only

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;

If tracheae/tracheoles confused, penalise once only

Allow 'next/close to' for enter cells

5. Tracheole walls are permeable to oxygen/air;

If tracheae/tracheoles confused, penalise once only

6. Cuticle/chitin/exoskeleton (impermeable) so reduce water loss;

Allow prevents 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

Reference to these 3 structures anywhere in answer = 1 mark

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

(b) **Breathing in**

1. Diaphragm (muscles) contract **and** diaphragm flattens;
   Accept 'pulled/moved down' for flattens.

2. External intercostal muscles contract **and** ribcage pulled up/out;

3. (Causes) volume increase **and** pressure decrease in thoracic cavity (to below atmospheric pressure);
   Accept lungs or thorax for 'thoracic cavity'
   Reject 'chest' once

Breathing out

4. Diaphragm (muscles) relaxes **and** diaphragm moves up;
   Accept 'returns to domed shape' for moves up

5. External intercostal muscles relax **and** ribcage moves down/in;
   Accept internal intercostal muscles contract

6. (Causes) volume decrease **and** pressure increase in thoracic cavity (to above atmospheric pressure);
   Accept lungs or thorax for 'thoracic cavity'
   Reject 'chest' once

5 max

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Q6.

(a) 1. (Red blood cells) do not have a nucleus/DNA;

Accept (To distinguish RBCs from other cells as) fish red blood cells have a nucleus

2. Haemoglobin;

Accept haem OR globin

Ignore Hb

2

(b) 1 mark for each correct row

		Volume / μm³	**Surface area:volume ratio**
			0.32:1
		8.5×10^4 **OR** 85 000	:

If no marks awarded, accept for 1 mark,

0.3217 (correct ratio calculation not given to 2 significant figures)
OR
Number that can be rounded to 85 000 eg 84615 (correct calculation not given to 2 significant figures)

2

(c) **(Difference)**

1. More cells (between water and capillary/ blood)
OR
Wider/thicker filament/lamella;

Accept thicker epithelium for more cells

Accept gill plate for lamella

(Explanation)

2. Longer diffusion pathway
OR
Longer diffusion distance;

3. (So) slower gas exchange
OR
(So) slower absorption of oxygen
OR
(So) slower release of carbon dioxide
OR
(So) slower rate of diffusion;

Ignore efficiency

Ignore less

3

Accept a correct difference and a correct explanation in either section

(d) 1 mark for each correct row

Difference	Circulation of blood in fish	Circulation of blood in mammal;
1	2 chambers **OR** 1 ventricle **OR** 1 atrium **OR** 2 valves	4 chambers **OR** 2 ventricles **OR** 2 atria **OR** 4 valves
2	Blood does not return to heart after being oxygenated **OR** Blood does not return to heart after passing through gills **OR** Heart contains deoxygenated blood	Blood returns to heart after being oxygenated **OR** Blood returns to heart after passing through lungs **OR** Heart contains oxygenated and deoxygenated blood;
3	One vein (carrying blood towards the heart)	Two veins (carrying blood towards heart)
4	One artery (carrying blood away)	Two arteries (carrying blood away)
5	Single circulation	Double circulation
6	Blood reaching body capillaries at low(er) pressure	Blood reaching body capillaries at high(er) pressure;

3 and 4 Accept name of relevant blood vessels eg aorta, pulmonary artery/vein, vena cava

5 Accept descriptions of single circulation and double circulation

5 Accept 'system' for circulatory system

2 max

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