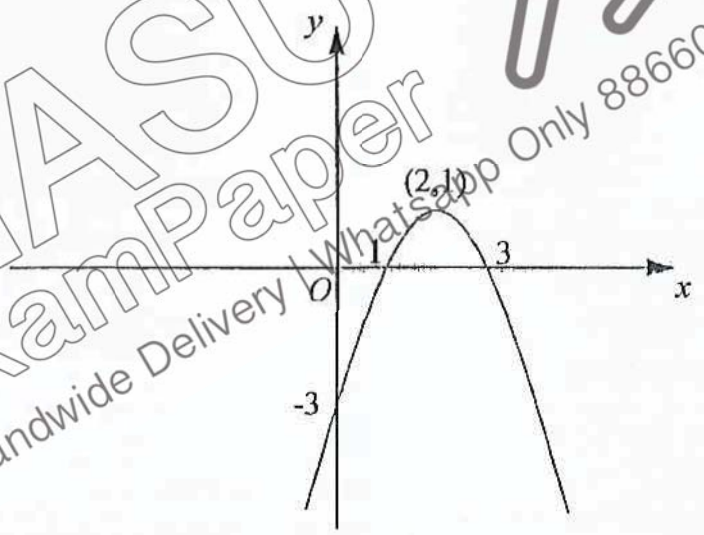
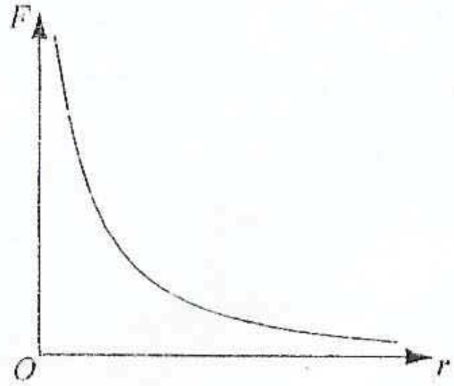
1	$\frac{22}{7}$, $3.14\dot{2}$, $3.\dot{1}4\dot{2}$, π
2	$16p^4-81q^4$ $=(4p^2)^2-(9q^2)^2$ $=(4p^2-9q^2)(4p^2+9q^2)$ $=(2p-3q)(2p+3q)(4p^2+9q^2)$
3	$\frac{1}{27}=9^k$ $3^{2k}=3^{-3}$ $k=-1.5$
4a	$\frac{34+35}{2}=34.5$
4b	$39\frac{2}{3}$ or 39.7
4c	$\sqrt{\frac{14465}{9}-\left(39\frac{2}{3}\right)^2}=5.81$ (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 $=\frac{30}{6}=5$ m/s

7	Let x be the number of adults. $\frac{x}{x+19+14} \le \frac{3}{5}$ $5x \le 3x+99$ $x \le 49.5$ 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	$\left.\begin{array}{l}\text{Adam's rate} = \frac{70}{30} \\ \text{Charlie's rate} = \frac{80}{45}\end{array}\right\}\text{Total rate} = \frac{70}{30} + \frac{80}{45} = \frac{37}{9}$ $\text{time} = \frac{1000}{\frac{37}{9}} = 243.24 \text{ min } (5 \text{ s.f.}) = 4 \text{ hours } 3.24 \text{ min}$ Time taken is 4 hours 4 minutes.
12	$\angle EBC = \frac{180° - 108°}{2} = 36° \Rightarrow \text{no. of sides} = \frac{360°}{36} = 10$
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	$(x+2)^2 - 4 - 11 = 0$ $(x+2)^2 = 15$ $x+2 = \pm\sqrt{15}$ $x = -2 \pm \sqrt{15} \Rightarrow x = 1.87 \text{ or } -5.87 \ (3 \text{ s.f.})$
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	$2\pi r^2 + 2\pi rh = 2\pi r^2 + \pi r^2$ $h = \frac{r}{2}$ vol. of cylinder $= \pi r^2 h$ $= \frac{1}{2}\pi r^3$
19	$P\left(1 + \frac{r}{100}\right)^3 = 1.2P$ $1 + \frac{r}{100} = \sqrt[3]{1.2}$ $r = 6.3$ (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, $\angle ABC\neq 90°$ By Right-Angle in Semicircle, AC is not a diameter.
22a	2.198
22b	$\frac{T}{2\pi}=\sqrt{\frac{L}{g}}\Rightarrow\frac{T^2}{4\pi^2}=\frac{L}{g}\Rightarrow g=\frac{4\pi^2L}{T^2}$
23a	$2:3.2\times1000\times100$ $1:160000$
23b	$\frac{27.5}{3.2}\times2=17.1875\text{ cm}$
23c	4 cm^2 represents 10.24 km^2 1.4 cm^2 represents 3.584 km^2
24a	$2^2\times3\times7$
24b	$2\times3=6$
24c	$2^3\times1\times7^2=392$
25a	$5(5+3)=40$
25b	$n(n+3)=154$ $n^2+3n-154=0$ $(n-11)(n+14)=0$ $n=11$ or $n=-14$ (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	$\angle BAD=180°-5x°$ (angles in opposite segments) $\angle BOD=2\times\angle BAD$ (angle at centre = $2\times$ angle at circumference) $=360°-10x°$ $360°-10x°+2x°+90°\times2=360°$ (tangent $\perp$ 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	$\frac{(-3h)^2}{8h^3j^5}\div\frac{27h^4j^2}{4j^3}$
	$=\frac{9h^2}{8h^3j^5}\times\frac{4j^3}{27h^4j^2}$
	$=\frac{1}{6h^5j^4}$
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 $\frac{1}{4}p^{-4}q^5r^{-1}$

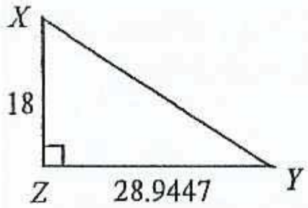
1e	$\frac{10}{x^2-9}-\frac{3}{x+3}=1$
	$10-3(x-3)=x^2-9$
	$10-3x+9=x^2-9$
	$x^2+3x-28=0$
	$(x+7)(x-4)=0$
	$x=-7$ or $x=4$
2a	1.50×10^{11} m (3 sig. fig)
2b	Time taken for sound to travel 1 au $=\frac{1.4959\times10^{11}}{343}$
	$=4.36\times10^{8}$ s (3 sig. fig)
2c	$\frac{384400\times10^3}{1.4959\times10^{11}}\times100$
	$=0.257\%$ (3 sig. fig)
2d	Time taken $=1.4959\times10^{11}\times8000\times10^{-9}$
	$=1.20\times10^{6}$ 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 $7=-\frac{11}{8}(-2)+c$
	$c=\frac{17}{4}$
	$y=-\frac{11}{8}x+\frac{17}{4}$ $y=-\frac{11}{8}x+\frac{17}{4}$
	$8y=-11x+34$ $8y=-11x+34$
4c	$8y+11x=-16$
	$8y=-11x-16$
	$y=-\frac{11}{8}x-2$
	Since they have the same gradient, they are parallel.

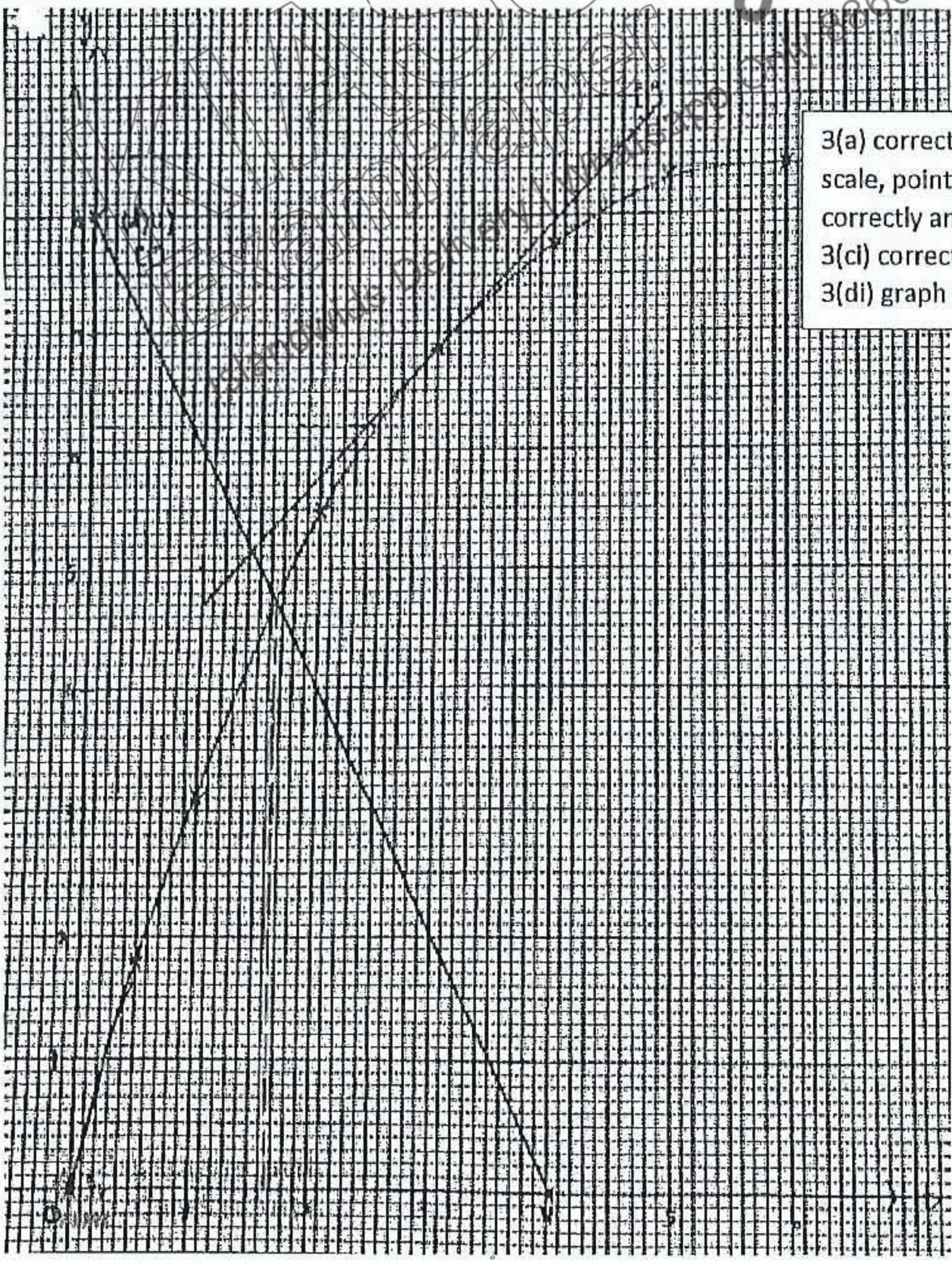
4d	$8k=-11(2)+34$ or $\frac{7-k}{-2-2}=-\frac{11}{8}$
	$k=1\frac{1}{2}$ $k=1\frac{1}{2}$
5a	Using Sine Rule,
	$\frac{\sin 120°}{800}=\frac{\sin 34°}{AC}$
	$AC=516.560$
	$=517\text{ m}$ (3 sig. fig)
5b	Area of triangle $ABC=\frac{1}{2}(800)(516.560)\sin 26°$
	$=90577.9$
	$=90600\text{ m}^2$ (3 sig. fig)
5c	Bearing of A from $B=360°-120°-34°$ or $180°+26°$
	$=206°$
5d	(i) Let the vertical height of the helicopter above E be h
	$\tan 11°=\frac{h}{300}$
	$h=300\tan 11°$
	$h=58.314$
	$h=58.3\text{ m}$ (3 sig. fig)
	(ii) $\sin 34°=\frac{EF}{300}$
	$EF=300\sin 34°$
	Let the angle of depression of F from the helicopter be θ
	$\tan\theta=\frac{58.314}{300\sin 34°}$
	$\theta=19.167$
	$\theta=19.2°$ (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 width of the tile will be negative.
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,
	$\frac{AR}{PR}=\frac{AB}{PQ}$
	$\frac{AR}{4}=\frac{12}{5}$
	$PB=9.6$ cm or $9\frac{3}{5}$ 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 km/h
11a	1 cm : 75 m
	$1 \text{ cm}^2 : 5625 \text{ m}^2$
	Area of building on the map $= \frac{134000}{5625}$
	$= 23.8 \text{ cm}^2$ (3 sig. fig)
11b	(i) actual circumference = 105 m
	$2\pi r = 105$
	Actual radius $= \frac{105}{2\pi}$ 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,
	$YZ^2 = \left(\frac{105}{2\pi}\right)^2 + \left(\frac{105}{2\pi}\right)^2 - 2\left(\frac{105}{2\pi}\right)\left(\frac{105}{2\pi}\right)\cos\frac{2\pi}{3}$
	$YZ = 28.9447$ m

	 By Pythagoras Theorem, $XY^2 = 18^2 + YZ^2$ $XY = 34.1$ m (3 sig. fig)	
	His claim is false.	
3b	$y = 6.2$	
3c	(i) gradient $= \dfrac{8.5-5}{4.5-1.3} = 1.09375$	
	(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(ci) correct tangent
3(di) graph of object