

Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	columnar / ciliated ; squamous / pavement ;	2	<b>Mark the first two answers.</b> <b>IGNORE</b> 'cilia cells'
	(a)	(ii)	<p>1. wall is <u>one cell</u> thick for short(er) <b>diffusion</b>, distance / pathway ;</p> <p>2. <b>squamous</b>, cells / epithelium , provide short diffusion distance / pathway ;</p> <p>3. <b>elastic</b> so, <b>recoil</b> / expel air / helps <b>ventilation</b> ;</p> <p>4. create / maintain, <b>concentration</b> <b>gradient</b> / described ;</p> <p>5. large number (of alveoli) provide large(r) <b>surface area</b> ;</p> <p>6. small size (of alveoli) provide large(r) <b>surface area to volume ratio</b> ;</p> <p>7. (cells secrete) surfactant to maintain surface area ; <b>max 4</b></p>		<p>Mp 1 &amp; 2 the phrase 'for short(er) diffusion distance' only needs to be stated once to gain both marks</p> <p><b>IGNORE</b> ref to rate of diffusion</p> <p><b>ACCEPT</b> 'alveolus / epithelium one cell thick' <b>DO NOT CREDIT</b> 'membrane / cell wall, one cell thick'</p> <p><b>ACCEPT</b> pavement / thin / flat for squamous <b>IGNORE</b> thin wall</p> <p><b>ACCEPT</b> gas for air <b>IGNORE</b> CO<sub>2</sub> / O<sub>2</sub></p> <p><b>IGNORE</b> diffusion gradient</p> <p>Take care not to confuse mp 5 &amp; 6 <b>DO NOT CREDIT</b> large in number so large SA:Vol <b>DO NOT CREDIT</b> small so provide large surface area</p> <p><b>CREDIT</b> SA:Vol</p> <p><b>ACCEPT</b> surfactant to prevent collapse</p>

Question			Expected Answers	Marks	Additional Guidance
			<b>QWC ;</b> <b>max 1</b>	5 max	Any <b>two</b> technical terms from the list below used appropriately and spelled correctly :  <b>concentration gradient</b> <b>surface area to volume ratio</b> <b>elastic recoil</b> <b>surface area</b> (note: do not allow as part of 'surface area to volume ratio') <b>diffusion</b> (note: do not allow as part of 'diffusion gradient')  <b>squamous ventilation</b>
	<b>(b)</b>	<b>(i)</b>	<u>spirometer</u> ;	1	<b>DO NOT CREDIT</b> respirometer <b>IGNORE</b> trace
		<b>(ii)</b>	13.5 ;	1	<b>ACCEPT</b> 13 or 14
		<b>(iii)</b>	0.5 ; ;	2	Correct answer = 2 marks If answer incorrect allow one mark for: either 3.6 – 3.1 (measured from peaks) OR 2.7 – 2.2 (measured from troughs)  <b>ECF</b> one mark for final answer if candidate has used 3.5 as the initial reading (3.5 – 3.1 = 0.4 for 1 mark)  <b>For candidates who have measured over less than a minute and divided by number of seconds:</b> <b>ACCEPT for two marks</b> 0.56 if measured peaks 0.52 if measured troughs <b>ACCEPT</b> working (3.6 – 3.1) x 60 / 54 for peaks OR (2.7 – 2.2) x 60 / 58 for troughs
			<b>Total</b>	<b>11</b>	

Question		Answer	Mark	Guidance		
				<b>DO NOT ALLOW</b> marks for use of just 'oxygen' in place of 'air' throughout question 2		
2	(a)	<p>1 <u>volume</u>, inside / of, jar increases ;</p> <p>2 <u>pressure</u> inside, jar / balloons, decreases ;</p> <p>3 to below pressure in atmosphere ;</p> <p>4 (therefore) air, moves / pushed / forced, into, balloons / glass tube ;</p>	3 max	<p><b>IGNORE</b> references to chest / lungs</p> <p><b>CREDIT</b> idea of creating a pressure gradient (between balloon and exterior)  <b>IGNORE</b> hydrostatic  <b>Note:</b> 'makes pressure in jar lower than atmosphere' = 2 marks</p> <p><b>ACCEPT</b> flows / enter / fills  <b>DO NOT CREDIT</b> suction / drawn / pulled in / diffuse in / taken in</p> <p><b>IGNORE</b> <i>just</i> into bell jar</p>		
	(b)	(i)		<p><u>volume</u> of air, inhaled / exhaled ;</p> <p>in, one / each, breath ;</p> <p>during, steady / regular, breathing ;</p>	2 max	<p><b>ACCEPT</b> breathed / moved, in (and / or out of lungs)  <b>IGNORE</b> amount</p> <p><b>ACCEPT</b> at rest / during steady exercise / normal / quiet breathing</p>
		(ii)		<p>up / down, movements (of rubber sheet / band) ;</p> <p><i>idea of:</i> small / steady / regular, movements (of rubber sheet) ;</p>	2	<p><b>ACCEPT</b> pull / push on rubber sheet / band  <b>ACCEPT</b> pull / push and let go</p> <p><b>ACCEPT</b> rhythmically / in time with breathing / repetitively  <b>IGNORE</b> gently  <b>Note:</b> pulled down slightly = 2 marks</p>

Question		Answer	Mark	Guidance
	(iii)	the maximum <u>volume</u> of air ;  inhaled / exhaled, in one breath ;	2	<b>ACCEPT</b> tidal volume + inspiratory reserve + expiratory reserve = 2 <b>ACCEPT</b> total lung capacity – residual volume = 1 mark <b>IGNORE</b> total volume  <b>ACCEPT</b> breathed, in / out, in one breath <b>DO NOT CREDIT</b> held in lungs or max vol in lungs <b>DO NOT CREDIT</b> breathed in <b>and</b> out in one breath
	(iv)	<b>idea that</b> pulled down on rubber, sheet / band, as far as possible <b>and</b> pushed up as far as possible ;	1	<b>ACCEPT</b> pull / push in either order <b>ACCEPT</b> pull <b>and</b> push as hard as possible
		<b>Total</b>	<b>10</b>	

Question			Answer	Marks	Guidance
3	(a)	(i)	<u>0.6 : 1</u> ; ;		<p>Correct answer = 2 marks  <b>Ratio must be correct way round</b> 1: 0.6 is not correct but can still allow mark for correct working if shown</p> <p>If answer incorrect <b>ALLOW</b> 1 mark for working  e.g. <math>600 \div 1000</math></p> <p><math>600 : 1000 = 1</math> mark</p>
		(ii)	<p>as SA:VOL ratio decreases rate of diffusion decreases  <b>OR</b>  as SA:VOL ratio increases rate of diffusion increases ;</p> <p>use of two pairs of figures with correct units (<math>\text{mms}^{-1}</math>) for rate to illustrate trend ;</p> <p>ref to rate of diffusion in either of the first two cubes not fitting trend ;</p>	2	<p><b>ACCEPT</b> <u>positive</u> correlation  <b>DO NOT CREDIT</b> as rate of <i>diffusion</i> decreases SA:VOL ratio decreases</p> <p>use of figs requires ratio quote and rate quote at two points  e.g. at SA:VOL of 3:1 rate is <math>0.02 \text{ mms}^{-1}</math>, at SA:VOL ratio of 0.2:1 rate is <math>0.013</math> (correct units only need to be used once)  <b>DO NOT CREDIT</b> if unit for SA:Vol given</p> <p><b>ACCEPT</b> correct calculation of rate change  e.g. when the SA:VOL ratio was 3:1 the rate of diffusion was <math>0.020 \text{ mms}^{-1}</math> which is <math>0.007 \text{ mms}^{-1}</math> faster than the cube with 0.2:1 SA:VOL ratio</p>
		(iii)	<p>(large plants) have a, small / low, SA : VOL ratio ;</p> <p><i>idea of</i> diffusion too slow (to supply requirements) ;</p> <p><i>idea of</i> need transport system (for water / minerals / assimilates) ;</p> <p><i>idea of</i> need (special) surface area for, gaseous exchange / uptake of minerals ;</p>	max 2	<p><b>DO NOT CREDIT</b> smaller unless we know smaller than what  <b>ACCEPT</b> e.g. larger plants have a smaller SA : Vol ratio</p> <p>must have idea of <b>too</b> slow  <b>ACCEPT</b> diffusion takes <b>too</b> long  <b>DO NOT CREDIT</b> transport of gases</p>
				max 2	

Question		Answer	Marks	Guidance
	(b) (i)	divided length of side by time taken ;	1	<b>IGNORE</b> divide mm by s (units alone too vague)
	(ii)	<i>idea that</i> student used whole length of side, rather than half length ;	1	<b>ACCEPT</b> needs to divide answer by 2 / distance has to be to centre of cube rather than whole length of side / assumed diffusion occurs (across whole cube) from one side
	(c)	<p><i>squamous epithelium</i> short(er) diffusion, distance / path ;</p> <p><i>large number of alveoli</i> large(r) surface area ;</p> <p><i>good blood supply</i> high / large / steep, concentration gradient OR removes oxygen (from lung surface) / brings carbon dioxide (to lung surface);</p> <p><i>good ventilation</i> high / large / steep, concentration gradient OR supplies oxygen (to alveoli) / removes carbon dioxide (from alveoli) ;</p>	4	<p><b>ACCEPT</b> reduced / shorter diffusion distance <b>ACCEPT</b> thin diffusion barrier <b>IGNORE</b> thin diffusion pathway</p> <p><b>ACCEPT</b> increases surface area <b>IGNORE</b> SA : Vol ratio</p> <p><b>ACCEPT</b> maintains / creates concentration gradient <b>IGNORE</b> ref diffusion gradient</p> <p><b>ACCEPT</b> maintains / creates concentration gradient <b>IGNORE</b> ref diffusion gradient <b>IGNORE</b> ref to air</p>
<b>Total</b>			<b>12</b>	

Question		Answer	Marks	Guidance
4	(a)	<p>low / small, surface area to volume ratio ;</p> <p>diffusion, too slow / distance too great ;</p> <p>to supply enough, oxygen / (named) nutrients ;</p> <p>to prevent, CO<sub>2</sub> / (named) waste product, building up ;</p> <p>active ;</p>	3 max	<p><b>Mark the first 3 suggestions</b></p> <p><b>CREDIT</b> SA/Vol, SA:Vol</p> <p><b>ACCEPT</b> surface area to volume (ie if 'ratio' missed)</p> <p><b>IGNORE</b> lower SA / Vol</p> <p><b>ACCEPT</b> diffusion pathway too long</p> <p><b>ACCEPT</b> diffusion insufficient because, body too large / tissues too deep</p> <p><b>ACCEPT</b> 'transport enough' for 'supply enough' idea of 'enough' is important</p> <p><b>ACCEPT</b> to remove waste products</p> <p><b>ACCEPT</b> to prevent waste reaching toxic levels</p> <p><b>ACCEPT</b> high demand for oxygen / energy</p> <p><b>OR</b> high metabolic rate</p> <p><b>OR</b> endotherm / maintaining temperature / exercising</p>
	(b) (i)	<p><u>electrocardiogram</u> ;</p>	1	<p><b>Mark the first answer.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p><b>IGNORE</b> ECG</p> <p><b>DO NOT CREDIT</b> electrocardiograph</p>
	(ii)	<p><b>A</b> sinoatrial node / SAN ;</p> <p><b>B</b> atrioventricular node / AVN ;</p>	2	<p><b>Mark the first answer on each prompt line.</b> If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = <b>0 marks</b></p> <p>sinoatrial node / sinoatrial node = NBOD</p> <p>atrioventricular / atrioventricular, node = BOD</p> <p>atrioventricular / atrioventricular node = NBOD</p>

Question		Answer	Marks	Guidance
	(c) (i)	(to allow time) for the atria to (fully) contract ;  to allow (time for), atria to empty / blood to move / ventricles to fill ;  so that ventricle(s) do not contract, too early ;	2 max	<b>ACCEPT</b> systole for contraction <b>IGNORE</b> pumping  <b>ACCEPT</b> so atria and ventricles do not contract at the same time <b>ACCEPT</b> (atria contract ) before ventricular systole occurs  <b>Note:</b> so ventricles do not contract before they are full = 2 so ventricles do not contract before atria are empty = 2 so atria have time to empty before the ventricles start to contract = 2
	(ii)	so that (ventricular) contraction starts at, apex / base / bottom ;  to push blood upwards OR into/ towards, (named) arteries ;  complete / efficient, emptying of ventricles ;	2 max	<b>IGNORE</b> ref to gravity / ref to blood pressure  <b>ACCEPT</b> systole for contraction <b>ACCEPT</b> contract from the apex <b>IGNORE</b> pumping  <b>ACCEPT</b> force all blood out of heart
		<b>Total</b>	<b>10</b>	



Question			Answer	Marks	Guidance
5	(a)	(i)	<u>tidal volume</u> ;	1	
		(ii)	being stretched / stretching ;	1	<b>ACCEPT</b> lengthening <b>DO NOT CREDIT</b> relaxing <b>IGNORE</b> expanding 'stretching and contracting' = <b>CON</b>
	(b)		<p><i>between B &amp; C expiration:</i></p> <p><b>1</b> (external) <b>intercostal</b> muscles / <b>diaphragm</b>, relax ;</p> <p><b>2</b> rib cage / ribs, move down OR diaphragm, moves / pushed, up ;</p> <p><b>3 volume</b> of, <b>thorax</b> / chest cavity / lungs, drops / decreases ;</p> <p><b>4 pressure</b> inside, thorax / chest cavity / lungs, increases ;</p> <p><b>5</b> above, external / atmospheric, pressure ;</p> <p><b>6</b> air leaves down pressure <b>gradient</b> ;</p> <p><b>7</b> (elastic) <b>recoil</b> of alveoli ; <b>3 max</b></p> <p>QWC – <b>two</b> technical terms used in context and spelt correctly ; <b>1</b></p>	4 max	<p><b>1 ACCEPT</b> ref to <u>internal</u> intercostal muscles contracting <b>1 DO NOT CREDIT</b> ref to diaphragm relaxing and intercostal muscles (unqualified) contracting</p> <p><b>2 IGNORE</b> 'diaphragm becomes domed / curved'</p> <p><b>3 ACCEPT</b> 'space inside' or 'air in' for volume</p> <p><b>5 ACCEPT</b> (pressure) higher than outside</p> <p><b>Answers given in context of 'at B' or 'at C' – QWC not awarded.</b> Any <b>two</b> from <b>intercostal, diaphragm, recoil, volume</b> <b>thorax, pressure, gradient</b></p>
	(c)		12 ;;	2	Allow two marks for correct answer. If answer wrong allow one mark for working $\frac{60}{5}$

Question		Answer	Marks	Guidance
	(d)	<p><i>idea that:</i> thorax / rib cage / lungs, cannot be completely , compressed / flattened ;</p> <p>trachea / bronchi, held open by cartilage ;</p> <p>bronchioles / alveoli, held open by elastic fibres ;</p> <p>AVP ;</p>	2 max	<p><b>IGNORE</b> bronchioles or alveoli</p> <p><b>IGNORE</b> bronchi or trachea</p> <p>eg absence of pressure gradient / atmospheric and thoracic pressures equal presence of surfactant in alveoli upward movement of diaphragm limited by collagen fibres</p>
<b>Total</b>			<b>10</b>	