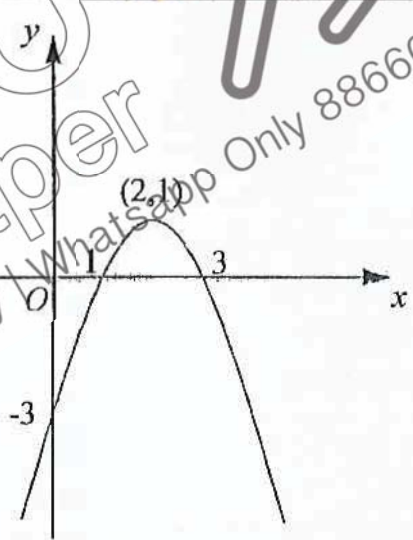
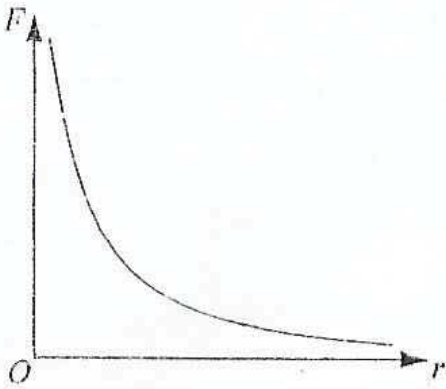


1	$\frac{22}{7}, 3.14\dot{2}, 3.\dot{1}4\dot{2}, \pi$
2	$16p^4 - 81q^4$ $= (4p^2)^2 - (9q^2)^2$ $= (4p^2 - 9q^2)(4p^2 + 9q^2)$ $= (2p - 3q)(2p + 3q)(4p^2 + 9q^2)$
3	$\frac{1}{27} = 9^k$ $3^{2k} = 3^{-3}$ $k = -1.5$
4a	$\frac{34+35}{2} = 34.5$
4b	$39\frac{2}{3}$ or 39.7
4c	$\sqrt{\frac{14465}{9} - \left(39\frac{2}{3}\right)^2} = 5.81 \text{ (3 s.f.)}$
5	
6a	$\frac{1}{2}(4)(v) = 20 \Rightarrow v = 10$
6b	$t = 6$ total distance $= \frac{1}{2}(6)(10) = 30$ avg speed $= \frac{30}{6} = 5 \text{ m/s}$

7	Let x be the number of adults. $\frac{x}{x+19+14} \leq \frac{3}{5}$ $5x \leq 3x+99$ $x \leq 49.5$ Therefore, the maximum number of adults is 49.
8a	Rhombus
8b	$\subset$ or $\subseteq$
9	1 unit - \$40 Total sum of money = $40 \times 9 = \\$360$
10	$\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$
11	Adam's rate = $\frac{70}{30}$ Charlie's rate = $\frac{80}{45}$ Total rate = $\frac{70}{30} + \frac{80}{45} = \frac{37}{9}$ time = $\frac{1000}{\frac{37}{9}} = 243.24 \text{ min (5 s.f.)} = 4 \text{ hours } 3.24 \text{ min}$ Time taken is 4 hours 4 minutes.
12	$\angle EBC = \frac{180^\circ - 108^\circ}{2} = 36^\circ \Rightarrow \text{no. of sides} = \frac{360^\circ}{36} = 10$
13	$\frac{5x}{14} - \frac{2x-3}{21} = 1$ $15x - 2(2x-3) = 42$ $15x - 4x + 6 = 42$ $11x = 36 \Rightarrow x = \frac{36}{11} = 3\frac{3}{11}$
14	$(x+2)^2 - 4 = 0$ $(x+2)^2 = 4$ $x+2 = \pm\sqrt{4}$ $x = -2 \pm \sqrt{4} \Rightarrow x = 1.87 \text{ or } -5.87 \text{ (3 s.f.)}$
15	$\frac{1}{x^2} + \frac{1}{y^2} = 3$ $x^2 + y^2 = 3x^2y^2$ $(x+y)^2 = 3x^2y^2 + 2xy$ $= 3(4)^2 + 2(4)$ $= 56$

16a	
16b	$r_{AB} = \frac{5}{2} r_{CD}$ $r_{AB}^2 = \frac{25}{4} r_{CD}^2$ $\frac{F_{AB}}{F_{CD}} = \frac{r_{CD}^2}{r_{AB}^2}$ $= \frac{4}{25}$ Answer: 4 : 25
17ai	$y = -x^3 + 3$
aii	$y = x^2 - 3$
aiii	$y = 3^{-x}$
bi	Any value greater than 2
bii	$y = 2x + c$, where $c < 0$
18	$2\pi r^2 + 2\pi r h = 2\pi r^2 + \pi r^2$ $h = \frac{r}{2}$ vol. of cylinder = $\pi r^2 h$ $= \frac{1}{2} \pi r^3$
19	$P \left(1 + \frac{r}{100} \right)^3 = 1.2P$ $1 + \frac{r}{100} = \sqrt[3]{1.2}$ $r = 6.3 \text{ (1 d.p.)}$

20	$\frac{l_1}{l_2} = \frac{9}{15} = \frac{3}{5}$ $\frac{V_1}{V_2} = \left(\frac{3}{5}\right)^3 = \frac{27}{125}$ $V_1 = \frac{27}{125}V_2$ $125V_1 = 27V_2$ Therefore, 27 large glasses could be filled.
21	$7^2 + 10^2 \neq 12^2$ $\therefore AB^2 + BC^2 \neq AC^2$ By Pythagoras Theorem, $\angle ABC \neq 90^\circ$ By Right-Angle in Semicircle, AC is not a diameter.
22a	2.198
22b	$\frac{T}{2\pi} = \sqrt{\frac{L}{g}} \Rightarrow \frac{T^2}{4\pi^2} = \frac{L}{g} \Rightarrow g = \frac{4\pi^2 L}{T^2}$
23a	$2 : 3.2 \times 1000 \times 100$ $1 : 160000$
23b	$\frac{27.5}{3.2} \times 2 = 17.1875 \text{ cm}$
23c	$4 \text{ cm}^2 \text{ represents } 10.24 \text{ km}^2$ $1.4 \text{ cm}^2 \text{ represents } 3.584 \text{ km}^2$
24a	$2^2 \times 3 \times 7$
24b	$2 \times 3 = 6$
24c	$2^3 \times 1 \times 7^2 = 392$
25a	$5(5+3) = 40$
25b	$n(n+3) = 154$ $n^2 + 3n - 154 = 0$ $(n-11)(n+14) = 0$ $n = 11 \text{ or } n = -14 \text{ (rejected)}$
25c	When n is odd, $n+3$ is even. When n is even, $n+3$ is odd. Product of odd and even is always even.
26	$\angle BAD = 180^\circ - 5x^\circ \text{ (angles in opposite segments)}$ $\angle BOD = 2 \times \angle BAD \text{ (angle at centre = } 2 \times \text{angle at circumference)}$ $= 360^\circ - 10x^\circ$ $360^\circ - 10x^\circ + 2x^\circ + 90^\circ \times 2 = 360^\circ \text{ (tangent } \perp \text{ radius, total interior angle of quadrilateral)}$ $x = 22.5$

2019 Sec 4E5N MYE EM P2 Solutions

Qn No	Solutions
1a	$\frac{3-x}{5} < 1 + \frac{2x+1}{4}$
	$\frac{3-x}{5} < \frac{4+2x+1}{4}$
	$4(3-x) < 5(5+2x)$
	$12-4x < 25+10x$
	$-14x < 13$
	$x > -\frac{13}{14}$
1b	$\frac{4y}{3-2y} - \frac{y}{(2y-3)^2}$
	$= \frac{-4y}{2y-3} - \frac{y}{(2y-3)^2}$ or $= \frac{4y}{3-2y} - \frac{y}{(3-2y)^2}$
	$= \frac{-4y(2y-3)-y}{(2y-3)^2}$ $= \frac{4y(3-2y)-y}{(3-2y)^2}$
	$= \frac{11y-8y^2}{(2y-3)^2}$ $= \frac{11y-8y^2}{(3-2y)^2}$
	$= \frac{y(11-8y)}{(2y-3)^2}$ $= \frac{y(11-8y)}{(3-2y)^2}$
1c	$\frac{(-3h)^2}{8h^3j^5} + \frac{27h^4j^2}{4j^3}$
	$= \frac{9h^2}{8h^3j^5} + \frac{4j^3}{27h^4j^3}$
	$= \frac{1}{6h^5j^4}$
1d	$\left(\frac{256p^{16}}{q^{20}r^{-4}}\right)^{-\frac{1}{4}}$
	$= \left(\frac{q^{20}r^{-4}}{256p^{16}}\right)^{\frac{1}{4}}$
	$= \frac{q^5r^{-1}}{4p^4}$
	$= \frac{q^5}{4p^4r}$ or $\frac{q^5r^{-1}}{4p^4}$ or $\frac{1}{4}p^{-4}q^5r^{-1}$

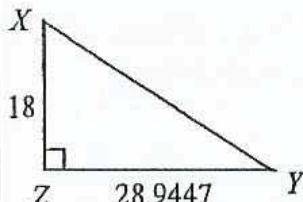
1e	$\frac{10}{x^2-9} - \frac{3}{x+3} = 1$
	$10 - 3(x-3) = x^2 - 9$
	$10 - 3x + 9 = x^2 - 9$
	$x^2 + 3x - 28 = 0$
	$(x+7)(x-4) = 0$
	$x = -7$ or $x = 4$
2a	1.50×10^{11} m (3 sig. fig)
2b	Time taken for sound to travel 1 au = $\frac{1.4959 \times 10^{11}}{343}$ $= 4.36 \times 10^8$ s (3 sig. fig)
2c	$\frac{384400 \times 10^3}{1.4959 \times 10^{11}} \times 100$ $= 0.257\%$ (3 sig. fig)
2d	Time taken = $1.4959 \times 10^{11} \times 8000 \times 10^{-9}$ $= 1.20 \times 10^6$ s (3 sig. fig)
3	Answers on the last page
4a	$AB = \sqrt{(-2-6)^2 + (7-(-4))^2}$ $= \sqrt{64+121}$ $= \sqrt{185} = 13.6$ units
4b	Gradient of AB = $\frac{7-(-4)}{-2-6} = -\frac{11}{8}$ Equation of AB : $y-7 = -\frac{11}{8}(x+2)$ or $7 = -\frac{11}{8}(-2)+c$ $c = \frac{17}{4}$ $y = -\frac{11}{8}x + \frac{17}{4}$ $8y = -11x + 34$
4c	$8y+11x = -16$ $8y = -11x - 16$ $y = -\frac{11}{8}x - 2$ Since they have the <u>same gradient</u> , they are parallel.

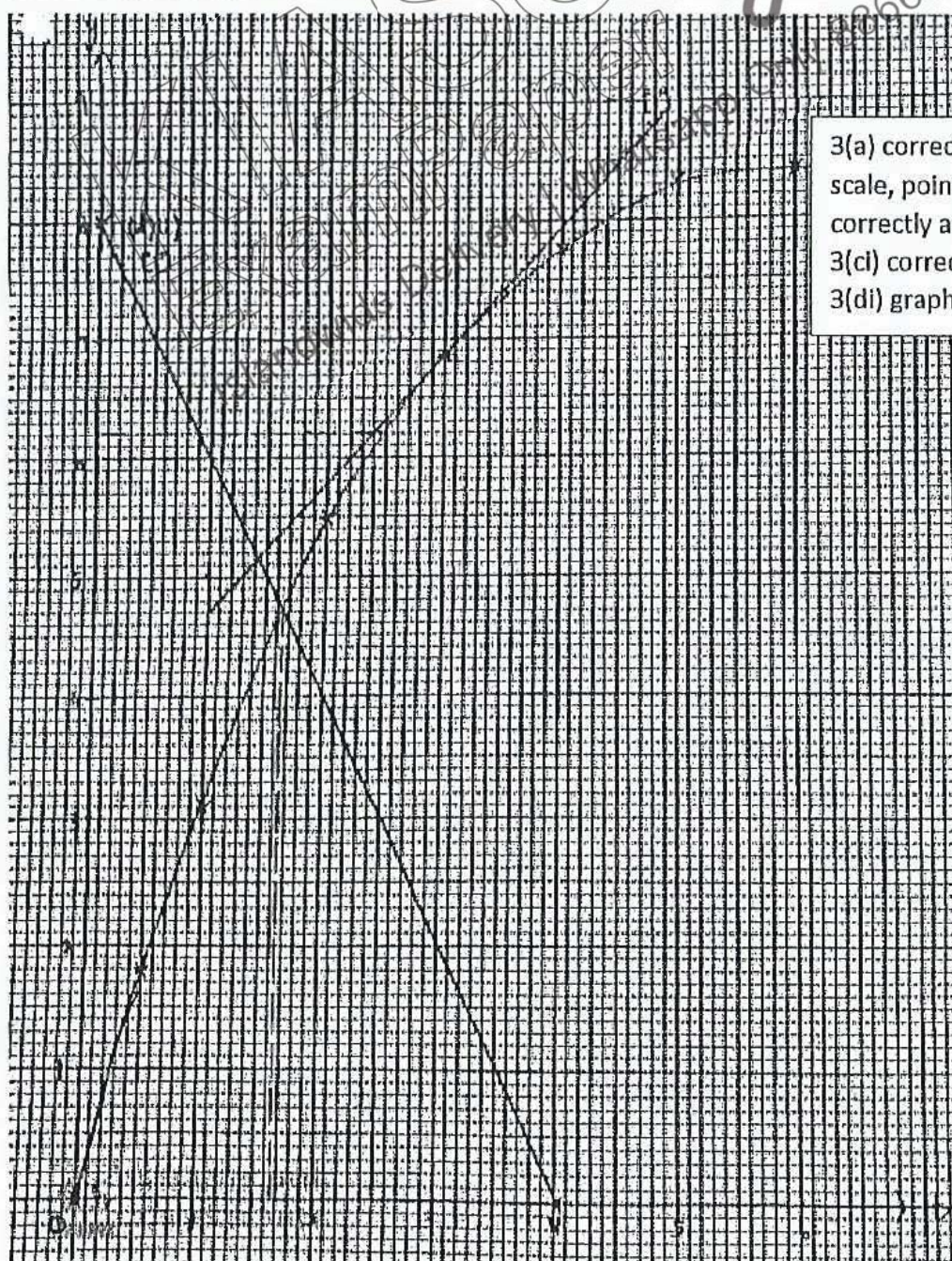
4d	$8k = -11(2) + 34$ or $\frac{7-k}{-2-2} = -\frac{11}{8}$
	$k = 1\frac{1}{2}$ $k = 1\frac{1}{2}$
5a	Using Sine Rule, $\frac{\sin 120^\circ}{800} = \frac{\sin 34^\circ}{AC}$ $AC = 516.560$ $= 517 \text{ m (3 sig. fig)}$
5b	Area of triangle $ABC = \frac{1}{2}(800)(516.560)\sin 26^\circ$ $= 90577.9$ $= 90600 \text{ m}^2 \text{ (3 sig. fig)}$
5c	Bearing of A from $B = 360^\circ - 120^\circ - 34^\circ$ or $180^\circ + 26^\circ$ $= 206^\circ$
5d	(i) Let the vertical height of the helicopter above E be h $\tan 11^\circ = \frac{h}{300}$ $h = 300 \tan 11^\circ$ $h = 58.314$ $h = 58.3 \text{ m (3 sig. fig)}$ (ii) $\sin 34^\circ = \frac{EF}{300}$ $EF = 300 \sin 34^\circ$ Let the angle of depression of F from the helicopter be θ $\tan \theta = \frac{58.314}{300 \sin 34^\circ}$ $\theta = 19.167$ $\theta = 19.2^\circ \text{ (1 d.p.)}$
6a	$\begin{pmatrix} w & 1 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} w & 1 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 6w-9 & w+2 \\ 0 & 4 \end{pmatrix}$ $\begin{pmatrix} w^2 & w+2 \\ 0 & 4 \end{pmatrix} = \begin{pmatrix} 6w-9 & w+2 \\ 0 & 4 \end{pmatrix}$ $w^2 = 6w - 9$ $w^2 - 6w + 9 = 0$ $(w-3)^2 = 0$ $w = 3$

6b	(i)	$A = \begin{pmatrix} 225 & 140 & 125 \\ 265 & 115 & 245 \\ 245 & 125 & 175 \end{pmatrix}$	
	(ii)	$\begin{pmatrix} 225 & 140 & 125 \\ 265 & 115 & 245 \\ 245 & 125 & 175 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$	
		$= \begin{pmatrix} 490 \\ 625 \\ 545 \end{pmatrix}$	
		Total number of waffles delivered to outlet 1 is 490, outlet 2 is 625 and outlet 3 is 545.	
6c	(i)	$C = \begin{pmatrix} 1.20 & 0.60 \\ 0.80 & 0.50 \\ 1.00 & 0.40 \end{pmatrix}$ or $C = \begin{pmatrix} 0.60 & 1.20 \\ 0.50 & 0.80 \\ 0.40 & 1.00 \end{pmatrix}$	
		$AC = \begin{pmatrix} 225 & 140 & 125 \\ 265 & 115 & 245 \\ 245 & 125 & 175 \end{pmatrix} \begin{pmatrix} 1.20 & 0.60 \\ 0.80 & 0.50 \\ 1.00 & 0.40 \end{pmatrix}$ or $AC = \begin{pmatrix} 225 & 140 & 125 \\ 265 & 115 & 245 \\ 245 & 125 & 175 \end{pmatrix} \begin{pmatrix} 0.60 & 1.20 \\ 0.50 & 0.80 \\ 0.40 & 1.00 \end{pmatrix}$	
		$= \begin{pmatrix} 507 & 255 \\ 655 & 314.50 \\ 569 & 279.50 \end{pmatrix}$ or $\begin{pmatrix} 255 & 507 \\ 314.50 & 655 \\ 279.50 & 569 \end{pmatrix}$	
	(ii)	Profit earned by outlet 2 = \$ 340.50	
7a	(i)	$\frac{208}{x-5}$ tiles	
	(ii)	$\frac{169}{x}$ tiles	
7b		$2\left(\frac{208}{x-5}\right) + 2\left(\frac{169}{x}\right) - 4 = 74$	
		$\frac{416}{x-5} + \frac{338}{x} = 78$	
		$416x + 338(x-5) = 78x(x-5)$	
		$416x + 338x - 1690 = 78x^2 - 390x$	
		$78x^2 - 1144x + 1690 = 0$	
		$3x^2 - 44x + 65 = 0$ (shown)	

7c	$(3x-5)(x-13)=0$
	$x=\frac{5}{3}=1\frac{2}{3}$ or $x=13$
7d	If $x=1\frac{2}{3}$, the <u>width</u> of the tile <u>will be negative</u> .
7e	Taking $x=13$, area of the wall that will be filled with tiles $= 13(13-5) \times 74$ $= 7696 \text{ cm}^2$
8a	$\cos 60^\circ = \frac{BC}{4}$ $BC = 2 \text{ cm}$
8b	Total cross-sectional area of medal $= 2 \left[\frac{1}{2} (2^2) \left(\frac{4\pi}{3} \right) + 2 \left(\frac{1}{2} \right) (4)(2) \sin 60^\circ \right]$ $= 30.6115$ $= 30.6 \text{ cm}^2$ (3 sig. fig)
8c	Volume of the medal $= 30.6115 \times 0.7$ $= 21.428$ $= 21.4 \text{ cm}^3$ (3 sig. fig)
9a	$\angle BAR = \angle QPR$ (alternate angles) $\angle ABR = \angle PQR$ (alternate angles) $\angle ARB = \angle PRQ$ (vertically opposite angles) Since all corresponding angles are equal, triangle PQR is similar to triangle ABR .
9b	Triangle CPQ and Triangle CBA
9c	Using similar triangles, $\frac{AR}{PR} = \frac{AB}{PQ}$ $\frac{AR}{4} = \frac{12}{5}$ $PB = 9.6 \text{ cm}$ or $9\frac{3}{5} \text{ cm}$
9d	$\frac{\text{Area of triangle } PQR}{\text{Area of triangle } ABR} = \left(\frac{5}{12} \right)^2 = \frac{25}{144}$
9e	$\left(\frac{5}{12} \right)^2 = \frac{15}{\text{Area of triangle } CBA}$ Area of triangle $CBA = 86.4 \text{ cm}^2$

	Area of $ABPQ = 71.4 \text{ cm}^2$
10a	(i) (a) median = 56.5 km/h
	(b) Interquartile range = $62.5 - 50$ = 12.5 km/h
	(c) 80 th percentile = 64 km/h
	(d) 65%
	(ii) Probability = $1 - \left(\frac{43}{100} \times \frac{42}{99} \right)$ = $\frac{1349}{1650}$
10b	(i) The median speed in the afternoon is 56.5 km/h while the median speed at night is 60 km/h. Vehicles at night travel faster. The interquartile range in the afternoon is 12.5 km/h while the interquartile range at night is 20 km/h. The speeds of the vehicles in the afternoon are less widespread (or more consistent) than the speeds at night due to smaller interquartile range in the afternoon.
	(ii) Range = $82 - 30 = 52 \text{ km/h}$
11a	1 cm : 75 m 1 cm ² : 5625 m ² Area of building on the map = $\frac{134000}{5625}$ = 23.8 cm^2 (3 sig. fig)
11b	(i) actual circumference = 105 m $2\pi r = 105$ Actual radius = $\frac{105}{2\pi} \text{ m}$
	(ii) Let the centre of forest valley be O and angle ZOY be θ radian $\left(\frac{105}{2\pi} \right) \theta = 35$ $\theta = \frac{2\pi}{3}$ Using Cosine Rule, $YZ^2 = \left(\frac{105}{2\pi} \right)^2 + \left(\frac{105}{2\pi} \right)^2 - 2 \left(\frac{105}{2\pi} \right) \left(\frac{105}{2\pi} \right) \cos \frac{2\pi}{3}$ $YZ = 28.9447 \text{ m}$

	By Pythagoras Theorem, $XY^2 = 18^2 + YZ^2$ $XY = 34.1 \text{ m (3 sig. fig)}$ 
	His claim is false.
3b	$y = 6.2$
3c	(i) gradient = $\frac{8.5 - 5}{4.5 - 1.3} = 1.09375$ (ii) The gradient represents the speed of the stone at $t = 3$.
3d	(ii) At $t = 1.65$



- 3(a) correct labelled axes & scale, points plotted correctly and smooth curve
 3(c) correct tangent
 3(di) graph of object

