

WJEC (Eduqas) Biology A-level
2.3: Adaptations for Transport
Questions by Topic - Mark
Scheme

1.	Question			Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)	(i)		D and E	1			1		
		(ii)		C and D		1		1		
		(iii)		B and F		1		1		
	(b)	(i)		603 = 3 marks If incorrect award 2 marks for 603.264 or [603.1858... if use π on calculator] If incorrect award 1 mark for sight of 3.142×0.0004^2 or 5.03×10^{-7} or 0.00000050272 [not used total cross section] $3.142 \times 0.0008^2 \times 1.2 \times 10^3$ or 2410 or 2412.7 or 2413 [not used radius as 0.0004]		3		3	3	
		(ii)		Any four (x1) from: A. low protein diet reduces {plasma protein/albumin} levels (1) B. {plasma proteins/albumin} reduce water potential of blood (1) C. (Lack of protein)water potential of plasma becomes higher (1) D. Decreases water potential gradient (1) E. so less <u>water</u> reabsorbed/ more <u>water</u> remains in tissue fluid/ <u>water</u> moves out of the blood into the tissue fluid (1) Accept blood in place of plasma Accept blood proteins in place of plasma proteins	3	1		4		
				Question 1 total	4	6	0	10	3	0

2.	Question			Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)	(i)		electrocardiogram (1) reject electrocardiograph/echocardiogram	1			1		
		(ii)		75 (1)		1		1	1	
		(iii)	I	<u>SAN</u> generates { <u>electrical</u> impulse/wave of excitation/ <u>electrical</u> signals} (1) (causes) <u>depolarisation of atria</u> (1) (causes) contraction of <u>atria/atrial</u> systole (1)	3			3		
			II	Any three (x1) from: A. <u>AVN</u> {transmits/relays/passes on} { <u>electrical</u> impulse/ <u>electrical</u> signals/wave of excitation}(1) B. Passes through {Bundle of His/Purkinje tissue/septum}(1) C. Depolarisation of <u>ventricles</u> (1) D. Causes contraction of <u>ventricles/ventricular</u> systole(1)	3			3		
			III	Repolarisation of ventricles (1) Causes <u>ventricular diastole/relaxation of ventricles</u> (1)	2			2		
	(b)			Shorter/closer together (1) NOT quicker/faster (due to) shorter isoelectric line/flat part/PR segment/P-QRS interval/T-P interval/less time between {atrial systole and ventricular systole/ventricular systole and ventricular diastole/ventricular systole and atrial systole} (1)		1	1	2		
	(c)	(i)		Circle at any point around the PR segment/flat section of the graph between the endpoint of the P wave and the onset of the QRS complex (1) Circle may extend slightly into QRS complex (NOT further than letter Q) but may extend to the start of the P wave (NOT further than start)		1		1		
		(ii)		AVN (1) Accept bundle of His/Purkyne tissue			1	1		
		(iii)		Slow heart rate/bradycardia/longer for a heart beat/longer between atrial systole and ventricular systole (1)		1		1		
				Question 2 total	9	4	2	15	1	

3.

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
3	<p>Indicative content</p> <p>Definitions: mesophyte – adapted to conditions of {adequate/moderate/sufficient/owtte} water supply xerophyte – adapted to conditions where water is scarce/groundwater is frozen/named example/dry conditions. hydrophyte – adapted to aquatic conditions/live in water/float on surface of water</p> <p>Pinus/xerophyte Adaptations to reduce transpiration/water (vapour) loss Comments must relate to image Reject adaptations not visible Linked points:</p> <ul style="list-style-type: none"> • Sunken stomata/stomata in pits + trap humid air/to reduce {diffusion/concentration/water potential} gradient • Small leaves/needle shaped/compact + reduce surface area/SA:vol • {fewer/smaller} stomata + {fewer/smaller} gaps for water loss • <u>Thick cuticle/epidemis</u> + reduce evaporation/water loss • Fibres/sclerenchyma/lignified tissue + provides support/prevents wilting <p>Potamogeton/hydrophyte Linked points:</p> <ul style="list-style-type: none"> • Cuticle thin/absent + no need to reduce water loss/evaporation • Stomata on {upper/adaxial} surface/no stomata on {lower/abaxial} surface + for gas exchange with air • Air spaces/Aerenchyma/lacunae + provide { buoyancy/flotation} for {light/photosynthesis}/{act as gas reservoir/for gas exchange} • {Little/no} {lignified tissue/xylem} + water provides support • Poorly developed/little xylem + water provided by surroundings 	3	6		9		
	<p>7-9 marks Correct Definitions of xerophytes + hydrophytes + mesophytes. + Full description of Pinus xerophytic adaptations + Full description of Potamageton hydrophytic adaptations</p> <p>The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with few irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.</p> <p>4-6 marks Any two from: definitions of mesophytes/xerophytes/hydrophytes description of adaptation of the xerophyte description of adaptation of the hydrophyte</p> <p>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.</p> <p>1-3 marks A definition of xerophyte/hydrophyte/mesophyte or an adaptation of xerophytes or an adaptation of hydrophytes</p> <p><i>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.</i></p> <p>0 marks <i>The candidate does not make any attempt or give a relevant answer worthy of credit.</i></p>						
	Question 3 total	3	6		9		

4.

Question		Marking details	Marks Available
4.	(a)	loss of water <u>vapour/ evaporation</u> of water; from (surface of) leaf /through stomata; Accept lenticels	2
	(b)	(i) TWO precautions and TWO reasons <ul style="list-style-type: none"> • Shoot cut under water/inserted under water/flood inside of apparatus with water/ assemble under water; to prevent air entering/ bubbles; • Shoot with large number of leaves; to ensure measurable rate of transpiration; • Avoid wetting leaves/ ensure leaves are dry; blocks stomata/ reduces rate of transpiration; • Leave time for apparatus to settle down; allow plant to adapt to new conditions/ to equilibrate; • Seal joints with Vaseline/ ensure screw clip is closed; to prevent air entering apparatus/ prevent leakage; • Ensure bubble set at appropriate position/ right hand end; to enable a (suitable) reading to be taken; Reference to not allowing air bubbles to enter = 1 mark (if no precautions are given)	4 max
	(c)	(i) Sun(light);	1
		(ii) Molecules of water moving together/ water pulled up; Because of <u>cohesion</u> of <u>molecules</u> ; <u>adhesion</u> to (walls of) { <u>xylem</u> / hydrophilic lining/ vessel wall}; root pressure {forces/ pushes} water upwards; IGNORE capillarity	2 max
	(d)	(i) A= phloem; B= xylem;	2
		(ii) {Xylem/ vascular <u>tissue</u> } is at the centre/ xylem is star shaped/ central stele; NOT bundle No vascular <u>bundles</u> / peripheral vascular <u>bundles</u> in stem; Endodermis visible in root/ no pith;	2 max
		Question 4 total	[13]

5.	Question	Marking details	Marks Available
5	(a)	(i) <i>atrio-ventricular node (max 2)</i> {collects/ receives} {wave of excitation/ impulses} <u>from SAN</u> ; NOT signal passes on to {Purkyne fibres/Eundle of His}; allows delay before wave passed to ventricles/ stops atria and ventricles contracting at the same time;	2
		(ii) <i>Bundle of His and Purkyne fibres</i> conducts wave to {base/ apex} of ventricles/ heart; ensures contraction (from base) upwards;	2
	(b)	(i) 11;	1
		(ii) 7;	1
		(iii) 1;	1
		(iv) 6;	1
		(v) 4;	1
		(vi) 2;	1
		(vii) 12;	1
		(viii) 10;	1
		Question 5 Total	[12]

6. (a)

A Right atrio-ventricular / tricuspid. [1]

B Left AV valve / bicuspid / mitral [1]

Award one mark for identifying both Atrioventricular Valves but not right and left.

C Semi lunar valves. [1]

(b)

Coronary;

Supplies oxygen / blood to the heart muscle / wall / tissue / cells OR correct function for vein; [2]

(c)

(i)

Valve {exposed to / works at} a higher pressure (in left ventricle)/

{Right ventricle pumps blood at / valve A exposed to} lower pressures (to lungs); [1]

(ii)

Blood leaks back (from ventricle) to atrium; [1]

(iii)

Breathlessness / fluid retention / fatigue / rapid or irregular heartbeat / blue lips / oedema / lower bp / faint / heart murmur; [1]

Question total [8]

7. (a)

(i)

Any 3 [3]

Has a reduced surface area / surface area:volume ratio;

Thick cuticle;

Curled / rolled (downwards with the stomata inside);

Hairs (to trap water vapour);

(ii)

Any scientifically correct explanation of their chosen feature / cuticle - comment on waterproofing / curled - trapping water /

SA - less area over which water can be lost /

stomata - trapping water vapour; [1]

(b)

Xerophyte; [1]

(c)

(i) Xylem; [2]

Transports water (and minerals);

(ii)

Phloem; [2]

Transports carbohydrates / sugars / products of photosynthesis / sucrose / amino acids;

Not glucose/nutrients

(iii)

Endodermis / starch sheath.

1

(iv)

Decent diagram of endodermis cell; [2]

Endodermis - with Casparian strip/band clearly labelled;

(v)

Any 4 [4]

Waterproof / Casparian strip / band / suberin;

Blocks the apoplast pathway;

Selective uptake / Active uptake / transport of minerals (by endodermis cells);

Into symplast pathway;

Active transport of minerals into pericycle;

Water follows by osmosis;

Water and minerals move into xylem vessels;

Question Total [16]

8.

Question			Marking details	Marks Available
8.	(a)	(i)	sucrose is produced in (photosynthesising) leaf/ leaves are the source of sucrose; sucrose travels in phloem; phloem removed (by the ringing process); sucrose cannot flow to roots/ is blocked;	3 max
		(ii)	amino acids/hormones/ florigen;	1
	(b)	sucrose used for {cell wall formation/ cell division/ mitosis/ respiration}; {Less/ no} sucrose used (by growing areas/sinks as they have been removed); therefore more will pass down stem; NOT accumulation	2 max	
	(c)	sucrose not replaced from above (the ring); so concentration decreases; as movement towards root continues; and sucrose used in respiration/storage/ converted to starch/ growth/ active transport;	3 max	
Question 8 Total				[9]

9.

Mark Scheme - Summer 2014

Question			Marking details	Marks Available
9.	(a)	Capillary;		1
	(b)	Lymph/ lymphatic fluid;		1
	(c) (i)	Protein / (serum) <u>albumin</u> ;		1
Question 9 Total				[3]

10.	Question	Marking details	Marks available	Question	Marking details	Marks available
10	(a)	<p>A (some) CO₂ {dissolves directly/ in solution} in the plasma;</p> <p>B (some)CO₂ {diffuses into/absorbed by} {red blood cells /erythrocytes};</p> <p>C (some) CO₂ combines with haemoglobin/ to form carbamino {haemoglobin/ compounds};</p> <p>D (most) CO₂ combines with water to give carbonic acid;</p> <p>E (catalysed) by carbonic anhydrase;</p> <p>F carbonic acid dissociates into hydrogen carbonate and hydrogen ions;</p> <p>G hydrogen carbonate ions pass out (into plasma);</p> <p>H (chloride shift) allows movement of Cl⁻ into red blood cells;</p> <p>I to maintain {electrical/ electrochemical} neutrality;</p> <p>J <u>increased</u> {conc/partial pressure} of CO₂ (dissolved in blood);</p> <p>K lowers pH of blood/blood becomes more acidic;</p> <p>L oxyhaemoglobin {accepts H⁺/acts as a buffer};</p> <p>M reduces <u>affinity</u> of haemoglobin for oxygen;</p> <p>N <u>more</u> oxygen is released (from oxyhaemoglobin)/ <u>more</u> oxyhaemoglobin dissociates;</p> <p>O oxygen dissociation curve moves to the right/Bohr {shift/effect}; Accept credit from graph/ diagram</p>		(b)	<p>A Both are tubular/contain a lumen/ OWTTE;</p> <p>B Both have movement by mass flow/OWTTE;</p> <p>C Both movement along pressure gradients;</p> <p>D Both movement in one direction only;</p> <p>E Artery transports blood, xylem water;</p> <p>F Movement of liquid pulsatile in arteries, smooth in xylem;</p> <p>G Arteries living, xylem dead;</p> <p>H Pressure generated by heart in arteries, no pump for xylem;</p> <p>I Xylem vessels contain lignin;</p> <p>J Xylem has support function;</p> <p>K {Adhesive forces/ hydrophilic lining} in xylem;</p> <p>L Arteries have {muscle/elastic tissue}; can be shown on diagram</p> <p>M Arteries distend/recoil;</p> <p>N Smooth endothelium of artery/ endothelium reduces friction;</p> <p>O Artery <u>walls</u> composed of layers</p>	10
Question 10 Total					[10]	

11.	Question	Marking details	Marks Available
11	(a)	(i) 24/ 25/26%;	1
		(ii) Any two from (vigorous) exercise/ OWTTE; high levels of (aerobic) <u>respiration</u> ; oxygen used/ needed (by muscle cells);	2 max
	(b)	C/mouse;	1
	(c)	(i) curve to right of C;	1
		(ii) Any three from (move to right) lowers affinity of <u>haemoglobin</u> for oxygen; <u>more</u> oxygen released/ oxygen <u>more</u> readily dissociates; at the same partial pressure of oxygen; for (aerobic) respiration;	3 max
	(d)	Any three from curve shows haemoglobin has high affinity for oxygen; can{ pick up/ absorb} oxygen at {low partial pressure/ high altitude}/ can be become saturated with oxygen {more easily/ lower partial pressure/ at altitude}; Llama lives at high altitudes where oxygen is scarce; small change in partial pressure results in a large change in % saturation;	3 max
	(e)	Curve A;	1
		Question11 total	[12]

12.	Question	Marking details	Marks Available
12	(a)	(i) Loss of water <u>vapour</u> /evaporation of water; From leaf/stomata/lenticels;	2
		(ii) Cooling effect/{supply/movement} of {mineral (ions)/water} /maintains transpiration {pull/stream} /required for photosynthesis /allows water to reach aerial parts;	1
	(b)	(i) Prevent entry of air into <u>xylem</u> / prevent formation of air bubble in <u>xylem</u> ; Which would break {transpiration stream/ cohesive forces}/ block movement of water;	2
		(ii) Diameter of capillary tube; Distance travelled by bubble; Time taken;	Max 2
	(c)	(i) Xerophytes;	1
		(ii) {High humidity/ humid atmosphere} in <u>air chamber</u> ; Because {water <u>vapour</u> /humid air} not removed by wind/ water <u>vapour</u> trapped; This produces a {less steep / reduces} {water potential/ diffusion/concentration} gradient; Between inside of leaf and air chamber/ inside and outside of stoma;	Max 3
		(iii) {Smaller/less/ rolled} leaves/spines + reduced <u>surface area</u> (exposed to environment); {Reduced number/closure of stomata} + <u>less openings</u> for water to be lost through; {Hairs on leaves/rolled leaves} + {increases humidity/ reduces {water potential/ diffusion/ concentration} gradient/ traps water <u>vapour</u> }; <u>Thick</u> cuticle + reducing <u>evaporation</u> from surface of leaf;	Max 2
Question 12 Total			[13]

13.	Question	Marking details	Marks Available								
13	(a) (Phloem) parenchyma; (Phloem) fibres;		2								
	(b)	<table border="1"> <thead> <tr> <th data-bbox="422 369 845 414">Feature</th> <th data-bbox="845 369 1276 414">Explanation</th> </tr> </thead> <tbody> <tr> <td data-bbox="422 414 845 582">Presence of <u>sieve</u> {plates/pores};</td> <td data-bbox="845 414 1276 582">Permits bidirectional flow/ permits flow {from cell to cell/ through the plant};</td> </tr> <tr> <td data-bbox="422 582 845 694">{Few/no} organelles/ {thin/peripheral} cytoplasm;</td> <td data-bbox="845 582 1276 694">No obstruction to flow of solutes;</td> </tr> <tr> <td data-bbox="422 694 845 907">Plasmodesmata;</td> <td data-bbox="845 694 1276 907">Allows transport of {molecules/ AIP/ sucrose} from <u>companion cell</u> (to sieve tube element);</td> </tr> </tbody> </table> <p data-bbox="422 974 1149 1064">Maximum of two features with matched explanation Explanation mark only given if feature correct</p>	Feature	Explanation	Presence of <u>sieve</u> {plates/pores};	Permits bidirectional flow/ permits flow {from cell to cell/ through the plant};	{Few/no} organelles/ {thin/peripheral} cytoplasm;	No obstruction to flow of solutes;	Plasmodesmata;	Allows transport of {molecules/ AIP/ sucrose} from <u>companion cell</u> (to sieve tube element);	Max 4
Feature	Explanation										
Presence of <u>sieve</u> {plates/pores};	Permits bidirectional flow/ permits flow {from cell to cell/ through the plant};										
{Few/no} organelles/ {thin/peripheral} cytoplasm;	No obstruction to flow of solutes;										
Plasmodesmata;	Allows transport of {molecules/ AIP/ sucrose} from <u>companion cell</u> (to sieve tube element);										
	(c) Mass flow is {a passive process/ not an active process}; From high to low {concentration/pressure}/ down a concentration gradient; {Mitochondria/energy/ATP} not required (in a passive process);		3								
	Question 13 Total	[9]									

14.

Question		Marking details	Marks Available
14	(a)	<ul style="list-style-type: none"> It has a large surface area to absorb {water / minerals / ions} / Accept: for osmosis many mitochondria for active transport of minerals / ions thin cell wall for a short diffusion pathway; 	1
	(b)	<p>Apoplast pathway – (water travels) through the cell walls; Symplast pathway – (water travels) through the cytoplasm <u>and</u> plasmodesmata;</p>	2
	(c)	<ol style="list-style-type: none"> The casparian strip / suberin; Blocks the apoplast pathway / forces water into the symplast pathway; The (endodermal cells / pericycle) <u>actively transport ions into the xylem vessels</u>; This lowers the water potential in the xylem; Causing water to move <u>into the xylem by osmosis</u>; Producing hydrostatic pressure (forcing water upwards); 	Max 4
	(d)	(i) Palisade / spongy / mesophyll;	1
		(ii) Sucrose;	1
	(e)	(Sucrose is) transported in the {phloem / sieve tubes};	1
			1
	(f)	(i) Radioactivity was detected above and below the {source / leaf} / Radioactivity was detected A and {B / C};	
	(ii) 38/90; 0.42 (cm min ⁻¹); Correct answer = 2 marks	2	
Question 14 total			[13]

15.

Question		Marking details	Marks Available						
15	(a)	It can generate its own {impulse / contraction} / it does not need to be stimulated by a nerve to make it <u>contract</u> ;	1						
	(b)	(i)	Acts as the pacemaker / generates the cardiac impulse/ releases a wave of excitation / generates an electrical stimulation; Brings about atrial {systole / contraction};	2					
		(ii)	Transmits impulse to apex of heart / spreads the cardiac impulse through (the walls of) the ventricles; Bringing about ventricular {systole / contraction};	2					
	(c)	(i)	<table border="1"> <tr> <td>The atrio-ventricular valve closes</td> <td>0.2</td> </tr> <tr> <td>The aortic valve closes</td> <td>0.56</td> </tr> </table>	The atrio-ventricular valve closes	0.2	The aortic valve closes	0.56	2	
			The atrio-ventricular valve closes	0.2					
	The aortic valve closes	0.56							
	(ii)	<table border="1"> <tr> <td>Blood is flowing from the atria to the ventricles</td> <td>A / E</td> </tr> <tr> <td>Blood is flowing from the ventricle to the aorta</td> <td>C</td> </tr> <tr> <td>When there is no movement of blood through the heart</td> <td>B / D</td> </tr> </table>	Blood is flowing from the atria to the ventricles	A / E	Blood is flowing from the ventricle to the aorta	C	When there is no movement of blood through the heart	B / D	3
		Blood is flowing from the atria to the ventricles	A / E						
		Blood is flowing from the ventricle to the aorta	C						
	When there is no movement of blood through the heart	B / D							
(iii)	<ul style="list-style-type: none"> • The {atrio-ventricular valves / bicuspid / mitral} close (preventing backflow of blood); • When the pressure in the ventricles exceeds the pressure in the atria / during ventricular {systole / contraction}; • Tendons prevent valves inverting; 	Max 2							
Question 15 total			[12]						

16. (a) 70 (plus/minus 5); 7
myogenic;
right atrium;
sino-atrial node;
atrio-ventricular node;
bundle of His/Purkinje/Purkyne fibres;
contract;
- (b) (i) Carried/circulates in a system of tubes/vessels/ 2
veins and arteries;
blood pumped at high pressure;
organs/tissues not in direct contact with blood;
- (ii) Separate pulmonary/ lungs and systemic/ body circulation; 2
blood passes through heart twice in one complete circuit;

17. 17. (a) blood travels through it twice during one complete circuit;
 separate {pulmonary/ to lungs} and {systemic/ to body} circulations;
 maintains high blood pressure (to body);
 rapid circulation of blood; 3 max
 no mixing of oxygenated/deoxygenated blood;
- (b) (i) position of both in right atrium (accept on dotted lines); 2
 AVN below SAN (only if both in right atrium);
- (ii) prevents direct transfer of wave of excitation to ventricles/
 prevents atria and ventricles from contracting at the same time;
 allows time for ventricles to fill;
 wave is picked up by AVN; 4 max
 which transfers to bundle of His/Purkinje/Purkyne fibres;
 causes contraction of ventricles from base;
- (c) 60000;
 800
 75 beats per minute;
 2
18. (a) (i) Contraction of {left ventricle/ ventricular systole} causes a {surge / 3
 increase in blood pressure};
 pressure drops when the {left ventricle relaxes/ ventricular diastole};
 pressure in aorta does not fall to zero because of the closing of the
 {aortic / semi-lunar valve};
 {elastic recoil/ elasticity} of the arteries maintains blood pressure.
- (ii) Friction/ resistance with vessel walls / increased cross-sectional / 1
 surface area of arterioles / blood vessels distance from heart

increased causes progressive pressure drop/ Not reference to capillaries

- (b) (i) R; 2
highest pO_2 / oxygen level OR lowest pCO_2 / carbon dioxide
- (ii) at arterial end: max 3
hydrostatic pressure (forcing liquid out of capillaries) greater than the osmotic pressure (drawing water in)
at venous end:
hydrostatic pressure has decreased;
water potential gradient / high osmotic pressure in capillary or osmotic pressure greater than hydrostatic pressure causes an inward flow
ORA;
not all water (re)absorbed into capillary, reject all references to blood
- (iii) Drains/ removes (excess) tissue fluid from the tissues / prevents 1
build up of tissue fluid / return (excess) tissue fluid to blood via lymphatic system NOT ref to waste products alone

Question Total 10

19. (a) no valves;
small/narrow lumen;
more elastic in walls;
thick(er)/muscular walls/ tunica media;
less collagen;
- (b) (i) artery;
- (ii) ventricular contraction/systole at X;
ventricular relaxation/diastole at Y;
- (iii) greater distance from heart;
ref to friction;

20.

(a)

	Atrial systole	Atrial diastole	Ventricular systole	Ventricular diastole
Bicuspid and tricuspid valves open	✓		✓	✓
Semi lunar/aortic valves closed	✓	(✓) neutral		✓
Initiated by SAN	✓			
Initiated by Purkyne fibres (Purkinje fibres)			✓	

[4]

(b) SAN / pacemaker in wall of right atrium;

Wave of depolarisation passes from here across atria;

[2]

(c) Prevents depolarisation in atria passing to ventricles;

Therefore stopping ventricles contracting downwards;

[2]

(d) Increased oxygen;

Increased glucose/nutrients;

Remove carbon dioxide;

Remove lactic acid;

Aerobic respiration;

Prevent arrhythmia

[4]

21. (a)	(i) suitable axes; axes labelled; points plotted;; -1 each incorrect plot lines labelled;	5
(b)	(i) correct point;	1
	(ii) Bohr shift/effect;	1
	(iii) release of carbon dioxide during aerobic respiration; forming carbonic acid/ more H ⁺ ;	2
	(iv) <u>more</u> oxygen released;	1
(c)	(i) curve to the left of ones drawn;	1
	(ii) more saturated than maternal haemoglobin/greater affinity for oxygen; at all oxygen partial pressures; oxygen will pass from maternal to foetal blood;	2

22.

- (a) Haemoglobin line is S-shaped;

Actual line rises much more steeply between 2kPa and 7kPa/is steeper in the middle;

Theoretical line shows no flattening at top;

Haemoglobin shows higher saturation throughout.

(Any two) [2]

- (b) (i) Only haemoglobin is fully saturated at pp in lung [1]

(ii) Haemoglobin carries much more oxygen for the muscle than the theoretical situation. [1]

(iii) Compared with theoretical, haemoglobin gives up its oxygen much more readily as oxygen pp falls. [1]

- (c) Accumulation of carbon dioxide / carbonic acid. [1]

causes fall in pH / increased acidity. [1]

which releases oxygen from oxyhaemoglobin. [1]

- (d) Myoglobin is saturated/has high affinity for oxygen at very low pp [1]

acts as an oxygen store [1]

used when muscle is exercising heavily/working hard [1]

[Total 11 marks]

23.

- (a) Time to travel 63 cm = $5-2\frac{1}{2} = 2\frac{1}{2}$ hours or 150 minutes [1]
- Rate = $63 \times 2/5$ or $63/150$ [1]
- = 25.2 cm/hr or 0.42 cm/min [1]
- (Correct answer showing no working =3, units missing or incorrect= -1)
- (b) (i) Source – region where photosynthate/sugar/carbohydrate is produced and exported. [1]
- Sink – region where photosynthate is used/stored. [1]
- (ii) Source – leaves [1]
- Sink – roots (accept aphid colony) [1]
- (c) (i) Sucrose [1]
- (ii) Translocation [1]
- (d) Phloem and sieve tubes (allow: mesophyll and palisade cells) [2]

[Total 11 marks]

24. (a)	Hydrophyte	1
(b)	<p>Large <u>air spaces</u> in <i>Nymphaea</i>, smaller in <i>Ligustrum</i> (not: ref. thicker spongy mesophyll / thickness of epidermis / more air spaces)</p> <p>Stomata on upper surface of leaf in <i>Nymphaea</i>, not in <i>Ligustrum</i></p> <p>(any 2) Comparison needed. Accept converse of points</p>	2
(c)	<p>Large air spaces for buoyancy/diffusion/floating</p> <p>Stomata on upper surface so allowing gas exchange with the air</p> <p>Thin cuticle as little water (vapour) loss (not: no cuticle)</p>	3
	<p>Little support tissue as buoyed by water</p> <p>Little xylem as surrounded by water</p> <p>Air spaces in stems allowing diffusion of gases</p> <p>(any 3)</p>	
(d)	<p>Rolled leaves (not: curled)</p> <p>Hairs</p> <p>Thick cuticle</p>	1
	<p>Sunken stomata (allow: in pits not grooves)</p> <p>Deep rooted</p> <p>Extra support tissue in leaf</p> <p>(any 1)</p>	
		Total 7 marks

25.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
25.	(a)	(i)	A B palisade mesophyll labelled clearly as A (1) xylem vessel(s) labelled clearly as B (1) Label lines must end in / Letters must be in / on the correct tissue layer / xylem vessel Accept correct names if given.		2		2		
		(ii)	Type of plant hydrophyte (1) <u>Mark type and adaptations independently – no ecf</u> Any two (x1) from: {stomata / guard cells} in <u>upper</u> {epidermis/ surface of leaf} (1) {large / numerous} air spaces (in spongy mesophyll) (1) {Thin / no} cuticle on <u>upper</u> {surface / epidermis} (1)		1		3		
		(iii)	Any 1 from: to {increase/ maximise} absorption of light / so that greater surface area of leaves face the sun / long axis of chloroplasts is in same direction as light (1)		1		1		
	(b)	(i)	× 60 (2) 1 mark for conversion of length of scale bar to µm: 1.5 cm × 10 000 15 mm × 1 000		2		2	2	
		(ii)	vacuolar: water crosses more membranes than symplast/ water moves in and out of vacuole/ water has to pass through the {tonoplast/ vacuolar membrane}/ water has to pass through vacuole and cytoplasm (1) NOT vacuole to vacuole symplast: (moves through cytoplasm and) {cell membrane/ plasmodesmata} / only crosses one membrane (1)		2		2		
	(c)	(i)	arranged around the {periphery / edge} (of the stem) (1) No reverse argument for arrangement in root	1			1		1
		(ii)	Both needed for 1 mark: xylem lignin (cellulose – neutral) phloem cellulose	1			1		
			Question25 total	2	9	1	12	2	3

26.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
26	(a)	(i)	E (1) coronary artery (1)	2			2		1
		(ii)	{oxygen / glucose} does not reach {cardiac/ heart} <u>muscle</u> (1) (Muscle) unable to respire (aerobically)/ less ATP produced (1)		2		2		
	(b)	(i)	B (superior vena cava)		1		1		1
		(ii)	Open (Atrial) diastole/ atrial {systole/ contraction} (1) Accept ventricular diastole Closed ventricular systole (1)	2			2		
		(iii)	Any 4 (x1) from: A. pressure increases in jugular due to increase in atrial pressure B. Because no valves between jugular and atrium/ backflow of blood into jugular Atrial pressure increases due to: C. Atrial systole/ atrial contraction(1) D. Atria filling with blood (1) E. ventricle contracts closing {tricuspid/ AV} valve(1) F. increased pressure in ventricle pushes back on atrium (1)			4	4		
			Question26total	4	3	4	11	0	2

27.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
27	(a)		<ul style="list-style-type: none"> Biconcave + {increases diffusion/ more oxygen absorbed/ increase gas exchange} / large surface area + {diffusion/ oxygen absorbed/ gas exchange} (1) {Biconcave/ thin} + short diffusion pathway (1) Enucleate/no nucleus + more space for haemoglobin (1) 	3			3		
	(b)		12 or 13 or 14 (μm) = 3 marks If incorrect award 2 marks for answer between 12-15 and shown to a decimal place If both above incorrect award 1 mark for (diameter of B/ diameter of A) \times 8 (1)		3		3	3	
	(c)	(i)	100 (2) (45 /4.5 \times 10 ⁶) \times 10 ⁷ (1)	1	1		2	2	
		(ii)	Yes. Mean volume higher than {normal / 95} (ecf)			1	1		
		(iii)	Any two (\times 1) from: A. Fewer cells so {less haemoglobin/ lower total surface area} (1) B. Larger cell therefore {smaller SA : vol / increased diffusion pathway} (1) C. Larger cells so harder for red blood cells to pass through capillaries (1)			2	2		
			Question27 total	4	4	3	11	5	0

28.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
28	(a)	(i)	2		1		1	1	
		(ii)	(-)1.7		1		1	1	
		(iii)	Lymph (capillary / vessel) / lymphatic Reject node/ lacteal	1			1		
	(b)		Any three (\times 1) from A. Fewer plasma proteins/ not enough protein in blood (1) B. Which {raises/increases} {water/solute} potential of {plasma/blood}/ osmotic pressure is too low (1) C. reduces {water/solute} potential gradient / hydrostatic pressure is greater than osmotic pressure (1) D. less water/ fluid reabsorbed (by osmosis) (1) Ignore concentration of water			3	3		
			Question28 total	1	2	3	6	2	0

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
29	<p>Indicative content</p> <p>Section A: From epidermis and across cortex:</p> <ul style="list-style-type: none"> • Apoplast + symplast + vacuolar pathway • (Apoplast) Along cell walls • (Symplast) through cytoplasm/ plasmodesmata • (Vacuolar pathway) passes through tonoplast/ cytoplasm • Down water potential gradient / by osmosis <p>Section B: Into vascular tissue:</p> <ul style="list-style-type: none"> • Endodermis has Casparian strip • Waterproof / composed of suberin • Blocks apoplast pathway • Water {forced / passes} into symplast • Active transport of {salts / minerals} <u>into xylem</u> • Lowers water potential in <u>xylem</u> • Water enters <u>xylem</u> by osmosis / down water potential gradient <p>Waterlogged soil:</p> <ul style="list-style-type: none"> • {Less / no} oxygen (for respiration) • {Less / no} respiration so {less / no} {energy / ATP} • for active transport of minerals in the {endodermis/ root hairs} Must be in context of no oxygen • Lower water potential gradient as a result of less active transport of salts / minerals into xylem • Less water enters xylem which lowers root pressure 	5	4				
	<p>7-9 marks Indicative content of this level is detailed content from all three areas</p> <p><i>The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.</i></p> <p>4-6 marks Indicative content of this level is detailed content from two areas or less detail from three areas</p> <p><i>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.</i></p> <p>1-3 marks Indicative content of this level is any correct statement from indicative content</p> <p><i>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.</i></p> <p>0 marks <i>The candidate does not make any attempt or give a relevant answer worthy of credit.</i></p>						
	Question 29 total	5	4	0	9	0	0

30.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
30	(a)	(i)	Any four (x1) from A. Xylem transports {water/minerals} {from roots / <u>up</u> the plant/ to the leaves}/ xylem allows transpiration (1) NOT nutrients B. Lack of water causes {leaf/ cells} to {lose turgor / become flaccid}/ cells become plasmolysed (1) C. Reduced surface area (1) D. {No/reduced} photosynthesis/ less water for photosynthesis (1) E. Less {products / named products} of photosynthesis (1) F. For respiration / growth (1)		2	2	4		
		(ii)	Phloem transport is bidirectional / up <u>and</u> down plant (1) (so) Symptoms appear in both roots and leaves (in potato leaf roll) (1)		2		2		
	(b)	(i)	A – sieve tube (element) NOT sieve plate B – companion cell (1) 1 mark for both	1			1		
		(ii)	A - lacks {nucleus / nucleolus } / {fewer/ no} mitochondria / ER / Golgi/ organelles/ less cytoplasm (1) ORA Must be clear which cell is referred to		1		1		
		(iii)	Plasmodesmata (1) {Loading / unloading/ transport/ transfer} of sucrose / Transport of {ATP / proteins / enzymes / macromolecules} (1)		2		2		
			Question30total	1	7	2	10	0	0

31.

Question			Marking details	Marks Available					
				AO1	AO2	AO3	Total	Maths	Prac
31	(a)		Bohr effect / shift (1)	1			1		
	(b)	(i)	70 % (1) 10 % (1)		2		2	2	
		(ii)	Reduced affinity of haemoglobin for oxygen/ (oxy)haemoglobin dissociates at a higher partial pressure (of oxygen) (1) More oxygen {released / unloaded/ dissociates}/ oxygen released (more) readily (1) Allow oxygen more readily dissociated from haemoglobin = 2 marks	2			2		
	(c)	(i)	CO ₂ removed faster/ more CO ₂ exhaled (1) Increases {diffusion / concentration} gradient (from blood into alveoli) (1)			2	2		
		(ii)	increased affinity of haemoglobin for oxygen / decreased dissociation of oxyhaemoglobin (1) Less oxygen {released/ available} (for respiration) (1)			2	2		
	(d)	(i)	X = carbonic anhydrase Y = carbonic acid / H ₂ CO ₃ Z = hydrogen ion / H ⁺ / proton 0/1 = 0 marks 2 correct = 1 mark, 3 correct = 2 marks	2			2		
		(ii)	{In solution/dissolved} in plasma / as carbamino compounds / as carbaminohaemoglobin (1)	1			1		
		(iii)	Any three from: <ul style="list-style-type: none"> Chloride shift (1) must be in context of red blood cells {chloride ions} {enter/diffuse} into red blood cells in exchange for hydrogen carbonate ions (1) One to one exchange / reference to figures (1) To maintain (electrochemical) neutrality (in red blood cell)/ to {equalise/ balance/ maintain} charge (1) 	1	2		3		
			Question31total	7	4	4	15	2	0

32.

Question	Marking details	Marks Available					
		AO1	AO2	AO3	Total	Maths	Prac
32	<p>Indicative content</p> <p>In systemic circulation:</p> <ul style="list-style-type: none"> • {High pressure/ pressure increase} (to 120 mmHg) in {aorta/ arteries} is due to ventricular systole/ contraction of left ventricle. • High pressure needed to pump blood {round body/ long distance} • Pressure decrease (to 80 mmHg) in {arteries / aorta} is due to {diastole/ ventricular relaxation}. • High pressure is maintained due to elastic recoil of artery walls / closure of {semilunar / aortic} valve. • Pressure decrease in {arterioles/ capillaries} is due to {frictional resistance / blood flowing through a greater (total) {cross sectional/ surface area}. • Pressure decrease in capillaries is also due to tissue fluid formation. • low pressure/ flow rate in capillaries necessary for diffusion • Blood flow in veins due to massaging effect of skeletal muscles. <p>In pulmonary circulation:</p> <ul style="list-style-type: none"> • Pressure increase in pulmonary arteries due to {ventricular systole/ contraction of thinner walled right ventricle}. • Lower pressure (than systemic) due to {shorter distance / (only) to lungs}. • Pressure decrease (to about 8 mmHg) in pulmonary arteries is due to diastole / ventricle relaxation. • Pressure in capillaries is lower than systemic to prevent tissue fluid formation in the alveoli / reduce damage to alveoli / allow time for gas exchange. <p>Benefit over single circulation:</p> <ul style="list-style-type: none"> • Correct description of single and double circulation • Pressure is lost when blood passes through (gill) capillaries. • so blood flow through the systemic circulation of a fish is slower. • Double circulation maintains high pressure (in systemic circulation) • to meet the high metabolic demands of a mammal. 	6	3		9		
	<p>7-9 marks Detailed explanation of systemic circulation And Detailed explanation of pulmonary circulation And Detailed explanation of benefit over single circulation</p> <p><i>The candidate constructs an articulate, integrated account, correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses scientific conventions and vocabulary appropriately and accurately.</i></p> <p>4-6 marks Any two from Explanation of systemic circulation Explanation of pulmonary circulation Explanation of benefit over single circulation</p> <p><i>The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate usually uses scientific conventions and vocabulary appropriately and accurately.</i></p> <p>1-3 marks Brief explanation of systemic circulation OR Brief explanation of pulmonary circulation OR Brief explanation of benefit over single circulation</p> <p><i>The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate has limited use of scientific conventions and vocabulary.</i></p> <p>0 marks <i>The candidate does not make any attempt or give a relevant answer worthy of credit.</i></p>						
	Question 32 total	6	3	0	9	0	0