

# BIOLOGY NUMERACY BOOKLET

## MARK SCHEME



Question	Answer	Marks	Guidance
(a)	(i) it (only) respire in the absence of oxygen ✓	1	Must imply that the absence of oxygen is the preferred/essential condition. e.g. 'can respire in the absence of oxygen' does not really imply this, as this statement also applies to aerobic organisms.
	(ii) it hydrolyses a peptide bond between two amino acids (residues) which are joined by a disulfide bond ✓	1	
(b)	(i) amount that is required to kill the 50 <sup>th</sup> mouse when they are arranged in order of lethal dose ✓	1	
* (ii)	4.25 (µg) ✓ ✓	2	<b>ALLOW</b> 1 mark for correct working using, least lethal dose is 50 ng kg <sup>-1</sup> 50 x 85 = 4250 ng /1000 = 4.25 µg
	(iii) <i>two from</i> intercostal muscles are / diaphragm muscle is, weakened / paralysed ✓ <i>idea that ventilation and oxygenation of blood is, reduced / compromised ✓</i> cells / (named) organ(s), cannot, obtain oxygen for respiration/ carry out aerobic respiration ✓	2	
(c)*	<b>Level 3 (5–6 marks)</b> A full explanation of why strains are immunologically distant <b>AND</b> a description of more than one method of action of the immune system.  <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i>	6	<b>Relevant points include:</b> <b>immunologically distinct</b> <ul style="list-style-type: none"> <li>toxins produced by each strain will be (slightly) different</li> <li>each (botulinum) toxin will have different, 3D shape / amino acid sequence / DNA nucleotide coding sequence</li> <li>toxin, acts as / is, antigen</li> <li>immune response determined by shape of antigen</li> <li>different compounds will have different shapes</li> </ul>

Question	Answer	Marks	Guidance
<b>2</b> (a) ✕	110 000 / $1.1 \times 10^5$ ✓ kJ km <sup>-2</sup> y <sup>-1</sup> ✓	2	<b>ALLOW</b> the word or any reasonable symbol for year <b>ALLOW</b> kJ y <sup>-1</sup> km <sup>-2</sup>
(ii)	25 ✓ ✓	2	<b>ALLOW</b> correct answer in the working if the answer line is left blank. If answer is incorrect, <b>award 1 mark</b> for $0.05 \div 0.2 \times 100$
(b)	(i) <u>Measures</u> fishing quotas ✓ mesh size ✓ species restriction ✓ trawler size / days at sea ✓ penalties / sanctions ✓ monitoring / surveillance ✓ publicity / public education ✓ <u>Difficulties</u> area too large ✓ expense of monitoring ✓ monitoring hampered by, weather / seasons ✓ false reporting of, catches / trawler size / mesh size / days ✓ death of fish caught but not kept (because of restrictions) ✓	4	<b>The difficulties should relate to the measures proposed.</b>
(ii)	<u>argument for</u> comparison of the energy in large fish and krill shows humans would get 100x more kJ/energy from krill than large fish ✓ <u>argument against</u> would require large change to fishing industry / consumer habits or could impact ecosystem at first trophic level ✓	2	<b>ALLOW</b> the use of figures to illustrate the data comparison.
<b>Total</b>		<b>10</b>	

Question	Marking Guidance	Mark	Comments
3.1	Hypothalamus;	1	
3.2	1. Water potential of blood will decrease; 2. Water moves from osmoreceptor into blood by osmosis;	2	
3.3	1. Permeability of membrane/cells (to water) is increased; 2. More water absorbed from/leaves distal tubule/collecting duct; 3. Smaller volume of urine; 4. Urine becomes more concentrated;	4	
✗ 3.4	115.2/115.3 (cm <sup>3</sup> minute <sup>-1</sup> );	1	
3.5	Any <b>two</b> of the following for 1 mark; Muscle/body mass Ethnicity Exercise <u>Kidney</u> disease – do not accept 'health'	1	

Question	Marking Guidance	Mark	Comments
4 <sub>1</sub>	1. Push hard – spread/squash tissue; 2. Not push sideways – avoid rolling cells together/breaking chromosomes;	2	Neutral – to see cells clearly
4 <sub>2</sub>	No (no mark)  Yes (no mark) 1. Chromosomes/chromatids are (in two groups) at poles of spindle/at ends of spindle; 2. V-shape shows that (sister) chromatids have been pulled apart at their centromeres/that centromeres of (sister) chromatids have been pulled apart;	2	1. Do not accept 'ends of cell'
4 <sub>3*</sub>	28.8 / 29;;	2	If incorrect, allow:  $\frac{6}{200} \times 960 = 1 \text{ mark}$

## Mark Scheme



		Working	Answer	Mark	Notes
*	(a)		2.5	2	M1 for $15 \div 6$ oe A1 for 2.5 or $2\frac{1}{2}$
	*(b)		Yes + evidence	2	M1 for a correct method to change 15 miles into kilometres C1(dep M1) for 24 km <b>and</b> statement with correct conclusion [SC: B1 for "Yes" oe and 24 km shown if M0 scored] or M1 for a correct method to change 20 kilometres into miles C1(dep M1) for 12.5 miles <b>and</b> statement with correct conclusion [SC: B1 for "Yes" oe and 12.5 miles shown if M0 scored]



PAPER: IMA0_1H					
Question	Working	Answer	Mark	Notes	
*		Answer in range 35 – 50	4	M1 for a method to either find the exact or approximate number of seconds in one day, e.g. $24 \times 60 \times 60$ (=86400) or the number of minutes in 2014 seconds, e.g. $2014 \div 60$ or $2000 \div 60$ ( $\approx 30$ ) M1 for a correct method to find the number of prizes; eg. ' $24 \times 60 \times 60$ ' $\div$ 2014 oe or $60 \div$ "30" $\times$ 24 oe B1 for rounding at least one appropriate value in the working to 1 sf, e.g. 24 rounded to 20 or 2014 rounded to 2000 or 86400 rounded to 90000 C1 (dep on M2) for answer in 35 – 50 clearly identified	

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	Working	Answer	Mark	Notes
(a)	$\sqrt{30} =$ 5.4772255...	0.876	2	M1 for $\sqrt{30} + 6.25$ or $5.4(7\dots) \div 2.5^2$ A1 for any answer in the range 0.876 to 0.877
(b)	$2.5^2 = 6.25$  $5.4772255\dots \div 6.25$ $= 4.5 \times 1000 \times$ 1000	4 500 000	2	M1 for complete method equivalent to $4.5 \times 1000 \times 1000$ A1 for 4 500 000 oe

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Paper 5MB1H 01				
Question	Working	Answer	Mark	Notes
		2.55	3	B1 for max as 42.5 or 42.49 M1 for max $\times 60$ or 2550 A1 for 2.55 (accept 2.549)

Question	Marking Guidance	Mark	Comments
<p>6.1</p>	<ol style="list-style-type: none"> <li>1. Facilitated diffusion involves channel or carrier proteins whereas active transport only involves carrier proteins;</li> <li>2. Facilitated diffusion does not use ATP / is passive whereas active transport uses ATP;</li> <li>3. Facilitated diffusion takes place down a concentration gradient whereas active transport can occur against a concentration gradient;</li> </ol>	3	<p>Since 'contrast', both sides of the differences needed</p>
<p>5.2</p>	3.3:1;;	2	<p>Correct answer = 2 marks</p> <p>If incorrect, allow 1 mark for 470–360/60 for rate in second hour</p>
<p>5.3</p>	<ol style="list-style-type: none"> <li>1. Group <b>A</b> – initial uptake slower because by diffusion (only);</li> <li>2. Group <b>A</b> – levels off because same concentrations inside cells and outside cells / reached equilibrium;</li> <li>3. Group <b>B</b> – uptake faster because by diffusion plus active transport;</li> <li>4. Group <b>B</b> fails to level off because uptake against gradient/no equilibrium to be reached;</li> <li>5. Group <b>B</b> – rate slows because few/fewer chloride ions in external solution/respiratory substrate used up;</li> </ol>	4 max	

Question Number	Answer	Mark
<b>(a)</b>	1. high numbers of obese people / eq ; 2. this is linked to increased risk of diseases such as {diabetes / CVD / eq} ; 3. idea that this puts an economic burden on society ;	<b>(2)</b>

Question Number	Answer	Mark
<b>(b)</b>	1. three fatty acids ; 2. contains a glycerol (molecule) / ref. to ester bonds ;	<b>(2)</b>

Question Number	Answer	Mark
<b>* (c)</b>	1. $80\% \times \{10 / 15 / 20\} \%$ OR $0.8 \times 0.1$ OR $0.8 \times 0.15$ OR $0.8 \times 0.2$ OR idea that percentage mortality has not changed ; 2. $0\% / 8\% / 12\% / 16\% /$ (range) 8 to 16% ;	<b>(2)</b>

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\*

Question Number	Answer	Mark
(e)(i)	<ol style="list-style-type: none"><li>1. correct values selected (8.7 and 11.8) ;</li><li>2. correct subtraction (<math>11.8 - 8.7 = 3.1</math>);</li><li>3. correct multiplication by <math>10\ 000 \div 100</math> ;</li></ol> <p>[Consequential errors apply]</p>	(3)

Question Number	Answer	Mark
(e)(ii)	it has been shown to reduce {CVD / stroke} / eq ;	(1)

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Question Number	Answer	Mark
(a)	<ol style="list-style-type: none"> <li>idea that, GD considers one species but SR considers {different / number} species ;</li> <li>idea that, GD considers {alleles / genotypes / eq} but SR is within a {habitat / area / eq} ;</li> </ol>	(2)
Question Number	Answer	Mark
(b)(i)	<ol style="list-style-type: none"> <li>take {less / smaller} space / eq ;</li> <li>can have more individuals / eq ;</li> <li>reference to {greater / more} genetic variety ;</li> <li>idea of less {maintenance / cost} ;</li> <li>likely to survive longer / eq ;</li> <li>can freeze seeds / eq ;</li> </ol>	max (2)

Question Number	Answer	Mark
(b)(ii)	<ol style="list-style-type: none"> <li>idea of {greater / maintain} genetic variety e.g. wider gene pool, different alleles ;</li> <li>idea of less chance of inbreeding ;</li> <li>idea of reducing chance of storing seeds with {low viability / disease / eq} ;</li> </ol>	max (2)

Question Number	Answer	Mark
* (c)(i)	<p>correct working shown e.g. <math>(3/48) \times 100</math> ;</p> <p>correct answer = {6.3 / 6.25} ;</p> <p><u>Note:</u>            2 marks for correct answer            1 mark for incorrect answer but correct working</p>	(2)

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Question Number	Answer	Mark
* (c)(i)	0.065 (%) ;;	(2)

Question Number	Answer	Mark
(c)(ii)	16 ;	(1)

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Question Number	Answer	Mark
(a)	<ol style="list-style-type: none"><li>1. protein / glycoprotein ;</li><li>2. facilitated diffusion ;</li><li>3. active transport / eq ;</li><li>4. ATP / adenosine triphosphate ;</li></ol>	(4)

Question Number	Answer	Mark
* (b)(i)	<ol style="list-style-type: none"><li>1. 77-70 / 7;</li><li>2. correct division by 77 (multiplied by 100) to give correct answer, e.g. 9.1 / 9.09 / 9.0 / 9</li></ol> <p>[CE applies]</p> <p>Correct answer = 2 marks</p>	(2)

Number		
(a)(i)	A ;	(1)

Question Number	Answer	Mark
(a)(ii)	D ;	(1)

Question Number	Answer	Mark
(a)(iii)	A ;	(1)

Question Number	Answer	Mark
(b)	<ol style="list-style-type: none"> <li>1. ref to thylakoids ;</li> <li>2. (made of) membranes ;</li> <li>3. (arranged as) {stacks / grana / eq} ;</li> <li>4. contain {pigment / chlorophyll} / eq ;</li> <li>5. (arranged as) quantasomes / photosystems ;</li> </ol>	maximum (3)

Question Number	Answer	Mark
<del>(c)</del> (c)(i)	<ol style="list-style-type: none"> <li>1. <math>(62.4 / 162) \times 100</math> ; [accept alternative correct working]</li> <li>2. 38.5(%) ; [must be to 1 dp]</li> </ol>	(2)

Question Number	Answer	Mark
(a)(i)	<ol style="list-style-type: none"> <li>(rate of) {production of / energy incorporated into / eq} {biomass / organic material / organic molecules / tissue} ;</li> <li>reference to {losses in respiration / GPP- R} ;</li> <li>in {producers / plants / eq} ;</li> </ol>	(2)

Question Number	Answer	Mark
* (a)(ii)	<ol style="list-style-type: none"> <li>correct readings from graph indicated e.g. (11 and 1) ;</li> <li>correct subtraction e.g. (11-1 / 10) ;</li> <li>correct division (by 1) x 100/1 to give 1000% ;</li> </ol> <p>[correct answer = 3 marks]</p>	(3)

Question Number	Answer	Mark
(b)	<ol style="list-style-type: none"> <li>idea that the rate of {(bio)chemical / metabolic / photosynthetic / named} reactions increases ;</li> <li>idea of increase in {movement / kinetic energy} of {enzyme / substrate / molecules / particles} / eq ;</li> <li>idea of (increase in reaction rate) because of more enzyme substrate interaction ;</li> </ol>	(2)

Question Number	Answer	Mark
<b>(a) (i)</b>	(7mm / largest seed size) because has greatest germination success ;	<b>(1)</b>

Question Number	Answer	Mark
<del>X</del> <b>(a) (ii)</b>	<ol style="list-style-type: none"><li>1. correct values from graph, i.e. 4 (au) and 20 (au) ;</li><li>2. correct subtraction e.g. <math>20 - 4 = 16</math> ;</li><li>3. (change <math>\div</math> original ) <math>\times 100</math> to give correct answer, e.g. <math>(16 / 4) \times 100 = 400\%</math> ;</li></ol> <p>For correct answer of 400% - 3 marks</p>	<b>(3)</b>

Question	Answer	Marks	Guidance
<del>PR</del> (a) (i)	seed dispersal ✓	1	
(ii)	(named) economic reason ✓ (named) aesthetic reason ✓	2	
(b) (i)	<i>advantage:</i> exhibit natural behaviour / less likely to catch disease from humans ✓ <i>disadvantage:</i> poaching more likely / could be wiped out by disease / more difficult to count ✓	2	Must give one advantage and one disadvantage.
* (ii)	3.1 (%) ✓ ✓	2	ALLOW one mark if calculation correct but final figure incorrect e.g. (480 – 254) / 254 x 100 / 29 = ALLOW 3% or 3.07%
(iii)	<i>three from</i> no evidence of causal effect ✓ the data may be inaccurate as a result of, indirect methods used / unhabituated animals hard to find ✓ annual growth rate higher after 1993 ✓ 3.2% (per year) before 1993 against 3.8% after 1993 ✓ figures may not be accurate due to collection technique ✓	3	
<b>Total</b>		<b>10</b>	

Question	Marking Guidance	Mark	Comments
19.1	<ol style="list-style-type: none"><li>1. Trachea and bronchi and bronchioles;</li><li>2. Down pressure gradient;</li><li>3. Down diffusion gradient;</li><li>4. Across alveolar epithelium;</li><li>5. Across capillary endothelium/epithelium;</li></ol>	4 max	<ol style="list-style-type: none"><li>4. Capillary wall neutral</li></ol>
19.2 *	(About) 80.0%;	1	
19.3	<ol style="list-style-type: none"><li>1. (Group <b>B</b> because) breathe out as quickly as healthy / have similar FEV to group <b>A</b>;</li><li>2. So bronchioles not affected;</li><li>3. FVC reduced / total volume breathed out reduced;</li></ol>	3	<ol style="list-style-type: none"><li>3. Allow this marking point for group <b>C</b></li></ol>

Question	Marking Guidance	Mark	Comments
201	<ol style="list-style-type: none"> <li>1. Contraction of internal intercostal muscles;</li> <li>2. Relaxation of diaphragm muscles/of external intercostal muscles;</li> <li>3. Causes decrease in volume of chest/thoracic cavity;</li> <li>4. Air pushed down pressure gradient;</li> </ol>	4	
* 201.2	19 (%);	1	
203	<ol style="list-style-type: none"> <li>1. Muscle walls of bronchi/bronchioles contract;</li> <li>2. Walls of bronchi/bronchioles secrete more mucus;</li> <li>3. Diameter of airways reduced;</li> <li>4. (Therefore) flow of air reduced;</li> </ol>	4	

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Question Number	Correct Answer	Additional guidance	Mark
21(a)	Measurement from diagram: $2.1 \text{ cm} = 0.021 \text{ m}$ (1)  Actual distance: $0.021 \text{ m} \div 226 = 9.2 \times 10^{-4} \text{ m}$ (1)  Calculate speed: $0.02 \text{ ms} = 2.0 \times 10^{-5} \text{ s}$  $9.2 \times 10^{-4} \text{ m} \div 2.0 \times 10^{-5} \text{ s} = 4.65 \text{ ms}^{-1}$ (1)	e.c.f. at any stage penalise once only  Correct answer gains full marks with no working	<b>(3)</b>
21(b)	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>• myelin may absorb / reflect light (1)</li> <li>• therefore less light passes to light sensitive cells (1)</li> <li>• hence some rod / light sensitive cells not stimulated / bleached (1)</li> </ul>	Additional guidance	<b>(3)</b>

(Total for Question 2 = 6 marks)

Question Number	Acceptable Answer	Additional guidance	Mark
<del>22</del> <b>23(a)(i)</b>	<ul style="list-style-type: none"> <li>length of cell = 20 (mm) (1)</li> <li>conversion into <math>\mu\text{m}</math> = <math>20000 \div 23.5</math> (1)</li> <li>magnification = 851 (1)</li> </ul>	Accept $\pm 1$ mm Accept other appropriate calculation, e.g. measure in cm or converting 23.5 $\mu\text{m}$ to mm or cm	
	[ecf applies for mp 2 and 3]	Correct answer gains full marks	<b>(3)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(a)(ii)</b>	A description that makes reference to the following: <ul style="list-style-type: none"> <li>centromeres have separated (1)</li> <li>spindle fibres have {shortened / contracted} (1)</li> <li>chromatids pulled apart (1)</li> <li>chromatids have moved to opposite poles (1)</li> </ul>		<b>(4)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(b)(i)</b>	C		<b>(1)</b>

Question Number	Acceptable Answer	Additional guidance	Mark
<b>4(b)(ii)</b>	Because E is {in cytokinesis / in late telophase / dividing its cytoplasm} but G is still in {anaphase / mitosis} (1)		<b>(1)</b>

(Total for Question 4 = 9 marks)

Question	Marking Guidance	Mark	Comments
23.1	<ol style="list-style-type: none"> <li>How to break open cells <u>and</u> remove debris;</li> <li>Solution is cold/isotonic/buffered;</li> <li>Second pellet is chloroplast;</li> </ol>	3	
23.2	<ol style="list-style-type: none"> <li>A stroma;</li> <li>B granum;</li> </ol>	2	2. Accept thylakoid
23.3 ✗	$\left(\frac{\text{length of chloroplast}}{\text{length of bar}}\right) \mu\text{m};$	1	
23.4	<p>Two of the following for <b>one</b> mark;</p> <p>Mitochondrion/ribosome/endoplasmic reticulum/lysosome/cell-surface membrane</p>	1 max	

Question	Marking Guidance	Mark	Comments
24.1	<ol style="list-style-type: none"> <li>1. Add drop of water to (glass) slide;</li> <li>2. Obtain thin section (of plant tissue) and place on slide / float on drop of water;</li> <li>3. Stain with/add iodine in potassium iodide;</li> <li>4. Lower cover slip using mounted needle;</li> </ol>	4	<ol style="list-style-type: none"> <li>3. Allow any appropriate method that avoids trapping air bubbles</li> </ol>
24.2	<ol style="list-style-type: none"> <li>1. <b>W</b> – chloroplast, photosynthesis;</li> <li>2. <b>Z</b> – nucleus, contains DNA/chromosomes / holds genetic information of cell;</li> </ol>	2	
24.3	<ol style="list-style-type: none"> <li>1. High resolution;</li> <li>2. Can see internal structure of organelles;</li> </ol>	2	
24.4 ✕	Length of bar in mm × 1000;	1	

Question	Answer	Marks	Guidance
<b>25</b> (a) (i)	DNA / RNA / nucleic acid ✓	1	
(ii)	lower / reduce / make more negative ✓	1	
(iii)	<i>two from</i> 1 strip is impervious to, water / solutions ✓ 2 forces water / solutions, to pass through, <u>plasma</u> / <u>cell surface</u> ; membrane ✓ 3 phospholipid (bilayer), repels / AW, ions / charged particles ✓	2	1 <b>IGNORE</b> ref to suberin. 3 The idea of charge / ion impermeability is wanted here. <b>ALLOW</b> answer in terms of ions / charged particles needing channels because phospholipid bilayer does not allow charged particles through.
<del>X</del> (b) (i)	3.75 ✓ ✓	2	ALLOW 3.750 µm or 0.375 cm for one mark. ALLOW 1 mark for correct working e.g. 3 x 1250
(ii)	(with light microscope) no further <u>resolution</u> (at x1250) ✓	1	<b>IGNORE</b> ref to further detail, as implied in question. <b>ALLOW</b> ref to <u>resolution</u> not the same as magnification.
(iii)	<i>two from</i> stay keep indoors / increase ventilation / wear masks ✓ measures to, exclude / not attract / kill, rats/fleas ✓ strict / immediate quarantine for persons with symptoms ✓	2	<b>ALLOW</b> (longer term) measures to reduce overcrowding.
(c) (i)	(stimulates) cell, elongation / division ✓	1	<b>IGNORE</b> ref to action outside the cell, or to unqualified "growth" etc.

Question Number	Answer	Mark
(a) ✱	<ol style="list-style-type: none"><li>1. correct measurements of wall without plaque = {8 +/- 1} (mm) ;</li><li>2. correct measurements of wall with plaque = {25 +/- 2} (mm);</li><li>3. correct calculation ;</li></ol>	(3)

Question Number	Answer	Mark
(b)(i)	<ol style="list-style-type: none"><li>1. reference to decrease in (energy /ATP) (with time) ;</li><li>2. idea that the drop in the fall of (energy /ATP) gets less with time ;</li><li>3. credit correct manipulation of figures ;</li></ol>	(2)

Question Number	Answer	Mark
(b)(i)	A granum	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(ii) *	1. (Image length) $76 / 76.5 / 77$ (mm) / eq ;  2. image length / 0.007 ;  3. (76) $10857.14286 / eq ;$ (76.5) $10928.57143 / eq ;$ (77) $11000 / eq ;$	2. CE applies  3. CE applies	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	1. idea of compartmentalisation (from cytoplasm);  2. thylakoid (membranes) are site of {light-dependent reaction / photophosphorylation / chemiosmosis} ;  3. credit named molecules {within / on / eq} membrane ;  4. idea that (thylakoid) membranes provide a space for accumulation of $H^+$ ;  5. stroma is site of {light-independent reaction / Calvin cycle / carbon fixation} ;  6. reference to {RuBP / RUBISCO / eq} ;	1. ACCEPT description of separation    3. e.g. chlorophyll / carotenoids / photosystems / electron carrier proteins / ATP synthetase / NADP reductase	(3)

## Mark Scheme

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Question	Working	Answer	Mark	Notes
(a)		$25 \leq t < 30$	1	B1 for the interval $25 \leq t < 30$ described unambiguously
(b)	$12.5 \times 6 + 17.5 \times 4 + 22.5 \times 24 +$ $27.5 \times 44 + 32.5 \times 10 + 37.5 \times 4$ $= 75 + 70 + 540 + 1210 + 325 + 150$ $= 2370$ $2370 \div 92$	25.8	4	M1 for finding at least 4 products $fx$ consistently within interval (including end points) M1 (dep) for use of at least 4 correct midpoints M1 (dep on first M) for $\frac{\sum fx}{\sum f}$ A1 25.76 – 25.8
(c)	Cf table: 6, 10, 34, 78, 88, 92 Cf graph	Correct CF graph	3	B1 Correct cumulative frequencies ( may be implied by correct heights on the grid) M1 for at least 5 of "6 points" plotted consistently within each interval A1 for a fully correct cf graph.
(d)	Median at the $(92+1) \div 2 = 46.5$ day temp  IQR = UQ – LQ = 69.75 <sup>th</sup> day temp – 23.25 <sup>th</sup> day temp	Median = 25.4 IQR = 6.7	3	B1 for a median in the range 24.5–26.5 or B1 ft read off at CF = 46(.5) from a CF graph tol $\frac{1}{2}$ square M1 for reading off temps at CF= 69 or 69.75 ( $\pm 0.5$ ) and 23 or 23.25 ( $\pm 0.5$ ) from a CF graph and subtracting A1 ft

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Question	Working	Answer	Mark	Notes
(a)	$15 \times 0 = 0$ $40 \times 14 = 560$ $55 \times 16 = 880$ $65 \times 21 = 1365$ $85 \times 9 = 765$ $3570 \div 60$	59.5	4	M1 for finding at least 4 products $f \times$ consistently within interval (including end points) M1 (dep) for use of at least 4 correct midpoints M1 (dep on first M) for " $\Sigma f \times$ " $\div$ 60 A1 for 59.5
(b)		14,30,51,60	1	B1 all 4 correct
(c)			2	M1 for at least 4 of "5 points" plotted consistently within each interval, $\pm 0.5$ full square, and joined by curve or line segments providing no gradient is negative. A1 for a fully correct cf graph.
(d)			2	B2 for answer in the range 21 - 25 (B1 for answer in the range 35 - 39) OR M1 (dep on graph being cf) for using $w = 63$ A1 ft ( $\pm 0.5$ square)

Paper SMB1H 01				
Question	Working	Answer	Mark	Notes
(a)	$5 \times 5 = 25$ $11 \times 20 = 220$ $23 \times 40 = 920$ $13 \times 65 = 845$ $8 \times 90 = 720$ $2730 \div 60$	45.5	4	M1 for $\sum fx$ with $x$ consistent within intervals (including the end points) allow one error M1 (dep) for use of all correct mid-interval values M1 (dep on first M1) for $\sum fx \div 60$ A1 cao
(b)		5, 16, 39, 52, 60	1	B1 cao
(c)		Cumulative frequency graph	2	M1 ft for at least 4 of 5 points from their cf table (values must be cumulative) plotted consistently within each interval A1 for a fully correct cf graph
(d)		15, 16 or 17	2	M1 for method shown to read off from $x = 60$ on their cf graph or linear interpolation from the table A1 ft from their cf graph

Question	Working	Answer	Mark	Notes
	$(23 \times 153 + 17 \times 165) \div (23 + 17)$	158.1	3	M1 for $23 \times 153 (= 3519)$ or $17 \times 165 (= 2805)$ M1 for '3519' + '2805' (= 6324) + '40' (= 23+17) A1 cao [An answer of 158 with no working gets no marks]

Question Number	Acceptable Answer	Additional guidance	Mark
32(a)(i) *	$1.3 - 0.2 = 1.1$ (1) $1.1 \div 20 = 0.055$ (1) units a.u. s <sup>-1</sup> (1)		(3)

Question Number	Acceptable Answer	Additional guidance	Mark
32(a)(ii)	An explanation that makes reference to three of the following: <ul style="list-style-type: none"> <li>• enzyme controlled reactions are very rapid (1)</li> <li>• therefore the {substrate / catechol} concentration is rapidly {reducing / used up} in the first 10s (1)</li> <li>• less substrate means fewer collisions and therefore the rate slows (1)</li> <li>• all the substrate has been converted to product by 50 seconds (1)</li> </ul>		(3)

Question Number	Answer	Additional guidance	Mark
33(a)(i)	correctly extracts values from graph 3.9 and 8.6 mm <sup>3</sup> (1)  (8.6 - 3.9) ÷ 12 = 0.39 (1)  mm <sup>3</sup> min <sup>-1</sup> (1)	Correct answer gains full marks, with no working shown.	(3)

Question Number	Answer	Additional guidance	Mark
33(b)	An explanation that makes reference to the following: <ul style="list-style-type: none"> <li>at a higher temperature water molecules have more kinetic energy (1)</li> <li>therefore more water molecules evaporate (1)</li> <li>therefore there is greater diffusion rate through stomata (1)</li> </ul>		(3)

(Total for Question 2 = 6 marks)

Question Number	Correct Answer	Additional guidance	Mark
<del>34a)</del> X	<ul style="list-style-type: none"> <li>• Numerator = 219.34 (1)</li> <li>• Denominator = 5 (1)</li> <li>• Standard deviation = 6.6 (1)</li> </ul>	Correct answer gains full marks	(3)

Question Number	Correct Answer	Additional guidance	Mark
<del>34b)</del> X	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• S.D. shows variation from the mean (1)</li> <li>• a larger S.D. means greater spread, smaller S.D. is more reliable representation of the data (1)</li> <li>• therefore although ranges of A and B are the same, the S.D. shows there is more variation in the data for method B (1)</li> </ul>	S.D. indicates spread of data	(3)

Question Number	Correct Answer	Additional guidance	Mark
<del>34c)</del>	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> <li>• for method A if there is an error made it is multiplied by four, when calculating pulse rate per minute (1)</li> <li>• for method B counting for one minute may lead to inaccuracy due to loss of concentration (1)</li> <li>• both methods are measuring pulse rate rather than heart rate (1)</li> </ul>		(3)

(Total for Question 8 = 9 marks)

Question Number	Answer	Mark
35 35 (b)(ii) *	<ol style="list-style-type: none"> <li>1. systolic blood pressure decreased in both groups / eq ;</li> <li>2. systolic blood pressure decreased more {in the treated group / by the drug / group A} than the {control / placebo / group B / eq} / eq ;</li> <li>3. diastolic blood pressure decreased {in the treated group / by the drug / group A} / eq ;</li> <li>4. diastolic blood pressure {unchanged / decreased slightly} {in the control group / by the placebo / group B} / eq ;</li> <li>5. systolic blood pressure was affected more than the diastolic blood pressure;</li> <li>6. greatest decrease in first year / eq ;</li> <li>7. credit correct manipulation of data (e.g. Systolic dropped 3 kPa in group B, systolic dropped 5.4 kPa in group A, 2.4 more than group B, diastolic dropped 0.6 kPa in group B, diastolic dropped 2 kPa in group A, 1.4 more than group B) ;</li> </ol>	(3)

Question Number	Answer	Mark
35 35 (b)(iii)	to see if the drugs affected both types of blood pressure / eq ;	(1)

Question Number	Answer	Mark
35 35 (b)(iv)	{incidence / numbers} of {deaths / heart attacks / strokes / any other correctly named condition} ;	(1)

Question Number	Answer	Mark
36 (c) *	<ol style="list-style-type: none"> <li>1. graph shows percentages ;</li> <li>2. population size is not known e.g. sample size not known / the actual number of males and females who are obese will depend on the population size of each gender / eq ;</li> <li>3. there may be a different number of males to females / eq ;</li> </ol>	(2)

Question Number	Answer	Mark
36 (d)(i) *	(relationship between two variables is such that) a change in one of the variables is reflected by a change in the other variable / eq ;	(1)

Question Number	Answer	Mark
36 (d)(ii) *	<ol style="list-style-type: none"> <li>1. the (consumption of) corn syrup goes up / eq ;</li> <li>2. (this is) before the increase in obesity / eq ;</li> <li>3. reference to the (consumption of) dextrose falling with time e.g. during the 1970s ;</li> <li>4. reference to the consumption of glucose staying fairly constant ;</li> </ol>	(3)

Question Number	Answer	Mark
37 4(b)(i)	<ol style="list-style-type: none"> <li>1. idea that mucus {traps / eq} {bacteria / pathogens} ;</li> <li>2. idea that {bacteria / mucus containing the bacteria} cannot be removed (by cilia);</li> <li>3. idea that mucus provides conditions for bacteria to {live / grow / develop / eq} ;</li> <li>4. reference to antibodies not being effective ;</li> <li>5. reference to trauma caused by coughing ;</li> <li>6. idea that resident {phagocytes / macrophages} cannot destroy bacteria ;</li> </ol>	max (2)

Question Number	Answer	Mark
* 5(b)(ii)	<ol style="list-style-type: none"> <li>1. {increase / eq} with age ;</li> <li>2. (increases) {from 0 to 25 / up to 25} ;</li> <li>3. {constant / eq} 25 to 35 ;</li> <li>4. {decreases / eq} 35 to 45 ;</li> <li>5. credit correct manipulation of figures ;</li> </ol>	max (3)

38

Question Number	Answer	Mark
(a)(i) *	<ol style="list-style-type: none"> <li>1. A has a {greater / eq} effect than B / eq ;</li> <li>2. A lowers total cholesterol more than B / eq ;</li> <li>3. A lowers LDL more than B / eq ;</li> <li>4. A raises HDL more than B / eq ;</li> <li>5. manipulation of figures to quantify mp 2 or 3 or 4 ;</li> </ol>	max (3)

Question Number	Answer	Mark
(a)(ii)	<ol style="list-style-type: none"> <li>1. drug A ;</li> <li>2. the {total cholesterol / LDL} levels are lower ;</li> <li>3. statins inhibit cholesterol synthesis ;</li> <li>4. statins result in more LDL receptors on liver cells ;</li> <li>5. so more LDL will be {cleared / eq} from the blood / eq ;</li> </ol>	max (3)

Question Number	Answer	Mark
(b)	<p>Any <b>two</b> from:</p> <p>gastrointestinal {problems / cancer} e.g. constipation, bowel complaints,          {joint / muscle} problems e.g. cramps, myositis, pain, myopathy,          muscle breakdown,          liver problems,          kidney problems,          mental health problems e.g. depression,          reduced vitamin uptake,          respiratory cancer ;;</p>	max (2)

Question Number	Answer	Mark
*(c)(i)	<ol style="list-style-type: none"> <li>1. reference to the (general) increase in heart disease with age ;</li> <li>2. more 18-44 year old females develop heart disease than males / eq ;</li> <li>3. in all other age groups more males have heart disease than females / eq ;</li> <li>4. greatest difference between females and males in the group 65 - 74 ;</li> <li>5. credit manipulation of figures ;</li> </ol>	<p style="text-align: right;"><b>max (3)</b></p>

Question Number	Answer	Mark
(c)(ii)	<ol style="list-style-type: none"> <li>1. {420 / 425} - {30 / 35} / 390 / 385 / 395 ;</li> <li>2. 11 - 13 ;</li> </ol>	<p style="text-align: right;"><b>(2)</b></p>

Question Number	Answer	Mark
(a)(i)	correct substitution ( e.g. $83 / 1.8 \times 1.8$ ) ; answer = 25.6 ; correct answer = 2 marks	(2)

Question Number	Answer	Mark
(a)(ii)	<ol style="list-style-type: none"> <li>1. calculated value is 25.6 which is {greater than 25.0 / in range 25.0 to 29.9} ;</li> <li>2. (therefore) man is overweight ;</li> <li>3. but only just (overweight) ;</li> </ol>	maximum (2)

Question Number	Answer	Mark
* (b)	<ol style="list-style-type: none"> <li>1. relative mortality decreases as BMI increases from 19 to {20 to 23} in (both men and women) / eq ;</li> <li>2. little change in relative mortality within the range {20 / 21 to 24 / 25} / eq ;</li> <li>3. as BMI increases from above {22 to 25} risk increases (in both men and women) / eq ;</li> <li>4. idea that from above {20 to 25} the risk for men is greater than that for women / risk the same between 19 and {20 to 25} ;</li> </ol>	maximum (3)

Question	Marking Guidance	Mark	Comments
40 011	Any <b>two</b> of the following; Concentration of enzyme Volume of substrate solution pH	1	Allow same concentration of substrate
40 012 *	Ratio between 5.18:1 and 5.2:1;; Initial rates incorrect but correctly used = 1 mark	2	Allow 1 mark if rate at: $60\text{ }^{\circ}\text{C} = 0.83\text{ g dm}^{-3}\text{ s}^{-1} / 49.8\text{ g dm}^{-3}\text{ minute}^{-1}$ <b>OR</b> $37\text{ }^{\circ}\text{C} = 0.16\text{ g dm}^{-3}\text{ s}^{-1} / 9.6\text{ g dm}^{-3}\text{ minute}^{-1}$
40 013	At $60\text{ }^{\circ}\text{C}$ : 1. More kinetic energy; 2. More E–S complexes formed;	2	Allow converse for $37\text{ }^{\circ}\text{C}$
40 014	Different times: 1. Higher temperature / $60\text{ }^{\circ}\text{C}$ causes denaturation of all of enzyme; 2. Reaction stops (sooner) because shape of active site changed; Different concentrations of product (at $60\text{ }^{\circ}\text{C}$ ) 3. Substrate still available (when enzyme denatured); 4. But not converted to product;	4	Accept converse for $37\text{ }^{\circ}\text{C}$ 2. Reject if active site on substrate

Question	Marking Guidance	Mark	Comments
41 Q2	$\times 0.22$ ;	1	
41 Q.2	<ol style="list-style-type: none"><li>1. Uptake in flask <b>G</b> much greater than in flask <b>F</b>;</li><li>2. Showing use of ATP in flask <b>G</b>;</li><li>3. Sodium ion concentration in flask <b>G</b> falls to zero;</li><li>4. Showing uptake against a concentration gradient;</li></ol>	4	
41 Q.3	<ol style="list-style-type: none"><li>1. (Uptake of sodium ions occurring by) <u>facilitated</u> diffusion;</li><li>2. Equilibrium reached/sodium ion concentrations in solution and in cells the same;</li></ol>	2	

Question	Marking Guidance	Mark	Comments
42 2.1	Concentration of substrate solution / of enzyme solution / pH;	1	
42 2.2 *	1. 2.5/0.04; 2. $\text{g dm}^{-3} \text{ minute}^{-1}$ / $\text{g dm}^{-3} \text{ s}^{-1}$ ;	2	1 mark for correct value 1 mark for related unit
42 2.3	1. Initial rate of reaction faster at 37 °C; 2. Because more kinetic energy; 3. So more E–S collisions/more E–S complexes formed; 4. Graph reaches plateau at 37 °C; 5. Because all substrate used up;	5	Allow converse for correct descriptions and explanations for curve at 25 °C

Question	Answer	Marks	Guidance
43 (a)	(i) <del>X</del> 32 ✓ $\text{mmol dm}^{-3} \text{ min}^{-1}$ ✓ (initial rate likely to be) greater ✓	2	<b>ALLOW</b> $\text{mmol dm}^{-3} / \text{min}^{-1}$ or ' $\text{mmol dm}^{-3}$ per , min / minute <b>ALLOW</b> $0.53 \text{ mmol dm}^{-3} / \text{s}$
	(ii) (initial rate likely to be) greater ✓ <i>because...</i> higher concentration of, substrate / amylose, molecules (at start) ✓ more chance of, substrate / AW, entering <u>active site</u> ✓	3	<b>ALLOW</b> 'starch'
	(b) (i) <i>three from</i> competes (with substrate) / competitive ✓ enters / fits in / binds to / blocks, active site ✓ prevents substrate from entering active site ✓ (binds to active site) temporarily ✓	3	
	(ii) (at high substrate concentration) rate approaches rate in absence of inhibitor ✓	1	<b>IGNORE</b> idea that increased substrate concentration overcomes the inhibition as answer must refer to evidence from the graph.
	(c) (i) <i>three from</i> specify volume of starch and amylase to be added to the tubes ✓ specify volume (in ml) of the solution that should be removed for testing ✓ stir before taking the sample ✓ test with iodine ✓ all carried out at same temperature ✓	3	

Question	Marking Guidance	Mark	Comments
<p>044</p>	<ol style="list-style-type: none"> <li>1. Oxygen produced in light-dependent reaction;</li> <li>2. The faster (oxygen) is produced, the faster the light-dependent reaction;</li> </ol>	2	
<p>442</p> <p>*</p>	35–36 $\mu\text{mol}$ oxygen per mg chlorophyll;;	2	Correct difference at 500 $\mu\text{mol photons m}^{-2} \text{s}^{-1}$ or incorrect difference but division by 4 shown = 1 mark
<p>443</p>	<p>At all light intensities, chloroplasts from mutant plants:</p> <ol style="list-style-type: none"> <li>1. Have faster production of ATP and reduced NADP;</li> <li>2. (So) have faster/more light-independent reaction;</li> <li>3. (So) produce more sugars that can be used in respiration;</li> <li>4. (So) have more energy for growth;</li> <li>5. Have faster/more synthesis of new organic materials;</li> </ol>	4 max	Accept converse points if clear answer relates to non-mutant plants

**Mark Scheme**

**4.5**

Question	Working	Answer	Mark	Notes
(a)	$1 - (0.15 + 0.32 + 0.27)$ $1 - (15 + 32 + 27)$ $1 - (15/100 + 32/100 + 27/100)$	0.26 26% $26/100$ (oe)	2	M1 for $1 - "(0.15 + 0.32 + 0.27)"$ oe A1 for 0.26 or $26/100$ (oe) or 26% (must include the % sign) [Note: 0.26 seen in the table and contradicted by an incorrect answer on the answer line gets M1A0]
(b)	$0.15 \times 300$	45	2	M1 for $0.15 \times 300 (= 45)$ oe A1 cao

**4.6**

SMB1H_01				
Question	Working	Answer	Mark	Notes
(a)	$1 - (0.4 + 0.25 + 0.15)$ $1 - 0.8$	0.2	2	M1 for $1 - "(0.4 + 0.25 + 0.15)"$ or $1 - 0.8$ or sight of 0.92 A1 for 0.2 oe
(b)	$0.4 \times 60$	24	2	M1 for $0.4 \times 60$ A1 for 24 or '24 out of 60' SC B1 for $\frac{24}{60}$ or 24 in 60

47

Question	Working	Answer	Mark	Notes
(a)	$1 - (0.12 + 0.39 + 0.18)$	0.31	2	M1 for $1 - (0.12 + 0.39 + 0.18)$ or 1 "0.69"
(b)	1 0.69 $50 \times 0.12$	6	2	A1 cao M1 for $50 \times 0.12$ seen or for $\frac{6}{50}$ A1cao

**Mark Scheme**

48

Question	Working	Answer	Mark	Notes
(a)	$y = 4 \times 7.5 + 5.4$	35.4	2	M1 for $4 \times 7.5 + 5.4$ A1 cao
(b)	$18.8 = 4x - 2.4$ $x = \frac{18.8 + 2.4}{4}$	5.3	2	M1 for intention to add 2.4 to 18.8 or to subtract -2.4 from 18.8 or to divide 18.8 and (-)2.4 by 4 A1 cao

49

Question	Working	Answer	Mark	Notes
(a)		-1, 0, 1, 2, 3	2	B2 for all 5 correct values; ignore repeats, any order (B1 for 4 correct (and no incorrect values) eg. 0, 1, 2, 3 or one additional value, eg -1, 0, 1, 2, 3, 4)
(b)		$-4 < x \leq 3$	2	B2 for $-4 < x \leq 3$ or $> -4$ and $\leq 3$ (B1 for $-4 < x$ or $x > -4$ or $x \leq 3$ or $3 \geq x$ or $> -4$ or $\leq 3$ or $-4 \leq x < 3$ ) (NB Accept the use of any letter)
(c)	$3y - 2 > 5$ $3y > 7$	$y > \frac{7}{3}$	2	M1 for clear intention to add 2 to both sides (of inequality or equation) or clear intention to divide all terms by 3 or $3y > 7$ or $3y < 7$ or $3y = 7$ A1 $y > \frac{7}{3}$ or $y > 2 \frac{1}{3}$ or $y > 2 \frac{\cdot}{3}$  NB. final answer <b>must</b> be an inequality (SC B1 for $\frac{7}{3}$ oe seen if M0 scored)

50

	Working	Answer	Mark	Notes
(a)	$3 \times -2 + 5$	-1	2	M1 for substitution of -2 into $3e + 5$ e.g. $3 \times -2 + 5$ A1 cao
(b)	$4y - 2y = 14 - 3$ $2y = 11$ $y = 1\frac{1}{2}$	$1\frac{1}{2}$	2	M1 for clear attempt to subtract 2y or 3 from both sides A1 for $1\frac{1}{2}$ oe
(c)	$3x - 15 = 21$ $3x = 36$ $x = 12$	12	2	M1 for $3 \times x - 3 \times 5$ or intention to divide both sides of equation by 3 as a first step A1 cao
(d)		-2, -1, 0, 1, 2, 3	2	B2 for all 6 correct values; ignore repeats, any order (B1 for 5 correct and no incorrect values e.g. -2, -1, 1, 2, 3 or 6 correct and one incorrect value e.g. -2, -1, 0, 1, 2, 3, 4)

51

	Working	Answer	Mark	Notes
	$3p^2 = y + 4$ $p^2 = \frac{y+4}{3}$	$p = \sqrt{\frac{y+4}{3}}$	3	M1 for clear intention to add 4 to both sides or divide all terms by 3 (with at least 3 terms) M1 for clear intention to find the square root from $p^2 = (\text{expression in } y)$ A1 for $p = \sqrt{\frac{y+4}{3}}$ oe (accept $\pm$ a correct root)

Question	Answer	Marks	Guidance
52 (a) (i)	too large / not fat soluble ✓	1	<b>IGNORE</b> 'no channels'
(ii)	<u>water</u> / <u>H<sub>2</sub>O</u> , and, lactase / enzyme ✓	1	<b>Mark the first two answers.</b> If they are correct and any other word is written that is incorrect or contradicts the correct answer then <b>0 marks.</b> <b>DO NOT ALLOW</b> H <sub>2</sub> O with incorrect case or subscript <b>IGNORE</b> refs to pH, buffers, hydrocarbonate etc.
(b)	sequence / order, of amino acids ✓	1	<b>ALLOW</b> primary structure.
(c)	<i>two from</i> (enzymes) re-used so less, <b>money</b> / <b>cost</b> (for new ones) ✓ downstream processing / purifying, <b>cost</b> / <b>expense</b> , reduced ✓ (higher temperature allows) more <b>profit</b> from faster yield ✓	2	<b>Mark the first answer on each prompt line.</b> If the prompt numbers are ignored, mark the <b>first two answers</b> as prose. Answers must refer to reduced cost / losses / expense, or increased profit. <b>ALLOW</b> ORA for any point if clearly stated <b>IGNORE</b> 'more economic' in general e.g. 'Continuous processing is more economic'. Look for the details listed.
(d)	* 0.04 ✓✓	2	<b>ALLOW</b> correct answer in the working if the answer line is left blank. If the answer is 0.03, award <b>2 marks</b> for rounding from calculations using more than 2 decimal places. If the answer is incorrect, award <b>1 mark</b> for (2pq =) 2 x 0.02 x 0.98. If the answer is not given to 2 decimal places, max <b>1 mark.</b>

## Mark Scheme

**Q3**

Question	Working	Answer	Mark	Notes
	$5 \times 6 \div 2$	$15\text{cm}^2$	3	M1 $5 \times 6 \div 2$ oe seen A1 15 B1 $\text{cm}^2$

54

Question	Working	Answer	Mark	Notes
	Triangular face: $\frac{1}{2} \times 5 \times 12 = 30$ Rectangular faces: (13×10), (12×10),(5×10)  Area: 30 + 30 + 130 + 120 + 50 =	360 cm <sup>2</sup>	4	M1 for $\frac{1}{2} \times 5 \times 12 (= 30)$ oe  M1 for 2 + of (13×10) and (12×10) and (5×10) oe  A1 cao  NB: No marks awarded for calculating volume  B1 (indep) units stated (cm <sup>2</sup> )

55

Question	Working	Answer	Mark	Notes
	$\frac{1}{2} \times 6(10 + 8) - \frac{1}{2} \times 3(7 + 5)$  $= 54 - 18$	36	3	M1 for $\frac{1}{2} \times 6(10 + 8)$ or $\frac{1}{2} \times 3(7 + 5)$ oe  M1(dep) for $\frac{1}{2} \times 6(10 + 8) - \frac{1}{2} \times 3(7 + 5)$ oe  A1 cao