Question			Answer	Marks	Guidance
1	(a)	(	11.3 **; ;**	2	**Correct answer = 2 marks** even if no working shown. **IGNORE** '-' before the number If the answer is incorrect, **ALLOW** 1 mark for seeing $\frac{(2.75 - 2.44)}{2.75} \times 100$ **or** $\frac{0.31}{2.75} \times 100$ If the answer is not given to 1 decimal place, **ALLOW** 1 mark for A correct but unrounded answer (11.2727…, 11.27˙ etc) **or** A correct answer that has been rounded to the wrong number or decimal places **or** A correct answer seen but has been rounded incorrectly (eg 11.2)

Question			Answer		Marks	Guidance
1	(a)	(i			4 max	**ACCEPT** curve / lung function / amount of exhaled air , as AW for FEV
			1	non-smokers' FEV higher than smokers' **; ora**		**1 DO NOT CREDIT** FEV is higher **at the start** (alone) as this implies it is lower later on
			2	smokers' FEV , declines / falls / drops / decreases (over time) **;**		**2 IGNORE** 'both decline'
			3	widening gap (between smokers and non-smokers) / rate of decline is lower in non-smokers / smaller reduction in non-smokers **;**		**3 ACCEPT** ora for decline and extent of reduction
			4	non smokers' (FEV) increases then decreases / peaks **;**		
			5	non-smokers' (curve / FEV / lung function) has peak at 1.5 years **and** 2.88 dm^3 **;**		
			6	appropriate figures to support mp 1 - 3 **;**		**6** Figures must include 2 FEVs with units linked to time in years and must support the point being made. **6 ALLOW** valid calculated comparison **6 ALLOW** comparative dates such as '2 years later'

Time (years)	FEV_1 (dm^3) had stopped smoking	FEV_1 (dm^3) continue to smoke	Acceptable range for difference	Other useful figures:
0.0	2	2.75	0.07	Increase over 1 ½ years for stopped smoking = 0.06 dm^3 Decrease over 1 ½ years for continue to smoke = 0.06 – 0.07 dm^3 Decrease over from 1 ½ years to 5 years for stopped smoking = 0.10 – 0.11 dm^3 Decrease over from 1 ½ years to 5 years for continue to smoke = 0.24 – 0.25 dm^3 Decrease over 5 years for stopped smoking = 0.04 – 0.05 dm^3 Decrease over 5 years for continuing smokers = 0.31 dm^3
0.5	2	2.73	0.12	
1.0	2	2.71	0.16	
1.5	2.88	2.68 – 2.69	0.19 – 0.20	
2.0	2.87	2.67 – 2.68	0.19 – 0.20	
2.5	2	2.64	0.22	
3.0	2	2.60	0.24	
3.5	2.82 – 2.83	2.56 – 2.57	0.25 – 0.27	
4.0	2	2.53	0.27	
4.5	2.78 – 2.79	2.49	0.29 – 0.30	
5.0	2.77 – 2.78	2.44	0.33 – 0.34	

Question			Answer		Marks	Guidance
1	(b)	(		*causes*	6 max	
			1	tar **;**		
			2	(cigarette smoke) destroys / damages / paralyses, cilia / ciliated epithelium **;**		**2 ALLOW** in response to any component of cigarette smoke **2 DO NOT CREDIT** 'kills cilia' / 'cilia die' **2 IGNORE** 'cilia stick together'
			3	(cigarette smoke stimulates) goblet cells to release more mucus **;**		**3 ALLOW** in response to any component of cigarette smoke **3** Must contain the idea of more mucus than normal
			4	mucus (in airways) , builds up / cannot be removed / AW **;**		
			5	more, pathogens / bacteria / viruses / microbes, collect / trapped / accumulate (in mucus) **;**		**5 IGNORE** 'pathogens' alone must have idea of increasing number of pathogens e.g. **ACCEPT** 'breeding' 'multiplying' /AW **5 ACCEPT** 'higher number of pathogens present' **5 ACCEPT** 'infections more likely'
			6	*idea that* cough is an attempt to , increase air flow / remove microbes , by removing mucus **;**		**6** There must be a reason for removing the mucus **6 ACCEPT** 'to clear the throat by removing mucus' **6 ACCEPT** 'to reduce infections by removing mucus'
				effects		
			7	(frequent coughing) damages / inflames, (named) airway / alveoli / elastic fibres **;**		**7 IGNORE** damage to lungs **7 IGNORE** damage as a result of elastase / emphysema
			8	formation of scar tissue **;**		**8 CREDIT** in any part of lung
			9	airway / bronchi / bronchiole, walls thicken **;**		**9 IGNORE** 'trachea' **9 CREDIT** 'smooth muscle (in wall) thickens'
			10	lumen of **,** airway / bronchi / bronchiole **,** narrows **;**		**10 IGNORE** 'trachea'
			11	flow of air restricted **;**		**11** 'airflow restricted due to extra smooth muscle' = 2 marks, mp **9** and **11**
			12	(damage to alveoli causes) reduced surface area for , gas exchange / oxygen diffusion **;**		
			QWC – One cause of cough and one effect of cough		**1**	**Award** if at least 1 mark has been given from each of the mark scheme sections (1-6 and 7-**11**) for this question.

Question				Answer	Marks	Guidance
1	(b)	(i		emphysema **;** chronic bronchitis **;** asthma **;**	**2 max**	**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** **ACCEPT** phonetic spellings **IGNORE** emphysemia
		(iii)	**1**	elastin is substrate **;**	**5 max**	**1** Must be a clear statement
			2	(elastin / substrate) binds to / fits into , active site **;**		**2 IGNORE** complementary **2 ACCEPT** goes in to
			3	active site / enzyme / elastase / substrate / elastin, shape changes **;**		**3/4 CREDIT** 'mould around' once for either mp 3 or mp 4 but award the alternate marking point if seen
			4	*idea of* closer fit (between active site and substrate) **;**		**4 ACCEPT** eg tighter / more precisely / in a better position
			5	more bonds form (between substrate and active site) **;**		**5 ACCEPT** 'interactions'
			6	forms enzyme-substrate-complex / ESC **;**		
			7	*idea that* (change in shape of active site) destabilises / weakens , bonds (in substrate) / substrate **;**		**7 ACCEPT** e.g. puts, pressure / strains, on
			8	activation energy reduced **;**		
			9	*idea of* further shape change of, active site / enzyme, after products form **;**		**9 IGNORE** 'the enzyme is unchanged'
				Total	**20**	

Question			Answer	Mark	Guidance
2	(a)	(	alveoli ; to provide large(r), surface area / SA ;	2	**ACCEPT** alveolus / alvioli, alviolis **ACCEPT** large(r) surface area to volume ratio **OR** SA:VOL
		(ii)	squamous / pavement ;	1	Look for the name **ACCEPT** squamas, squamos, squarmous **DO NOT CREDIT** ref to ciliated
		(iii)	to prevent bursting ; recoil ; to return air sac to original, size / shape ; to help expel air ;	2 max	**IGNORE** stretch / contract **DO NOT CREDIT** in context of inhaling **IGNORE** ref to role returning airways back to size **IGNORE** ref to fibres returning to original size **DO NOT CREDIT** carbon dioxide / waste gas, expelled
	(b)	(	**1** increases, partial pressure / concentration, of oxygen (in the air sac) ; **2** so concentration of oxygen (in the air sac) is higher than that in the blood ; **3** decreases, partial pressure / concentration, of carbon dioxide (in air sac) ; **4** so concentration of CO_2 (in the air sac) is lower than that in the blood ;	2	**ACCEPT** (provides) high concentration of oxygen (in air sac) **IGNORE** 'maintains' throughout
		(ii)	**EITHER** **D1** (continuous) blood flow (in the capillaries) ; **E1** to, bring in (more) carbon dioxide / take away (more) oxygen ; **OR** **D2** oxygen combines with haemoglobin ; **E2** to keep concentration in, blood / plasma, low ;	2	idea of blood flow **ACCEPT** good / copious / continuous, blood supply **IGNORE** highly vascular / many capillaries present **IGNORE** short diffusion path / capillaries very close to alveoli
			Total	**9**	

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(i)	production of vesicles / packaging proteins **;** modification of / processing of / adding carbohydrate to **,** proteins **;** production of lysosomes **;**	**max 1**	**Mark the first answer.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** lipids **IGNORE** ref to transport / secretion / exocytosis / substances / materials **DO NOT CREDIT** stores proteins **ACCEPT** makes glycoproteins
3	(a)	(ii)	allow movement (of substances) in or out of nucleus **;** correctly named substance (entering or leaving nucleus) **;** ref to correct destination of substance **;**	**max 2**	**IGNORE** messages / information / communication **IGNORE** name of substance for MP 1 **IGNORE** ref to mechanism of movement e.g. RNA / (m)RNA / (r)RNA (t)RNA / polymerase nucleotides / ribosomes / helicase / proteins / (steroid) hormones **IGNORE** ref nutrients **DO NOT CREDIT** if incorrect direction of movement described (e.g. RNA into nucleus **or** RNA in and out of nucleus) **DO NOT CREDIT** DNA as named substance ***Note*** 'allows mRNA out of nucleus' = **two marks** e.g. RNA to ribosomes or RER helicase to DNA polymerase to **,** DNA / gene nucleotides to DNA (steroid) hormones to **,** DNA / gene / chromosome

Question			Expected Answer	Mark	Additional Guidance
3	(a)	(iii)	contain / release **,** lysins / lytic enzymes / hydrolytic enzymes / digestive enzymes **;**		**DO NOT CREDIT** 'engulf' **DO NOT CREDIT** 'lysosomes are digestive enzymes'
			digest / break down **,** organelles / foreign objects / toxins / cells / pathogens **;**		**ACCEPT** destroy **ACCEPT** ref to digestion of contents of phagocytic vesicle **IGNORE** ref to (unwanted) substances / materials / food **IGNORE** ref to acrosomes
			apoptosis / autolysis / described **;**	**max 1**	
3	(b)		*idea of* more than one (type of) tissue **;**		**ACCEPT** named examples of tissues
			working together / performing a function(s) **;**	**2**	**ACCEPT** job or task

Question			Expected Answer	Mark	Additional Guidance
3	(c)				allow **F** marks even if **C** mark not quite accurate
			C1 thin / **squamous**, **epithelium** ; **C2** thin **endothelium** (of capillary) ;		**C1/C2** **IGNORE** ref to alveolus / alveolar wall / capillary wall **,** without ref to epithelium / endothelium
			F1 (provides) short **diffusion** distance / described ;		**F1** **ACCEPT** diffusion barrier **,** thin / one cell thick **IGNORE** refs to speed or rate of diffusion **IGNORE** ref to reduces diffusion distance alone – must be in context of short distance **DO NOT CREDIT** ref to thin **,** cell walls / membranes
			F2 ref to **surfactant** (from epithelial cells) **,** reducing surface tension / preventing alveoli collapsing ;		**F2** **IGNORE** ref to moisture
			C3 blood / red blood cells / **erythrocytes** ;		**C3** **IGNORE** (named) blood vessel **ACCEPT** blood supply / supply of blood
			F3 transports (named) gas(es) **,** to / from **,** exchange surface / alveoli ; **C4** diaphragm / intercostals **, muscles** ;		**F3** **IGNO** ref to lungs **IGNORE** description of gas exchange
			F4 (maintains / creates) **diffusion** / **concentration , gradient** ;		**F4** This can be awarded in context of **F3** or **C4**
			C5 **ciliated** epithelium / **goblet** cells / ciliated cells ; **F5** *idea of:* protection from / removal of **,** dust / bacteria / pollen / spores ;		**F5** **AC PT** trap **,** dust / bacteria / pollen / spores **IGNORE** dirt / germs
			C6 **cartilage** ; **F6** hold airway open ;		
			C7 smooth **muscle** ;		***continued***

Question	Expected Answer	Mark	Additional Guidance
continued			
	F7 constrict / control diameter of **,** airway / blood vessel **;** **C8** elastic , fibres / tissue **;** **F8** for recoil / aiding ventilation **;** **C9** **macrophage** / **neutrophil** **;** **F9** engulf / destroy pathogens **or** protect from infection **;**	**max 4**	**F7** **ACCEPT** narrows lumen **C8** **IGNORE** elastin / elasticated **F8** **ACCEPT** prevent alveoli bursting **C9** **IGNORE** ref to white blood cell unqualified
	QWC **;**	**1**	Any **three** with correct spelling and a suitable context from: **epithelium / epithelial**, **endothelium,** **cartilage,** **diffuse / diffusion,** **gradient,** **goblet,** **ciliated,** **concentration,** **squamous,** **macrophage,** **neutrophil,** **surfactant,** **muscle,** **erythrocyte**
	Total	**[11]**	

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(i)	**1** *idea of* not breathing through nose **;** **2** subject breathes **,** evenly / normally / regularly **;** **3** *idea of* (measure) height / amplitude **,** of waves (from trace) **;** **4** measure at least three waves and calculate mean **;** **5** detail of how spirometer works **;**	**max 3**	**1** e.g. subject wears nose clip / plug or holds nose **2** **IGNORE** at rest **3** **ACC PT** (measure) difference between peak and trough **ACCEPT** annotated diagram / annotations on graph **5** e.g. as breathe <u>in</u> lid goes <u>down</u> / as breathe <u>out</u> lid goes <u>up</u> e.g. movement of lid recorded **,** on trace / by data logger e.g. pen attached to lid moves up/down as breathe **DO NOT CREDIT** description of water level changing **IGNORE** ref to using mouthpiece, soda lime, oxygen
4	(a)	(ii)	10 further waves drawn with similar heights **;** trace falls **;**	**2**	Look for 10 extra peaks and 10 extra troughs ***Note*** 'similar' means no wave drawn for vital capacity – all waves should be pproximately same height

Question			Expected Answer	Mark	Additional Guidance
4	(a)	(iii)	**1** measure **,** volume of oxygen used / decrease in volume in chamber **;** **2** one detail of how to measure volume change **;** **3** measure time taken (to use this oxygen) **;** **4** divide (volume) by time taken **;**	**3**	**1** **ACCEPT** annotations on graph **ACCEPT** **'**measure how much the trace has gone down' **or** 'measure decrease in trace' **2** e.g. draw line along tips of **,** peaks / troughs e.g. find difference in height from one **,** peak / trough **,** to another **3** **ACCEPT** (measure volume of oxygen used) in a given time **4** **ACCEPT** unit stated to indicate rate has been calculated e.g. dm^3s^{-1} / dm^3min^{-1} ***NOTE*** **'**draw line along tips of, peaks / troughs **and** calculate gradient of line' = **3 marks** **(mark points 1, 3 & 4)**
4	(b)		**1** check health of volunteer **;** **2** oxygen used **;** **3** new / sterilised / disinfected **,** mouthpiece (for each volunteer)**;** **4** *idea of:* soda lime working **;** **5** sufficient oxygen in chamber **;** **6** water level not too high / water must not enter tubes **;** **7** ensure valves working correctly **;**	**max 2**	**Mark the first *two* factors.** **1** e.g. check medical history of volunteer ask about asthma / TB / pneumonia / flu / bronchitis / emphysema **3** **IGNORE** clean mouthpiece **4** **CREDI** need to remove CO_2 / CO_2 accumulates **5** **IGNORE** enough air in chamber **6** **IGNOR** general ref to leaks
			Total	**[10]**	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		A = bronchiole **;** B = alveolus / alveoli **;**	**2**	**Mark the first answer for each letter.** If the first answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**. **DO NOT CREDIT** bronchus **ACCEPT** phonetic spelling of alveolus and bronchiole e.g. aveoli
	(b)		**1** large, surface area / SA :VOL **;** **2** (alveolar) wall / epithelium, one cell thick **;** **3** (made of) squamous, cells / epithelium **;** **4** ref to surfactant **;** *idea of:* **5** (very) close to, capillaries / blood supply **OR** rich blood supply / many capillaries **;**	**2 max**	**Mark the first <u>two</u> suggestions only. Read as prose unless candidate has indicated two points by bullets or numbers – in this case mark the first comment in each bullet.** **ACCEPT** large SA / VOL, (alveoli) are small **and** in large number **DO NOT CREDIT** large amounts of tiny alveoli **ACCEPT** thin wall / thin barrier **DO NOT CREDIT** ref to cell wall / lining **IGNORE** alveolus one cell thick **ACCEPT** correct description of squamous cells (e.g. thin flat cell layer) **ACCEPT** pavement epithelium **IGNORE** reference to moist **DO NOT CREDIT** endothelium **IGNORE** ref to elastic fibres

Question			Expected Answers	Marks	Additional Guidance
	(c)		**1** (histamine), binds / attaches, to, receptor / glycoprotein **;** *idea of :* **2** in / on, plasma / cell surface, membrane (of muscle cell) **;** **3** <u>complementary</u> (shape) **;** **4** triggers response / causes effect, inside cells **;**	**2 max**	**binds to complementary receptor = 2 marks** **ACCEPT** glycolipids **IGNORE** binding site, ref antigens **ACCEPT** in / on, cell surface / cell membrane (of muscle cells) **ACCEPT** membrane bound receptors (on muscle cells) **CREDIT** correct examples of effects / details inside cells e.g. ref to opening sodium channes in cell surface membrane ref to second messenger ref to cyclic AMP ref to activation of enzymes / kinases ref to phosphorylation
	(d)		*idea of :* **1** more tissue fluid formed / increase in volume of tissue fluid **;** **2** increase pressure in tissue **;** **3** swelling / inflammation / oedema**;** **4** (more) white blood cells pass into tissues **;** **5** larger molecules / (named) proteins , pass into tissue fluid **;**	**2 max**	**Mark the first <u>two</u> suggestions only. Read as prose unless candidate has indicated two points by bullets or numbers – in this case mark the first comment in each bullet.** **IGNORE** refs to the capillaries becoming more leaky **IGNORE** more water passes out **DO NOT CREDIT** *cells* swell **ACCEPT** (more) white blood cells leave the capillary **IGNORE** ref to more, glucose / nutrients / gases, leave blood capillary **IGNORE** ref to increased rate of diffusion
			Total	**8**	