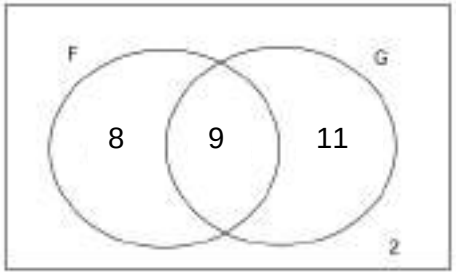
Question			Answer	Marks	Part marks and guidance	
1	(a)		5120	1		
	(b)		Topozero, Tana, Mweru, Ladoga, Victoria or 986, 3200, 5120, 18 100, 68 900 oe in standard form	2	**B1** for Topozero as smallest or Victoria as largest or all in correct reverse order	9.86×10^2, 3.20×10^3, 5.12×10^3, 1.81×10^4, 6.89×10^4 condoning superfluous zeros and slip in index
	(c)		1.5×10^4 nfww isw	4	**B3** for 15000 oe or $1.49[0..] \times 10^4$ or **B2** for 14900 oe or **M1** for figs 181 – figs 32 If **0** scored **SC1** for *their* value correctly rounded to 2 significant figures	eg 15000 may be 15×10^3 Subtraction may be implied by figs 15 or figs 149 *Their* unrounded value must be seen
2	(a)		285	2	**M1** for $760 \div (2 + 3 + 3)$ soi by 95	
	(b)		24	2	**M1** for $\frac{2}{3} \times 36$ oe	Allow $(0.66 \text{ or } 0.7) \times 36$ for **M1** only
3			$2x + 7$ as final answer	2	**B1** for each part or **M1** for $3x + 6$ or $^-x + 1$	
4	(a)		Triangle at $(^-8, 6)$, $(^-8, 2)$, $(0, 6)$	2	**B1** for reflection in $x = k$ or in $y = 0$	Mark intention, condoning freehand

Question			Answer	Marks	Part marks and guidance	
	(b)		Enlargement $\frac{1}{4}$ or 0.25 (0, -6)	**3**	**B1** for each element	Marks spoilt if extra transformations Condone omission of brackets Accept centre as a vector
5	**(a)**		0.14, 0.09, (0.19), 0.2[0], 0.13, 0.25	**2**	**B1** for three or four correct relative frequencies in the correct place	Accept fractions
	(b)	**(i)**	[Unbiased dice] would have each [rf=] 0.16-0.17 or [Unbiased dice] would have each [f=] 50 or comment about very unequal [relative] frequencies and implied comparison	**1**		Accept “about 0.16” Accept “about 50” Not enough to say one number was rolled the most. Must say 6 [and 4] or some numbers are much higher or 2 or 5 or some numbers are much lower
		(ii)	need larger sample oe	**1**		

Question			Answer	Marks	Part marks and guidance	
6			5 : 6 nfww	4		Accept for all part marks *n* replaced by a consistent integer
					B3 for 5*kn* : 6*kn* *k*>0 or equivalent correct unsimplified ratio seen	Eg 2.5*n* : 3*n* or 5*n* : 6*n* or 10 : 12 etc
					OR	
					M1 for two ratios with a common number of mints implied by … : 10*k* **and** 10*k* : … seen, *k*>0 with one correct ratio or for 2.5*n* : 5 seen	May be seen as two separate ratios Eg 5*n* : 10 and 10 : 6*n* or 10 : 20 and 20 : 12 etc For **M1** the examples just require the common 10 or the common 20 etc
					A1 for 5*kn* : 10*k* : 6*kn*	
7	**(a)**		Ruled bisector of angle ABC to reach CD with construction arcs	2	**B1** for correct ruled bisector at least 2cm long by eye with no construction arcs or correct construction arcs with no/wrong bisector drawn	Tolerance ±2˚ Construction arcs on AB and on BC and two intersecting arcs from these
	(b)		Arc, centre C, radius 5 cm, intersecting *their* line twice or intersecting BC and CD or two points marked on *their* line that are 5 cm from C	2	**B1** for any arc, centre C, intersecting *their* line at least once or intersecting BC or CD or short arc (at least 1 cm), centre C, radius 5 cm	Tolerance 4.8 – 5.2 cm Max **B1** for freehand, all within template
			Locus of line within arc from C rad indicated	1dep	**Dep** on at least **B1** in (a) and **B1** in (b)	

Question			Answer	Marks	Part marks and guidance	
8	(a)		54 nfww	4	**B3** for 90 min and 144 min or for 0.9h or **B2** for 90 min or 144 min or for A: 1.5h and B 2.4h or **M1** for evidence of time = distance / speed	For **B3 and B2** accept 1 h 30 min and 2 h 24 min
	(b)		1000*x*/3600 oe isw	2	**B1** for 1000*x* [m/h] or *x*/3600 [km/s] or *x*1000/3600 oe	For **2** marks, final answer must not have any units within the expression isw wrong simplification after correct answer. Accept *x*/3.6 and (0.277 to 0.28)*x* For **B1** allow *x* × 1000 or *x* ÷ 3600 or these clearly implied in a longer calculation
9	(a)		59.5 60.5	2	**B1** for either one correct or both correct but reversed	

Question			Answer	Marks	Part marks and guidance	
	(b)	(i)	Accept any correctly matched wall and 6 × cupboard where values quoted satisfy: wall < 6 × cupboard where 362.5 ≤ wall < 363 and 362.5 < 6 × cupboard ≤ 363 OR wall ÷ 6 < cupboard where 362.5 ≤ wall < 363 and $60.41\dot{6}$ to 60.42 < cupboard ≤ 60.5 OR wall ÷ cupboard < 6 where 362.5 ≤ wall < 363 and $60.41\dot{6}$ to 60.42 < cupboard ≤ 60.5	3	**B1** for 362.5 ≤ wall value < 363 **B1** for 362.5 < 6 × cupboard value ≤ 363 or $60.41\dot{6}$ to 60.42 < cupboard value ≤ 60.5 e.g. wall is 362.5 cupboard is 60.49 362.5 ÷ 60.49 = 5.9[9…] < 6	For any method: Condone use of 60.5cm for cupboard value Condone use of 363cm for 6 × cupboard value
		(ii)	6.5 cm	3	**M2** for 363.5 – 6 × *their* lower bound of cupboard or 363.5 – 357 or **M1** for [upper bound of wall =] 363.5 or for 6 × *their* lower bound of cupboard or [6 cupboards =] 357	

Question			Answer	Marks	Part marks and guidance	
10	(a)		Using interior angles: ((10 – 2) × 180) ÷ 10 or 1440 ÷ 10 seen [Int angle of triangle =] 60 in working 360 – (144 + 60) oe [= 156]	 **1** **1** **1**	Using exterior angles: 360 ÷ 10 seen [Ext angle of triangle =] 120 in working 36 + 120 [= 156] Alternative method: **1** for 360 ÷ 10 seen **1** for [Int angle of triangle =] 60 in working **1** for 180 – (60 – 36) [= 156] If **0** scored **SC1** for 24, 36, 60, 120 or 144 shown in correct place on diagram	Mark the working. Mark angles on diagram only if 0 scored. Working backwards from 156 to 144 [to 10 sides] scores 0
	(b)		15	**2**	**M1** for $[n =]\frac{360}{180-156}$ or $\frac{180(n-2)}{n}=156$	
11	(a)			**3**	**B2** for 8, 9 or 11 correctly placed or **B1** for the total of F = 17 or for the total of G = 20 or for all 3 regions add up to 28 or for 17 – *x* , *x*, 20 – *x*	Do not accept a blank region to represent 0

Question			Answer	Marks	Part marks and guidance	
	(b)		88/435 oe or 0.202(…) with correct working	**5**	**B1** for $\frac{8}{30}$ oe soi or $\frac{11}{30}$ soi **M1** for P(F only, G only) [+] P(G only, F only) **M1** for P(F only, G only) = $\frac{their\ 8}{30} \times \frac{their\ 11}{29 \text{ or } 30}$ or $\frac{their\ 11}{30} \times \frac{their\ 8}{29 \text{ or } 30}$ **A1** for 88/870 or 44/435 or 0.101(…) If **0**, **1** or **2** scored, instead award **SC3** for answer 88/435 oe or 0.202(…) with no or insufficient working If **0** or **1** scored, instead award **SC2** for 88/870 or 44/435 or 0.101(…) with no or insufficient working If **0** scored **SC1** for 88/450, 44/225 or 0.195[5..] to 0.196 with no working	"Correct working" requires evidence of at least **M1M1** eg correct branches identified on tree or implied by *their* subsequent calculation FT *their* **(a)** *their* 8 and *their* 11 are FT *their* **(a)** Likely incorrect answers with working: **B1M1M1** for answer 88/450, 44/225 or 0.195[5..] to 0.196 **B1M0M1** for answer 88/900, 44/450, 22/225 or 0.097[7..] to 0.098

Question			Answer	Marks	Part marks and guidance	
12			answer with at least 4 sf rounding to 46.9 with correct working	6	**M1** for [vol =] 235 ÷ 7.78 [=30.2…] AND **M2** for $r^3 = \frac{their\,30.2... \times 3}{4 \times \pi}$ oe [=7.2…] or **M1** for *their* 30.2 = $\frac{4}{3}\pi r^3$ **A1** for r = 1.93… AND **M1** for [SA =] $4 \times \pi \times their\,1.93...^2$ If **0** scored **SC1** for [r =] 1.93… with no working	"Correct working" requires evidence of at least **M1** AND **M1** AND **M1** ie using formulas for density, volume and surface area After *their* 30.2 = $\frac{4}{3}\pi r^3$, r = 1.93… scores **M2A1** Condone working in reverse for a maximum of 2 marks: **M1** for 46.9 = $4\pi r^2$ **A1** for r = 1.93...
13			$y = -\frac{x}{4} + 3$ oe simplified form	4	**B3** for correct equation not in required form OR **B1** for gradient of perp line = -¼ oe soi **M1** for $y - 1 =$ *their grad* $\times (x - 8)$ or $1 =$ *their grad* $\times 8 + c$ **M1** for correct simplification to $y = mx + c$ form of *their* $y - 1 =$ *their grad* $\times (x - 8)$ or using *their* $c = 1 -$ *their* grad $\times 8$	*their* grad may be 4 ie they are finding the equation of the parallel line. Max **M1** if *their* grad is '*m*'

Question			Answer	Marks	Part marks and guidance	
14	(a)		$y = \frac{30}{\sqrt{x}}$ oe	3	**M1** for $y = \frac{k}{\sqrt{x}}$ oe **B1** for [k =] 30	eg condone $y = \frac{k}{\sqrt{36}}$ for **M1**
	(b)		2.25 oe	3	**B2** for $\sqrt{x} = \frac{3}{2}$ oe or **M1** for $20 = \frac{\textit{their}\ 30}{\sqrt{x}}$ or $\frac{20}{5} = \frac{\sqrt{36}}{\sqrt{x}}$	

Question			Answer	Marks	Part marks and guidance	
15	(a)		$2^3 - 5 \times 2 - 1 = {}^-3$ $3^3 - 5 \times 3 - 1 = 11$ Sign change so solution between $x = 2$ and $x = 3$	3	**M2** for $2^3 - 5 \times 2 - 1 = {}^-3$ and $3^3 - 5 \times 3 - 1 = 11$ or **M1** for $2^3 - 5 \times 2 - 1$ or $3^3 - 5 \times 3 - 1$ soi by $^-3$ or 11 <u>Alternative method</u> After $x^3 - 5x = 1$ seen **M2** for $2^3 - 5 \times 2 = {}^-2$ and $3^3 - 5 \times 3 = 12$ **A1** for $^-2 < 1$ and $12 > 1$ so solution between $x = 2$ and $x = 3$ OR **M1** for $2^3 - 5 \times 2$ or $3^3 - 5 \times 3$ soi by $^-2$ or 12 <u>Alternative method</u> **SC3** for using an iterative equation that converges to a value in the range 2.25 to 2.35 **and** concluding statement that $2 < 2.25$ to $2.35 < 3$ oe or **SC2** for using an iterative equation that converges to a value in the range 2.25 to 2.35	Accept other values of x used between 2 and 3 (see table in part (b)). For full marks, the two values need to produce a sign change. Examples just sufficient for third mark include: change of sign $^-3 < 0 < 11$ $x = 2$ gives an answer < 0 and $x = 3$ gives an > 0 Examples insufficient for third mark: so x lies between 2 and 3 If within part **(a)** candidates <u>refer to</u> their working in part **(b)**, award marks for this final alternative method.

<table>
<tr><th colspan="3">Question</th><th>Answer</th><th>Marks</th><th>Part marks and guidance</th><th></th></tr>
<tr><td></td><td>(b)</td><td></td><td>Two correct evaluations in the range 2.25 to 2.35, one which gives a positive value and the other giving a negative value

and

2.3</td><td>M3

A1dep</td><td>M2 for two correct evaluations between 2 and 3, one which gives a positive value and the other giving a negative value

or

M1 for one correct evaluation between 2 and 3

Dependent on achieving at least M2

<u>Alternative method</u>
M1 rearranges to a correct iterative formula (converging or diverging)

M1 <u>attempts</u> first iteration (either substitution seen or found to at least 2dp (rot)

M1 continues iteration(s) to reach x in the range 2.25 to 2.35

A1 for 2.3

If 0 scored
SC1 for answer 2.3 with no worthwhile working</td><td>Likely values: accept rot to 2+sf
<table><tr><th>x</th><th>$x^3 - 5x - 1$</th><th>x</th><th>$x^3 - 5x - 1$</th></tr><tr><td>2.1</td><td>-2.239</td><td>2.25</td><td>-0.859</td></tr><tr><td>2.2</td><td>-1.352</td><td>2.26</td><td>-0,757</td></tr><tr><td>2.25</td><td>-0.859</td><td>2.27</td><td>-0.653</td></tr><tr><td>2.3</td><td>-0.333</td><td>2.28</td><td>-0.548</td></tr><tr><td>2.4</td><td>0.824</td><td>2.29</td><td>-0.441</td></tr><tr><td>2.5</td><td>2.125</td><td>2.30</td><td>-0.333</td></tr><tr><td>2.6</td><td>3.576</td><td>2.31</td><td>-0.224</td></tr><tr><td>2.7</td><td>5.183</td><td>2.32</td><td>-0.113</td></tr><tr><td>2.75</td><td>6.047</td><td>2.33</td><td>-0.001</td></tr><tr><td>2.8</td><td>6.952</td><td>2.34</td><td>0.113</td></tr><tr><td>2.9</td><td>8.889</td><td>2.35</td><td>0.228</td></tr></table>
Condone missing subscripts

If within part (b) candidates <u>refer to</u> their working in part (a), award up to full marks for part (b).</td></tr>
</table>

Question			Answer	Marks	Part marks and guidance	
16	(a)		Subst into correct formula (may be implied) and partial simplification	2	**B2** for $25 = 20t - \frac{1}{2} \times 8 \times t^2$ oe or $25 = 20t + (-4)t^2$ or **B1** for subst eg $25 = 20t + \frac{1}{2}(-8)t^2$	Only accept $25 = 20t - 4t^2$ if subst seen For **B1**, condone ambiguity caused by missing brackets
			$25 = 20t - 4t^2$ seen and correct completion to $4t^2 - 20t + 25 = 0$	1dep	Dep on previous 2 marks	
	(b)		2.5 oe	3	**M2** for $(2t - 5)(2t - 5)$ or **M1** for any two factors that give two correct terms when expanded or for partial factorisation $2t(2t - 5) - 5(2t - 5)$ OR **M2** for $[t =] \frac{20 \pm \sqrt{400 - 400}}{8}$ or better **M1** for $[t =] \frac{-(-20) \pm \sqrt{(-20)^2 - 4 \times 4 \times 25}}{2 \times 4}$ with at most one error	eg a sign error, short fraction line, short root but condone missing brackets

Question			Answer	Marks	Part marks and guidance	
	(c)		Shows $v = 0$ and concludes "stationary"	3	**M1** for $[v^2 =] 20^2 + 2(^-8)25$ or $[v =] 20 + (^-8)\times$*their* (b) **A1** $v = 0$ If **0** scored, instead award **SC2** for $v = 0$ and other values substituted into a relevant equation as a correct check or **SC1** for $v = 0$	

Question			Answer	Marks	Part marks and guidance	
17			113 to 114 with correct working	5	Check diagram for incorrect triangle. Correct triangle or no triangle indicated: **M2** for $\sqrt{6.8^2 + 2.8^2}$ [= 7.35…] or for full alternative method or **M1** for $6.8^2 + 2.8^2$ [= 54.08 or 54.1] AND **M2** for $5.6 \times 5.6 + 4 \times \frac{1}{2} \times 5.6 \times$ *their* 7.35... or **M1** for $\frac{1}{2}$ × 5.6 × *their* 7.35… Incorrect triangle indicated: **M1** for complete Pythagoras to find hypotenuse with a maximum of one incorrect dimension If **0** or **M1** scored, instead award **SC2** for answer 113 to 114 with no or insufficient working If **0** scored **SC1** for 7.35 either correctly placed on diagram or with no working	"Correct working" requires evidence of at least **M2** AND **M1** ie correct triangle with Pythagoras and area of a triangle eg Finding AC, AO, AE then the height (AC = 7.919…, AE = 7.868…) eg EB found as $\sqrt{6.8^2 + 2.8^2}$ is using an incorrect dimension for OB

Question			Answer	Marks	Part marks and guidance	
18			$y = \frac{4}{3t-17}$ or $y = \frac{-4}{17-3t}$	5	**B4** for $\frac{4}{3t-17}$ or $y = \frac{2}{1.5t-8.5}$ as final answer OR **M2** for $10y + 4 = 3ty - 7y$ or $5 + \frac{2}{y} = 1.5t - 3.5$ or **M1** for $\frac{2(5y+2)}{y} = 3t - 7$ or $5y + 2 = \frac{y(3t-7)}{2}$ or $10y + 4$ or $3ty - 7y$ seen or $5 + \frac{2}{y} = \frac{3t-7}{2}$ or $\frac{5y+2}{y} = 1.5t - 3.5$ **M1ft** for correctly collecting y terms on one side and non-y terms on the other (need not be simplified at this stage) **M1ft** for factorising *their* 2 or 3 terms	To award full marks, solution must be correct eg $4 = 3ty - 7y - 10y$ or $\frac{2}{y} = 1.5t - 3.5 - 5$ ft for formulae of equal difficulty (eg must include a ty term oe) eg $4 = y(3t - 17)$ or $\frac{y}{2} = \frac{1}{1.5t-8.5}$