Question			Expected Answers	Marks	Additional Guidance
1	(a)	(i)	columnar / ciliated **;** squamous / pavement **;**	2	**Mark the first two answers.** **IGNORE** 'cilia cells'
	(a)	(ii)	1. wall is <u>one</u> <u>cell</u> thick for short(er) **diffusion,** distance / pathway **;** **2. squamous,** cells / epithelium , provide short diffusion distance / pathway **;** 3. **elastic** so, **recoil /** expel air **/** helps **ventilation ;** 4. create / maintain, **concentration gradient /** described **;** **5.** large number (of alveoli) provide large(r) **surface area ;** **6.** small size (of alveoli) provide large(r) **surface area to volume ratio ;** **7.** (cells secrete) surfactant to maintain surface area **;** **max 4**		Mp 1 & 2 the phrase 'for short(er) diffusion distance' only needs to be stated once to gain both marks **IGNORE** ref to rate of diffusion **ACCEPT** 'alveolus / epithelium one cell thick' **DO NOT CREDIT** 'membrane / cell wall, one cell thick' **ACCEPT** pavement / thin / flat for squamous **IGNORE** thin wall **ACCEPT** gas for air **IGNORE** CO_2 / O_2 **IGNORE** diffusion gradient Take care not to confuse mp 5 & 6 **DO NOT CREDIT** large in number so large SA:Vol **DO NOT CREDIT** small so provide large surface area **CREDIT** SA:Vol **ACCEPT** surfactant to prevent collapse

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

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

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

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

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

Question			Answer	Marks	Guidance
4	(a)		low / small, surface area to volume ratio **;** diffusion, too slow / distance too great **;** to supply enough**,** oxygen / (named) nutrients **;** to prevent, CO_2 / (named) waste product, building up **;** active **;**	3 max	**Mark the first 3 suggestions** **CREDIT** SA/Vol, SA:Vol **ACCEPT** surface area to volume (ie if 'ratio' missed) **IGNORE** lower SA / Vol **ACCEPT** diffusion pathway too long **ACCEPT** diffusion insufficient because, body too large / tissues too deep **ACCEPT** 'transport enough' for 'supply enough' idea of 'enough' is important **ACCEPT** to remove waste products **ACCEPT** to prevent waste reaching toxic levels **ACCEPT** high demand for oxygen / energy **OR** high metabolic rate **OR** endotherm / maintaining temperature / exercising
	(b)	(i)	electrocardiogram **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** ECG **DO NOT CREDIT** electrocardiograph
		(ii)	**A** sinoatrial node / SAN **;** **B** atrioventricular node / AVN **;**	2	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** sinalatrial node / sanatrial node = NBOD atroventricular / atrialventricular, node= BOD artrialventricular / avioventricular node = NBOD

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	**ACCEPT** systole for contraction **IGNORE** pumping **ACCEPT** so atria and ventricles do not contract at the same time **ACCEPT** (atria contract) before ventricular systole occurs **Note:** 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	**IGNORE** ref to gravity / ref to blood pressure **ACCEPT** systole for contraction **ACCEPT** contract from the apex **IGNORE** pumping **ACCEPT** force all blood out of heart
			Total	**10**	

Question			Answer	Marks	Guidance
5	(a)	(i)	tidal volume ;	1	
		(ii)	being stretched / stretching ;	1	**ACCEPT** lengthening **DO NOT CREDIT** relaxing **IGNORE** expanding 'stretching and contracting' = **CON**
	(b)		*between **B** & **C** expiration:* **1** (external) **intercostal** muscles / **diaphragm**, relax ; **2** rib cage / ribs**,** move down OR diaphragm, moves / pushed, up ; **3 volume** of, **thorax** / chest cavity / lungs, drops / decreases ; **4 pressure** inside, thorax / chest cavity / lungs, increases ; **5** above, external / atmospheric, pressure ; **6** air leaves down pressure **gradient** ; **7** (elastic) **recoil** of alveoli ; **3 max** QWC – **two** technical terms used in context and spelt correctly ; **1**	4 max	**1 ACCEPT** ref to internal intercostal muscles contracting **1 DO NOT CREDIT** ref to diaphragm relaxing and intercostal muscles (unqualified) contracting **2 IGNORE** 'diaphragm becomes domed / curved' **3 ACCEPT** 'space inside' or 'air in' for volume **5 ACCEPT** (pressure) higher than outside **Answers given in context of 'at B' or 'at C' – QWC not awarded.** Any **two** from **intercostal**, **diaphragm**, **recoil**, **volume** **thorax**, **pressure**, **gradient**
	(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)		*idea that:* thorax / rib cage / lungs, cannot be completely , compressed / flattened **;** trachea / bronchi, held open by cartilage **;** bronchioles / alveoli, held open by elastic fibres **;** AVP **;**	2 max	**IGNORE** bronchioles or alveoli **IGNORE** bronchi or trachea eg absence of pressure gradient / atmospheric and thoracic pressures equal presence of surfactant in alveoli upward movement of diaphragm limited by collagen fibres
			Total	**10**	