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.** $a=2,$ $b=3$ **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.** $\angle SQR = 37.8°$ **14a.** $v=48$ **14b.** 6 m/s^2 **14c.** 36

14d. Sketch **15a.**

$\angle QPC = \angle RPD$ (common $\angle$), $\angle RDP = 90^0$ (tan $\perp$ rad)

$\angle QCP = 90^0$ (tan $\perp$ rad), $\therefore \angle RDP = \angle QCP$

$PD = PC$ (tangents from an external point)

Hence by ASA test, it is shown that ΔPQC is congruent to ΔPRD.

15b.

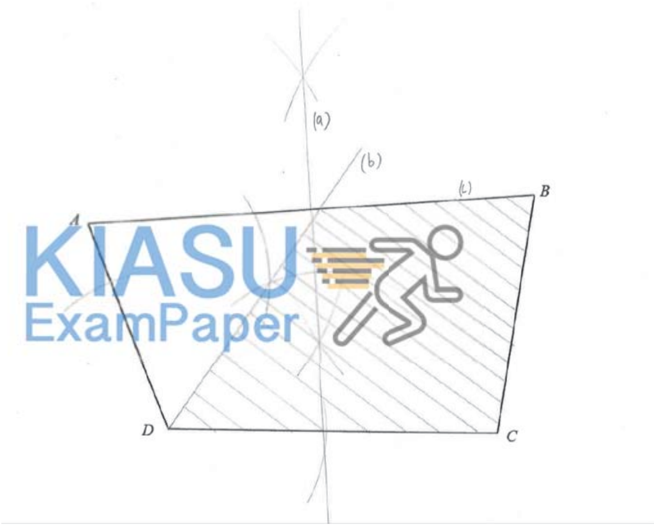
$\angle OCR = \angle PDR = 90°$ (tan $\perp$ rad) , $\angle ORC = \angle PRD$ (common $\angle$)

Hence, by AA test, it is shown that ΔOCR is similar to ΔPDR.

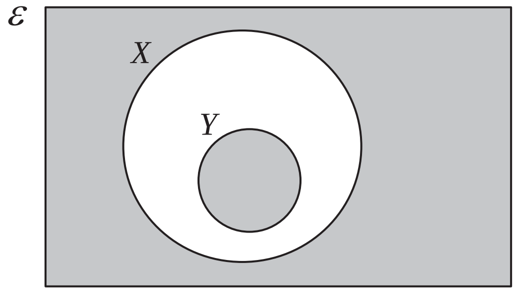
16. Area of the shaded square representing mortality rate is not in proportion to the percentage quoted or the number of confirmed cases quoted.(with specific data quoted)

17a. 1.378×10^6 km **17bi.** $y(y-2)(y-4)$ **17bii.** 0 **18a.** 71 **18b.** 19.5 **18c.** 68 **18d.** 40%

19.



MATHEMATICS PAPER 2 ANSWER KEY

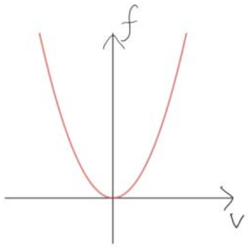
aQuestion		Solution
1	(a)(i)	*As shown*
	(a)(ii)	4
	(b)	$-\frac{1}{11a+7b}$
	(c)	5
2	(a)	\$462000
	(b)	\$62.50
	(c)	\$14499.92 (to nearest cent)
3	(a)	*As shown*
	(b)	5.86 cm
	(c)	3.77 cm^2
4	(a) (i)	$B = \{12, 15, 18, 21, 24, 27, 30\}$
	(a)(ii)	$n(A' \cap B') = 11$
	(a)(iii)	$A \cap B = C$
	(b)(i)	
	(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)	*As shown*
	(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

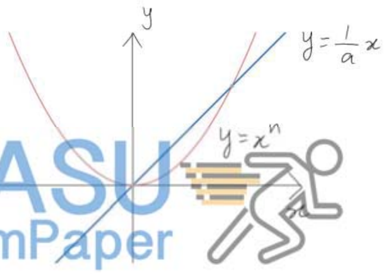
4048/01 Mathematics Paper 1

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	$v=\frac{k}{t^3}$ $v_{new}=\frac{k}{(2t)^3}$ $=\frac{k}{8t^3}$ $=\frac{1}{8}v$ $=\frac{1}{8}\times 20$ $=2.5$	 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

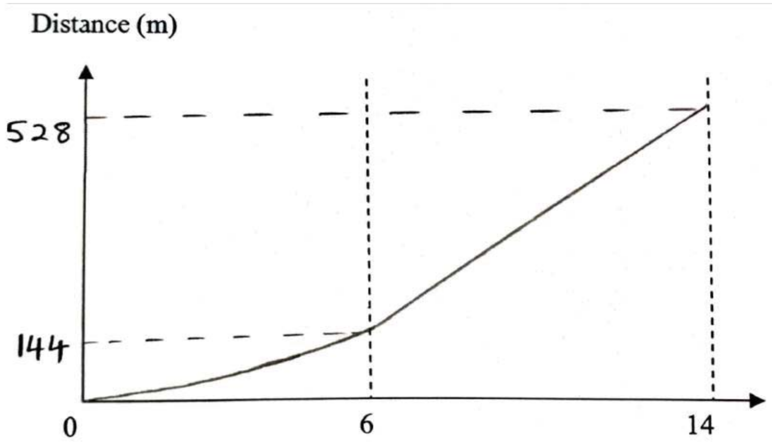
	When $2-\frac{x}{4}\le\frac{x}{3}-\frac{4x}{7}$, $\frac{8-x}{4}\le\frac{7x-12x}{21}$ $21(8-x)\le 4(-5x)$ $168-21x\le -20x$ $x\ge 168$ Hence, $x\ge 168$.	M1 A1	
5b	$\frac{3}{(2x-1)^2}=\frac{1}{3}$ $(2x-1)^2=9$ $2x-1=3$ or $2x-1=-3$ When $2x-1=3$, $2x=4$ $x=2$ When $2x-1=-3$, $2x=-2$ $x=-1$ Hence $x=2$ 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	$9\sqrt[3]{3^{3x}} = \dfrac{1}{3^{3(2-x)}}$ $3^2 \times 3^x = \dfrac{1}{3^{6-3x}}$ $3^{2+x} = 3^{-6+3x}$ $2+x=-6+3x$ $-2x=-8$ $x=4$	M1 M1 A1	3
6c	$x(ax^{n-1}-1)=0$ $x=0$ 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. **Alternative Method:** $ax^n = x$ $x^n = \dfrac{1}{a}x$ 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	$x^2-2x+3 = x^2-2x+3+(-1)^2-(-1)^2$ $\quad = (x-1)^2+2$	M1 A1	2
7b	Minimum value= 2	B1	1
7c	$x=1$	B1	1

8a	$2 \lfloor 13824$ $2 \lfloor 6912$ $2 \lfloor 3456$ $2 \lfloor 1728$ $2 \lfloor 864$ $2 \lfloor 432$ $2 \lfloor 216$ $2 \lfloor 108$ $2 \lfloor 54$ $3 \lfloor 27$ $3 \lfloor 9$ $3 \lfloor 3$ 1 $13824 = 2^9 \times 3^3$	B1	1
8b	Since $13824 = (2^3 \times 3)^3$, 13824 can be written as a cube of another number.	B1	1
8c	$a = 2$, $b = 3$	B1 B1	2
9	$4x - y = -4$ ---------- (1) $\frac{1}{3}y + x = \frac{5}{2}$ ---------- (2) From (2), $x = \frac{5}{2} - \frac{1}{3}y$ ---------- (3) Sub (3) into (1): $4\left(\frac{5}{2} - \frac{1}{3}y\right) - y = -4$ $10 - \frac{4}{3}y - y = -4$ $-\frac{7}{3}y = -14$ $y = 6$ Sub $y = 6$ into (2): $x = \frac{5}{2} - \frac{1}{3} \times 6$ $= \frac{1}{2}$ Hence, $x = \frac{1}{2}$ & $y = 6$.	M1 M1 A1	3

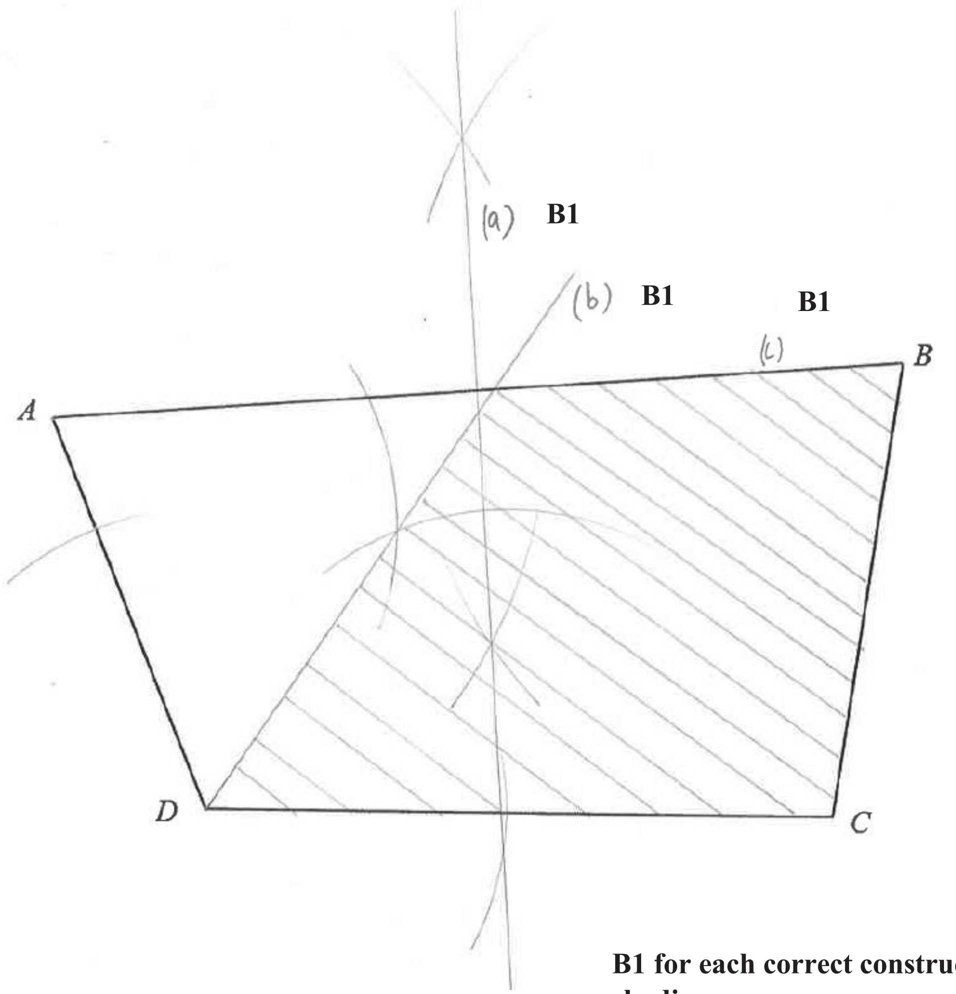
10a	gradient = $\dfrac{2-0}{-4-3}$ $= -\dfrac{2}{7}$ $y-0=-\dfrac{2}{7}(x-3)$ $y=-\dfrac{2}{7}x+\dfrac{6}{7}$ or $7y=-2x+6$ **<u>Alternative Method:</u>** $\dfrac{y-0}{x-3}=\dfrac{2-0}{-4-3}$ $y=-\dfrac{2}{7}x+\dfrac{6}{7}$	M1 M1 A1 M1 A2	3
10b	length of AB= $\sqrt{(-4-3)^2+(2-0)^2}$ $=\sqrt{53}$ units = 7.28 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	$T_n=n^2-(2n+3)$ or $T_n=n^2-2n-3$	B1	1
11b	$T_8=8^2-(2\times8+3)$ $= 64 - 19$ $= 45$	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 $\frac{\text{area of }\Delta SQR}{\text{area of }\Delta PQS}=\frac{1}{2}$ $\frac{\frac{1}{2}\times 12\times QS\times\sin SQR}{\frac{1}{2}\times 22\times QS\times\sin 42°}=\frac{1}{2}$ $12\sin SQR=11\sin 42°$ $\angle SQR=37.8°$	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	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 $\angle$) $\angle RDP = 90^0$ (tan $\perp$ rad) $\angle QCP = 90^0$(tan $\perp$ rad) $\therefore \angle RDP = \angle QCP$ $PD = PC$ (tangents from an external point) Hence by ASA test, it is shown that ΔPQC is congruent to ΔPRD. **Alternative Solution:** $CQ = DR$(sum of radius of circle) $\angle PCQ = \angle PDR = 90^0$ (tan $\perp$ rad) $PD = PC$ (tangents from an external point) Hence by SAS test, it is shown that ΔPQC is congruent to ΔPRD.	B1 B1 B1 B1 B1 (for both) B1	3
15b	$\angle OCR = \angle PDR = 90°$ (tan $\perp$ rad) $\angle ORC = \angle PRD$ (common $\angle$) Hence, by AA test, it is shown that ΔOCR is similar to ΔPDR.	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	$(2\times 6.95\times 10^5)-(2\times 6\times 10^6\div 10^3)=1378000$ $= 1.378\times 10^6$ 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.

O

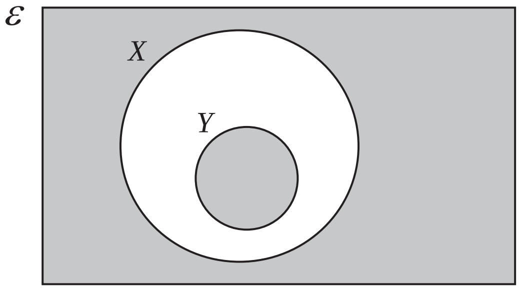
ANDERSON SECONDARY SCHOOL
Prelim Examination 2020
Secondary Four Express and Five Normal

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 $2p\neq 3q$, $2p-3q\neq 0$ $x=3y$ (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)	Total tickets sold $= \frac{85}{100}(12000)$ $= 10200$ Total amount from sales $= 35(3200) + 50(10200 - 3200)$ $= \$462000$	[M1] [A1]	
	(b)	Cost of Dec 2019 show for an adult $= \frac{100}{80} \times 50$ $= \$62.50$	[M1] [A1]	
	(c)	Profit $= \frac{7}{15}(375000)$ $= \$175000$ Compound Interest $= 175000\left(1 + \frac{4/4}{100}\right)^{2\times 4} - 175000$ $= \$14499.92$ (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)	Angle $AXC = \frac{1}{2}(360^\circ - 90^\circ) = 135^\circ$ Length of minor arc $AC = \frac{135^o}{360^o} \times 2\pi(2.485)$ $= 5.855$ $= 5.86$ cm	[M1] [M1] [A1]	
	(c)	Area of shaded region = Area of sector *OCD* – Area of minor sector *AXC* – Area of ΔOAX $= \frac{45^o}{360^o} \times \pi(6^2) - \frac{135^o}{360^o} \times \pi(2.485^2) - \frac{1}{2} \times 2.485^2$ $= 3.7745$ $= 3.77$ 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)		[B1]	
	(b)(ii)	P'	[B1]	Award B1 if correct answer even if not simplified
5	(a)	$AB = \sqrt{7.9^2 + 6^2 - 2(7.9)(6)\cos 130^\circ}$ $= 12.62324306$ $= 12.6$ cm (to 3 s.f)	[M2] [A1]	
	(b)	$\frac{\sin \text{ (angle } ADC)}{7.9} = \frac{\sin 50^\circ}{6.4}$ angle $ADC = 71.011^\circ$ $= 71.0^\circ$ (to 1 dp)	[M1] [A1]	
	(c)	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. $\frac{1}{2}AB(d) = 18.155$ $d = \frac{18.155}{0.5(12.623)}$ $= 2.876$ $= 2.88$ cm Shortest distance from C to AB $= 2.88$ 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)	**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)	$S = (3.80 \quad 3.50 \quad 4.00) - (2.60 \quad 2.60 \quad 2.60)$ $= (1.20 \quad 0.90 \quad 1.40)$ [shown]	[B1]	
	(d)(i)	**T = S(QR)** $= (1.20 \quad 0.90 \quad 1.40) \begin{pmatrix} 945 \\ 795 \\ 715 \end{pmatrix}$ = (2850.50)	[B1]	
	(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.	[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 = $\frac{14\times 75+a}{15}$ $=\frac{1050+a}{15}$ $2.30^2=\frac{14\times 75^2+a^2}{15}-\left(\frac{1050+a}{15}\right)^2$ $1190.25=1181250+15a^2-1102500-2100a-a^2$ $14a^2-2100a+77559.75=0$ $a=\frac{-(-2100)\pm\sqrt{(-2100)^2-4(14)(77559.75)}}{2(14)}$ $a=84$ or $a=66$ (to nearest whole number)	[M1] [M1] [M1] [A1]	
	(b)(i)	P(first draw not an '8') = $\frac{7}{8}$	[B1]	
	b(ii)	P(it will take exactly n draws) = $\left(\frac{7}{8}\right)^{n-1}\left(\frac{1}{8}\right)$	[B1]	
	b(iii)	P(it will take at least n 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 = $\sqrt[3]{\frac{15}{\frac{4}{3}\pi}}$ $=1.5299$ $=1.53$ cm (to 3 sf)	[M1] [A1]	
	(b)(i)	Volume of cookie after baking = $\pi(3)^2(0.6)$ $=16.964$ cm^3 Volume of trapped air = $16.964-15$ $=1.964$ $=1.96$ cm (to 3 sf)	[M1] [A1]	

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