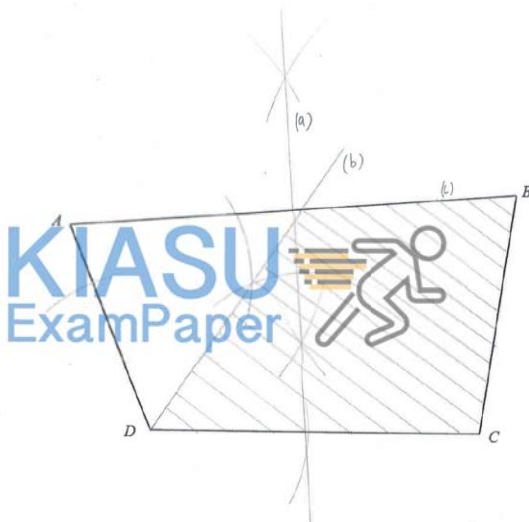
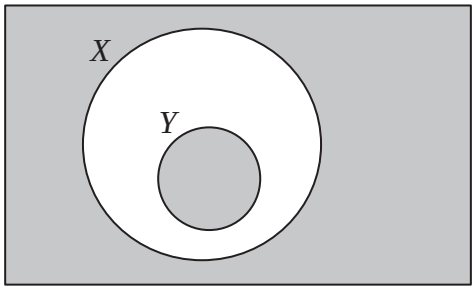


Answer Key:

1. Smallest = 35 000 Largest = 44 999 2a. $(x-3y+1)(x-3y-1)$ 2b. $\frac{14-3x}{3(x-4)^2}$
- 3a. 2.5 3b. Sketch 4a. 1 : 300 000 4b. 100 cm^2
- 5a. $x \geq 168$ 5b. $x = 2$ or $x = -1$ 6a. $\frac{5y^2}{x^3}$ 6b. $x = 4$ 6c. 2 solutions
- 7a. $(x-1)^2 + 2$ 7b. 2 7c. $x = 1$ 8a. $13824 = 2^9 \times 3^3$
- 8b. Can write as cube of another no' 8c. $\begin{matrix} a = 2, \\ b = 3 \end{matrix}$ 9. $x = \frac{1}{2}$ & $y = 6$
- 10a. $y = -\frac{2}{7}x + \frac{6}{7}$ or $7y = -2x + 6$ 10b. 7.28 units
- 10c. Different gradient, one pt of intersection 11a. $T_n = n^2 - (2n+3)$ or $T_n = n^2 - 2n - 3$
- 11b. 45 12. $y = \frac{7}{3}$ 13. $\angle SQR = 37.8^\circ$ 14a. $v = 48$ 14b. 6 m/s^2 14c. 36
- 14d. Sketch 15a.
- $\angle QPC = \angle RPD$ (common $\angle$), $\angle RDP = 90^\circ$ (tan $\perp$ rad)
 $\angle QCP = 90^\circ$ (tan $\perp$ rad), $\therefore \angle RDP = \angle QCP$
 $PD = PC$ (tangents from an external point)
Hence by ASA test, it is shown that $\triangle PQC$ is congruent to $\triangle PRD$.
- 15b.
- $\angle OCR = \angle PDR = 90^\circ$ (tan $\perp$ rad) , $\angle ORC = \angle PRD$ (common $\angle$)
Hence, by AA test, it is shown that $\triangle OCR$ is similar to $\triangle PDR$.
16. Area of the shaded square representing mortality rate is not in proportion to the percentage quoted or the number of confirmed cases quoted.(with specific data quoted)
- 17a. $1.378 \times 10^6 \text{ km}$ 17bi. $y(y-2)(y-4)$ 17bii. 0 18a. 71 18b. 19.5 18c. 68 18d. 40%
- 19.



MATHEMATICS PAPER 2 ANSWER KEY

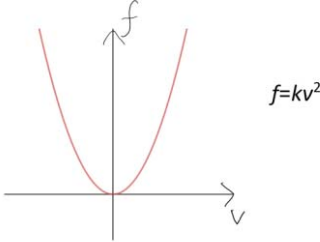
aQuestion		Solution
1	(a)(i)	<i>As shown</i>
	(a)(ii)	4
	(b)	$-\frac{1}{11a+7b}$
	(c)	5
2	(a)	\$462000
	(b)	\$62.50
	(c)	\$14499.92 (to nearest cent)
3	(a)	<i>As shown</i>
	(b)	5.86 cm
	(c)	3.77 cm ²
4	(a) (i)	$B = \{12, 15, 18, 21, 24, 27, 30\}$
	(a)(ii)	$n(A' \cap B') = 11$
	(a)(iii)	$A \cap B = C$
	(b)(i)	$\mathcal{E}$ 
	(b)(ii)	P'
5	(a)	12.6 cm (to 3 s.f)
	(b)	71.0° (to 1 dp)
	(c)	2.88 cm
6	(a)	$\mathbf{Q} = \begin{pmatrix} 280 & 320 & 345 \\ 250 & 265 & 280 \\ 190 & 235 & 290 \end{pmatrix}$
	(b)(i)	$\mathbf{R} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$
	(b)(ii)	$\begin{pmatrix} 945 \\ 795 \\ 715 \end{pmatrix}$
	(c)	<i>As shown</i>
	(d)(i)	(2850.50)
	(d)(ii)	T represents the total amount of profit generated from the sales of AndClean hand sanitizers in all the 3 shops over the three months.

	(e)	$\begin{pmatrix} 483 \\ 392 \\ 406 \end{pmatrix}$
7	(a)	$p = -1.6$
	(c)	$x = 4.5$
	(d)	21
	(e)(ii)	$x = 2.9$
	(e)(iii)	$A = 10, B = -20$
8	(a)	35°
	(b)	290°
	(c)	15°
	(d)	105°
	(e)	30°
9	(a)(i)	The mean mark of class C was 75. Since the standard deviation of the class was zero, all students scored the same marks of 75.
	(a)(ii)	Class B had the best performance as the mean mark was the highest at 86.5. Class B also had the highest inconsistency in the scores at the standard deviation was the greatest at 2.128.
	(a)(iii)	$a = 84$ or $a = 66$
	(b)(i)	$\frac{7}{8}$
	b(ii)	$\left(\frac{7}{8}\right)^{n-1} \left(\frac{1}{8}\right)$
	b(iii)	$\left(\frac{7}{8}\right)^{n-1}$
	(c)	Not valid
10	(a)	1.53 cm
	(b)(i)	1.96 cm (to 3 sf)
	(b)(ii)	11.6% (to 3 sf)
	(c)(i)	6 cm
	(c)(ii)	5.20 cm (to 3 sf)
	(c)(iii)	9.46 cm
11	(a)	Defrosting required
	(b)	111 cm, 110 cm, 66 cm

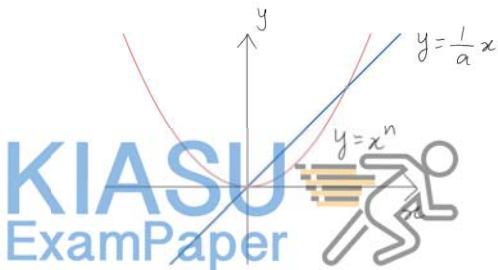
4048/01 Mathematics Paper 1

Preliminary Examination 2020 Mark Scheme

Qn	Solution	Marks	Total Marks
1	Smallest = 35 000 Largest = 44 999	B1 B1	2
2a	$x^2 + 9y^2 - 6xy - 1$ $= (x - 3y)^2 - 1$ $= (x - 3y + 1)(x - 3y - 1)$	M1 A1	2
2b	$\frac{2}{3(x-4)^2} + \frac{1}{4-x} = \frac{2}{3(x-4)^2} - \frac{1}{x-4}$ $\frac{2}{3(x-4)^2} - \frac{1}{x-4} = \frac{2-3(x-4)}{3(x-4)^2}$ $= \frac{14-3x}{3(x-4)^2}$ Alternative Method: $\frac{2}{3(x-4)^2} + \frac{1}{4-x} = \frac{2}{3(4-x)^2} + \frac{1}{4-x}$ $\frac{2}{3(4-x)^2} + \frac{1}{4-x} = \frac{2+3(4-x)}{3(4-x)^2}$ $= \frac{14-3x}{3(4-x)^2}$	M1 A1 M1 M1 A1	2
3a	$v = \frac{k}{t^3}$ $v_{\text{new}} = \frac{k}{(2t)^3}$ $= \frac{k}{8t^3}$ $= \frac{1}{8}v$ $= \frac{1}{8} \times 20$ $= 2.5$	M1 M1 A1	3

3b		B1	1
4a	$4 \text{ cm}^2 : 36 \text{ km}^2$ $1 \text{ cm}^2 : 9 \text{ km}^2$ $1 \text{ cm} : 3 \text{ km}$ $1 : 300\,000$	M1 A1	2
4b	$1 : 60\,000$ $1 \text{ cm} : 0.6 \text{ km}$ $1 \text{ cm}^2 : 0.36 \text{ km}^2$ $36 \div 0.36 = 100 \text{ cm}^2$ <u>Alternative Method:</u> Let x be the area of the town on the second map. $x : 36 = 1 : 0.6^2$ $\frac{x}{36} = \frac{1}{0.36}$ $x = \frac{36}{0.36}$ $x = 100$	M1 A1 M1 (for squaring the values) A1	2
5a	When $9 - 5x < 2 - \frac{x}{4}$, $9 - 5x < \frac{8 - x}{4}$ $36 - 20x < 8 - x$ $-19x < -28$ $x > 1\frac{9}{19}$	M1	3

	When $2 - \frac{x}{4} \leq \frac{x}{3} - \frac{4x}{7}$, $\frac{8-x}{4} \leq \frac{7x-12x}{21}$ $21(8-x) \leq 4(-5x)$ $168 - 21x \leq -20x$ $x \geq 168$ Hence, $x \geq 168$.	M1 A1	
5b	$\frac{3}{(2x-1)^2} = \frac{1}{3}$ $(2x-1)^2 = 9$ $2x-1 = 3 \text{ or } 2x-1 = -3$ When $2x-1 = 3$, $2x = 4$ $x = 2$ When $2x-1 = -3$, $2x = -2$ $x = -1$ Hence $x = 2$ or $x = -1$.	M1 A1 (for both answers)	2
6a	$\left(\frac{x^6}{25y^4}\right)^{-\frac{1}{2}} = \left(\frac{25y^4}{x^6}\right)^{\frac{1}{2}}$ $= \frac{5y^2}{x^3}$ <u>Alternative Method:</u> $\left(\frac{x^6}{25y^4}\right)^{-\frac{1}{2}} = \frac{x^{-3}}{5^{-1}y^{-2}}$ $= \frac{5y^2}{x^3}$	M1 A1 M1 A1	2

6b	$9\sqrt[3]{3^{3x}} = \frac{1}{3^{3(2-x)}}$ $3^2 \times 3^x = \frac{1}{3^{6-3x}}$ $3^{2+x} = 3^{-6+3x}$ $2+x = -6+3x$ $-2x = -8$ $x = 4$	M1 M1 A1	3
6c	$x(ax^{n-1} - 1) = 0$ $x = 0 \text{ or } ax^{n-1} - 1 = 0$ When $ax^{n-1} - 1 = 0$, $ax^{n-1} = 1$ If n is even, $n-1$ is odd. Hence, $ax^{n-1} = 1$ will have 1 solution. There will be a total of 2 solutions for the given equation. <u>Alternative Method:</u> $ax^n = x$ $x^n = \frac{1}{a}x$ When n is even, we will have a curve and a straight line as seen below.  Hence, there will be 2 solutions for the given equation.	M1 M1 A1 M1, M1 (1 mark for each sketch) A1	3
7a	$x^2 - 2x + 3 = x^2 - 2x + 3 + (-1)^2 - (-1)^2$ $= (x-1)^2 + 2$	M1 A1	2
7b	Minimum value= 2	B1	1
7c	$x = 1$	B1	1

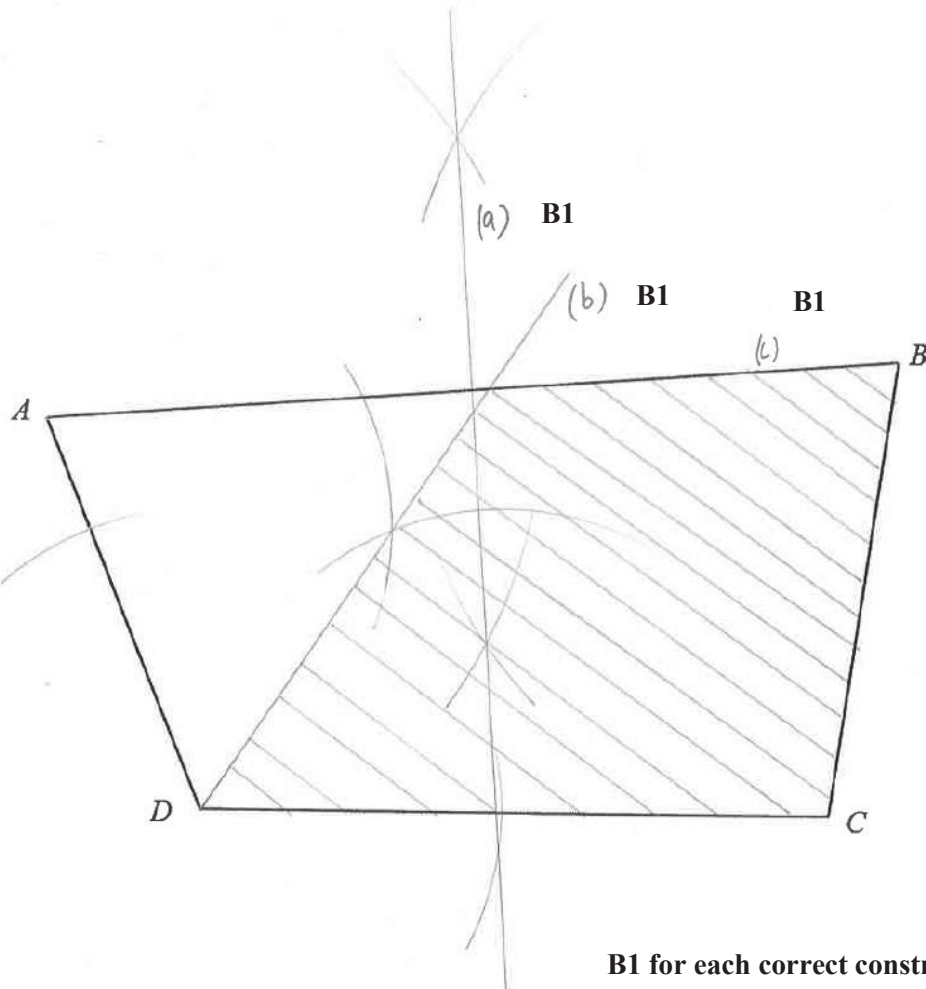
10a	$\text{gradient} = \frac{2-0}{-4-3}$ $= -\frac{2}{7}$ $y-0 = -\frac{2}{7}(x-3)$ $y = -\frac{2}{7}x + \frac{6}{7} \text{ or } 7y = -2x + 6$ <u>Alternative Method:</u> $\frac{y-0}{x-3} = \frac{2-0}{-4-3}$ $y = -\frac{2}{7}x + \frac{6}{7}$	M1 M1 A1 M1 A2	3
10b	$\text{length of } AB = \sqrt{(-4-3)^2 + (2-0)^2}$ $= \sqrt{53} \text{ units}$ $= 7.28 \text{ units}$	M1 A1	2
10c	Since both the lines have a <u>different gradient</u> , they are not parallel. Hence, there will be <u>one point of intersection</u> between both the lines.	B2 (No marks for answers without reasoning)	2
11a	$T_n = n^2 - (2n+3) \text{ or } T_n = n^2 - 2n - 3$	B1	1
11b	$T_8 = 8^2 - (2 \times 8 + 3)$ $= 64 - 19$ $= 45$	B1	1

12	$\frac{l_1}{l_2} = \sqrt[3]{\frac{1}{8}}$ $= \frac{1}{2}$ $\frac{A_1}{A_2} = \left(\frac{1}{2}\right)^2$ $= \frac{1}{4}$ $\frac{y}{y+7} = \frac{1}{4}$ $4y = y + 7$ $3y = 7$ $y = \frac{7}{3}$	M1 M1 A1	3
13	Area of $\Delta SQR = 2 \times$ Area of ΔPQS $\frac{\text{area of } \Delta SQR}{\text{area of } \Delta PQS} = \frac{1}{2}$ $\frac{\frac{1}{2} \times 12 \times QS \times \sin SQR}{\frac{1}{2} \times 22 \times QS \times \sin 42^\circ} = \frac{1}{2}$ $12 \sin SQR = 11 \sin 42^\circ$ $\angle SQR = 37.8^\circ$	M1 M1 A1	3
14a	Let v be maximum speed. $720 = \frac{1}{2} \times 6 \times v + 8 \times v + \frac{1}{2} \times (8 \times v)$ $= 3v + 8v + 4v$ $15v = 720$ $v = 48$	M1 A1	2
14b	$\text{deceleration} = \frac{48 \text{ m/s}}{8 \text{ s}}$ $= 6 \text{ m/s}^2$	B1	1
14c	Let x be speed of car at $t = 16$. $6 = \frac{48 - x}{2}$ $12 = 48 - x$ $x = 36$	M1 A1	2

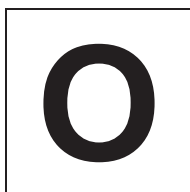
14d		B2 (award 1 mark if distance is not written and shape of graph is correct)	2
15a	$\angle QPC = \angle RPD$ (common $\angle$) $\angle RDP = 90^\circ$ (tan $\perp$ rad) $\angle QCP = 90^\circ$ (tan $\perp$ rad) $\therefore \angle RDP = \angle QCP$ $PD = PC$ (tangents from an external point) Hence by ASA test, it is shown that $\triangle PQC$ is congruent to $\triangle PRD$. Alternative Solution: $CQ = DR$ (sum of radius of circle) $\angle PCQ = \angle PDR = 90^\circ$ (tan $\perp$ rad) $PD = PC$ (tangents from an external point) Hence by SAS test, it is shown that $\triangle PQC$ is congruent to $\triangle PRD$.	B1 B1 B1 B1 (for both) B1	3
15b	$\angle OCR = \angle PDR = 90^\circ$ (tan $\perp$ rad) $\angle ORC = \angle PRD$ (common $\angle$) Hence, by AA test, it is shown that $\triangle OCR$ is similar to $\triangle PDR$.	B1 B1	2
16	Area of the shaded square representing mortality rate is not in proportion to the percentage quoted or the number of confirmed cases quoted. Supporting reason (in terms of percentage): The mortality rate for COVID-19 is 2% while the mortality rate for SARS is 10% but the area of the shaded square is smaller for SARS. OR The mortality rate for Ebola is 40% while the mortality rate for MERS is 34% yet, the area of the shaded square for MERS is so much smaller than that of the shaded square for Ebola. Supporting reason (in terms of number of confirmed cases): The number of COVID-19 confirmed cases is 73,336 which is more than double the	B2 (Any one of the supporting reason is sufficient) Award B1 if no exact data is quoted	2

	number of Ebola cases. However, the area of the unshaded square for the case of COVID-19 is not double the area of the unshaded square for the case of Ebola.	from the infograph.	
17a	$(2 \times 6.95 \times 10^5) - (2 \times 6 \times 10^6 \div 10^3) = 1378000$ $= 1.378 \times 10^6 \text{ km}$	M1 (for calculation) A1 for answer in standard form	2
17bi	$(y-2)^3 - 4(y-2) = (y-2)[(y-2)^2 - 4]$ $= (y-2)(y-2-2)(y-2+2)$ $= y(y-2)(y-4)$	M1 A1	2
17bii	Since $y \geq 4$, minimum value of $y(y-2)(y-4)$ will be 0.	B1	1
18a	Median = 71	B1	1
18b	Lower quartile = 63.5 Upper quartile = 83 Interquartile range = $83 - 63.5$ $= 19.5$	M1 A1	2
18c	Modal score = 68	B1	1
18d	Percentage distinction = $\frac{10}{25} \times 100\%$ $= 40\%$	B1	1
19a	Refer to diagram attached.		
19b	Refer to diagram attached.		
19c	Refer to diagram attached.		

- 19 The diagram below shows a plot of farming land $ABCD$.



B1 for each correct construction / shading.



ANDERSON SECONDARY SCHOOL
Prelim Examination 2020
Secondary Four Express and Five Normal



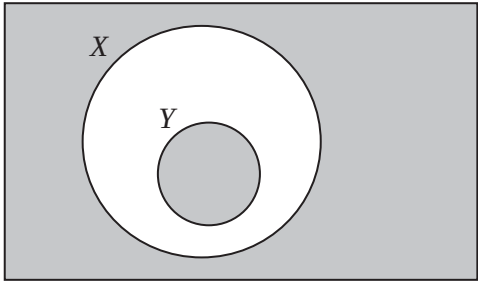
Marking Scheme

MATHEMATICS

4048/02

Question		Solution	Mark	Remarks
1	(a)(i)	$\frac{2px+9qy}{2py+qx} = 3$ $2px + 9qy = 6py + 3qx$ $2px - 3qx = 6py - 9qy$ $x(2p - 3q) = 3y(2p - 3q)$ Since $2p \neq 3q$, $2p - 3q \neq 0$ $x = 3y \text{ (shown)}$	[M1] [A1]	
	(a)(ii)	$\frac{x}{y} = 3$ $\frac{x+y}{y} = \frac{x}{y} + 1$ $= 3 + 1$ $= 4$	[M1] [A1]	
	(b)	$\frac{3a+7b}{16a^2-49(a+b)^2} = \frac{3a+7b}{[4a+7(a+b)][4a-7(a+b)]}$ $= \frac{3a+7b}{(11a+7b)(-3a-7b)}$ $= -\frac{1}{11a+7b}$	[M1] [M1] [A1]	
	(c)	$2^{x+3} = 320 - 2^{x+1}$ $2^{x+1} + 2^{x+3} = 320$ $2^x \times 2 + 2^x \times 2^3 = 320$ $2^x(2+8) = 320$ $2^x = 32$ $= 2^5$ $x = \underline{\underline{5}}$	[M1] [M1] [A1]	

2	(a)	$\text{Total tickets sold} = \frac{85}{100}(12000)$ $= 10200$ $\text{Total amount from sales} = 35(3200) + 50(10200 - 3200)$ $= \$462000$	[M1] [A1]	
	(b)	$\text{Cost of Dec 2019 show for an adult}$ $= \frac{100}{80} \times 50$ $= \$62.50$	[M1] [A1]	
	(c)	$\text{Profit} = \frac{7}{15}(375000)$ $= \$175000$ $\text{Compound Interest} = 175000 \left(1 + \frac{4/4}{100} \right)^{2 \times 4} - 175000$ $= \$14499.92 \text{ (to nearest cent)}$	[M1] [M1] [A1]	
3	(a)	Let the radius of circle ABC be r cm. $OX^2 = OA^2 + AX^2$ $(6 - r)^2 = r^2 + r^2$ $36 - 12r + r^2 = 2r^2$ $r^2 + 12r - 36 = 0$ $r = \frac{-12 \pm \sqrt{12^2 - 4(1)(-36)}}{2}$ $= \frac{-12 \pm \sqrt{288}}{2}$ Since $r \geq 0$, $r = 2.485$ Radius of circle ABC is 2.49 cm.	[M1] [M1] [A1]	
	(b)	$\text{Angle } AXC = \frac{1}{2}(360^\circ - 90^\circ) = 135^\circ$ $\text{Length of minor arc } AC = \frac{135^\circ}{360^\circ} \times 2\pi(2.485)$ $= 5.855$ $= 5.86 \text{ cm}$	[M1] [M1] [A1]	
	(c)	Area of shaded region = Area of sector OCD – Area of minor sector AXC – Area of $\triangle OAX$ $= \frac{45^\circ}{360^\circ} \times \pi(6^2) - \frac{135^\circ}{360^\circ} \times \pi(2.485^2) - \frac{1}{2} \times 2.485^2$ $= 3.7745$ $= 3.77 \text{ cm}^2$	[M2] [A1]	

4	(a) (i)	$B = \{12, 15, 18, 21, 24, 27, 30\}$	[B1]	
	(a)(ii)	$A' \cap B' = \{10, 11, 13, 14, 17, 19, 22, 23, 25, 26, 29\}$ $n(A' \cap B') = 11$	[B1]	
	(a)(iii)	$A \cap B = C$	[B1]	
	(b)(i)	$\mathcal{E}$ 	[B1]	
	(b)(ii)	P'	[B1]	Award B1 if correct answer even if not simplified
5	(a)	$AB = \sqrt{7.9^2 + 6^2 - 2(7.9)(6)\cos 130^\circ}$ $= 12.62324306$ $= 12.6 \text{ cm (to 3 s.f.)}$	[M2] [A1]	
	(b)	$\frac{\sin(\text{angle } ADC)}{7.9} = \frac{\sin 50^\circ}{6.4}$ $\text{angle } ADC = 71.011^\circ$ $= 71.0^\circ \text{ (to 1 dp)}$	[M1] [A1]	
	(c)	$\text{Area of triangle } ABC = \frac{1}{2}(7.9)(6)\sin 130^\circ$ $= 18.155 \text{ cm}^2$ Let the perpendicular distance from C to AB be d cm. $\frac{1}{2}AB(d) = 18.155$ $d = \frac{18.155}{0.5(12.623)}$ $= 2.876$ $= 2.88 \text{ cm}$ Shortest distance from C to AB $= 2.88 \text{ cm}$	[M1] [M1] [A1]	

6	(a)	$\mathbf{Q} = \begin{pmatrix} 280 & 320 & 345 \\ 250 & 265 & 280 \\ 190 & 235 & 290 \end{pmatrix}$	[B1]	
	(b)(i)	$\mathbf{R} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$	[B1]	
	(b)(ii)	$\mathbf{QR} = \begin{pmatrix} 280 & 320 & 345 \\ 250 & 265 & 280 \\ 190 & 235 & 290 \end{pmatrix} \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$ $= \begin{pmatrix} 945 \\ 795 \\ 715 \end{pmatrix}$	[B1]	
	(c)	$S = (3.80 \ 3.50 \ 4.00) - (2.60 \ 2.60 \ 2.60)$ $= (1.20 \ 0.90 \ 1.40) \text{ [shown]}$	[B1]	
	(d)(i)	$\mathbf{T} = \mathbf{S}(\mathbf{QR})$ $= (1.20 \ 0.90 \ 1.40) \begin{pmatrix} 945 \\ 795 \\ 715 \end{pmatrix}$ $= (2850.50)$	[B1]	
	(d)(ii)	$\mathbf{T}$ represents the total amount of profit generated from the sales of AndClean hand sanitizers in all the 3 shops over the three months.	[B1]	
	(e)	$1.4 \begin{pmatrix} 345 \\ 280 \\ 290 \end{pmatrix}$ $= \begin{pmatrix} 483 \\ 392 \\ 406 \end{pmatrix}$	[M1] [A1]	Accept row matrix, Award 1M if scalar multiplication poorly expressed but used. Award 0 if matrix multiplication used
7	(a)	$p = -1.6$	[B1]	
	(b)	All points plotted correctly Smooth curve passing through all points Correct scale used with labels	[M1] [M1] [M1]	

	(c)	Draw line of $y = 2$ $x = 4.5$	[M1] [B1]	Allow +/- 0.1
	(d)	Correct tangent drawn Gradient of tangent = $\frac{2.6 - (-3.5)}{4.8 - 2.9}$ $= 3.21$	[M1] [A1]	Allow +/- 0.1
	(e)(i)	Correct line drawn	[B1]	
	(e)(ii)	$x = 2.9$	[B1]	
	(e)(iii)	$\frac{1}{5}x^3 - \frac{4}{5}x^2 = 4 - 2x$ $\frac{1}{5}x^3 - \frac{4}{5}x^2 + 2x - 4 = 0$ $x^3 - 4x^2 + 10x - 20 = 0$ $A = 10, B = -20$	[M1] [A2]	
8	(a)	Angle $OEA = 35^\circ$ (Angles in the same segment)	[B1]	
	(b)	Angle $AOB = 35^\circ \times 2$ (angle at centre = 2 angles at circumference) $= 70^\circ$ Reflex $AOB = 360^\circ - 70^\circ$ (Angles at a point) $= 290^\circ$	[M1] [A1]	
	(c)	Angle $OAE = 35^\circ$ ($OA = OE$) Angle $BAC = 90^\circ - 35^\circ - 40^\circ$ (Right angle in semi-circle) $= 15^\circ$ OR Angle $BAO = \frac{180^\circ - 70^\circ}{2}$ ($OA = OB$) $= 55^\circ$ Angle $BAC = 55^\circ - 40^\circ$ $= 15^\circ$	[M1] [A1] [M1] [A1]	
	(d)	Angle $CDE = 180^\circ - 40^\circ - 35^\circ$ (angles in opposite segment) $= 105^\circ$ Angle $FEB = 105^\circ$ (Corresponding angles, BE parallel to CD)	[M1] [A1]	
	(e)	Angle $OED = 180^\circ - 105^\circ$ (adj angles on a straight line) $= 75^\circ$ Angle $DOE = 180^\circ - 75^\circ - 75^\circ$ ($OD = OE$) $= 30^\circ$	[M1] [A1]	
9	(a)(i)	The mean mark of class C was 75.	[B1]	

		Since the standard deviation of the class was zero, all students scored the same marks of 75.	[B1]	
	(a)(ii)	Class B had the best performance as the mean mark was the highest at 86.5. Class B also had the highest inconsistency in the scores at the standard deviation was the greatest at 2.128.	[B1] [B1]	
	(a)(iii)	Let the new student's score be a . New mean = $\frac{14 \times 75 + a}{15}$ $= \frac{1050 + a}{15}$ $2.30^2 = \frac{14 \times 75^2 + a^2}{15} - \left(\frac{1050 + a}{15} \right)^2$ $1190.25 = 1181250 + 15a^2 - 1102500 - 2100a - a^2$ $14a^2 - 2100a + 77559.75 = 0$ $a = \frac{-(-2100) \pm \sqrt{(-2100)^2 - 4(14)(77559.75)}}{2(14)}$ $a = 84 \text{ or } a = 66 \text{ (to nearest whole number)}$	[M1] [M1] [M1] [A1]	
	(b)(i)	$P(\text{first draw not an '8'}) = \frac{7}{8}$	[B1]	
	b(ii)	$P(\text{it will take exactly } n \text{ draws}) = \left(\frac{7}{8} \right)^{n-1} \left(\frac{1}{8} \right)$	[B1]	
	b(iii)	$P(\text{it will take at least } n \text{ draws}) = \left(\frac{7}{8} \right)^{n-1}$	[B1]	
	(c)	Statement is not valid. As the balls were drawn with replacement , her chances of getting an '8' in the draw is independent of her previous draws.	[A1] [M1]	No A1 if reason is invalid.
10	(a)	Radius of sphere = $\sqrt[3]{\frac{15}{4\pi}}$ $= 1.5299$ $= 1.53 \text{ cm (to 3 sf)}$	[M1] [A1]	
	(b)(i)	Volume of cookie after baking = $\pi(3)^2(0.6)$ $= 16.964 \text{ cm}^3$ Volume of trapped air = $16.964 - 15$ $= 1.964$ $= 1.96 \text{ cm (to 3 sf)}$	[M1] [A1]	

	(b)(ii)	$\% \text{ of trapped air} = \frac{1.964}{16.964} \times 100\%$ $= 11.577$ $= 11.6\% \text{ (to 3 sf)}$	[B1]	
	(c)(i)	Length of $OP = 6$ cm	[B1]	
	(c)(ii)	$OQ = \sqrt{6^2 - 3^2}$ $= 5.196$ $= 5.20 \text{ cm (to 3 sf)}$	[M1] [A1]	
	(c)(iii)	$\frac{TS}{6} = \frac{5.196 + 3}{5.196}$ $TS = 9.464 \text{ cm}$ $\text{Length of one side of box} = 9.46 \text{ cm (to 3 sf)}$	[M1] [A1]	
11	(a)	$(100 - 2x)(55 - 2x) = 105(50 - x)$ $2(50 - x)(55 - 2x) = 105(50 - x)$ $(50 - x)[2(55 - 2x) - 105] = 0$ $x = 50 \text{ or } 2(55 - 2x) = 105$ $55 - 2x = 52.5$ $x = 1.25$ Since $x \leq 27.5$, $x = 1.25$ Defrosting is required since the thickness of frost > 1 cm.	[M1] [M1] [M1] [A1]	
	(b)	$\text{Length of box space} = 100 + 2(2) + 2(3.5)$ $= 111 \text{ cm}$ $\text{Height of box space} = 100 + 3 + 2(3.5)$ $= 110 \text{ cm}$ $\text{Width of box space} = 55 + 2(2) + 2(3.5)$ $= 66 \text{ cm}$ Assumption: The height of the legs of the freezer is negligible.	[B1] [B1] [B1] [B1]	

