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Class	Index Number	Candidate Name

ANG MO KIO SECONDARY SCHOOL
PRELIMINARY 1 EXAMINATION 2016
SECONDARY FOUR EXPRESS

MATHEMATICS **4048/01**
Paper 1

Setter: Mr Tan Wee Hong

Friday **06 May 2016** **2 hours**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any question it must be shown with the answer.
Omission of essential working will result in loss of marks.
Calculators should be used where appropriate.
If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant figures. Give answers in degrees to one decimal place.
For π, use either your calculator value or 3.142, unless the question requires the answer in terms of π.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is **80**.

For Examiner's Use
80

This document consists of **19** printed pages and **1** blank page

Mathematical Formulae

Compound interest

$$\text{Total amount} = P\left(1 + \frac{r}{100}\right)^n$$

Mensuration

Curve surface area of a cone $= \pi rl$

Surface area of a sphere $= 4\pi r^2$

$$\text{Volume of a cone} = \frac{1}{3}\pi r^2 h$$

$$\text{Volume of a sphere} = \frac{4}{3}\pi r^3$$

$$\text{Area of triangle } ABC = \frac{1}{2}ab \sin C$$

Arc length $= r\theta$, where θ is in radians

$$\text{Sector Area} = \frac{1}{2}r^2\theta, \text{ where } \theta \text{ is in radians}$$

Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A$$

Statistics

$$\text{Mean} = \frac{\sum fx}{\sum f}$$

$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f}\right)^2}$$

1 (a) Calculate $\frac{3.61^2}{\sqrt{12.1-5}}$.

Write down the first six digits on your calculator display.

..... *Answer (a)* ..... [1]

(b) Write your answer to part **(a)** correct to 4 significant figures.

Answer (b) ..... [1]

2 (a) Solve the inequality $3x-1<2x+9\leq 7x+4$.

Answer (a) ..... [2]

(b) **Hence** or otherwise, if x is a perfect cube, write down the possible values of x.

Answer (b) ..... [1]

3 Annabelle took a loan from a bank which charges compound interest of 4% per annum. At the end of 6 years, the interest she paid to the bank $398. How much did she borrow from the bank? Give your answer correct to the nearest dollar.

Answer $ [2]

4 **(a)** Factorise $(1-2x)^2+6x^2-3x$ completely.

Answer (a) ..... [2]

(b) Simplify $\frac{t}{t-2}-\frac{3t+1}{(2t-4)^2}$.

Answer (b) [3]

5 **(a)** Given that $243^{x} = \frac{1}{9}$, find the value of x.

Answer (a) $x =$ ..... [2]

(b) The table below shows the amount of some vitamins and minerals (in grams) in each pill of a particular brand of multivitamin.

Vitamin K	Folic Acid	Vitamin B12
8×10^{5}	4×10^{-4}	5×10^{-5}

(i) Express the amount of Vitamin K to the amount of Folic Acid as a ratio in its lowest terms.

Answer (b)(i) ..... : ..... [1]

(ii) How many pills are needed to contain a total of 1.2 milligrams of Vitamin B12?

Answer (b)(ii) ..... [1]

6 Town A and Town B are connected by direct route. A car travels from Town A to Town B along the route at a constant speed of p m/s.

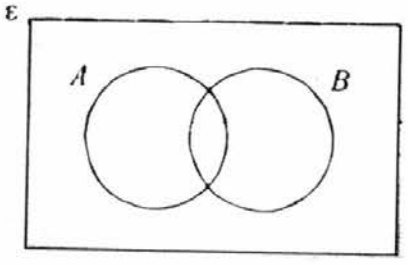
(a) Convert p m/s into km/h, leaving your answer in terms of p.

Answer (a) ..... km/h [1]

(b) A truck leaves Town B for Town A at the same time as the car along the same route. Given that the truck travels at a constant speed of 50 km/h and the length of the route is 75 km, express, in terms of p, the distance from Town A where they will meet.

Answer (b) ..... km [2]

7 **(a)** On the Venn diagram below, shade the set represented by $A' \cup B$.



[1]

(b) It is given that
$\varepsilon = \{ x : x \text{ is an integer and } 2 \le x < 10 \}$,
$C = \{ x : x \text{ is divisible by } m \}$ and
$D = \{ x : x \text{ is a prime number} \}$.

(i) List the elements in D'.

Answer (b)(i) ..... [1]

(ii) Given that m is an integer, find the smallest possible value of m such that $n(C \cap D) = 0$

Answer (b)(ii) $m =$ ..... [1]

8 The table below shows the times taken by 140 girls to complete the AMKSS Life Run 2016.

Time (t minutes)	$10 \le x < 20$	$20 \le x < 30$	$30 \le x < 40$	$40 \le x < 50$
Frequency	25	39	62	14

(a) Calculate an estimate of

(i) the mean time,

Answer *(a)(i)* ..... minutes [1]

(ii) the standard deviation.

Answer *(a)(ii)* ..... minutes [2]

(b) The mean time for the boys to complete the run was 23.7 minutes and the standard deviation was 9.12 minutes.
Compare briefly, in two ways, the times for the boys and the times for the girls.

Answer .....

.....

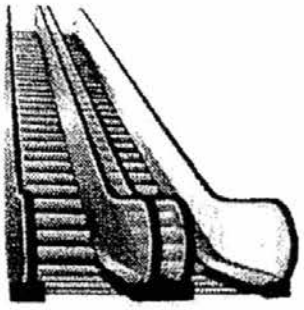
.....

.....

.....

..... [2]

9 The picture shows 2 identical escalators travelling upwards at the same rate in a MRT station.

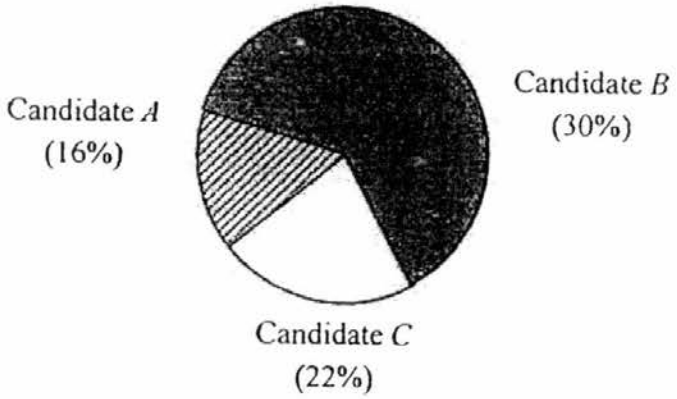


Fred and George walk up the escalators at the same time. Fred takes 12 seconds to reach the top of the escalator while George only takes 10 seconds. In 1 second, George takes 4 steps while Fred can take only 3 steps. Given that the escalator is moving at x steps per second, form a linear equation in x. Solve the equation to find the total number of steps in one escalator.

Answer ..... steps [2]

10 The graph shows the results of voting for a Student Council President election in a school.

Candidate *B* Receives Overwhelming Support in the Election



Explain one way in which the graph is misleading.

Answer .....

.....

..... [2]

11 Project Jewel is a new mixed-use building complex being developed at Changi Airport. It has a land area of 34 560 m^2 and represented by an area of 60 cm^2 on a map.

(a) Find the scale of the map in the form 1 : n.

....

Answer (a) ..... [2]

(b) The length of a cargo terminal is 15 cm on the map. Find, in centimetres, the length representing this road on another map with a scale of 1 : 14 400.

Answer (b) ..... [2]

12 **(a)** Express $x^2 - 12x + 15$ in the form of $(x+p)^2 + q$ where p and q are constants

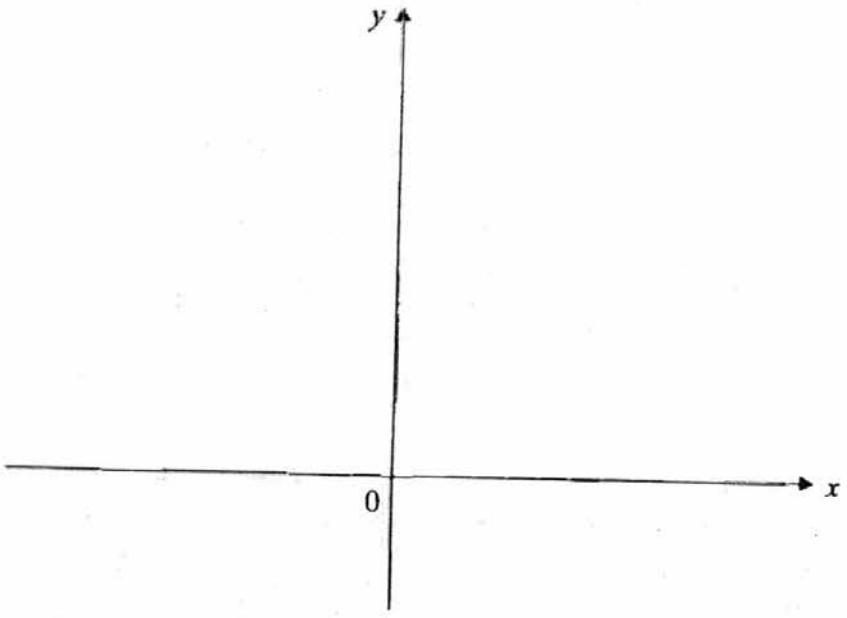
Answer (a) ..... [1]

(b) **Hence** solve the equation $2x^3 - 24x^2 + 30x = 0$, giving your answers correct to two decimal places.

Answer (b) $x =$ ..... or ..... or [3]

13 (a) Sketch the graph of $y = -(x-2)(x+3)$.

Answer (a)

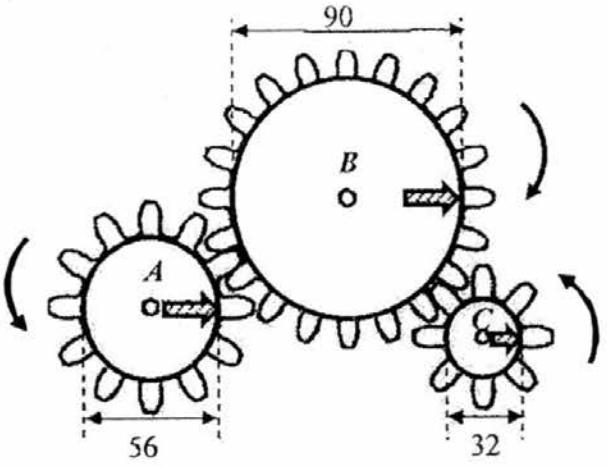


[2]

(b) Write down the equation of the line of symmetry of the graph of $y = -(x-2)(x+3)$.

Answer (b) ..... [1]

14 The diagram below shows three gears connected to each other. Gear A, B and C has a diameter of 56 cm, 90 cm and 32 cm respectively. Each gear has an arrow printed on it. At the start of the motion, all three arrows point to the right.



What is the number of revolution(s) that gear A must complete before all three arrows point to the right again?

Answer ..... [3]

15 A bag contains 5 balls, numbered 1, 2, 3, 4 and 5. Two balls are taken at random from the bag.

(a) Complete the possibility diagram to show all the possible outcomes.

Answer (a)

	1	2	3	4	5
1		1, 2			
2					
3					
4					
5					

[2]

(b) Find, in its simplest form, the probability that

(i) at least one number is a factor of 10,

Answer (b)(i) ..... [1]

(ii) the product of the two numbers is an even number.

Answer (b)(ii) ..... [1]

16 It is given that $\overrightarrow{OR} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$, $\overrightarrow{RS} = \begin{pmatrix} 8 \\ b \end{pmatrix}$ and S is the point $(5a, -a)$.

(a) State the equation of the line OR.

Answer *(a)* ..... [1]

(b) Find

(i) the values of a and b,

Answer *(b)(i)* $a =$ .....

$b =$ ..... [2]

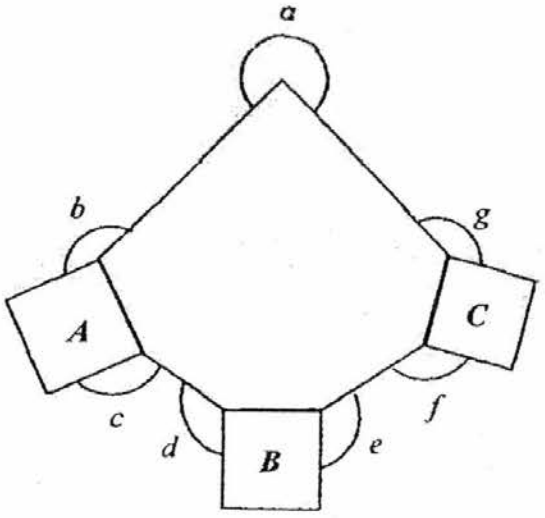
(ii) $\left|\overrightarrow{RS}\right|$.

Answer *(b)(ii)* ..... units [1]

17 (a) Find the sum of the interior angles of a heptagon. Show all your working.

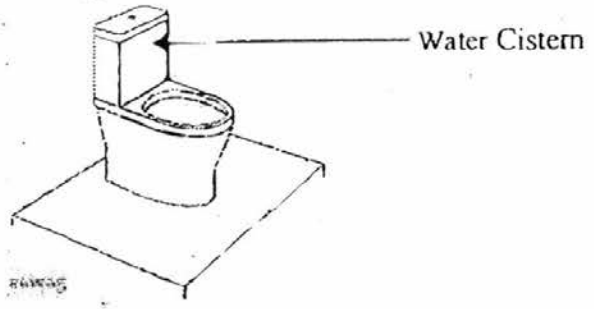
Answer *(a)* ..... ° [2]

(b) In the diagram below, A, B and C are squares. Find the sum of the angles a, b, c, d, e, f and g.

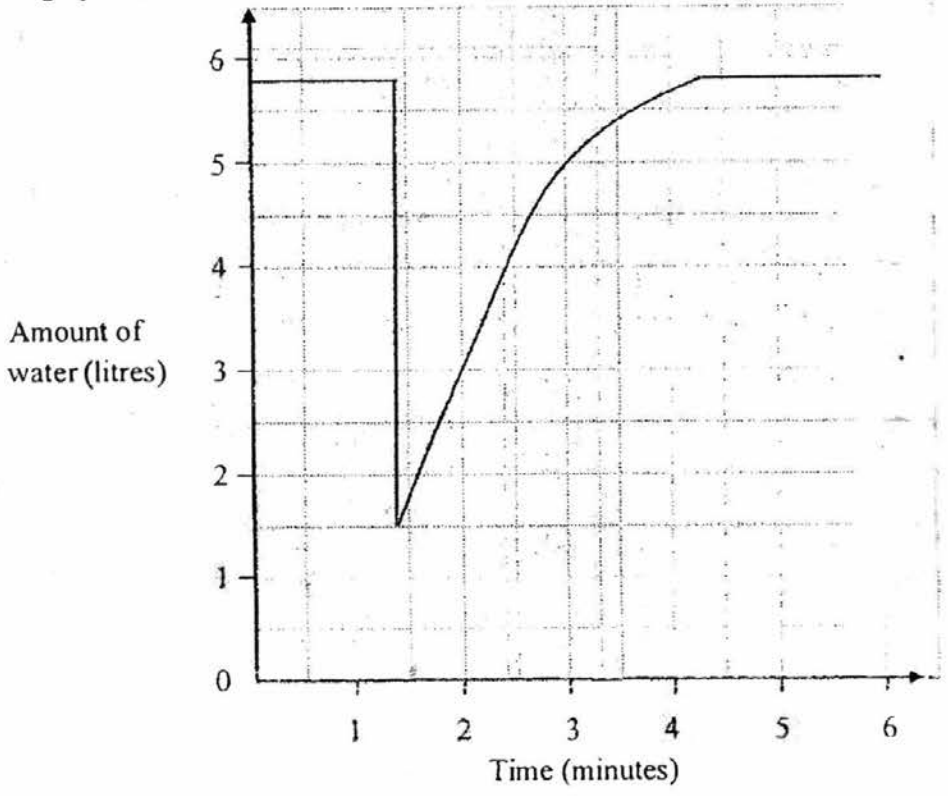


Answer *(b)* ..... ° [2]

18 The diagram shows a flush toilet with a water cistern.



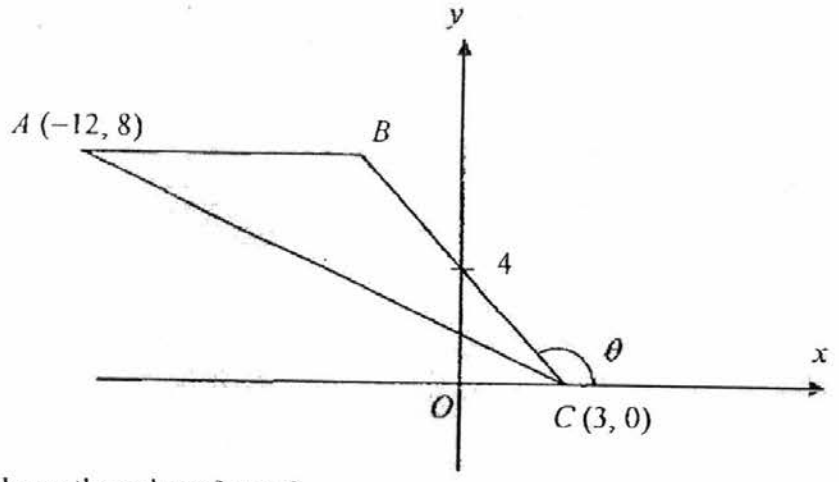
The graph below shows the amount of water in the cistern over a 6 minute period.



Find the average rate of water supplied to the cistern after a flush?
Give your answer in litres/min.

Answer ..... litres/min [2]

19 In the diagram below, the coordinates of points A and C are $(-12, 8)$ and $(3, 0)$ respectively. AB is a horizontal line segment. BC makes an angle of θ with the x-axis.



(a) Write down the value of $\cos\theta$.

Answer (a) ..... [1]

(b) Find the length of AC.

Answer (b) ..... units [2]

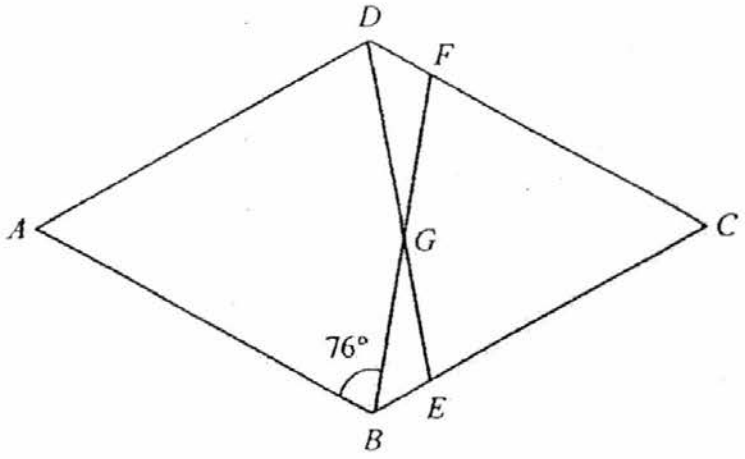
(c) State the equation of AB.

Answer (c) ..... [1]

(d) Find the coordinates of B.

Answer (d) B (..... , ...) [2]

20 In the diagram below, $ABCD$ is a rhombus. $\angle EDC = \angle FBC$ and $\angle ABF = 76°$. DE intersects BF at G.



(a) **Prove** that ΔCDE is congruent to ΔCBF.

Answer .....

.....

.....

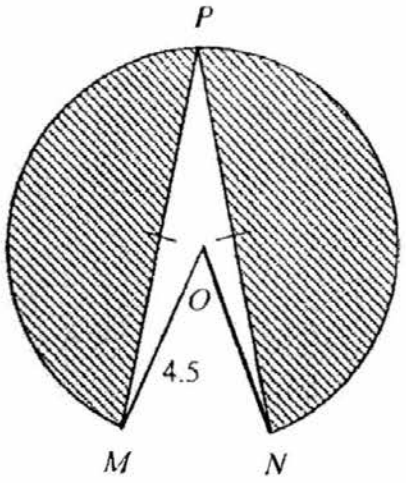
.....

..... [2]

(b) **Hence** or otherwise, find $\angle FGE + \angle FCE$.

Answer *(b)* ..... ° [2]

21



The diagram shows a major sector of a circle, MON, of radius 4.5 cm. P is a point on the arc MN such that $PM = PN$ and the length of arc MN is 8π cm.

(a) Show that $\angle MPN = \frac{\pi}{9}$ radians. State reason(s) for your answer.

Answer .....

.....

.....

.....

.....

..... [3]

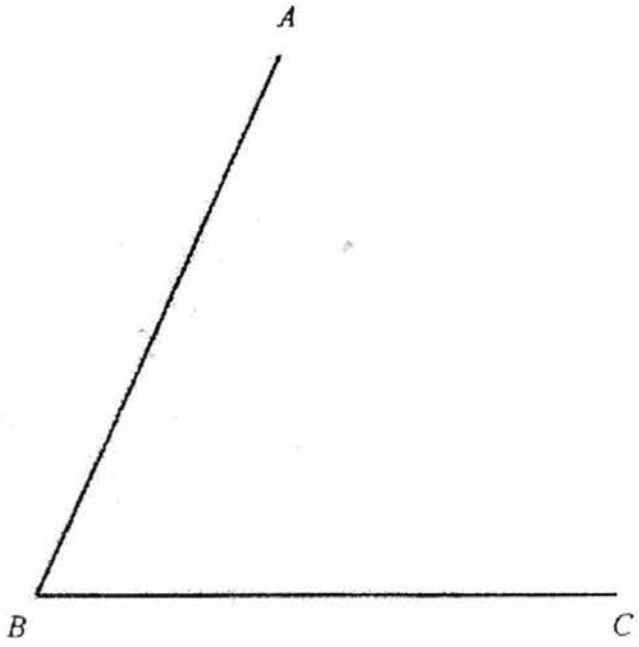
(b) Find the area of the shaded region.

Answer *(b)* ..... cm^2 [3]

22 **(a)** Construct a quadrilateral $ABCD$ where $\angle BCD = 100°$, $AD = 7$ cm where $BD > 10$ cm.
AB and BC have already been drawn. [1]
Write down the length of CD.

Answer (a) $CD =$ ..... cm [1]

Answer (a) and (b)



(b) **(i)** Construct the perpendicular bisector of AD. [1]
(ii) Constructor the bisector of angle ABC. [1]

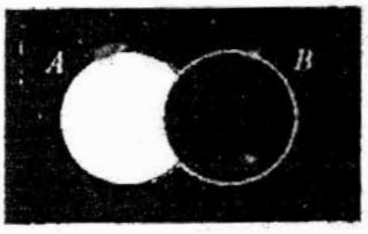
(c) The two bisectors drawn in **(b)** meet at P.
Complete the statement below.

Answer (c) The point P is equidistant from the lines ..... and .....
and equidistant from the points ..... and ..... . [1]

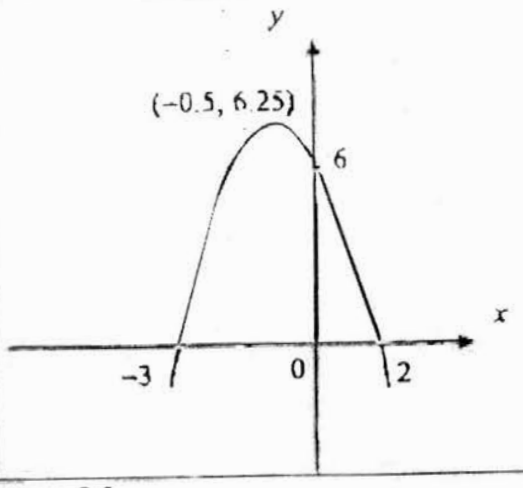
END OF PAPER

2016 4E/5NA Prelim 1 E.Math Paper 1 Solutions

	Solution	Mark	
1(a)	6.78049	B1	
1(b)	6.780	B1	
2(a)	$3x-1<2x+9\le 7x+4$ $3x-1<2x+9$ and $2x+9\le 7x+4$ $x<10$ and $-5x\le -5$ $x\ge 1$ $1\le x<10$	 M1 A1	
2(b)	1 and 8	B1	
3	Let P be the principal amount $P+398=P\left(1+\frac{4}{100}\right)^6$ $P-P\left(1+\frac{4}{100}\right)^6=-398$ $P\left[1-\left(1+\frac{4}{100}\right)^6\right]=-398$ $P=\frac{-398}{\left[1-\left(1+\frac{4}{100}\right)^6\right]}=\$1500$	 M1 A1	
4(a)	$(1-2x)^2-3x(-2x+1)$ $=(1-2x)[(1-2x)-3x]$ $=(1-2x)(1-5x)$	M1 (factorise to get common factor) A1	
4(b)	$\frac{t}{t-2}-\frac{3t+1}{(2t-4)^2}$ $=\frac{t}{t-2}-\frac{3t+1}{4(t-2)^2}$ $=\frac{4t(t-2)-(3t+1)}{4(t-2)^2}$ $=\frac{4t^2-8t-3t-1}{4(t-2)^2}$ $=\frac{4t^2-11t-1}{4(t-2)^2}$ Alternatively, $=\frac{2t}{2t-4}-\frac{3t+1}{(2t-4)^2}$ M1 $=\frac{2t(2t-4)-(3t+1)}{(2t-4)^2}$ M1	 M1 (Factorise denominator) M1 (Combine into single fraction) A1	

	$= \dfrac{4t^2 - 8t - 3t - 1}{4(t-2)^2}$ $= \dfrac{4t^2 - 11t - 1}{4(t-2)^2}$ A1		
5(a)	$3^{5x} = 3^{-2}$ $5x = -2$ $x = -\dfrac{2}{5}$	M1 A1	
5(b)(i)	1: 5	B1	
5(b)(ii)	$\dfrac{1.2 \times 10^{(3)}}{5 \times 10^{-2}} = 24$	B1	
6(a)	$p \times \dfrac{3600}{1000} = \dfrac{18p}{5}$ (accept 3.6p)	B1	
6(b)	Let t be the time taken for them to meet. $3.6pt + 50t = 75$ $t(3.6p + 50) = 75$ $t = \dfrac{75}{3.6p + 50}$ Distance from A where they will meet $= \dfrac{75}{3.6p+50} \times \dfrac{18p}{5}$ $= \dfrac{270p}{3.6p+50}$ (accept $\dfrac{1350p}{18p+250}$ or $\dfrac{675p}{9p+125}$)	M1 A1	
7(a)	ξ  	B1	
7(b)(i)	4, 6, 8, 9	B1	
7(b)(ii)	$m = 4$	B1	
8(a)(i)	Mean = 29.64285714 = 29.6 min (3sf)	 B1	
8(a)(ii)	Standard Deviation = 8.977011457 = 8.98 min (3sf)	B2	
8(b)	The boys took less time to complete the life run as their mean time is shorter. The girls' timings were more consistent as their standard deviation is smaller than that of the boys.	B1 B1	
9	Let the escalator be moving at x steps per second.		

	Fred is moving at $x+3$ steps per second George is moving at $x+4$ steps per second Given that the number of steps should be the same, $12(x+3)=10(x+4)$ $12x+36=10x+40$ $2x=4$ $x=2$ Total number of steps in the escalator $=12(2+3)=60$	M1 A1	
10	The size of each sector is **not proportional** to the percentage of votes – gives the impression that candidate B achieve **more than** twice the number of votes of A and C. The percentages do not add up to 100% – percentage of voided votes (or people who did not vote) is more than any of the candidates. Title of the bar chart is biased – does not allow reader to make own judgement.	B1, B1 (Award 1 mark for misleading feature and one mark for the effect of this feature on the graph)	
11(a)	$60\text{ cm}^2 : 34\,560\text{ m}^2$ $1\text{ cm}^2 : 576\text{ m}^2$ 1 cm : 24 m 1 : 2 400	 M1 A1	
11(b)	Actual length $= 15\times 2400 = 36000$ cm. Length on map $= \frac{36000}{14400} = 2.5$ cm	M1 A1	
12(a)	$x^2-12x+15$ $=x^2-12x+(6)^2+15-(6)^2$ $=(x-6)^2-21$	 B1	
12(b)	$2x^3-24x^2+30x=0$ $2x(x^2-12x+15)=0$ $x=0$ or $x^2-12x+15=0$ $(x-6)^2-21=0$ $x-6=\sqrt{21}$ or $x-6=-\sqrt{21}$ $x=10.58257569$ or $x=1.417424305$ $x=10.58$ or $x=1.42$ (2d.p)	 A1 A1, A1	

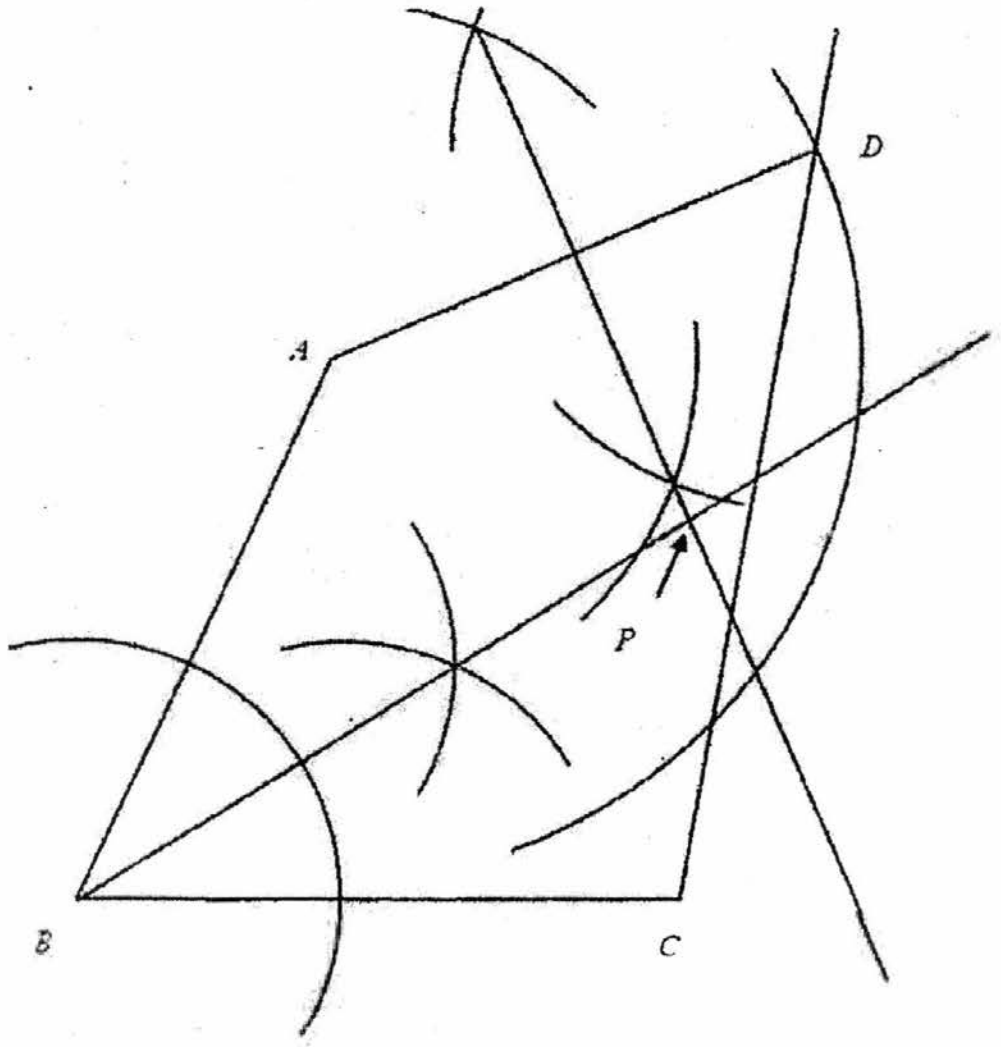
13(a)		B1 - Correct parabola passing through 6 on y-axis B1 - Correct x-intercepts and turning point	
13(b)	$x = -0.5$	B1	
14	Circumference of gear A $= 56\pi$ cm Circumference of gear B $= 90\pi$ cm Circumference of gear C $= 32\pi$ cm For all three arrows to point to the right again, the gears must move through the same distance. $56 = 2^3 \times 7$ $90 = 2 \times 3^2 \times 5$ $32 = 2^5$ LCM $= 2^5 \times 3^2 \times 5 \times 7$ $= 10080$ Each gear move 10080π cm Number of revolutions by gear A $= \dfrac{10080\pi}{56\pi}$ $= 180$	M1 (accept continuous division or listing) M1 A1	
15(a)		B1 for correct values B1 for indicating that there are no (1,1), (2,2), (3,3), (4,4) & (5,5)	

	1	2	3	4	5
1		1,2	1,3	1,4	1,5
2	2,1		2,3	2,4	2,5
3	3,1	3,2		3,4	3,5
4	4,1	4,2	4,3		4,5
5	5,1	5,2	5,3	5,4	

15(b)(i)	$\dfrac{9}{10}$	B1	
15(b)(ii)	$\dfrac{7}{10}$	B1	
16(a)	$y = 3x$	B1	

16(b)(i)	$\begin{pmatrix}5a\\-a\end{pmatrix}=\overrightarrow{OR}+\overrightarrow{RS}=\begin{pmatrix}2\\6\end{pmatrix}+\begin{pmatrix}8\\b\end{pmatrix}$ $5a=10$ $a=2$ $-a=6+b$ $-2=6+b$ $b=-8$	 B1 B1	
16(b)(ii)	$\lvert\overrightarrow{RS}\rvert = \sqrt{(8)^2+(-8)^2}$ $= 11.3137085$ $= 11.3$ units (3sf)	 B1	
17(a)	Sum of interior angles of heptagon $=(7-2)\times 180°$ $=900°$	M1 A1	
17(b)	Sum of angles $=7(360°)-900°-6(90°)$ $=1080°$ Alternatively, by extending the sides of the heptagon and using sum of exterior angles = 360° Sum of angles $=(360°)+180°+6(90°)=1080°$	M1 A1	
18	Amount of water used = 4.3 litres Amount of time taken to fill up the cistern = 2.9 min Average rate of water supplied $=\frac{4.3}{2.9}=1.48$ litres/min. (3sf)	M1 A1	
19(a)	$\cos\theta=-\frac{3}{5}$	B1	
19(b)	Length of $AC = \sqrt{(-12-3)^2+(8-0)^2}$ $= 17$ units.	M1 A1	
19(c)	$y=8$	B1	
19(d)	Let coordinates of B be $(b, 8)$ $\frac{8-0}{b-3}=\frac{4-0}{0-3}$ $\frac{8}{b-3}=-\frac{4}{3}$ $-6=b-3$ $b=-3$ Coordinates of B are $(-3, 8)$ Alternatively,	M1 A1	

	Gradient of $BC = \frac{4-0}{0-3} = -\frac{4}{3}$ Equation of BC is $y = -\frac{4}{3}x + 4$ Subs. $(b, 8)$ into equation: $8 = -\frac{4}{3}b + 4$ M1 $-\frac{4}{3}b = 4$ $b = -3$ Coordinates of B are $(-3, 8)$ A1		
20(a)	$\angle EDC = \angle FBC$ (Given) $\angle ECD = \angle FCB$ (Common) $CD = CB$ (equal sides of rhombus) $\triangle CDE \equiv \triangle CBF$ (AAS)	M1 A1	
20(b)	$\angle CFB = \angle FBA = 76°$ (Alternate angles) $\angle CED = 76°$ (From (a)) $\angle FGE + \angle FCE = 360° - 76° - 76° = 208°$ (sum of $\angle$ in quad.)	M1 A1	
21(a)	Reflex $\angle MON = 8 \times 4.5 = \frac{16\pi}{9}$ rad. $\angle MON = 2\pi - \frac{16\pi}{9} = \frac{2\pi}{9}$ rad. $\angle MPN = \frac{2\pi}{9} \times 2 = \frac{\pi}{9}$ rad. (Angle at centre = 2 × angle at circumference)	M1 M1 M1	
21(b)	Area of sector $MPN = \frac{1}{2}(4.5)^2\left(\frac{16\pi}{9}\right)$ $= 18\pi$ cm^2. Area of quadrilateral $= 2\left[\frac{1}{2}(4.5)(4.5)\sin\left(\frac{8\pi}{9}\right)\right]$ $= 6.925907902$ cm^2. Area of shaded region $= 18\pi - 6.925907902$ $= 49.62275986$ $= 49.6$ cm^2. (3sf)	M1 M1 A1	
22(a)	Correct quadrilateral constructed 10.3 cm (±0.2)	B1 B1	
22(a),(b)	See Attached Correct perpendicular bisector Correct angle bisector	B1 B1	
22(c)	AB and BC and A and D.	B1	


D
A
P
B
C