Subject – Math AI(Standard Level)
Topic - Geometry and Trigonometry
Year - May 2021 – Nov 2024
Paper -1
Answers

Question 1

(a) (i) 0.909 (0.909181…) ***A2***

(ii) (very) strong and positive ***A1A1***

Note: Award ***A1*** for (very) strong ***A1*** for positive.

[4 marks]

(b) $y = 1.14x + 0.578$ ($y = 1.14033\ldots x + 0.578183\ldots$) ***A1A1***

[2 marks]

(c) (i) $1.14 \times 10 + 0.578$ ***M1***

12.0 (11.9814…) ***A1***

(ii) no the estimate is not reliable ***A1***

outside the known data range ***R1***

OR

a score greater than 10 is not possible ***R1***

(d)

Competitors	A	B	C	D	E	F	G	H
Stan's rank	7	8	6	4	2	4	1	4
Minsun's rank	7	8	6	4.5	3	2	1	4.5

A1A1

[2 marks]

(e) (i) 0.933 (0.932673…) ***A2***

(ii) Stan and Minsun strongly agree on the ranking of competitors. ***A1A1***

[4 marks]

(f) decreasing the score to 9.1, does not change the rank of competitor G ***A1***

[1 mark]

Total [17 marks]

Question 2

(a) $4\times\frac{360^{\circ}}{12}$ **OR** $4\times 30^{\circ}$ ***(M1)***

120° ***A1***

[2 marks]

(b) substitution in cosine rule ***(M1)***

$AB^2 = 10^2+6^2-2\times 10\times 6\times\cos(120^{\circ})$ ***(A1)***

$AB = 14$ cm ***A1***

Note: Follow through marks in part (b) are contingent on working seen.

[3 marks]

(c) $\theta = 13\times 6$ ***(M1)***

$= 78^{\circ}$ ***A1***

[2 marks]

(d) substitution into the formula for arc length ***(M1)***

$l=\frac{78}{360}\times 2\times\pi\times 10$ **OR** $l=\frac{13\pi}{30}\times 10$

$=13.6$ cm $\left(13.6135\ldots,\ 4.33\pi,\ \frac{13\pi}{3}\right)$ ***A1***

[2 marks]

(e) substitution into the area of a sector ***(M1)***

$A=\frac{78}{360}\times\pi\times 10^2$ **OR** $l=\frac{1}{2}\times\frac{13\pi}{30}\times 10^2$

$=68.1\ \text{cm}^2$ $\left(68.0678\ldots,\ 21.7\pi,\ \frac{65\pi}{3}\right)$ ***A1***

[2 marks]

(f) 23 ***A1***

[1 mark]

(g) correct substitution *(M1)*

$h = 10\cos(160^\circ) + 13$

$= 3.60 \text{ cm} \ (3.60307...)$ *A1*

[2 marks]

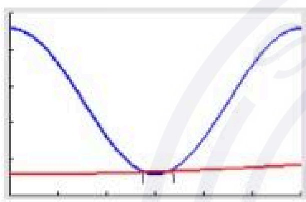
(h) 10 *A1*

[1 mark]

(i) **EITHER**

$10 \times \cos(\theta) + 13 = -10 \times \cos\left(\frac{\theta}{12}\right) + 13$ *(M1)*

OR



(M1)

Note:	Award ***M1*** for equating the functions. Accept a sketch of $h(\theta)$ and $g(\theta)$ with point(s) of intersection marked.

THEN

$k = 196^\circ \ (196.363...)$ *A1*

Note:	The answer 166.153… is incorrect but the correct method is implicit. Award ***(M1)A0***.

[2 marks]

Total [17 marks]

Question 3

(a) use of cosine rule *(M1)*

$\hat{ACB} = \cos^{-1}\left(\frac{1005^2 + 1225^2 - 650^2}{2 \times 1005 \times 1225}\right)$ *(A1)*

$= 32.0^\circ \ (31.9980...)$ ***A1***

[3 marks]

(b) use of sine rule *(M1)*

$\frac{DE}{\sin 31.9980...^\circ} = \frac{210}{\sin 100^\circ}$ *(A1)*

$(DE =) \ 113 \text{ m} \ (112.9937...)$ ***A1***

[3 marks]

(c) **METHOD 1**

$180^\circ - (100^\circ +$ their part $(a))$ *(M1)*

$= 48.0019...^\circ$ **OR** $0.837791...$ *(A1)*

substituted area of triangle formula *(M1)*

$\frac{1}{2} \times 112.9937... \times 210 \times \sin 48.002^\circ$ *(A1)*

$8820 \text{ m}^2 \ (8817.18...)$ ***A1***

METHOD 2

$\frac{CE}{\sin(180 - 100 - \text{their part } (a))} = \frac{210}{\sin 100}$ *(M1)*

$(CE =) \ 158.472...$ *(A1)*

substituted area of triangle formula *(M1)*

EITHER

$\frac{1}{2} \times 112.993... \times 158.472... \times \sin 100$ *(A1)*

OR

$\frac{1}{2} \times 210... \times 158.472... \times \sin(\text{their part } (a))$ *(A1)*

THEN

$8820 \text{ m}^2 \ (8817.18...)$ ***A1***

METHOD 3

$CE^2 = 210^2 + 112.993...^2 - (2 \times 210 \times 112.993... \times \cos(180 - 100 - \text{their part } (a)))$ ***(M1)***

$(CE =)\ 158.472...$ ***(A1)***

substituted area of triangle formula ***(M1)***

$\frac{1}{2} \times 112.993... \times 158.472... \times \sin 100$ ***(A1)***

$8820\ \text{m}^2\ \ (8817.18...)$ ***A1***

[5 marks]

(d) $1005 - 210$ **OR** 795 ***(A1)***

equating answer to part (c) to area of a triangle formula ***(M1)***

$8817.18... = \frac{1}{2} \times DF \times (1005 - 210) \times \sin 48.002...^\circ$ ***(A1)***

$(DF =)\ 29.8\ \text{m}\ \ (29.8473...)$ ***A1***

[4 marks]

Total [15 marks]

Question 5

(a) $\tan(\theta) = \frac{6}{10}$ ***(M1)***

$(\theta =)\ 31.0^\circ\ (30.9637...^\circ)$ **OR** $0.540\ (0.540419\ldots)$ ***A1***

[2 marks]

(b) (i) $(\text{CV} =)\ 40\tan(\theta)$ **OR** $(\text{CV} =)\ 4\times 6$ ***(M1)***

> **Note:** Award ***(M1)*** for an attempt at trigonometry or similar triangles (e.g. ratios).

$(\text{CV} =)\ 24\text{ m}$ ***A1***

(ii) $(V =)\ \frac{1}{3}80^2\times 24 - \frac{1}{3}60^2\times 18$ ***M1A1A1***

> **Note:** Award ***M1*** for finding the difference between the volumes of two pyramids, ***A1*** for each correct volume expression. The final ***A1*** is contingent on correct working leading to the given answer.
> If the correct final answer is not seen, award at most ***M1A1A0***. Award ***M0A0A0*** for any height derived from $V = 29\,600$, including 18.875 or 13.875.

$(V =)\ 29\,600\text{ m}^3$ ***AG***

[5 marks]

(c) **METHOD 1**

$\left(\frac{29\,600}{80} =\right)\ 370$ (days) ***A1***

$(370 > 366)$ Joshua is correct ***A1***

> **Note:** Award ***A0A0*** for unsupported answer of "Joshua is correct". Accept $1.01... > 1$ for the first ***A1*** mark.

METHOD 2

$80\times 366 = 29280\text{ m}^3$ **OR** $80\times 365 = 29200\text{ m}^3$ ***A1***

$(29280 < 29600)$ Joshua is correct ***A1***

> **Note:** The second ***A1*** can be awarded for an answer consistent with their result.

[2 marks]

(d) height of trapezium is $\sqrt{10^2+6^2}$ $(=11.6619...)$ ***(M1)***

area of trapezium is $\frac{80+60}{2}\times\sqrt{10^2+6^2}$ $(=816.333...)$ ***(M1)(A1)***

$(SA=)\ 4\times\left(\frac{80+60}{2}\times\sqrt{10^2+6^2}\right)+60^2$ ***(M1)***

Note: Award ***M1*** for adding 4 times their (MNOP) trapezium area to the area of the (60×60) base.

$(SA=)\ 6870\text{ m}^2\ (6865.33\text{ m}^2)$ ***A1***

Note: No marks are awarded if the correct shape is not identified.

[5 marks]
Total: [14 marks]

Question 5

(a) (i) maximum $h = 130$ metres **A1**

(ii) minimum $h = 50$ metres **A1**

[2 marks]

(b) (i) $(60 \div 12 =)$ 5 seconds **A1**

(ii) $360 \div 5$ ***(M1)***

Note: Award ***(M1)*** for 360 divided by their time for one revolution.

$= 72^{\circ}$ **A1**

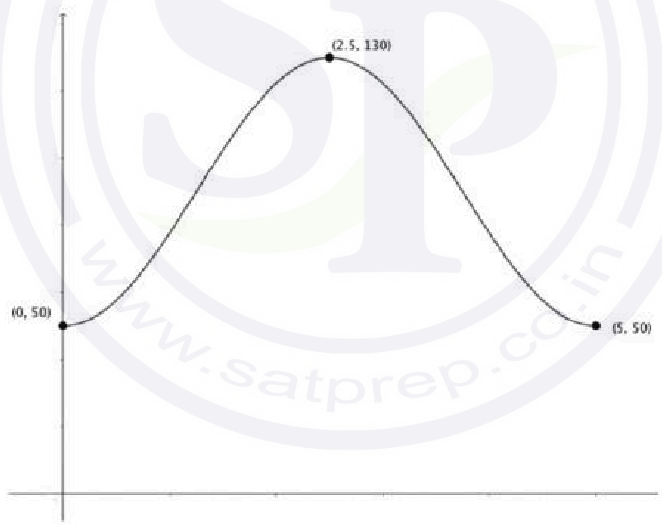
[3 marks]

(c) (i) (amplitude $=$) 40 **A1**

(ii) (period $= \frac{360}{72} =$) 5 **A1**

[2 marks]

(d)



Maximum point labelled with correct coordinates. **A1**

At least one minimum point labelled. Coordinates seen for any minimum points must be correct. **A1**

Correct shape with an attempt at symmetry and "concave up" evident as it approaches the minimum points. Graph must be drawn in the given domain. **A1**

[3 marks]

(e) (i) $h = 90 - 40\cos(144°)$ *(M1)*

$(h =)$ 122 m $(122.3606.....)$ ***A1***

(ii) evidence of $h = 100$ on graph **OR** $100 = 90 - 40\cos(72t)$ *(M1)*

t coordinates 3.55 $(3.54892...)$ **OR** 1.45 $(1.45107...)$ or equivalent *(A1)*

Note: Award ***A1*** for either t-coordinate seen.

= 2.10 seconds $(2.09784\ldots)$ ***A1***

[5 marks]

(f) (i) $5 - 2.09784\ldots$ *(M1)*

$\frac{(2.902153...)}{5}$ *(M1)*

0.580 $(0.580430...)$ ***A1***

(ii) **METHOD 1**

changing the frequency/dilation of the graph will not change the proportion of time that point C is visible. ***A1***

0.580 $(0.580430...)$ ***A1***

METHOD 2

correct calculation of relevant found values

$\frac{(2.902153...)/2}{5/2}$ ***A1***

0.580 $(0.580430...)$ ***A1***

Note: Award ***A0A1*** for an unsupported correct probability.

[5 marks]

Total: [20 marks]

Question 6

(a) (i) $\left(\frac{1}{2}\hat{AOB}=\right)\ \arccos\left(\frac{4}{4.5}\right)=27.266...$ ***(M1)(A1)***

$\hat{AOB}=54.532...\approx 54.5^\circ$ ($0.951764...\approx 0.952$ radians) ***A1***

Note: Other methods may be seen; award ***(M1)(A1)*** for use of a correct trigonometric method to find an appropriate angle and then ***A1*** for the correct answer.

(ii) finding area of triangle

EITHER

area of triangle = $\frac{1}{2}\times 4.5^2\times\sin(54.532...)$ ***(M1)***

Note: Award ***M1*** for correct substitution into formula.

$=8.24621...\approx 8.25\ \text{m}^2$ ***(A1)***

OR

$AB=2\times\sqrt{4.5^2-4^2}=4.1231\ldots$

area triangle $=\frac{4.1231\ldots\times 4}{2}$ ***(M1)***

$=8.24621...\approx 8.25\ \text{m}^2$ ***(A1)***

finding area of sector

EITHER

area of sector = $\frac{54.532...}{360}\times\pi\times 4.5^2$ ***(M1)***

$=9.63661...\approx 9.64\ \text{m}^2$ ***(A1)***

OR

area of sector = $\frac{1}{2}\times 0.9517641..\times 4.5^2$ ***(M1)***

$=9.63661...\approx 9.64\ \text{m}^2$ ***(A1)***

THEN

area of segment = $9.63661...-8.24621...$

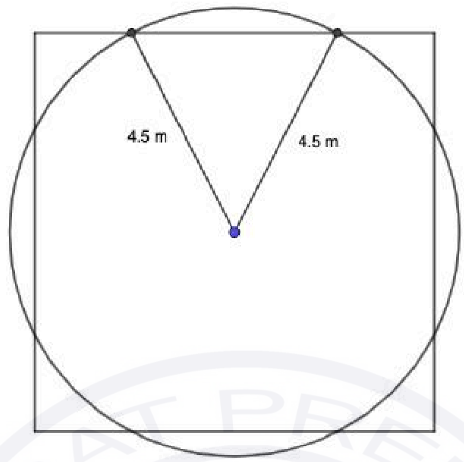
$=1.39\ \text{m}^2$ $(1.39040...)$ ***A1***

[8 marks]

(b) (i) $\pi \times 4.5^2$ *(M1)*

63.6 m^2 $(63.6172\ldots \text{m}^2)$ ***A1***

(ii) **METHOD 1**



$4 \times 1.39040...$ (5.56160) *(A1)*

subtraction of four segments from area of circle *(M1)*

$= 58.1 \text{ m}^2$ $(58.055...)$ ***A1***

METHOD 2

$$4(0.5 \times 4.5^2 \times \sin 54.532\ldots) + 4\left(\frac{35.4679}{360} \times \pi \times 4.5^2\right)$$ *(M1)*

$= 32.9845\ldots + 25.0707$ *(A1)*

$= 58.1 \text{ m}^2$ $(58.055\ldots)$ ***A1***

[5 marks]

(c) sketch of $\frac{dV}{dt}$ **OR** $\frac{dV}{dt} = 0.110363...$ **OR** attempt to find where $\frac{d^2V}{dt^2} = 0$ *(M1)*

$t = 1$ hour ***A1***

[2 marks]

[Total 15 marks]

Question 7

(a) **EITHER**
annual cycle for daylight length ***R1***

OR
there is a minimum length for daylight (cannot be negative) ***R1***

OR
a quadratic could not have a maximum and a minimum or equivalent ***R1***

Note: Do not accept "Paula's model is better".

[1 mark]

(b) (i) 4 ***A1***

(ii) 12 ***A1***

(iii) $y = 12$ ***A1A1***

Note: Award ***A1*** " $y =$ (a constant) " and ***A1*** for that constant being 12.

[4 marks]

(c) $f(t) = -4\cos(30t) + 12$ **OR** $f(t) = -4\cos(-30t) + 12$ ***A1A1A1***

Note: Award ***A1*** for $b = 30$ (or $b = -30$), ***A1*** for $a = -4$, and ***A1*** for $d = 12$. Award at most ***A1A1A0*** if extra terms are seen or form is incorrect. Award at most ***A1A1A0*** if x is used instead of t.

[3 marks]

(d) $10.5 = -4\cos(30t) + 12$ ***(M1)***

EITHER
$t_1 = 2.26585\ldots,\ t_2 = 9.73414\ldots$ ***(A1)(A1)***

OR
$t_1 = \frac{1}{30}\cos^{-1}\frac{3}{8}$ ***(A1)***
$t_2 = 12 - t_1$ ***(A1)***

THEN
$9.73414\ldots - 2.26585\ldots$
7.47 (7.46828…) months (0.622356…years) ***A1***

Note: Award ***M1A1A1A0*** for an unsupported answer of 7.46. If there is only one intersection point, award ***M1A1A0A0***.

[4 marks]

Question 8

(a) (i) an attempt to find the amplitude *(M1)*

$\frac{61.8}{2}$ **OR** $\frac{64.5-2.7}{2}$

$(a=)\ 30.9\text{ m}$ ***A1***

Note: Accept an answer of $(a=)\ -30.9\text{ m}$.

(ii) (period $=\frac{60}{1.5}=$) 40 (s) *(A1)*

$\left((b=)\ \frac{360^\circ}{40}\right)$

$(b=)\ 9$ ***A1***

Note: Accept an answer of $(b=)\ -9$.

(iii) attempt to find d *(M1)*

$(d=)\ 30.9+2.7$ **OR** $\frac{64.5+2.7}{2}$

$(d=)\ 33.6\text{ m}$ ***A1***

[6 marks]

(b) 12×1.5 **OR** $\frac{12\times60}{40}$ *(M1)*

18 (revolutions per ride) ***A1***

[2 marks]

(c) (i) $0\le t\le 720$ ***A1***

(ii) $2.7\le h\le 64.5$ ***A1A1***

Note: Award ***A1*** for correct endpoints of domain and ***A1*** for correct endpoints of range. Award ***A1*** for correct direction of both inequalities.

[3 marks]

(d) graph of $h(t)$ and $y=16.7$ **OR** $h(t)=16.7$ *(M1)*

$6.31596\ldots$ and $33.6840\ldots$ *(A1)*

27.4 (s) $(27.3680\ldots)$ ***A1***

[3 marks]

(e) (i) d **A1**

(ii) **EITHER**

$d + 30.9 = 65.2$ ***(A1)***

OR

$65.2 - (61.8 + 2.7) = 0.7$ ***(A1)***

OR

3.4 (new platform height) ***(A1)***

THEN

$(d =)$ 34.3 m **A1**

[3 marks]

Total [17 marks]

Question 9

(a) $\left(\frac{2+6}{2}, \frac{2+0}{2}\right)$ *(M1)*

$(4, 1)$ ***A1***

Note: Award ***A0*** if parentheses are omitted in the final answer.

[2 marks]

(b) attempt to substitute values into gradient formula *(M1)*

$\left(\frac{0-2}{6-2}=\right)-\frac{1}{2}$ *(A1)*

therefore the gradient of perpendicular bisector is 2 *(M1)*

so $y-1=2(x-4)$ $(y=2x-7)$ ***A1***

[4 marks]

(c) identifying the correct equations to use: *(M1)*

$y=2-x$ and $y=2x-7$

evidence of solving their correct equations or of finding intersection point graphically *(M1)*

$(3, -1)$ ***A1***

Note: Accept an answer expressed as "$x=3$, $y=-1$".

[3 marks]

(d) attempt to use distance formula *(M1)*

$\text{YZ}=\sqrt{(7-(-1))^2+(7-3)^2}$

$=\sqrt{80}$ $\left(4\sqrt{5}\right)$ ***A1***

[2 marks]

(e) **METHOD 1 (cosine rule)**

length of XZ is $\sqrt{80}$ $\left(4\sqrt{5}, 8.94427...\right)$ *(A1)*

Note: Accept 8.94 and 8.9.

attempt to substitute into cosine rule *(M1)*

$\cos \text{X}\hat{\text{Y}}\text{Z}=\frac{80+32-80}{2\times\sqrt{80}\sqrt{32}}$ $(=0.316227\ldots)$ *(A1)*

Note: Award ***A1*** for correct substitution of XZ, YZ, $\sqrt{32}$ values in the cos rule. Exact values do not need to be used in the substitution.

$\left(\text{X}\hat{\text{Y}}\text{Z}=\right)$ $71.6°$ $(71.5650\ldots°)$ ***A1***

METHOD 2 (splitting isosceles triangle in half)

length of XZ is $\sqrt{80}$ $\left(4\sqrt{5}, 8.94427...\right)$ ***(A1)***

Note: Accept 8.94 and 8.9.

required angle is $\cos^{-1}\left(\frac{\sqrt{32}}{2\sqrt{80}}\right)$ ***(M1)(A1)***

Note: Award ***A1*** for correct substitution of XZ (or YZ), $\frac{\sqrt{32}}{2}$ values in the cos rule.
Exact values do not need to be used in the substitution.

$\left(X\hat{Y}Z =\right)$ $71.6°$ $(71.5650°)$ ***A1***

Note: Last ***A1*** mark may be lost if prematurely rounded values of XZ, YZ and/or XY are used.

[4 marks]

(f) (area =) $\frac{1}{2}\sqrt{80}\sqrt{32}\sin 71.5650\ldots$ **OR** (area =) $\frac{1}{2}\sqrt{32}\sqrt{72}$ ***(M1)***

$= 24 \text{ km}^2$ ***A1***

[2 marks]

(g) *Any sensible answer such as:*
There might be factors other than proximity which influence shopping choices.
A larger area does not necessarily result in an increase in population.
The supermarkets might be specialized / have a particular clientele who visit even if other shops are closer.
Transport links might not be represented by Euclidean distances.
etc. ***R1***

[1 mark]
Total [18 marks]

Question 10

(a) (i) B **A1**

(ii) F **A1**

[2 marks]

(b) correct substitution into the midpoint formula **(M1)**

$$\frac{8+5}{2}$$

$y = 6.5$ **A1**

Note: Answer must be an equation for the ***A1*** to be awarded.

[2 marks]

(c) midpoint $= (5, 7)$ **(A1)**

correct use of gradient formula **(M1)**

$$\frac{8-6}{7-3}$$

gradient of $BC = 0.5$ **(A1)**

negative reciprocal of gradient **(M1)**

perpendicular gradient $= -2$

$y - 7 = -2(x-5)$ (or $y = -2x + 17$) **A1**

[5 marks]

(d) (i) attempt to find the intersection of two perpendicular bisectors (BC & CD) **(M1)**

Note: This may be seen graphically or algebraically.

$6.5 - 7 = -2(x-5)$ **OR** $6.5 = -2x + 17$

Note: Accept equivalent methods using the perpendicular bisector of BD, $y - 5.5 = 4(x-5)$ **OR** $y = 4x - 14.5$

$x = 5.25, y = 6.5$ **OR** $(5.25, 6.5)$ **A1**

Note: The x-coordinate must be exact or expressed to at least 3 sf.

(ii) their correct substitution into distance formula **(M1)**

$$\sqrt{(5.25-7)^2 + (6.5-5)^2}$$

$= 2.30\text{ km}$ $\left(2.30488\ldots, \frac{\sqrt{85}}{4}\right)$ **A1**

[4 marks]

Total [13 marks]

Question 11

(a) (i) 19° *A1*

(ii) $\frac{\text{BD}}{\sin 120^{\circ}} = \frac{40}{\sin 19^{\circ}}$ ***(M1)(A1)***

Note: Award ***M1*** for substituted sine rule for BCD, ***A1*** for their correct substitution.

$(\text{BD} =)\ 106\ \text{m}\quad (106.401...)$ ***A1***

[4 marks]

(b) **METHOD 1 (cosine rule)**

$\cos \text{BAD} = \frac{85^2 + 85^2 - 106.401...^2}{2 \times 85 \times 85}$ ***(M1)(A1)***

Note: Award ***M1*** for substituted cosine rule, ***A1*** for their correct substitution.

77.495 ***A1***

Note: Accept an answer of 77.149 from use of 3 sf answer from part (a). The final answer must be correct to five significant figures.

METHOD 2 (right angled trig/isosceles triangles)

$\sin\left(\frac{\text{BAD}}{2}\right) = \frac{53.2008...}{85}$ ***(A1)(M1)***

Note: Award ***A1*** for $53.2008...$ seen. Award ***M1*** for correctly substituted trig ratio. Follow through from part (a).

$77.495...$ ***A1***

Note: Use of 3 sf answer from part (a), results in 77.149.

[3 marks]

(c) **EITHER**

$(\text{Area} =)\ \frac{1}{2} \times 85 \times 85 \times \sin(77^{\circ})$ ***(M1)(A1)***

Note: Award ***M1*** for substituted area formula, ***A1*** for correct substitution. Award at most ***(M1)(A1)A0*** if an angle other than 77° is used.

OR

$(\text{Area} =)\ \frac{1}{2} \times \left(2 \times 85 \times \sin(38.5^{\circ})\right) \times \left(85 \times \cos(38.5^{\circ})\right)$ ***(M1)(A1)***

Note: Award ***M1*** for substituted area formula $A = \frac{1}{2}bh$, ***A1*** for correct substitution.

$3520\ \text{m}^2\ (3519.91...)$ ***A1***

[3 marks]

(d) 85 m **A1**

[1 mark]

(e) $85+85+\frac{77}{360}\times 2\pi\times 85$ ***(M1)(M1)***

Note: Award ***M1*** for correctly substituted into $\frac{\theta}{360}\times 2\pi\times r$, ***M1*** for addition of AB and AD.

284 m (284.231...) **A1**

[3 marks]

(f) $\frac{77}{360}\times\pi\times(85)^2-3519.91\ldots$ ***(M1)(M1)***

Note: Award ***M1*** for correctly substituted area of sector formula, ***M1*** for subtraction of their area from part (c).

1330 m^2 (1334.93...) **A1**

[3 marks]
Total [17 marks]

Question 12

(a) $\frac{18-4}{2}$ **(M1)**

(a) $=7$ **A1**

[2 marks]

(b) $\frac{18+4}{2}$ **OR** $18-7$ **OR** $4+7$ **(M1)**

(d) $=11$ **A1**

[2 marks]

(c) (time between high and low tide is) 6h15m **OR** 375 minutes **(A1)**

multiplying by 2 **(M1)**

750 minutes **A1**

[3 marks]

(d) **EITHER**

$\frac{360^{\circ}}{b}=750$ **(A1)**

OR

7cos(b x 375) + 11 = 4 **(A1)**

THEN

$(b=)$ 0.48 **A1**

Note: Award ***A1A0*** for an answer of $\frac{2\pi}{750}\left(=\frac{\pi}{375}=0.00837758...\right)$

[2 marks]

(e) equating their cos function to 6 or graphing their cos function and 6

(M1)

$7\cos(0.48t)+11=6$

$\Rightarrow t=282.468...$ (minutes) **(A1)**

=4.70780… (hr) **OR** 4hr 42 mins (4hr 42.4681… mins) **(A1)**

so the time is 10:42 **A1**

[4 marks]

(f) next solution is $t = 467.531...$ ***(A1)***

$467.531... - 282.468...$

185 (mins) (185.063...) ***A1***

Note: Accept an (unsupported) answer of 186 (from correct 3 sf values for ***t***)

[2 marks]

[Total: 15 marks]

Question 13

(a) attempt to use sine rule ***(M1)***

$$\frac{\sin A\hat{B}O}{25.9} = \frac{\sin 10^\circ}{6.36}$$ ***(A1)***

45.0° $(45.0036...^\circ)$ ***A1***

Note: Accept an answer of 45° for full marks.

[3 marks]

(b) $(O\hat{A}B =)$ $124.996...^\circ$ ***(A1)***

attempt to use area of triangle formula ***(M1)***

$$\frac{1}{2} \times 25.9 \times 6.36 \times \sin(124.996...^\circ)$$ ***(A1)***

67.5 m^2 $(67.4700... \text{ m}^2)$ ***A1***

Note: Units are required. The final ***A1*** is only awarded if the correct units are seen in their answer; hence award ***(A1)(M1)(A1)A0*** for an unsupported answer of 67.5. Accept $67.4670\ldots \text{m}^2$ from use of 3 sf values.
Full follow through marks can be awarded for this part even if their $O\hat{A}B$ is not obtuse, provided that all working is shown.

[4 marks]

(c) attempt to use cosine rule ***(M1)***

$(BK =)\sqrt{12^2 + 6.36^2 - 2 \times 12 \times 6.36 \times \cos 45^\circ}$ ***(A1)***

8.75 (m) (8.74738…(m)) ***A1***

Note: Award ***(M1)(A1)(A0)*** for radian answer of 10.2 (m) (10.2109…(m)) with or without working shown.

[3 marks]

(d) **METHOD 1**

attempt to use sine rule with measurements from triangle OKX ***(M1)***

$$\frac{\text{OX}}{\sin 51.1^\circ} = \frac{22.2}{\sin 53.8^\circ}$$ ***(A1)***

$(\text{OX} =)\ 21.4\ (\text{m})\ (21.4099\ldots)(\text{m})$ ***A1***

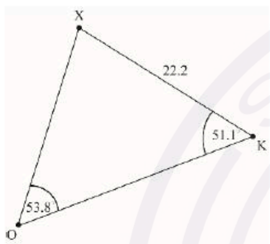
$(21.4\ (\text{m}) < 22.2\ (\text{m}))$

Odette is closer to the football / Khemil is further from the football ***A1***

Note: For the final ***A1*** to be given, $21.4\ \ (21.4099\ldots)$ must be seen. Follow through within question part for final ***A1*** for a consistent comparison with their OX.

METHOD 2

sketch of triangle OXK with vertices, angles and lengths ***(A1)***



$51.1°$ is smallest angle in triangle OXK ***R1***

opposite side (OX) is smallest length ***R1***

therefore Odette is closest ***A1***

[4 marks]

(e) attempt to use length of arc formula ***(M1)***

$$\frac{135}{360} \times 2\pi \times 12$$ ***(A1)***

$28.3\,(\text{m})\ \ (9\pi,\ 28.2743...)\ \ (\text{m})$ ***A1***

[3 marks]

Total [17 marks]

Question 14

(a) 45 (m) — ***A1***

[1 mark]

(b) (i) recognition of need to use Pythagoras theorem — ***(M1)***

$BE^2 = 32^2 + 45^2$

(BE =) 55.2 (55.2177…, $\sqrt{3049}$) (m) — ***A1***

(ii) correct use of trig ratio for $\hat{BEM}$ — ***(M1)***

$(\hat{BEM} =)\ \tan^{-1}\left(\frac{45}{32}\right)$ or equivalent

$(\hat{BEM} =)$ 54.6 (54.5829...) — ***A1***

[4 marks]

(c) attempt to use arc length formula — ***(M1)***

(arc length =) $\frac{2 \times 54.5829...}{360} \times 2\pi(55.2177\ldots)$ — ***(A1)***

(arc length =) 105 (105.206…) (m) — ***A1***

[3 marks]

(d) 59.2177… (seen anywhere) — ***(A1)***

use of area of sector formula — ***(M1)***

recognition of subtracting areas of two sectors — ***(M1)***

(area =) $\frac{109.165\ldots}{360} \times \pi\left((59.2177\ldots)^2 - (55.2177\ldots)^2\right)$

(area =) 436 (m^2) (436.068…) — ***A1***

[4 marks]

(e) multiplying their area from part (d) by 0.15 or 15 — ***(M1)***

0.15 (m) seen **OR** 4360688 (cm^2) seen — ***(A1)***

$436.068\ldots \times 0.15$ **OR** 4360688×15

65.4 (65.4103…) m^3 **OR** 65400000 (65410332) cm^3 — ***A1***

[3 marks]

[Total 15 marks]

Question 15

(a) $25\ (\text{m})$ **A1**

[1 mark]

(b) (i) recognition of need to use Pythagoras theorem **(M1)**

$BF^2 = 20^2 + 25^2$

$(BF =)\ 32.0\ \ (32.0156\ldots,\ \sqrt{1025},\ 5\sqrt{41})$ (m) **A1**

(ii) correct use of trig ratio for $B\hat{F}M$ **(M1)**

$(B\hat{F}M =)\ \tan^{-1}\left(\frac{25}{20}\right)$ or equivalent

$(B\hat{F}M =)\ 51.3\ (51.3401\ldots)$ **A1**

Note: Accept an answer of 51.4 from use of 3sf answer to part (b)(i) and then either cosine rule or inverse sine.

[4 marks]

(c) attempt to use arc length formula **(M1)**

(arc length =) $\frac{2\times 51.3401\ldots}{360}\times 2\pi(32.0156\ldots)$ **(A1)**

(arc length =) $57.4\ \ (57.3755\ldots)$ (m) **A1**

Note: Accept 57.3 from use of 3 sf. values of their answers from parts (b)(i) and (b)(ii).

[3 marks]

(d) $34.0156\ldots$ (seen anywhere) **(A1)**

use of area of sector formula **(M1)**
recognition of subtracting areas of two sectors **(M1)**

(area =) $\frac{102.680\ldots}{360}\times\pi\left((34.0156\ldots)^2-(32.0156\ldots)^2\right)$

(area =) $118\ (\text{m}^2)\ \ (118.335\ldots)$ **A1**

[4 marks]

(e) multiplying their area from part (d) by 0.12 or 12 **(M1)**

0.12 (m) seen **OR** $1183350\ (\text{cm}^2)$ seen **(A1)**

$118.335\ldots\times 0.12$ **OR** 1183350×12

$14.2\ \ (14.2002\ldots)\ \text{m}^3$ **OR** $14200000\ (14200236)\ \text{cm}^3$ **A1**

[3 marks]
[Total 15 marks]

Question 16

(a) (i) correct approach to find missing length **(A1)**

$\sqrt{4^2-1^2}\quad(=\sqrt{15})$

attempt to find cross-section **(M1)**

e.g. use of area of trapezoid formula or rectangle+triangle or rectangle – triangle

use of volume of prism formula **(M1)**

(their cross-section multiplied by 3)

$$3\left[\frac{1}{2}(10+11)\left(\sqrt{4^2-1^2}\right)\right]$$

$=122\,(\text{m}^3)\;\;(121.998\ldots)$ **A1**

(ii) correct approach to find missing height **(A1)**

$\sqrt{4^2-3.2^2}\quad(=2.4)$

attempt to find volume **(M1)**

(multiplication by 3.2 and 3 seen)

$$3\left[\frac{1}{2}\left(10+10+\sqrt{4^2-3.2^2}\right)(3.2)\right]$$

$=108\,(\text{m}^3)\;\;(107.52\ldots)$ **A1**

(iii) correct approach to find missing lengths **(A1)**

$\sin(60^\circ)$ and $\cos(60^\circ)$ **OR** $\sin(60^\circ)$ and Pythagoras etc seen in work

$$3\left[\frac{1}{2}(10+10+4\cos(60^\circ))\,4\sin(60^\circ)\right]$$

$=114\,(\text{m}^3)\;\;(114.315\ldots)$ **A1**

[9 marks]

(b) $V=3\left[\frac{1}{2}(10+10+4\cos(\theta))\,4\sin(\theta)\right]$ **A1**

all correct intermediate working leading to given answer **A1**

e.g. $V=6\sin(\theta)(20+4\cos(\theta))$

$V=24\sin(\theta)(5+\cos(\theta))$ **AG**

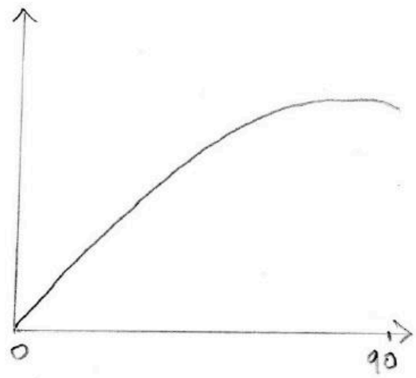
Note: The ***AG*** line must be seen for the final ***A1*** to be awarded.

[2 marks]

(c) *accept any reasoning along the lines:* "skip would have zero volume" or "if the angle is zero, then the contents would fall out" **R1**

[1 mark]

(d) (i)



A1A1

Note:	Award ***A1*** for the correct shape and ***A1*** for the graph on the correct, labelled, domain. Condone omission of θ / V labels (or x/y).

(ii) $\theta = 79.3^\circ$ $(79.2723...^\circ)$ $(1.38$ $(1.38356...))$, $V_{\max} = 122$ $(122.292...)$ ***A1A1***

Note:	Award ***A0A1*** if values are reversed and ***A0A0*** for a coordinate pair.

[4 marks]

[Total: 16 marks]

Question 17

(a) $\text{BC} = 20\ (\text{m})$ **_A1_**

[1 mark]

(b) use of Pythagoras **_(M1)_**

$\text{AB} = \sqrt{12^2 + 4^2}$

$= 12.6\ (\text{m})\quad (12.6491\ldots,\ \sqrt{160})$ **_A1_**

[2 marks]

(c) **METHOD 1 – finding angle ABC**

correct use of a trig ratio to find $\text{A}\hat{\text{B}}\text{C}$ (or finding the bearing of B from A) **_(A1)_**

e.g. $\tan\left(\text{A}\hat{\text{B}}\text{C}\right) = \dfrac{12}{4}$, $\cos \text{A}\hat{\text{B}}\text{C} = \dfrac{20^2 + 12.649^2 - 20^2}{2 \times 20 \times 12.649}$, $\cos \text{A}\hat{\text{B}}\text{C} = \dfrac{6.3245}{20}$

$\text{A}\hat{\text{B}}\text{C} = 71.6\ (71.5650\ldots)$ **_(A1)_**

Note: Angle $\text{A}\hat{\text{B}}\text{C}$ can be 71.5 or 72.2 depending on their working out. Bearings should be given in degrees.

$180 + 71.5650\ldots = 252°\quad (251.565\ldots)$ **_A1_**

Note: The final ***A1*** can be awarded for 180 plus their 71.6. If radians used, award ***A1A1*** for 1.24904… or 4.39063… seen, and then ***A0*** for the radian answer.

METHOD 2 – finding angle that AB makes with the horizontal (angle *H*)

correct use of a trig ratio to find H, the angle AB makes with horizontal **_(A1)_**

e.g. $\tan \hat{H} = \dfrac{4}{12}$, $\cos \hat{H} = \dfrac{12^2 + 12.649^2 - 4^2}{2 \times 12 \times 12.649}$

$\hat{H} = 18.4\ (18.4349...)$ **_(A1)_**

Note: Accept 18.5 (18.5078…) from use of 3sf answer from part (b). Bearings should be given in degrees.

$270 - 18.4348... = 252°\quad (251.565\ldots)$ **_A1_**

Note: The final ***A1*** can be awarded for 270 minus their 18.4. If radians used, award ***A1A1*** for 0.321750… or 4.39063… seen, and then ***A0*** for the radian answer.

[3 marks]

(d) (i) $-\frac{4}{3}$ $\left(-\frac{16}{12}\right)$ ***A1***

(ii) $(6, 8)$ ***A1A1***

Note: Award ***A1A0*** if parentheses are missing.

(iii) gradient of (their) perp line = $\frac{3}{4}$ ***(M1)***

equation of perpendicular bisector of AC ***(A1)***

e.g. $(y-8)=\frac{3}{4}(x-6)$ **OR** $y=\frac{3}{4}x+3.5$

EITHER

equation of perpendicular bisector of BC is $y=10$ ***(A1)***

OR

equation of perpendicular bisector of AB is $y=-3x+36$ ***(A1)***

Note: The ***A1*** is for either equation of perpendicular bisector of BC or AB.

point of intersection $\left(8\frac{2}{3}, 10\right)$ **OR** $(8.67, 10)$ $\left[(8.666\ldots, 10)\right]$ ***(M1)A1***

Note: Award ***M1*** for an attempt to equate their perpendicular bisectors
Award the final ***A1*** for the correct coordinate pair – parentheses omitted or not.

[8 marks]
[Total: 14 marks]

Question 18

(a) attempt to use Pythagoras' theorem **(M1)**

$\sqrt{3.4^2 - 2^2}$

$= 2.75\ (2.74954\ldots)$ (m) **A1**

[2 marks]

(b) (i) **METHOD 1** (Use of $\frac{1}{2} \times a \times b \times \sin(\theta)$)

$60°$ ***(A1)***

attempt to find area of one triangle using $\frac{1}{2} \times a \times b \times \sin(\theta)$ ***(M1)***

$\frac{1}{2} \times 2 \times 2 \times \sin(60°)$

$\left(6 \times \frac{1}{2} \times 2 \times 2 \times \sin(60°)\right) = 10.4\ (10.3923\ldots,\ 6\sqrt{3})\ (\text{m}^2)$ ***A1***

Note: Award ***A0M0A0*** for $\frac{1}{2} \times 2 \times 2$ or equivalent.

METHOD 2 (Use of altitude)

(altitude is) $\sqrt{3}$ ***(A1)***

attempt to find the area of one triangle using $\frac{1}{2} \times b \times h$ with their altitude. ***(M1)***

$\frac{1}{2} \times 2 \times \sqrt{3}$

$\left(6 \times \frac{1}{2} \times 2 \times \sqrt{3}\right) = 10.4\ (10.3923\ldots,\ 6\sqrt{3})\ (\text{m}^2)$ ***A1***

Note: Award ***A0M0A0*** for $\frac{1}{2} \times 2 \times 2$ or equivalent.

METHOD 3 (Finding the area of a trapezoid)

(altitude of one trapezoid is) $\sqrt{3}$ ***(A1)***

attempt to find area of one trapezoid using $\frac{1}{2} \times (a+b)h$ ***(M1)***

$\frac{1}{2} \times (2+4)\sqrt{3}\quad \left(3\sqrt{3}\right)$

$\left(2 \times \frac{1}{2} \times (2+4)\sqrt{3}\right) = 10.4\ (10.3923\ldots,\ 6\sqrt{3})\ (\text{m}^2)$ ***A1***

(ii) $\frac{1}{3} \times 10.3923... \times 2.74954...$ ***(A1)***

$= 9.52 \text{ m}^3$ $(9.52470\ldots)$ ***A1***

Note: Units must be seen.

[5 marks]

(c) $\cos(\hat{MAT}) = \frac{2}{3.4}$ or correct equivalent ***(A1)***

$(\hat{MAT} =)$ $54.0°$ $(53.9681\ldots)$ ***A1***

[2 marks]

(d) Angle $YAX = 180 - 53.9681... = 126.031\ldots°$ ***(A1)***

Angle $YXA = 180 - 35 - 126.031... = 18.9681\ldots°$ ***(A1)***

Note: These angles may be seen in the sine rule.

Attempt to substitute into sine rule ***(M1)***

$$\frac{AY}{\sin(18.9681...)} = \frac{2.6}{\sin(126.031)}$$

$AY = 1.05$ $(1.04503\ldots)$ (m) ***A1***

[4 marks]

(e) attempt to substitute into cosine rule to form a quadratic for YZ ***(M1)***

$0.9^2 = YZ^2 + 1.04503...^2 - 2 \times 1.04503... \times YZ \times \cos(35)$ ***(A1)***

$YZ = 0.185$ $(0.184692\ldots)$ (m), 1.53 $(1.52739\ldots)$ (m) ***A1A1***

[4 marks]

[Total: 17 marks]

Question 19

(a) (i) $\frac{45-8}{2}$ **A1**

18.5 (m) **AG**

Note: Use of 18.5 in the calculation is reverse engineering, and falls short of the demand of the command term "Show that'. In such cases, award ***A0***.

(ii) $(2\pi \times 18.5 =)\ 116\ \ (116.2389\ldots,\ 37\pi)\ \text{(m)}$ **A1**

[2 marks]

(b) recognition the distance is the arc length ***(M1)***

$\frac{10°}{360°} \times 2\pi \times 18.5$ **OR** $\frac{116.2389\ldots}{36}$ ***(A1)***

$= 3.23\ \left(3.228859\ldots,\ \frac{37\pi}{36}\right)\ \text{(m)}$ ***A1***

[3 marks]

(c) (i) $\left(b = \frac{360}{15} =\right)\ 24$ ***A1***

(ii) $\frac{\text{max+min}}{2}$ ***(A1)***

$(d =)\ \frac{45+8}{2}$ **OR** $45 - 18.5$ **OR** $8 + 18.5$

$= 26.5$ ***A1***

(iii) $h(t) = 18.5\sin(24t) + 26.5$ ***A1A1***

Note: Award ***A1*** for 18.5 seen as parameter a, ***A1*** for a completely correct equation (including LHS).

[5 marks]

(d) attempt to equate 33 with $h(t)$ **OR** sketch graph of curve and line ***(M1)***

$h(t)(= 18.5\sin(24t) + 26.5) = 33$

$t = 0.857\ \ (0.857083\ldots)$ and $t = 6.64\ \ (6.64291\ldots)$ (minutes) ***A1A1***

[3 marks]

(e) 4 (revolutions per hour) seen **OR** 32 (revolutions per day) seen ***(A1)***

$(4 \times 8 \times 3000 =)\ 96000$ ***(A1)***

9.6×10^4 ***A1***

[3 marks]

[Total 16 marks]

Question 20

(a) $(2, 2)$ **A1**

> **Note:** Award ***A0*** if paretheses are omitted.

[1 mark]

(b) (i) attempt to use midpoint formula (at least one correct) ***(M1)***

$$\left(\frac{9+10}{2}, \frac{0+6}{2}\right)$$

$(9.5, 3)$ ***A1***

(ii) $\left(m=\frac{6-0}{10-9}=\right)6$ ***(A1)***

finding negative reciprocal of their gradient ***(M1)***

$$m_{\perp}=-\frac{1}{6}$$

attempt to substitute their midpoint and their gradient into equation of straight line ***(M1)***

eg. $y-3=-\frac{1}{6}\left(x-\frac{19}{2}\right)$ **OR** $3=-\frac{1}{6}(9.5)+c$

$y=-\frac{1}{6}x+\frac{55}{12}$ **OR** $y=-0.167x+4.58$ $\left(y=-0.166666...x+4.58333...\right)$ ***A1***

> **Note:** Substituting $m=6$ (no negative reciprocal) and their point into the equation of straight line would receive at most ***A1M0M1A0***.

[6 marks]

Question 21

(a) attempt to use Pythagoras' theorem **(M1)**

$\sqrt{4.2^2 - 3^2}$

$= 2.94$ (2.93938…) (m) **A1**

[2 marks]

(b) (i) **METHOD 1** (Use of $\frac{1}{2} \times a \times b \times \sin(\theta)$)

60° ***(A1)***

attempt to find area of one triangle using $\frac{1}{2} \times a \times b \times \sin(\theta)$ ***(M1)***

$\frac{1}{2} \times 3 \times 3 \times \sin(60°)$

$\left(6 \times \frac{1}{2} \times 3 \times 3 \times \sin(60°)\right) = 23.4 \ \left(23.3826..., \frac{27\sqrt{3}}{2}\right)$ (m^2) ***A1***

Note: Award ***A0M0A0*** for $\frac{1}{2} \times 3 \times 3$ or equivalent.

METHOD 2 (Use of altitude)

(altitude is) $\frac{3}{2}\sqrt{3}$ (2.59807…) ***(A1)***

attempt to find area of one triangle using $\frac{1}{2} \times b \times h$ with their altitude ***(M1)***

$\frac{1}{2} \times 3 \times \frac{3}{2}\sqrt{3}$

$\left(6 \times \frac{1}{2} \times 3 \times \frac{3}{2}\sqrt{3}\right) = 23.4 \left(23.3826\ldots, \frac{27\sqrt{3}}{2}\right)$ (m^2) ***A1***

Note: Award ***A0M0A0*** for $\frac{1}{2} \times 2 \times 2$ or equivalent.

METHOD 3 (Finding the area of a trapezoid)

(altitude of one trapezoid is) $\frac{3}{2}\sqrt{3}$ (2.59807…) ***(A1)***

attempt to find area of one trapezoid using $\frac{1}{2} \times (a+b)h$ ***(M1)***

$\frac{1}{2}(3+6)\left(\frac{3}{2}\sqrt{3}\right)$ **OR** $\frac{27}{4}\sqrt{3}$

$\left(2 \times \frac{1}{2}(3+6)\left(\frac{3}{2}\sqrt{3}\right)\right) = 23.4 \left(23.3826\ldots, \frac{27\sqrt{3}}{2}\right)$ (m^2) ***A1***

(ii) $\frac{1}{3} \times 23.3826... \times 2.93938...$ ***(A1)***

$= 22.9\text{ m}^3\ (22.9102\ldots)$ ***A1***

Note: Units must be seen.

[5 marks]

(c) $\cos(\text{O}\hat{\text{A}}\text{T}) = \frac{3}{4.2}$ or correct equivalent ***(A1)***

$(\text{O}\hat{\text{A}}\text{T} =)\ 44.4°\quad (44.4153\ldots,\ 0.775193\ldots$ radians$)$ ***A1***

[2 marks]

(d) Angle $\text{QAP} = 180 - 44.4... = 135.584\ldots°$ ***(A1)***

Angle $\text{QPA} = 180 - 30 - 135.584... = 14.4153\ldots°$ ***(A1)***

Note: These angles may be seen in the sine rule.

Attempt to substitute into sine rule ***(M1)***

$$\frac{\text{AQ}}{\sin(14.4153...)} = \frac{3.5}{\sin(135.584\ldots)}$$

$\text{AQ} = 1.25\quad (1.24500\ldots)\ (\text{m})$ ***A1***

Note: Accept 1.24, from use of a 3sf value for $\text{Q}\hat{\text{A}}\text{P}$ and $\text{Q}\hat{\text{P}}\text{A}$.

[4 marks]

(e) attempt to substitute into cosine rule to form a quadratic for QR ***(M1)***

$0.8^2 = \text{QR}^2 + 1.24500...^2 - 2 \times 1.24500... \times \text{QR} \times \cos(30)$ ***(A1)***

$\text{QR} = 0.576\ (0.575717\ldots)\ (\text{m}),\ 1.58\ \ (1.58068\ldots)\ (\text{m})$ ***A1A1***

[4 marks]

[Total: 17 marks]

Question 22

(a) (i) $\frac{45-8}{2}$ **A1**

18.5 (m) **AG**

Note:	Use of 18.5 in the calculation is reverse engineering, and falls short of the demand of the command term "Show that'. In such cases, award ***A0***.

(ii) $(2\pi\times 18.5=)\ 116\ \ (116.2389\ldots,\ 37\pi)\ (\text{m})$. **A1**

[2 marks]

(b) recognition the distance is the arc length ***(M1)***

$\frac{10°}{360°}\times 2\pi\times 18.5$ **OR** $\frac{116.2389\ldots}{36}$ ***(A1)***

$=3.23\ \left(3.228859\ldots,\ \frac{37\pi}{36}\right)(\text{m})$ ***A1***

[3 marks]

(c) (i) $\left(b=\frac{360}{15}=\right)\ 24$ ***A1***

(ii) $\frac{\text{max}+\text{min}}{2}$ ***(A1)***

$(d=)\ \frac{45+8}{2}$ **OR** $45-18.5$ **OR** $8+18.5$

$=26.5$ ***A1***

(iii) $h(t)=18.5\sin(24t)+26.5$ ***A1A1***

Note:	Award ***A1*** for 18.5 seen as parameter a, ***A1*** for a completely correct equation (including LHS).

[5 marks]

(d) attempt to equate 33 with $h(t)$ **OR** sketch graph of curve and line ***(M1)***

$h(t)(=18.5\sin(24t)+26.5)=33$

$t=0.857\ \ (0.857083\ldots)$ and $t=6.64\ \ (6.64291\ldots)$ (minutes) ***A1A1***

[3 marks]

(e) 4 (revolutions per hour) seen **OR** 32 (revolutions per day) seen ***(A1)***

$(4\times 8\times 3000=)\ 96000$ ***(A1)***

9.6×10^{4} ***A1***

[3 marks]

[Total 16 marks]

Question 23

(a) $(2, 6)$ ***A1***

Note: Award ***A0*** if parentheses are omitted.

[1 mark]

(b) (i) attempt to use midpoint formula (at least one correct) ***(M1)***

$$\left(\frac{11+12}{2}, \frac{0+6}{2}\right)$$

$(11.5,\ 3)$ ***A1***

(ii) $\left(m = \frac{6-0}{12-11} =\right) 6$ ***(A1)***

finding negative reciprocal of their gradient ***(M1)***

$$m_{\perp} = -\frac{1}{6}$$

attempt to substitute their midpoint and their gradient into equation of straight line ***(M1)***

eg. $y-3=-\frac{1}{6}\left(x-\frac{23}{2}\right)$ **OR** $3=-\frac{1}{6}(11.5)+c$

$y=-0.167x+4.92\left(y=-0.166666\ldots x+4.91666\ldots, y=-\frac{1}{6}x+\frac{59}{12}\right)$ ***A1***

Note: Substituting $m=6$ (no negative reciprocal) and their point into the equation of straight line would receive at most ***A1M0M1A0***.

[6 marks]