

WJEC (Wales) Biology A-level
Topic 2.2: Adaptations for Gas
Exchange
Questions by Topic - Mark
Scheme

1.

Question		Marking details	Marks Available
1.	(a)	<p>Any 4 Intercostal muscles <u>contract and</u> ribs move <u>up and out</u>;</p> <p>Diaphragm (muscles) <u>contract and</u> diaphragm <u>flattens</u>;</p> <p>(Internal) volume of <u>thorax</u> increases; accept chest reject lungs</p> <p>Pressure in lungs/ thorax decreases;</p> <p>{Higher/ <u>difference in</u>} air <u>pressure</u> outside {forces/ pushes/ moves/ drawn} air into lungs;</p>	4
	(b)	<p>(i) blood flows across (gills/ filaments/ lamellae/ gill plates) in opposite direction to water; water always has more oxygen than blood/ (oxygen) {diffusion/ concentration} gradient maintained; oxygen passes from water into blood; across entire {gill/ gas exchange} surface; NOT longer higher saturation of blood with oxygen/ more oxygen taken up;</p> <p>(ii) Parallel (flow);</p> <p>(iii) Equilibrium is reached (part way across the gill plates/ lamellae)/{diffusion/ concentration} gradient not maintained; {Lower percentage saturation with/ <u>only</u> 50% saturation} oxygen/ less oxygen uptake/ less diffusion of oxygen; NOT slower</p>	4 1 2
	(c)	<p>gills dry out; prevents oxygen from dissolving on surface of gills;</p> <p>gills may {stick together/not open as easily/ collapse}; decrease in surface area;</p> <p>(Explanation cannot be accepted alone)</p>	2 max
		Question 1 Total	[13]

2.	Question	Marking details	Marks Available
2	(a)	Increases surface area; <u>Diffusion</u> takes place (over whole area);	2
	(b)	(i) Mouth opens/floor of buccal cavity lowered; Volume of {buccal cavity/inside the mouth} increases/pressure lowered inside {buccal cavity/mouth}; Water {pulled in from outside/ enters due to pressure difference}; Mouth closes and {buccal cavity then contracts/ floor of buccal cavity raises}; Water forced {across/through} gills (into gill cavity); Pressure in gill cavity increases; Forces open the operculum / gill slits;	Max 4
		(ii) Blood flows across (gills/ filaments/ lamellae/ gill plates) in <u>opposite</u> direction to water; Blood always meets water containing a <u>higher</u> oxygen concentration/{diffusion/ concentration} gradient maintained/ equilibrium is never reached; Across entire {gill/ gas exchange surface}; <u>Higher</u> saturation of blood with oxygen achieved;	Max 3
	(c)	(i) Diffusion pathway would be too long/ ensures a short diffusion pathway; Speed of diffusion too slow; To supply sufficient oxygen;	Max 2
		(ii) Less fluid/ fluid moves into muscle fibres/ fluid level decreases; More area for gaseous exchange/ shorter diffusion pathway;	2
Question 2 Total			[13]

3.	Question	Marking details	Marks Available
3	(a)	lamellae/gill plates;	1
	(b)	water {forced/ flows} over gill (filaments); by pressure changes/ OWTTE; (pumping) action of mouth and operculum/ OWTTE; water flows in opposite direction to blood/counter-current mechanism; maintains {diffusion/ concentration} gradient across {entire/ whole} gill (filament); as blood always meets water with a higher oxygen concentration/ equilibrium is never reached;	max 4
	(c)	Any four <u>large</u> surface area; {(dense) network/ large number} of <u>capillaries</u> ; NOT good blood supply {thin/permeable} <u>epithelium</u> , moist; short diffusion pathway;	max 4
	Question 3 Total		[9]

4. (a)

(i)

A Alveoli/alveolar sacs; [1]

B Capillary (network);

Both for 1 mark.

(ii)

C Pulmonary artery; [1]

D Pulmonary vein;

Both for 1 mark.

(b)

Any 2 [2]

Thin alveolus (walls) /one cell thick;

NOT membrane or thin alone.

Large surface area / highly folded;

(volume - neutral)

Large number of capillaries (or implied);

(c)

Contraction of intercostal muscles and diaphragm OR ribcage moves up and out and diaphragm flattens / contract; [2]

Increased volume and decreased pressure so air moves in(to lungs);

Question total 6

5.

Question		Marking details	Marks Available
5	(a)	<ol style="list-style-type: none"> 1. They have <u>many</u> alveoli; 2. Which increases / provides a large surface area (for gas exchange); 3. The {alveolar / capillary} <u>walls</u> are {thin / one cell thick} / capillaries are close to alveoli / alveoli are composed of squamous epithelial cells; 4. Providing a short diffusion {pathway / distance} (for oxygen to enter the blood); 5. Many blood {capillaries / vessels} / <u>{rich / good}</u> blood supply / capillary network; reject arteries / veins 6. To maintain (steep) concentration gradients; <p>(Max 2 from 1,3 and 5 and Max 2 from 2,4 and 6)</p>	Max 4
	(b)	<p>(i)</p> <ol style="list-style-type: none"> 1. The intercostal muscles relax allowing the ribcage to move downwards <u>and</u> inwards; (ignore reference to internal / external) 2. The diaphragm (muscles) relaxes <u>and</u> becomes dome shaped; 3. This decreases the volume of the {<u>thoracic cavity / thorax</u>}; NOT lungs 4. Which increases the pressure inside the {lungs / thoracic cavity}; 5. {Forcing / pushing} air out of the lungs / moving air out of the lungs down a pressure gradient; <p>(NB must be reference to air moving from higher pressure to lower pressure not simply 'air moves out of lungs' unqualified)</p>	Max 4
		<p>(ii)</p> <ul style="list-style-type: none"> • Have high metabolic rates / are {homeothermic / endothermic}; • Ventilation maintains a (steep) concentration gradient (at the alveoli) / {sufficient / enough / more} <u>oxygen</u> supplied to the {alveoli / gas exchange surface}; 	2
		Question 5 total	[10]

6.

Question		Marking details	Marks Available
6	(a)	{minimise / reduce} heat <u>and</u> water loss Reject: prevent	1
	(b)	Any four from: <ul style="list-style-type: none"> • Intercostal muscles contract (and expand the ribcage); • (outer) pleural membranes pulled out (by expanding ribcage); • pleural pressure reduced; • (inner) pleural membrane pulls on lungs and expand alveoli; • alveolar pressure lowers; • air moves in {when alveolar pressure is lower than atmospheric pressure / and increases alveolar pressure}; • reference to data from graph; 	4
	(c)	Premature babies / lung transplants / respiratory distress syndrome; lowers surface tension of the fluid in the alveoli / to prevent alveoli from collapsing;	2
		Question 6 Total	[7]

7. (a)

(Gill) lamellae / filaments / plates; [1]

(b)

Any 3 [3]

Large surface area (for diffusion); (volume neutral)

Thin / short diffusion pathway;

Permeable;

Good blood supply or implied; NOT transport system

NOT moist.

(c)

Water is forced over the gill by {ventilation mechanisms / pressure differences / continuous swimming}; [4]

Unidirectionally / one way flow;

Countercurrent flow of blood and water / or description of;

{Diffusion / concentration} gradient is maintained or description of;

over the entire gill surface;

High affinity Hb;

Question total [8]

8.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)	Both needed for one mark X = (gill) filaments Y = (gill) arch/bar	1			1		1
		(ii)	{Filter/sieve/remove/catch} {food/particles/solids NOT molecules} /protection from debris/preventing damage to the gill filaments (1)		1		1		
		(iii)	A. normally water separates {filaments/lamellae/plates/gills}/Gills dry out (when out of water) (1) B. {Filaments/lamellae/plates/gills} {stick together/collapse} (1) C. Reduced Surface Area for {diffusion/gas exchange} (1) D. Water needed for <u>diffusion</u> (of gases)/{oxygen/gases} need to be in solution to <u>diffuse</u> (1)	4			4		
	(b)		Accept reverse argument for any point A. Countercurrent more efficient (1) B. Maintains {diffusion/concentration} gradient/or description of/equilibrium not met (1) C. Across {entire/whole} {gill/filament/lamellae/plate} (1) D. {Higher/more} {saturation/oxygen absorbed} (1) Accept correct references to higher percentages in counter current/use of values e.g. 80% compared to 50%	4			4		
	(c)	(i)	C = parallel flow and A = countercurrent flow (1)		1		1		
		(ii)	Correct insertion of arrows on A <u>only</u> (1) NOT ECF	1			1		
			Question 4 total	10	2	0	12	0	1

9.	Question	Marking details	Marks Available								
5.	(a)	<table border="1"> <thead> <tr> <th>FUNCTION</th> <th>STRUCTURE</th> </tr> </thead> <tbody> <tr> <td>Flattens</td> <td>H/ diaphragm</td> </tr> <tr> <td>Become constricted</td> <td>C/ bronchioles</td> </tr> <tr> <td>Contain a surfactant</td> <td>E/ alveoli</td> </tr> </tbody> </table>	FUNCTION	STRUCTURE	Flattens	H/ diaphragm	Become constricted	C/ bronchioles	Contain a surfactant	E/ alveoli	3
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	(b)	(Thin walls) Reduce diffusion distance/short diffusion path (for gas exchange);	1								
		(capillaries) In close contact to reduce diffusion distance/speed up gas exchange; Circulation {creates/establish/maintains} {diffusion/concentration} gradient; Transports gases to and from site of gas exchange; Large surface area {for gas exchange (with blood)/ so oxygen can be absorbed/ to ensure blood is saturated with oxygen};	max 2								

- 10.
- (a) Beat;
Move mucus + bacteria upwards. [2]
- (b) (i) Prevent trachea closing;
During inspiration. [2]
- (ii) to allow room for oesophagus to expand when swallowing food. [1]

Total 5 marks

11.

Question		Marking details	Marks Available							
4	(a)	large surface area; thin walls; NOT cell wall {extensive/large} capillary network; (NOT good blood supply)	3							
	(b)	Any one from <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Adaptation</th> <th style="width: 50%;">Explanation</th> </tr> </thead> <tbody> <tr> <td>large surface area</td> <td>increases area over which <u>diffusion</u> can occur;</td> </tr> <tr> <td>thin walls</td> <td>reduces <u>diffusion</u> distance/ short diffusion paths; Not diffusion occurs faster</td> </tr> <tr> <td>extensive capillary network</td> <td>maintains <u>diffusion</u> gradient;</td> </tr> </tbody> </table>	Adaptation	Explanation	large surface area	increases area over which <u>diffusion</u> can occur;	thin walls	reduces <u>diffusion</u> distance/ short diffusion paths; Not diffusion occurs faster	extensive capillary network	maintains <u>diffusion</u> gradient;
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