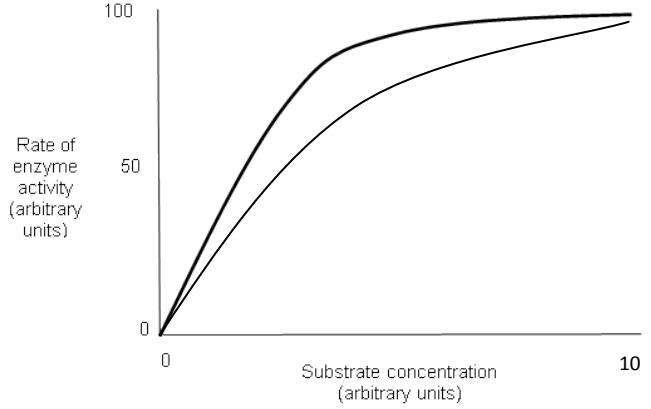
Question			Expected Answers	Mark	Additional Guidance
1	(a)	(i)	peptide (bond / link) **;**	1	**DO NOT CREDIT** dipeptide
1	(a)	(ii)	hydrolysis **;** water / H_2O , is , added / used / needed **;**	 2	**IGNORE** name of bond **CREDIT** OH and H put back on amino acids **ACCEPT** (broken down) with water
1	(b)		**1** substrate / protein , shape is (nearly) complementary to active site **; ora** **2** substrate / protein , enters / fits into , active site (on enzyme) **;** **3** induced fit / description of induced fit **;** **4** (forms) enzyme-substrate complex / ESC **;** **5** destabilising / straining / AW , of bonds (in substrate) **;** then (forms) enzyme-product complex **;** **6** product(s) / amino acids , leave (active site) **;**	 5 max	**1 ACCEPT** complimentary **1** "substrate binds to the active site which is complementary to the substrate shape" = 2 marks, mp1 and mp2 **2 ACCEPT** binds to / holds / bonds to **2 IGNORE** collides **5 IGNORE** breaks **6 IGNORE** EPC
1	(c)	(i)	 no units for , 2nd column / egg white **;** amount (rather than volume / in 4th column) **;** incorrect unit / m , in final / time , column **;**	 3	**IGNORE** prompt, and mark the first three answers. **IGNORE** subsequent answers. **CREDIT** marks clearly annotated on table **ACCEPT** volume of egg white needs cm^3 **ACCEPT** 'they should have written volume' **ACCEPT** should have been s **IGNORE** should have been , sec / secs / seconds

Question			Expected Answers	Mark	Additional Guidance
1	(c)	(ii)	equal volume in each tube **;** add buffer / control pH **;**	 1	**ACCEPT** "make sure the tubes have the same cm^3"
1	(c)	(iii)	control ;	1	**DO NOT CREDIT** control variable
1	(c)	(iv)	improve reliability **;** assess, variability / spread of results **;** allows calculation of mean **;**	 2	**IGNORE** accurate **ACCEPT** identify , anomalous results / outliers **IGNORE** eliminate anomalous results **ACCEPT** reference to statistical test **ACCEPT** standard deviation / t-test / Mann-Whitney **CREDIT** improves accuracy of mean
1	(d)	(i)	line drawn below line on graph ; line from origin that does not peak or plateau ;	 2	If the line goes above the original line at any point = 0 marks **ALLOW** lines touching at right hand end **DO NOT CREDIT** line with increasing gradient **ALLOW** plateau if it joins the original line **ALLOW** plateau below original line if it starts 4 small squares (or fewer) from the end  = 2 marks

Question			Expected Answers	Mark	Additional Guidance
1	(d)	(ii)	similar shape to , substrate / (part of) albumin / protein **;** complementary (shape) to (part of) active site **;**	2	**IGNORE** same **ACCEPT** same shape as part of substrate **IGNORE** structure **ACCEPT** tertiary structure
			Total	**[19]**	

Question			Answer	Marks	Guidance
2	(a)	(i)	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…, $11.27\dot{}$ 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
2	(a)	(ii)			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	2.82	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	2.85	2.73	0.12	
1.0	2.87	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	2.86	2.64	0.22	
3.0	2.84	2.60	0.24	
3.5	2.82 – 2.83	2.56 – 2.57	0.25 – 0.27	
4.0	2.80	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
2	(b)	(i)		*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
2	(b)	(ii)	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			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	**A** hydrogen **;** **B** glycosidic **;**	**2**	**DO NOT CREDIT** 'H bond' as this is not a name Correct spelling only. **IGNORE** α or β or numbers
3	(a)	(ii)	hydrolysis / addition of water **;**	**1**	
3	(a)	(iii)	β / beta **,** glucose **;**	**1**	Must be qualified as β or beta or B or b
3	(b)		enzymes are specific **;** the **,** carbohydrate molecules / substrates **,** are different shapes **;** active site and substrate are complementary **;** so that substrate will fit / formation of ESC **;** lock and key / induced fit **;**	**3 max**	

Question			Expected Answers	Marks	Additional Guidance
3	(c)	(i)	pH much **,** higher / less acidic **,** than optimum (for enzyme 2) **;** change in charge of active site **;** hydrogen / ionic **,** bonds break **;** tertiary structure / 3D shape / active site shape **,** altered **;** enzyme / tertiary structure **,** denatured **;** substrate no longer fits active site / ESC does not form **;**	**3 max**	Needs idea of much greater or too high **DO NOT CREDIT** just 'higher than' or 'above' **DO NOT CREDIT** too / more **,** alkaline **DO NOT CREDIT** peptide / disulphide **,** bonds break **DO NOT CREDIT** in context of heat / vibration **IGNORE** ref to denaturing active site **IGNORE** ref to denaturing active site **DO NOT CREDIT** kill / die 'substrate doesn't bind to enzyme' is not quite enough
3	(c)	(ii)	*Mark 1st response on each numbered line unless no answer on one line, then mark 1st 2 answers* temperature **;** substrate concentration **;** enzyme concentration **;**	**2 max**	**IGNORE** ref to time

Question			Expected Answers	Marks	Additional Guidance
3	(d)		***Marking points 2 – 6 can be applied to the standard solutions or the sample***		
		1	using **,** standard / known , concentrations (of reducing sugar) **;**		e.g. serial dilutions
		2	heat with **,** Benedicts (solution) / $CuSO_4$ + NaOH **;**		**ALLOW** boil / > 80^oC **DO NOT CREDIT** warm
		3	(use of) same volumes of solutions (each time) **;**		**DO NOT CREDIT** amount / quantity
		4	(use of) excess Benedicts **;**		
		5	changes to **,** green / yellow / orange / brown / (brick) red **;**		
		6	remove precipitate / obtain filtrate **;**		**CREDIT** description of method e.g. filtering / centrifuging & decanting
		7	calibrate / zero **,** colorimeter **;**		
		8	using **,** a blank / water / unreacted Benedicts **;**		
		9	use (red) filter **;**		
		10	reading of **,** transmission / absorbance **;**		**ACCEPT** 'measure how much light **,** does / does not **,** pass through'
		11	more transmission / less absorbance **,** of filtrate = more sugar present **;** **ora**		If precipitate is **clearly indicated** as being present in sample, **ALLOW** **'**less transmission / more absorbance **,** = more sugar present'
		12	(obtain) calibration curve **;**		
		13	plotting **,** transmission / absorbance **,** against (reducing) sugar concentration **;**		
		14	use reading of unknown sugar solution and read off graph to find conc. **;**	**6 max**	
			Total	**18**	