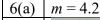
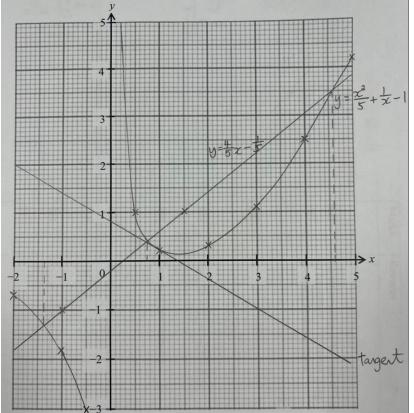
NCH	S 2024 EM Paper 2 Solutions		
1	$(a) \frac{9a^2 - 4b^2}{3ap + 6aq - 4bq - 2bp}$ $= \frac{(3a + 2b)(3a - 2b)}{(3ap + 6aq) - (2bp + 4bq)}$ $= \frac{(3a + 2b)(3a - 2b)}{3a(p + 2q) - 2b(p + 2q)}$ $= \frac{(3a + 2b)(3a - 2b)}{(p + 2q)(3a - 2b)}$ $= \frac{3a + 2b}{p + 2q}$	(b) $\frac{x}{6-7x-5x^2} + \frac{1}{5x}$ $= \frac{x}{-(5x-3)(x+2)} + \frac{-x+2(2+x)}{(5x-3)(x+2)}$ $= \frac{-x+4+2x}{(5x-3)(x+2)}$ $= \frac{x+4}{(5x-3)(x+2)}$	$\frac{2}{x-3}$ $\frac{2}{5x-3}$
1(c)	$ \frac{-\frac{1}{2} < \frac{2y}{5} - \frac{1+y}{3} \le \frac{5}{6}}{-\frac{1}{2} < \frac{3(2y) - 5(1+y)}{15}} and \frac{3(2y) - 5(1+y)}{15} \le \frac{5}{6} \\ -\frac{1}{2} < \frac{6y - 5 - 5y}{15} \qquad \frac{6y - 5 - 5y}{15} \le \frac{5}{6} \\ -\frac{1}{2} < \frac{y - 5}{15} \qquad \frac{y - 5}{15} \le \frac{5}{6} \\ -15 < 2(y - 5) \qquad y - 5 \le \frac{25}{2} \\ -15 < 2y - 10 \qquad y \le 17\frac{1}{2} $		
2(a)	$\frac{r}{19} = \frac{25}{40}$ $r = \frac{25}{40} \times 19$ $= 11.875$ $V = \frac{1}{3}\pi (11.875)^{2} (25)$ $= 3691.78 cm^{3}$ $= 3.69 \ litres$		40
(b)	Method 1 Volume of container = $\frac{1}{3}\pi(19)^2(40)$ $\left(\frac{h_1}{h_2}\right)^3 = \frac{V_1}{V_2}$ $\left(\frac{h_1}{40}\right)^3 = \frac{\frac{1}{3}\pi(19)^2(40) - \frac{1}{3}\pi(11.875)^2(25)}{\frac{1}{3}\pi(19)^2(40)}$ $\frac{h_1}{40} = \sqrt[3]{\frac{(19)^2(40) - (11.875)^2(25)}{(19)^2(40)}}$ $h_1 = 40 \times \sqrt[3]{\frac{(19)^2(40) - (11.875)^2(25)}{(19)^2(40)}}$ $= 36.437$ Depth of water = $40 - 36.437$ $= 3.56 cm (3sf)$		h_1 h_2
	Method 2 $ \frac{r_1}{19} = \frac{h_1}{40} $ $ r_1 = \frac{19}{40}h_1 $ $ \frac{1}{3}\pi(19)^2(40) - \frac{1}{3}\pi(r_1)^2(h_1) = 3691.78 $ $ \frac{1}{3}\pi(r_1)^2(h_1) = 11429.75 $		h_I r_I 40

_		
	$\left(\frac{19}{40}h_1\right)^2(h_1) = 10914.61$	
	$\left(\frac{-n_1}{40}n_1\right) (n_1) = 10914.01$	
	$h_1^3 = 48375.00277$	
	$h_1 = 36.437$	
	Depth of water = $40 - 36.437$	
	=3.56 cm (3sf)	
3(a)	$\frac{108888 - 100176.96}{108888} \times 100\%$	
	= 8%	
(b)	Balance owed = $\frac{85}{100} \times 108888$	
	=**	
	= \$92554.80	
	Interest = $\frac{92554.80 \times 2.98 \times 5}{100}$	
	= \$13790.6652	
	Monthly instalment = $\frac{92554.80 + 13790.6652}{5 \times 12}$	
	= \$1772.42 (2dp)	
(-)		
(c)	P = 108888 - 18888	
	= \$90000	
	$A = 960 \times 10 \times 12$	
	= \$115200	
	$A = P\left(1 + \frac{R}{100}\right)^n$	
	, = * * /	
	$115200 = 90000 \left(1 + \frac{R}{100}\right)^{10}$	
	$\left(1 + \frac{R}{100}\right)^{10} = \frac{115200}{90000}$	
	$\left(1 + \frac{1}{100}\right) = \frac{1}{90000}$	
	$1 + \frac{R}{100} = \sqrt[10]{\frac{115200}{90000}}$	
	/ 50000	
	$R = 100 \left(\sqrt[10]{\frac{115200}{90000}} - 1 \right)$	
	$1 - 100 \left(\sqrt{90000} \right)$	
	= 2.499	
	= 2.50 (3sf)	
4(a)	(1.20)	
4(a)	1	
	$Q = \left(1.50\right)$	
	\0.95/	
(b)	$(60 \ 68 \ 55) (1.20)$	
	$R = (49 \ 56 \ 71)(1.50)$	
	\53 70 80/\0.95/	
	/226.25\	
	= (210.25)	
	244.60/	
(c)	The elements in R represent the total cost of baking c	caramel.
(-)	strawberry and mint cupcakes in outlet A, B and C	
	respectively	
(1)		-41 - 12
(d)		ethod 2
		ofit for each type of cupcake
	$\begin{pmatrix} 3 & 0 & 0 \\ \end{pmatrix} \begin{pmatrix} 1.20 \\ \end{pmatrix}$	$\begin{pmatrix} 2 & 0 & 0 \end{pmatrix} \begin{pmatrix} 1.20 \end{pmatrix}$
	= (0 2.5 0)(1.50)	(0 1.5 0)(1.50)
	$\binom{0}{0} \binom{0}{4} \binom{0.95}{0}$	$\binom{0}{0} = \binom{3}{0.95}$
	(3.60)	(2.40)
	= (3.75)	(2.25)
	$\frac{1}{3.80}$	(2.85)
	.5100	
	·	

	Profit earned in a week $= \begin{pmatrix} 60 & 68 & 55 \\ 49 & 56 & 71 \\ 53 & 70 & 80 \end{pmatrix} \begin{pmatrix} 3.60 \\ 3.75 \\ 3.80 \end{pmatrix} - \begin{pmatrix} 226.25 \\ 210.25 \\ 244.60 \end{pmatrix}$ $= \begin{pmatrix} 680 \\ 656.20 \\ 757.30 \end{pmatrix} - \begin{pmatrix} 226.25 \\ 210.25 \\ 244.60 \end{pmatrix}$ $= \begin{pmatrix} 453.75 \\ 445.95 \\ 512.70 \end{pmatrix}$ Total Profit earned in a month $= 4 \begin{bmatrix} (1 & 1 & 1) \begin{pmatrix} 453.75 \\ 445.95 \\ 512.70 \end{pmatrix} \end{bmatrix}$ $= 4(1412.40)$ $= (5649.60)$ Total Profit = \$5649.60	Profit earned in a week $= \begin{pmatrix} 60 & 68 & 55 \\ 49 & 56 & 71 \\ 53 & 70 & 80 \end{pmatrix} \begin{pmatrix} 2.40 \\ 2.25 \\ 2.85 \end{pmatrix}$ $= \begin{pmatrix} 453.75 \\ 445.95 \\ 512.70 \end{pmatrix}$ Total Profit earned in a month $= 4 \begin{bmatrix} (1 & 1 & 1) \begin{pmatrix} 453.75 \\ 445.95 \\ 512.70 \end{pmatrix} \end{bmatrix}$ $= 4(1412.40)$ $= (5649.60)$ Total Profit = \$5649.60	
5(a)	$\frac{WY}{\sin 102.6^{\circ}} = \frac{12.5}{\sin 34^{\circ}}$ $WY = \frac{12.5}{\sin 34^{\circ}} \times \sin 102.6^{\circ}$ $= 21.815$ $XY^{2} = 10.3^{2} + 21.815^{2} - 2(10.3)(21.815)(\cos XY) = 16.306 \text{or} -16.306(NA)$ $= 16.3 (3sf)$	s 45.3°)	
(b)	Method 1 $\angle N_1WZ = 102.6^\circ + 34^\circ (ext \angle of \Delta)$ $= 136.6^\circ$ $\angle WZN_2 = 180^\circ - 136.6^\circ (int \angle, N_1W//N_2Z)$ $= 43.4^\circ$ Bearing of W from $Z = 360^\circ - 43.4^\circ (\angle at a)$ $= 316.6^\circ$ Method 2 $\angle YWZ = 180^\circ - (34^\circ + 102.6^\circ) (\angle sum of \Delta)$	W 45.3°	
	= 43.4° $\angle WZN_2 = 43.4^{\circ} (alt \angle, N_1W//N_2Z)$ Bearing of W from $Z = 360^{\circ} - 43.4^{\circ} (\angle at a)$ = 316.6°	34°	
(c)	$\angle YWZ = 43.4^{\circ} \ (alt \ \angle, N_1Y//N_2Z)$ $l = 12.5 \sin 43.4^{\circ} \text{OR} \frac{1}{2} \times 21.815 \times l = \frac{1}{2} \times 12.5 \times 21.815 \times \sin 43.4^{\circ}$ $= 8.5886 \qquad \qquad l = 8.5886$ Let the greatest angle of elevation be θ $\tan \theta = \frac{8-1.9}{12.5 \sin 43.4^{\circ}}$ $\theta = 35.38^{\circ}$ $= 35.4^{\circ}$ 1.9 0 8.5886 21.815		







- Draw tangent at (1, 0.2)(c)
 - Gradient = -0.5 to -0.7

(d)
$$x^2 + \frac{5}{3} - 4x - 4 = 0$$

$$\frac{x^2}{5} + \frac{1}{x} - \frac{4}{5}x - \frac{4}{5} = 0$$

Gradient = -0.5 to -0.

$$x^{2} + \frac{5}{x} - 4x - 4 = 0$$

$$\frac{x^{2}}{5} + \frac{1}{x} - \frac{4}{5}x - \frac{4}{5} = 0$$

$$\frac{x^{2}}{5} + \frac{1}{x} - 1 = \frac{4}{5}x - \frac{1}{5}$$

$$y = \frac{4}{5}x - \frac{1}{5}$$
Plot graph of $x = \frac{4}{5}x =$

$$y = \frac{4}{5}x - \frac{1}{5}$$

Plot graph of $y = \frac{4}{5}x - \frac{1}{5}$ $x = -1.35 \pm 0.05$ or 0.75 ± 0.05 or 4.6 ± 0.05

Method 1 7(a)

 $\angle BRC = \angle PRQ \ (common \ \angle)$

$$\frac{CR}{OR} = \frac{1}{2}$$
 (C is midpt of QR)

 $\frac{CR}{QR} = \frac{1}{2} \quad (C \text{ is midpt of } QR)$ $\frac{BR}{PR} = \frac{1}{2} \quad (diagonals \text{ of parallelogram bisect each other})$

 ΔRBC and ΔRPQ are similar (SAS Similarity)

Method 2

Since diagonals of a parallelogram bisect each other, B is the midpoint of PR.

In addition C is given as the midpoint of QR, using midpoint theorem, BC is parallel to PQ.

$$\angle BRC = \angle PRQ \ (common \ \angle)$$

$$\angle BCR = \angle PQR \ (corresponding \ \angle, BC//PQ)$$

 ΔRBC and ΔRPQ are similar (AA Similarity)

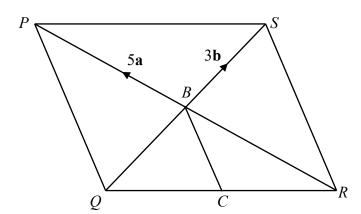
Without
$$\overrightarrow{PC} = \overrightarrow{PQ} + \overrightarrow{QC}$$

$$= (\overrightarrow{PB} + \overrightarrow{BQ}) + \frac{1}{2}\overrightarrow{QR}$$

$$= -5\boldsymbol{a} - 3\boldsymbol{b} + \frac{1}{2}(-5\boldsymbol{a} + 3\boldsymbol{b})$$

$$= -\frac{15}{2}\boldsymbol{a} - \frac{3}{2}\boldsymbol{b}$$

$$= -\frac{3}{2}(5\boldsymbol{a} + \boldsymbol{b}) \quad (Shown)$$



Method 2

$$\overrightarrow{PC} = \overrightarrow{PB} + \overrightarrow{BC}$$

$$= \overrightarrow{PB} + \frac{1}{2}\overrightarrow{PQ}$$

$$= -5a + \frac{1}{2}(-5a - 3b)$$

$$= -\frac{15}{2}a - \frac{3}{2}b$$

$$= -\frac{3}{2}(5a + b) (Shown)$$
Method 1

(c)

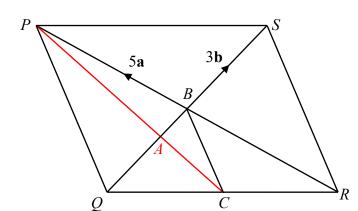
$$\overrightarrow{AQ} = \frac{2}{3}(-3b)$$

$$= -2b$$

$$\overrightarrow{AC} = \overrightarrow{AQ} + \overrightarrow{QC}$$

$$= -2b + \frac{1}{2}(-5a + 3b)$$

$$= -\frac{5}{2}a - \frac{1}{2}b \quad or \quad -\frac{1}{2}(5a + b)$$



Method 2

$$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$$

$$= \mathbf{b} + \frac{1}{2}(-5\mathbf{a} - 3\mathbf{b})$$

$$= -\frac{5}{2}\mathbf{a} - \frac{1}{2}\mathbf{b} \qquad \mathbf{or} \qquad -\frac{1}{2}(5\mathbf{a} + \mathbf{b})$$

 \therefore C is a common point, P, A and C are collinear.

Method 1 (e)

BC//PQ (ΔRBC and ΔRPQ are similar)

Area
$$\triangle BPQ = \frac{1}{2} \times PQ \times h$$
 or $Area \triangle PBC = \frac{1}{2} \times BC \times h$
= $Area \triangle CPQ$ = $Area \triangle QBC$

Since $\triangle APQ$ is common area or $\triangle ABC$ is common area

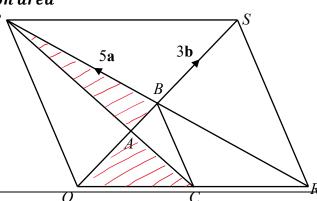
 \therefore Area $\triangle PAB$ and Area $\triangle QAC$ are the same

Method 2

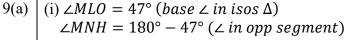
$$\angle PAB = \angle QAC \ (vert \ opp \ \angle)$$

$$\frac{AB}{QA} = \frac{1}{2} \ (from \ (c)) \quad \& \quad \frac{PA}{AC} = \frac{2}{1} \ (from \ (d))$$

$$\frac{Area \, \Delta PAB}{Area \, \Delta QAC} = \frac{\frac{1}{2} \times PA \times AB \times \sin \angle PAB}{\frac{1}{2} \times QA \times AC \times \sin \angle QAC}$$
$$= \frac{PA}{AC} \times \frac{AB}{QA}$$



		2 1			
		$=\frac{2}{1}\times\frac{1}{2}$			
Method 3 Area of ΔPAB Area of ΔPAB Area of ΔPAB $= \frac{1}{4} \times PAX \times h_1}{\frac{1}{4} \times PAX \times h_1}{\frac{1}{4} \times PAX \times h_2}{\frac{1}{4} \times PAX \times h_2}}$ $= \frac{1}{4} \times AC \times h_1}{\frac{1}{4} \times AC \times h_2}$ $= \frac{1}{4} \times AC \times h_2$ $= \frac{1}{4} \times \frac{AB}{AC}$ $= \frac{1}{4} \times \frac{1}{2}$ $= \frac{1}{1}$ $\therefore Area \Delta DABB and Area \Delta QAC are the same$ (f) (i) $\frac{Area of \Delta ABC}{Area of \Delta ABC} = \frac{1}{3}$ (ii) $\frac{Area of \Delta ABC}{Area of \Delta RPQ} = \frac{1}{Area of \Delta QBC} \times \frac{Area of \Delta QBC}{Area of \Delta QBC} \times \frac{Area of \Delta RBC}{Area of \Delta RBC} \times \frac{Area of \Delta RBC}{Area of \Delta RBC}$ $\frac{1}{4} \times \frac{1}{4} \times \left(\frac{1}{2}\right)^2$ $= \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $= \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $= \frac{1}{12}$ 8(a) (iii) Median Length = 10.6 cm (iii) Q1 position = 200th Q3 position = 600th Q1 = 9.95 Q3 = 11.25 or 11.2 Interquartile Range = 11.25 - 9.95 or 11.2 - 9.95 = 1.3 cm or 1.25 cm (b) $Percentage = \frac{15 + 25}{800} \times 100\% \text{ or } \frac{20 + 25}{800} \times 100\%$ $= 5\% \text{ or } 5.625\%$ (c) Lobsters caught in June are shorter in length as the median length of 9.3 cm is lower as compared to 10.6 cm in May. The lengths of the lobsters caught in June has a wider spread as its ITR of 3.7 cm is higher as compared to 1.3 cm in May. I disagree with Jill as 25% of lobsters needed to be released in June because they are shorter than 8.3 cm which is higher as compared to the total percentage released of 5.625% in May. Or I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as		1 2			
Method 3 Area of ΔPAB Area of ΔPAB Area of ΔPAB $= \frac{1}{4} \times PAX \times h_1}{\frac{1}{4} \times PAX \times h_1}{\frac{1}{4} \times PAX \times h_2}{\frac{1}{4} \times PAX \times h_2}}$ $= \frac{1}{4} \times AC \times h_1}{\frac{1}{4} \times AC \times h_2}$ $= \frac{1}{4} \times AC \times h_2$ $= \frac{1}{4} \times \frac{AB}{AC}$ $= \frac{1}{4} \times \frac{1}{2}$ $= \frac{1}{1}$ $\therefore Area \Delta DABB and Area \Delta QAC are the same$ (f) (i) $\frac{Area of \Delta ABC}{Area of \Delta ABC} = \frac{1}{3}$ (ii) $\frac{Area of \Delta ABC}{Area of \Delta RPQ} = \frac{1}{Area of \Delta QBC} \times \frac{Area of \Delta QBC}{Area of \Delta QBC} \times \frac{Area of \Delta RBC}{Area of \Delta RBC} \times \frac{Area of \Delta RBC}{Area of \Delta RBC}$ $\frac{1}{4} \times \frac{1}{4} \times \left(\frac{1}{2}\right)^2$ $= \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $= \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $= \frac{1}{12}$ 8(a) (iii) Median Length = 10.6 cm (iii) Q1 position = 200th Q3 position = 600th Q1 = 9.95 Q3 = 11.25 or 11.2 Interquartile Range = 11.25 - 9.95 or 11.2 - 9.95 = 1.3 cm or 1.25 cm (b) $Percentage = \frac{15 + 25}{800} \times 100\% \text{ or } \frac{20 + 25}{800} \times 100\%$ $= 5\% \text{ or } 5.625\%$ (c) Lobsters caught in June are shorter in length as the median length of 9.3 cm is lower as compared to 10.6 cm in May. The lengths of the lobsters caught in June has a wider spread as its ITR of 3.7 cm is higher as compared to 1.3 cm in May. I disagree with Jill as 25% of lobsters needed to be released in June because they are shorter than 8.3 cm which is higher as compared to the total percentage released of 5.625% in May. Or I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as		$=\frac{1}{1}$			
$ \begin{vmatrix} Area of \Delta PAB \\ Area of \Delta QABC \\ Area of \Delta ADBC \\ Area of \Delta ADBC \\ Area of \Delta ADBC \\ Area of \Delta QAC \\ = \frac{1}{2} \times PAM \times h_1}{\frac{1}{2} \times AC \times h_1}{\frac{1}{2} \times QA \times h_2}} \\ = \frac{1}{\frac{1}{2} \times AC \times h_1}{\frac{1}{2} \times AC \times h_2} \\ = \frac{1}{\frac{1}{2} \times AC \times h_2} \\ = \frac{1}{4} \times \frac{1}{2} \\ = \frac{1}{1} \\ \therefore Area \Delta PAB \ and \ Area \Delta QAC \ are \ the \ same \\ (f) Area of \Delta ABBC \\ Area of \Delta ABPC \\ Area$		\therefore Area \triangle PAB and Area \triangle QAC are the same			
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$ \begin{vmatrix} Area of \Delta PAB \\ Area of \Delta QABC \\ Area of \Delta ADBC \\ Area of \Delta ADBC \\ Area of \Delta ADBC \\ Area of \Delta QAC \\ = \frac{1}{2} \times PAM \times h_1}{\frac{1}{2} \times AC \times h_1}{\frac{1}{2} \times QA \times h_2}} \\ = \frac{1}{\frac{1}{2} \times AC \times h_1}{\frac{1}{2} \times AC \times h_2} \\ = \frac{1}{\frac{1}{2} \times AC \times h_2} \\ = \frac{1}{4} \times \frac{1}{2} \\ = \frac{1}{1} \\ \therefore Area \Delta PAB \ and \ Area \Delta QAC \ are \ the \ same \\ (f) Area of \Delta ABBC \\ Area of \Delta ABPC \\ Area$		Method 3			
$=\frac{\frac{1}{2}\times PANAh}{\frac{1}{2}\times AC\times h_1}{\frac{1}{2}\times AC\times h_2} \times \frac{\frac{1}{2}\times ABNAh_2}{\frac{1}{2}\times QA\times h_2}$ $=\frac{PA}{AC}\times \frac{AB}{QA}$ $=\frac{2}{1}\times \frac{1}{2}$ $=\frac{1}{1}$ $\therefore Area \triangle PAB \ and \ Area \triangle QAC \ are \ the \ same$ (f) $\frac{Area of \triangle ABC}{Area of \triangle QBC} = \frac{1}{3}$ (ii) $\frac{Area of \triangle ABC}{Area of \triangle ABC} = \frac{Area of \triangle ABC}{Area of \triangle QBC} \times \frac{Area of \triangle QBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (ii) $\frac{All dolle \ position = 400^{th}}{Area of \triangle QBC} \times \frac{Area of \triangle QBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (ii) $\frac{All dolle \ position = 400^{th}}{Area of \triangle QBC} \times \frac{Area of \triangle RBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (ii) $\frac{All dolle \ position = 400^{th}}{Area of \triangle QBC} \times \frac{Area of \triangle RBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (b) $\frac{All dolle \ position = 200^{th}}{All dolle \ position = 600^{th}}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Position = 200^{th}$ Pos					
$=\frac{\frac{1}{2}\times PANAh}{\frac{1}{2}\times AC\times h_1}{\frac{1}{2}\times AC\times h_2} \times \frac{\frac{1}{2}\times ABNAh_2}{\frac{1}{2}\times QA\times h_2}$ $=\frac{PA}{AC}\times \frac{AB}{QA}$ $=\frac{2}{1}\times \frac{1}{2}$ $=\frac{1}{1}$ $\therefore Area \triangle PAB \ and \ Area \triangle QAC \ are \ the \ same$ (f) $\frac{Area of \triangle ABC}{Area of \triangle QBC} = \frac{1}{3}$ (ii) $\frac{Area of \triangle ABC}{Area of \triangle ABC} = \frac{Area of \triangle ABC}{Area of \triangle QBC} \times \frac{Area of \triangle QBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (ii) $\frac{All dolle \ position = 400^{th}}{Area of \triangle QBC} \times \frac{Area of \triangle QBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (ii) $\frac{All dolle \ position = 400^{th}}{Area of \triangle QBC} \times \frac{Area of \triangle RBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (ii) $\frac{All dolle \ position = 400^{th}}{Area of \triangle QBC} \times \frac{Area of \triangle RBC}{Area of \triangle RBC} \times \frac{Area of \triangle RBC}{Area of \triangle RPQ}$ $=\frac{1}{3}\times \frac{1}{1}\times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (b) $\frac{All dolle \ position = 200^{th}}{All dolle \ position = 600^{th}}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Q1 \ position = 200^{th}$ $Q3 \ position = 600^{th}$ $Position = 200^{th}$ Pos		$\frac{1}{Area\ of\ \Delta OAC} = \frac{1}{Area\ of\ \Delta ABC} \times \frac{1}{Area\ of\ \Delta OAC}$			
$ = \frac{PA}{AC} \times \frac{AB}{QA} $ $ = \frac{2}{1} \times \frac{1}{2} $ $ = \frac{1}{1} $ $ \therefore Area \Delta PAB \text{ and } Area \Delta QAC \text{ are the same} $ $ (f) \begin{cases} \frac{Area \text{ of } \Delta ABC}{Area \text{ of } \Delta QBC}} = \frac{1}{3} $ $ (ii) \frac{Area \text{ of } \Delta ABC}{Area \text{ of } \Delta RPQ} = \frac{1}{Area \text{ of } \Delta QBC} \times \frac{Area \text{ of } \Delta QBC}{Area \text{ of } \Delta RPQ} \times \frac{Area \text{ of } \Delta RPC}{Area \text{ of } \Delta RPQ} $ $ = \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2 $ $ = \frac{1}{12} $ $ = \frac{1}{12} $ $ (ii) \frac{Area \text{ of } \Delta RPQ}{Area \text{ of } \Delta RPQ} = \frac{Area \text{ of } \Delta RBC}{Area \text{ of } \Delta RBC} \times \frac{Area \text{ of } \Delta RPQ}{Area \text{ of } \Delta RPQ} $ $ = \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2 $ $ = \frac{1}{12} $ $ (iii) \frac{Area \text{ of } \Delta RPQ}{Area \text{ of } \Delta RPQ} = \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2 $ $ = \frac{1}{12} \times \frac$		$\frac{1}{-} \times PA \times h_1$ $\frac{1}{-} \times AB \times h_2$			
$=\frac{PA}{AC} \times \frac{AB}{QA}$ $=\frac{2}{1} \times \frac{1}{2}$ $=\frac{1}{1}$ $\therefore Area \Delta PAB and Area \Delta QAC are the same$ (f) (i) $\frac{Area of \Delta ABC}{Area of \Delta QBC} = \frac{1}{3}$ (ii) $\frac{Area of \Delta ABC}{Area of \Delta QRC} = \frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $=\frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $=\frac{1}{3} \times \frac{1}{1} \times \left(\frac{1}{2}\right)^2$ $=\frac{1}{12}$ (8(a) Middle position = 400^{th} Median Length = 10.6 cm (ii) Q1 position = 200^{th} Q3 position = 600^{th} Q1 position = 200^{th} Q3 position = 600^{th} Q1 position = 900^{th} Q3 = 9.95 Q3 = $11.25 \text{ or } 11.2$ Interquartile Range = $11.25 - 9.95$ or $11.2 - 9.95$ = 1.3 cm or 1.25 cm (b) $\frac{Percentage}{S00} = \frac{15 + 25}{800} \times 100\%$ or $\frac{20 + 25}{800} \times 100\%$ = 5% or 5.625% (c) Lobsters caught in June are shorter in length as the median length of 9.3 cm is lower as compared to 10.6 cm in May. The lengths of the lobsters caught in June has a wider spread as its ITR of 3.7 cm is higher as compared to 1.3 cm in May. (d) I disagree with Jill as 25% of lobsters needed to be released in June because they are shorter than 8.3 cm which is higher as compared to the total percentage released of 5.625% in May. I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as		$=\frac{2}{1} \times 4C \times h \times \frac{2}{1} \times 0.4 \times h$			
$ \begin{array}{c} = \frac{2}{1} \times \frac{1}{2} \\ = \frac{1}{1} \\ \vdots \\ Area \ \Delta PAB \ and \ Area \ \Delta QAC \ are \ the \ same \\ \hline (f) \\ (i) \ Area \ of \ \Delta ABC \\ Area \ of \$		$\frac{-\lambda}{2} \wedge RC \wedge R_1 \qquad \frac{-\lambda}{2} \wedge QA \wedge R_2$			
$ \begin{array}{c} = \frac{2}{1} \times \frac{1}{2} \\ = \frac{1}{1} \\ \vdots \\ Area \ \Delta PAB \ and \ Area \ \Delta QAC \ are \ the \ same \\ \hline (f) \\ (i) \ Area \ of \ \Delta ABC \\ Area \ of \$		$=\frac{1}{4C}\times\frac{RD}{OA}$			
Second Secon					
Second Secon		$=\frac{1}{1}\times\frac{1}{2}$			
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 (f) (i) Area of ΔABC Area of ΔABC		1			
 (ii) Area of ΔQBC = 3 (iii) Area of ΔABC Area of ΔABC Area of ΔQBC × Area of ΔQBC × Area of ΔRBC Area of ΔRBC × Are		∴ Area ΔPAB and Area ΔQAC are the same	T		
 (ii) Area of ΔABC Area of ΔQBC Area of ΔQBC Area of ΔQBC Area of ΔQBC Area of ΔRBC Area of ΔRBC	(f)	$\frac{Area \ of \ \Delta ABC}{ABC} = \frac{1}{2}$			
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 (c) Lobsters caught in June are shorter in length as the median length of 9.3 cm is lower as compared to 10.6 cm in May. The lengths of the lobsters caught in June has a wider spread as its ITR of 3.7 cm is higher as compared to 1.3 cm in May. (d) I disagree with Jill as 25% of lobsters needed to be released in June because they are shorter than 8.3 cm which is higher as compared to the total percentage released of 5.625% in May. Or I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as 		= 5% or $5.625%$			
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Or I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as	(d)				
I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as			d of 5.625% in May.		
		I disagree with Jill as 75% of the lobsters caught in June are within the legal length which is lower as			
		1			
			<u> </u>		



$$= 133^{\circ}$$

(ii)
$$\angle MOH = 47^{\circ} \times 2 \ (\angle \ at \ center = 2 \ \angle \ at \ circumference)$$

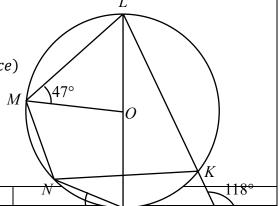
= 94°

(iii)
$$\angle LHJ = 90^{\circ} (tangent \perp radius)$$

 $\angle HLI = 118^{\circ} - 90^{\circ} (ext \angle of \Delta)$

$$= 28^{\circ}$$

 $\angle KNH = 28^{\circ} (\angle in same segment)$



H

15°

(b)
$$\angle LHG = 90^{\circ} (tangent \perp radius)$$

$$\angle OHN = 90^{\circ} - 15^{\circ}$$

$$= 75^{\circ}$$

$$\angle OMN = 360^{\circ} - (133^{\circ} + 75^{\circ} + 94^{\circ}) \, (\angle \, sum \, of \, \, quadrilateral)$$

$$= 58^{\circ}$$

$$\angle NML + \angle MLI = (58^{\circ} + 47^{\circ}) + (47^{\circ} + 28^{\circ})$$

= 180°

Using property of interior angles, $\angle NML$ and $\angle MLI$ add up to 180°, MN and LI are parallel lines.

10 Method 1

(a)
$$\sin 60^{\circ} = \frac{h_1}{10^{\circ}}$$

$$\sin 60^{\circ} = \frac{h_1}{10}$$
 $\tan \left(\frac{\frac{3 \times 180}{5}}{2}\right)^{\circ} = \frac{h_2}{5}$
 $h_1 = 10 \sin 60^{\circ}$ $h_2 = 5 \tan 54^{\circ}$
 $= 8.6603$ $= 6.8819$

$$h_1 = 10\sin 60^{\circ}$$

$$h_2 = 5 an 54^{\circ}$$

$$= 8.6603$$

$$= 6.8819$$

$$h_1 + h_2 = 15.5422$$

$$Area\ PAO = \frac{1}{2} \times 15.5422 \times 5$$

Area of 5 pointed star =
$$10 \times \frac{1}{2} \times 15.5422 \times 5$$

$$= 388.555$$

$$= 389 \ cm^2 \ (3sf)$$

Method 2

Area of 1 equilateral
$$\Delta$$

Area of 1 isosceles
$$\Delta$$

$$= \frac{1}{2} \times 10 \times 10 \times \sin 60^{\circ} \qquad = \frac{1}{2} \times 10 \times 5 \tan \left(-\frac{1}{2} \right)$$

$$=\frac{1}{2}\times 10\times 5\tan\left(\frac{\frac{3\times180}{5}}{2}\right)^{\circ}$$

$$= 43.301$$

$$= 34.410$$

$$AC = 16.180 \ cm$$

Area of 5 pointed star

$$= 5 \times Area \Delta APE + 2 \times Area \Delta ABC + \times Area \Delta ACE$$

Area of 5 pointed star = $5 \times (43.301 + 34.410)$

= 388.555

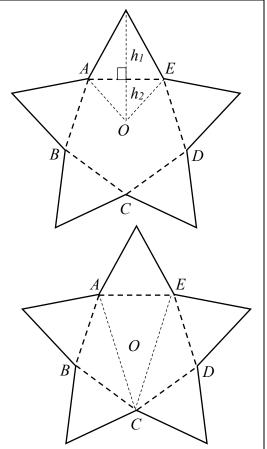
 $= 389 cm^2 (3sf)$

$$= 5 \times \left(\frac{1}{2} \times 10 \times 10 \times \sin 60^{\circ}\right) + 2 \times \left(\frac{1}{2} \times 10 \times 10 \times \sin 108^{\circ}\right) + \frac{1}{2} \times 16.180 \times 10 \times \sin 72^{\circ}$$

$$= 216.506 + 95.106 + 76.940$$

$$= 388.552$$

$$= 389 cm^2 (3sf)$$



(b)
$$Density = 900kg/m^3$$

= 0.9 g/cm^3

Design I

Outer Radius =
$$15.5422 + 6 = 21.5422$$

Cross $SA = \pi(21.5422)^2 - \pi(15.5422)^2$
= 699.024 cm^2
Volume = 699.024×12
= 8388.288 cm^3
Mass (wood) = 8388.288×0.9
= 7549.4592 grams
Total Mass = $7549.4592 + 600$

= 8149.4592 grams

Design II

$$l = \frac{6}{\cos 36^{\circ}}$$
$$= 7.4164$$

Cross SA

$$= 5 \left[\frac{1}{2} (15.5422 + 7.4164)^2 \sin 72^\circ - \frac{1}{2} (15.5422)^2 \sin 72^\circ \right]$$

 $=678.905 cm^2$

 $Volume = 678.905 \times 12$

 $= 8146.86 \ cm^3$

 $Mass(wood) = 8146.86 \times 0.9$

 $=7332.174\ grams$

 $Total\ Mass = 7332.174 + 600$

= 7932.174 grams

Since 7932.174 < 8000 < 8149.4592 grams, Jack should choose **Design II**.

