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NAME: _____ ()

CLASS: _____



FAIRFIELD METHODIST SCHOOL (SECONDARY)

PRELIMINARY EXAMINATION 2014

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

MATHEMATICS

4016/01

Paper 1

Date: 25 August 2014

Duration: 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, highlighters, 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.

You are expected to use a scientific calculator to evaluate explicit numerical expressions.

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 number of marks for this paper is 80.

For Examiner's Use	
Paper 1	/ 80
Paper 2	/100
Total	%

Setters: Mdm Toh and Mr Wilson Ho

This question paper consists of 19 printed pages including the cover page.

*Mathematical Formulae**Compound interest*

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

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

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

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

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

Trigonometry

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

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

Statistics

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

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

Name: _____ () Class: _____

Answer **all** the questions.

- 1 Calculate $\frac{8.679 + 3.457}{9.46^2 - \sqrt{48.7}}$, giving your answer correct to 2 significant figures.

Answer..... [2]

- 2 A retailer bought a pair of headphones from a manufacturer for \$120. In addition to that, he paid a 15% tax. If he sold the headphones to a customer for \$150, calculate the profit he made.

Answer \$ [2]

Name: _____ () Class: _____

- 3 (a) Simplify $\frac{a^2 \times a^4}{\sqrt{a}}$ and give your answer in the form a^n .
- (b) Simplify $7 \div 3p^{-5}$.

Answer(a) [1]

(b) [1]

- 4 An architect is trying to produce a model of a house using a scale of 1 : 20.

- (a) Given that the length of the model house is 53 cm, find in metres, the actual length of the house.
- (b) Given that the actual floor area of the house is 103 m^2 , find in square centimetres, the floor area of the model house.

Answer(a) m [1]

(b) cm^2 [1]

Name: _____ () Class: _____

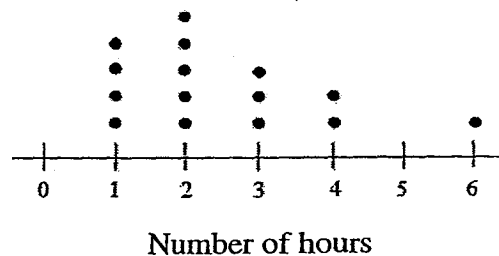
- 5 A motorist travels 144 km in h hours for the whole journey. Write down, in its simplest form, an expression in terms of h for his average speed in metres per second.

Answer m/s [2]

- 6 A survey was conducted to find out the number of hours that students spent on the internet on weekends and the data collected was displayed on a dot diagram.

Find

- (a) the range,
(b) the median number of hours.



Answer (a) hours[1]

(b) hours[1]

Name: _____ ()

Class: _____

- 7 Express as a single fraction in its simplest form

$$\frac{2x}{x^2 - 4y^2} + \frac{1}{2y - x}$$

Answer..... [3]

- 8 It is given that $72 = 2^3 \times 3^2$.

- (a) By expressing 540 as a product of prime factors, find the highest common factor of 72 and 540.
- (b) Find the smallest positive integer n such that $540n$ is a perfect cube.

Answer(a) [2]

(b) n = ... [1]

Name: _____ () Class: _____

9 A spacecraft at Mars is 78 billion metres from Earth.

- (a) Express 78 billion metres in standard form.
- (b) The spacecraft signals to Earth by emitting radio waves which travel 1 metre in 3.3 nanoseconds. How many seconds do the radio waves take to travel from the spacecraft to Earth? Express your answer to the nearest second.

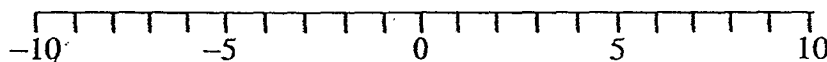
Answer(a) metres [1]

(b)..... seconds [2]

10 Solve the inequality $2x - 1 < 8 + x \leq 3x + 2$.

Show your solution on the number line in the answer space.

Answer



[3]

- 11 (a) The n th term of a sequence is given by $n^2 - 2$.
Write down the first 4 terms of the sequence.
- (b) The first 4 terms of another sequence is given by 2, 7, 14, 23, ...
Write down an expression in terms of n , for the n th term of the sequence.
- (c) A third sequence is formed by adding the first term of sequence in (a) to the first term of sequence in (b), the second term of sequence in (a) to the second term of sequence in (b) and so on. Write down an expression for the n th term in this third sequence in its simplest form.

Answer(a) [1]

(b) [1]

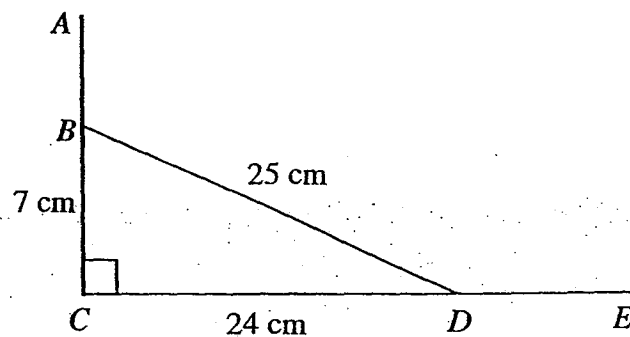
(c) [1]

- 12 BCD is a right-angled triangle in which $CD = 24$ cm and $BD = 25$ cm.

CB is produced to A and CD is produced to E .

Express, as a fraction, the value of

- (a) $\sin \angle ABD$,
 (b) $\cos \angle BDE$,
 (c) $\tan (90^\circ - \angle CBD)$.



Answer(a) $\sin \angle ABD =$ [1]

(b) $\cos \angle BDE =$ [1]

(c) $\tan (90^\circ - \angle CBD) =$ [1]

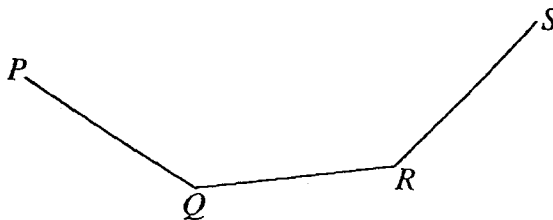
Name: _____ () Class: _____

- 13 P, Q, R and S are the vertices of a regular polygon with 12 sides.

Calculate

(a) $\angle PQR$,

(b) $\angle QPR$.



Answer(a) $\angle PQR = \dots\dots\dots^\circ$ [2]

(b) $\angle QPR = \dots\dots\dots^\circ$ [1]

14

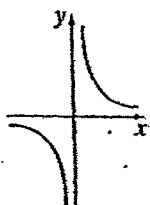


Figure 1

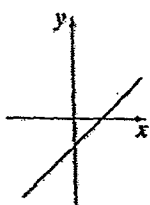


Figure 2

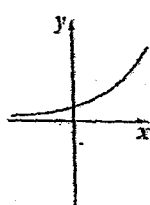


Figure 3

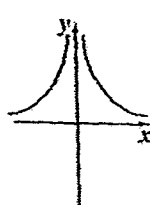


Figure 4

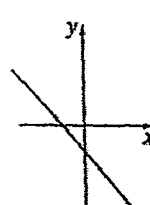


Figure 5

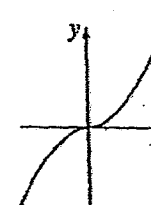


Figure 6

Which of the graphs shown above could be the graph of

(a) $y = \frac{1}{x}$,

(b) $y = -x - 3$,

(c) $y = 2^x$?

Answer(a) Figure [1]

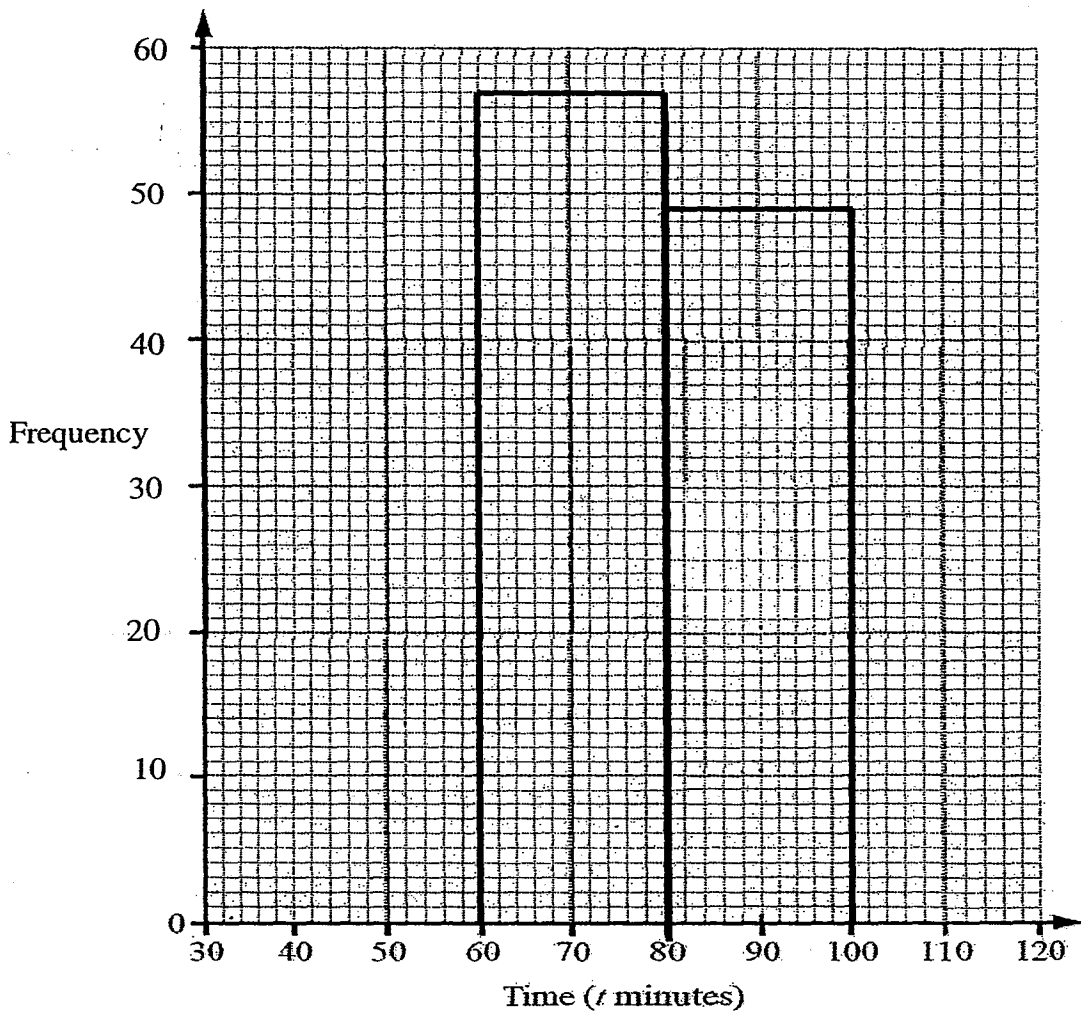
(b) Figure [1]

(c) Figure [1]

- 15 The distribution of the times spent by 200 customers at a coffee cafe one afternoon is shown in the table.

Time (t minutes)	$40 \leq t < 60$	$60 \leq t < 80$	$80 \leq t < 100$	$100 \leq t < 120$
Frequency	36	57	49	58

The diagram shows part of the histogram that represents this data.



- (a) Complete the histogram. [1]
- (b) Find the estimated mean time.

Answer(b) minutes[2]

Name: _____ ()

Class: _____

- 16 (a) Simplify $2(y-4)^2 - y + 3$.
- (b) Hence solve the equation $2(y-4)^2 = y - 3$.

Answer(a) [2]

(b)y = ... [2]

- 17 (a) Two unbiased dice are thrown together. Find the probability that
- (i) both dice show the same number,
- (ii) the sum of the two numbers on the dice is at least 10.
- (b) Three unbiased dice are thrown together. Find the probability that
- (i) all the dice show different numbers,
- (ii) at least two dice show the same number.

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

(ii) [1]

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

(ii) [1]

18 (a) A team of thirty-five workers in a department must work 8 hours a day to complete a project in a given period of time. If 3 workers are transferred to another department before the project begins, how long should the remaining workers work a day to complete the project in the same period of time?

(b) p is directly proportional to q^3 .
If q is increased by 20 %, find the percentage increase in p .

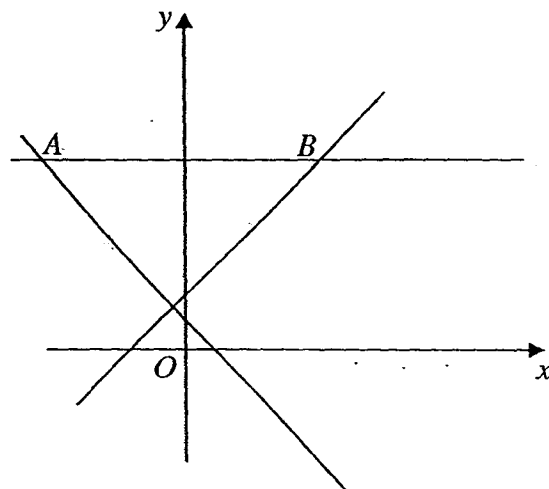
Answer(a) hours [2]

(b) % [2]

Name: _____ () Class: _____

- 19 The diagram, which is not drawn accurately, shows three lines $y = 5$, $y = -2x + 1$ and $2y = 5 + 3x$. Find

- (a) the coordinates of A and B ,
- (b) the gradient of the line $2y = 5 + 3x$,
- (c) the equation of the line parallel to $y = -2x + 1$, through the point $(4, 3)$.



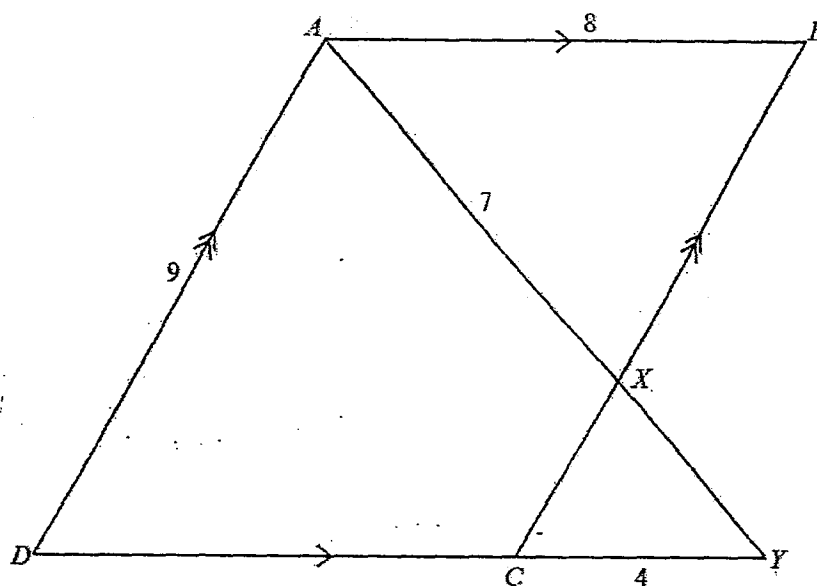
Answer (a) A is (,) [1]

B is (,) [1]

(b) [1]

(c) [1]

20



In the diagram, $ABCD$ is a parallelogram. X is a point on BC .
 AXY and DCY are straight lines. $AB = 8$ cm, $AX = 7$ cm, $AD = 9$ cm and $CY = 4$ cm.

- (a) Show that triangles ABX and YDA are similar. Give a reason for each of your statements.

.....

[2]

- (b) Calculate AY .

Answer(b) cm[2]

Name: _____ () Class: _____

- 21 Two corners, L and M , of a horizontal triangular field are 320 m apart. The diagram below is part of a scale drawing of the field.

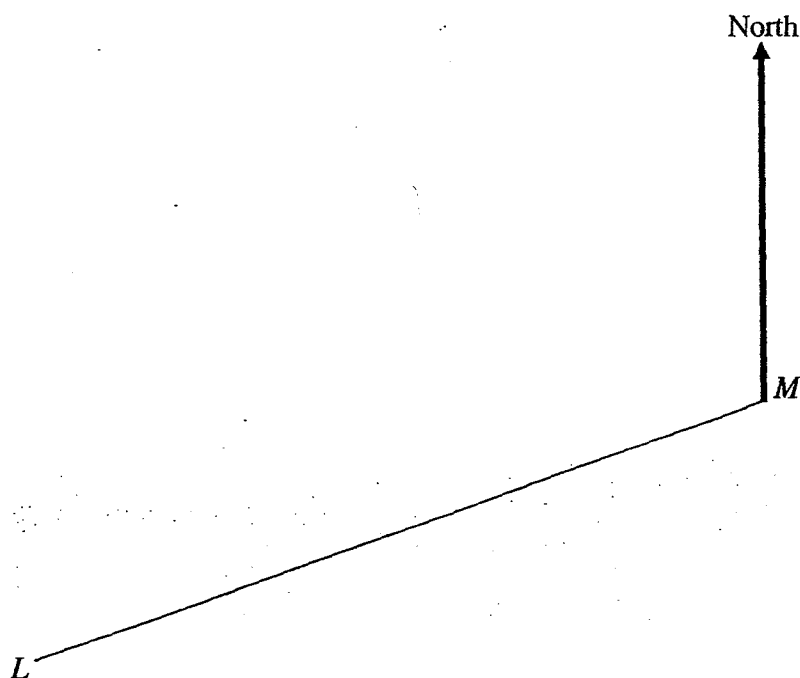
- (a) Find the bearing of L from M , giving your answer to the nearest degree.

Answer (a)° [1]

- (b) Construct the perpendicular bisector of the line LM . [1]

- (c) The third corner, N , of the field is north-east of L and 192 m from M . Using ruler, protractor and compasses only, find and label the possible positions of N on the scale drawing. [2]

Answer(b) and (c)

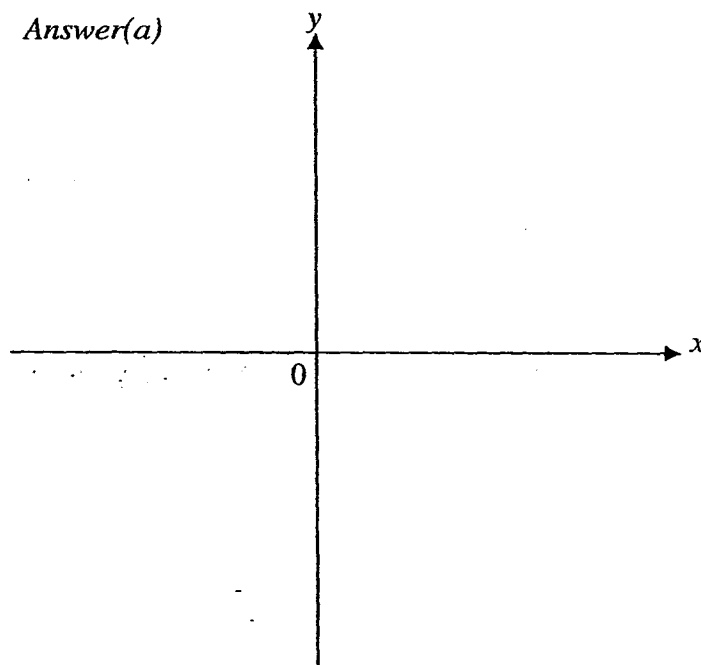


Name: _____ ()

Class: _____

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

Answer(a)

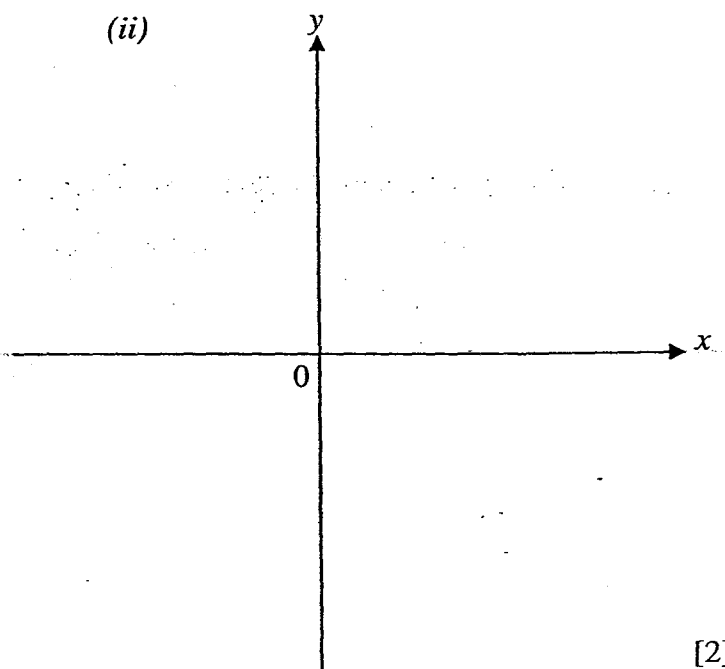


[2]

- (b) (i) Express $x^2 - 6x + 10$ in the form $(x+a)^2 + b$.
 (ii) Sketch the graph of $y = x^2 - 6x + 10$.

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

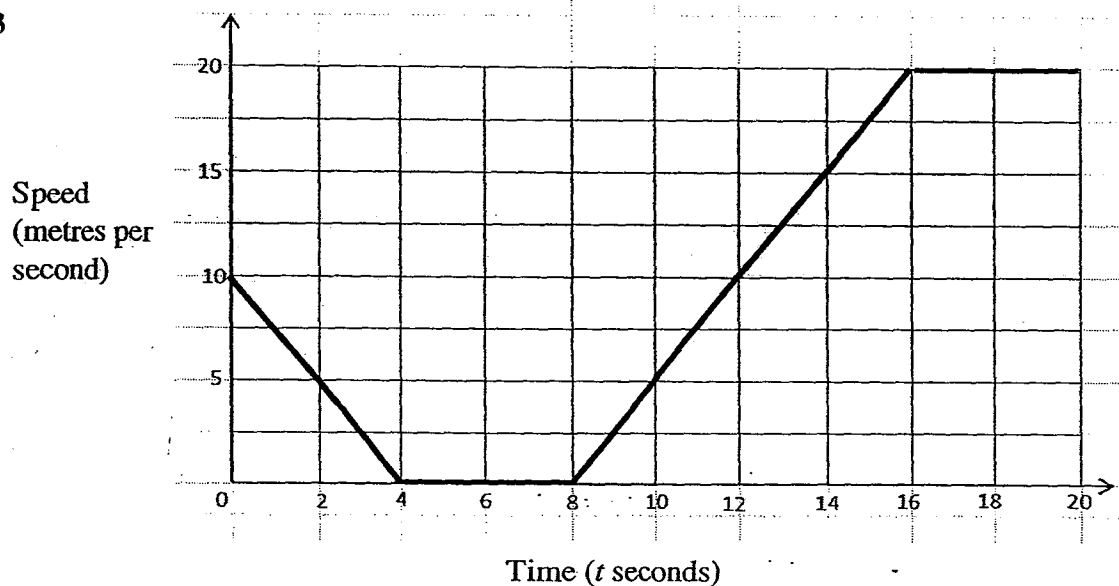
(ii)



[2]

Name: _____ () Class: _____

23



The diagram shows the speed-time graph for the first 20 seconds of a car journey.

(a) Calculate

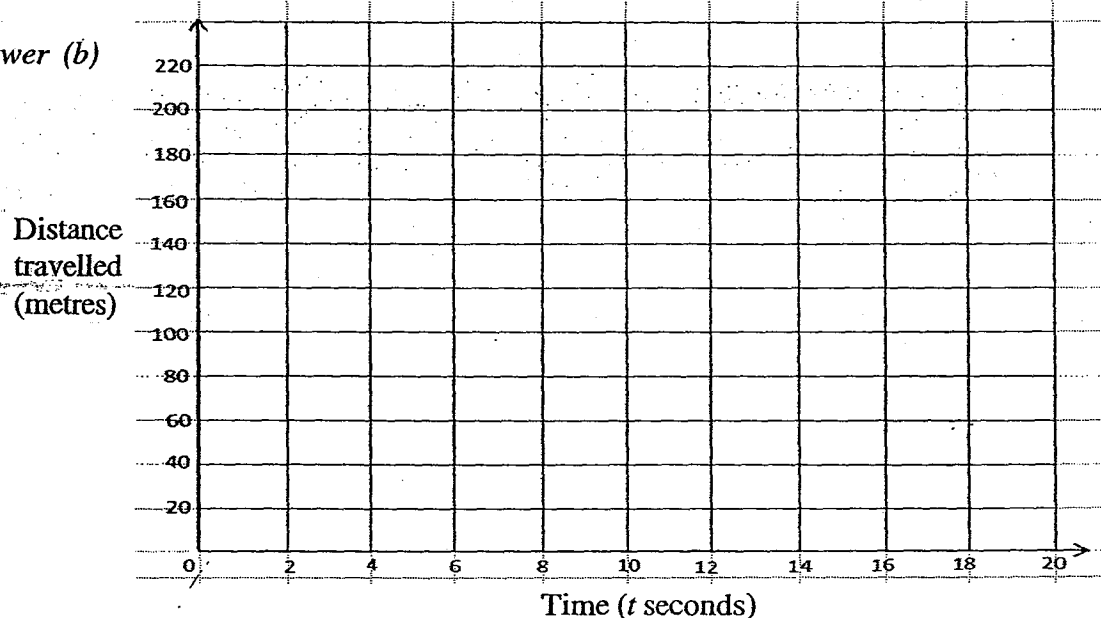
- (i) the acceleration of the car when $t = 10$,
- (ii) the total distance travelled in the first 20 seconds.

Answer(a)(i) m/s^2 [1]

(ii) m [1]

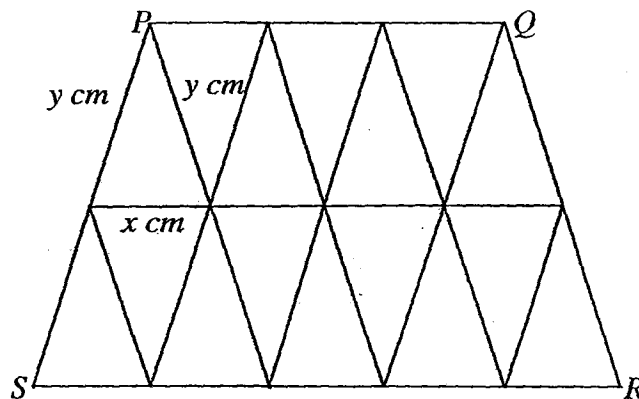
(b) Use the grid below to sketch the distance-time graph for the journey.

Answer (b)



[3]

- 24 The frame work shown in the figure is made from a piece of wire 114cm in length. The outer perimeter $PQRSP$ is 36 cm long and all the 16 isosceles triangles are congruent. The lengths of the sides of each isosceles triangle are x cm and y cm respectively.



Given $PQ = 3x$ cm and $QR = 2y$ cm.

- (a) Use the above information to write down two equations in x and y .

Answer(a) [2]

- (b) Solve the simultaneous equations.

Answer(b) $x =$

Name: _____ () Class: _____
 $y =$ [2]

24 (c) Hence, find the area of trapezium $PQRS$.

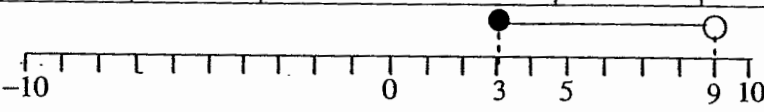
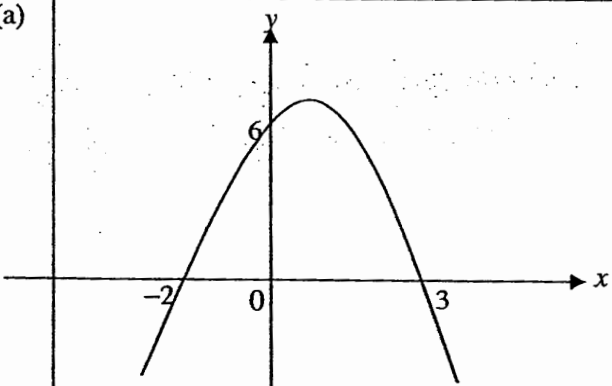
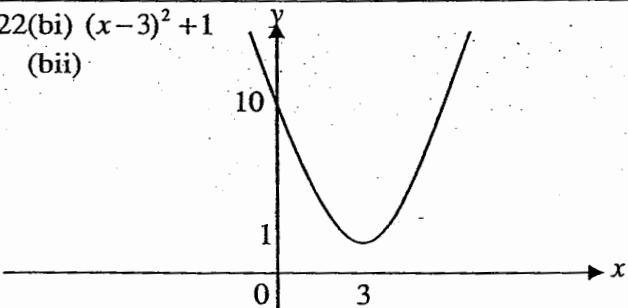
Answer(c) cm² [3]

End of paper

Name: _____ ()

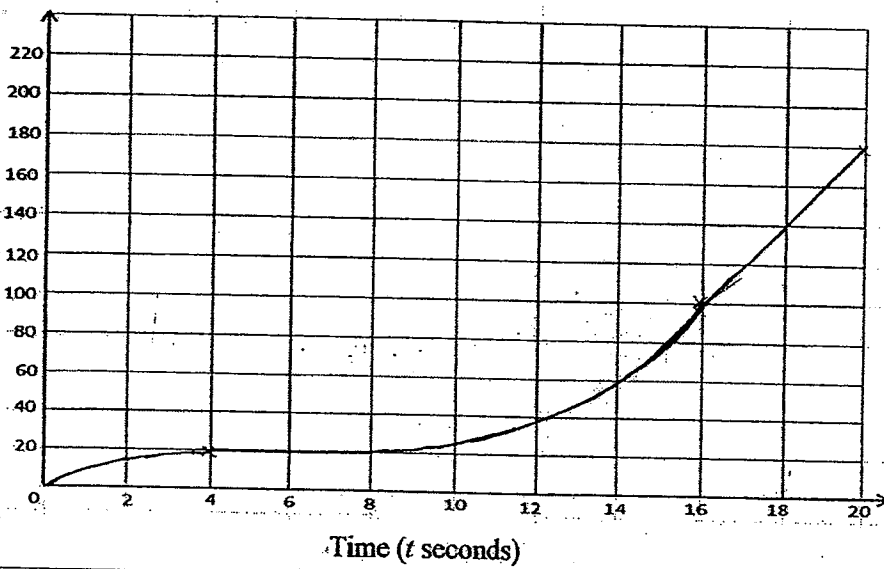
Class: _____

Fairfield Methodist School (Secondary)
Preliminary Examination 2014
Sec 4 Exp /5N(A) Mathematics
Answer Key Paper 1

1	0.15	2	\$12	3(a), (b)	$\frac{11}{a^2}, \frac{7p^5}{3}$
4(a) (b)	10.6 m, 2575 cm ²	5	$\frac{40}{h}$	6(a) (b)	5, 2
7	$\frac{1}{(x+2y)}$	8(a) (b)	36, 50	9(a), (b)	7.8×10^{10} metres, 257 seconds
10	$3 \leq x < 9$ 				
11(i)	-1, 2, 7, 14	11(ii)	$(n+1)^2 - 2$	11(iii)	$2n^2 + 2n - 3$
12(a)	$\frac{24}{25}$	12(b)	$-\frac{24}{25}$	12(c)	$\frac{7}{24}$
13(a)	150°	13(b)	15°	14(a),(b), (c)	Figure 1, Figure 5, Figure 3
15(a)	*** see below for completed histogram	15(b)	82.9 minutes	16(a) (b)	$2y^2 - 17y + 35$ $y = 3.5$ or 5
17(ai) (aii)	$\frac{1}{6}, \frac{1}{6}$	17(bi) (bii)	$\frac{5}{9}, \frac{4}{9}$	18(a) (b)	8.75 hours 72.8%
19(a)	A is (-2, 5), B is $(1\frac{2}{3}, 5)$	19(b)	$\frac{3}{2}$ or $1\frac{1}{2}$ or 1.5	19(c)	$y = -2x + 11$
20(a)	$\angle BAX = \angle PYA$ (alt. ~~4s~~) (A) $\angle AXB = \angle YAD$ (alt. ~~4s~~) (A) $\therefore \angle ABX = \angle YDA$ (A) Hence, $\triangle ABX$ is similar to $\triangle YDA$ (AAA)			20(b)	10.5 cm
21(a)	250°	21(b), (c)	*** see below for construction workings		
22(a)			22(bi) $(x-3)^2 + 1$ (bii)		

Class: _____

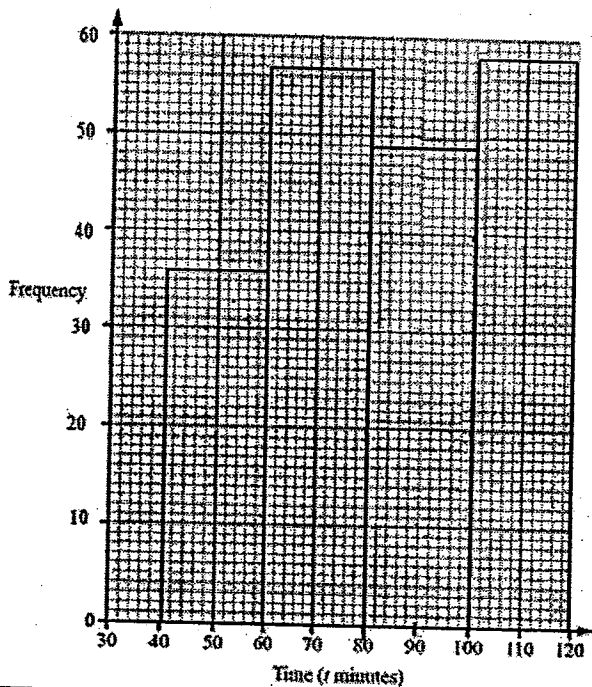
(b)



78.4 cm ²

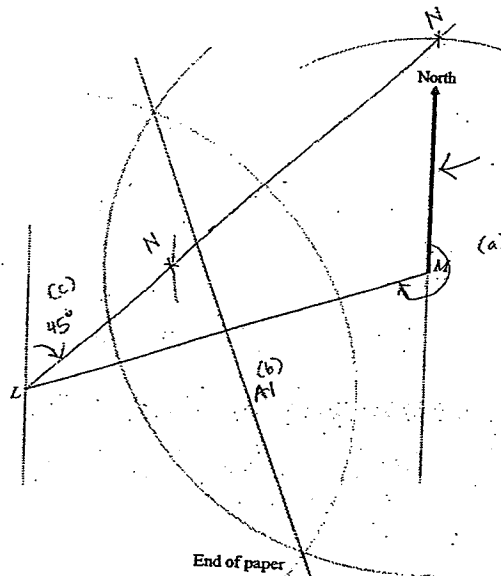
15(a)

21(b), (c)



Answer (b) and (c).

$$\frac{192 \text{ m}}{32} = 6 \text{ cm}$$





FAIRFIELD METHODIST SCHOOL (SECONDARY)

PRELIMINARY EXAMINATION 2014

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

MATHEMATICS

4016/01

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Paper 2	/100
Total	%

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Answer **all** the questions.

- 1 Calculate $\frac{8.679 + 3.457}{9.46^2 - \sqrt{48.7}}$, giving your answer correct to 2 significant figures.

$$\sim 0.14708 = 0.147(3\text{s.f.}) = 0.15 (2 \text{ sf})$$

Answer.....0.15..... [B2]

- 2 A retailer bought a pair of headphones from a manufacturer for \$120. In addition to that, he paid a 15% tax. If he sold the headphones to a customer for \$150, calculate the profit he made.

$$115\% \text{ ----- } \frac{115}{100} \times 120 \quad [\text{M1}]$$

$$= \$138$$

$$\text{Profit he made} = \$150 - \$138$$

$$= \$12 \quad [\text{A1}]$$

Answer \$ 12..... [2]

- 3 (a) Simplify $\frac{a^2 \times a^4}{\sqrt{a}}$ and give your answer in the form a^n .
- (b) Simplify $7 \div 3p^{-5}$.

$$\begin{aligned} & \frac{a^2 \times a^4}{\sqrt{a}} \\ \text{(a)} &= \frac{a^6}{a^{\frac{1}{2}}} \\ &= a^{\frac{11}{2}} \end{aligned}$$

$$\begin{aligned} & 7 \div 3p^{-5} \\ \text{(b)} &= \frac{7}{3p^{-5}} \\ &= \frac{7p^5}{3} \end{aligned}$$

Answer(a) $a^{\frac{11}{2}}$ [B1]

(b) $\frac{7p^5}{3}$ [B1]

- 4 An architect is trying to produce a model of a house using a scale of 1 : 20.
- (a) Given that the length of the model house is 53 cm, find in metres, the actual length of the house.
- (b) Given that the actual floor area of the house is 103 m^2 , find in square centimetres, the floor area of the model house.

$$\begin{aligned} \text{(a)} \quad & \text{Model} \text{ ---- Actual} \\ & 1\text{cm} \text{ ---- } 20\text{cm} \\ & 53\text{cm} \text{ ---- } 1060 \text{ cm} = 10.6\text{m} \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad & \text{Scale area: } 1\text{cm}^2 \text{ ---- } 0.04 \text{ m}^2 \\ & \therefore \text{floor area of the model house} = 103 \div 0.04 = 2575 \text{ cm}^2 \end{aligned}$$

Answer(a) 10.6 m [B1]

(b) 2575 cm^2 [B1]

- 5 A motorist travels 144 km in h hours for the whole journey. Write down, in its simplest form, an expression in terms of h for his average speed in metres per second.

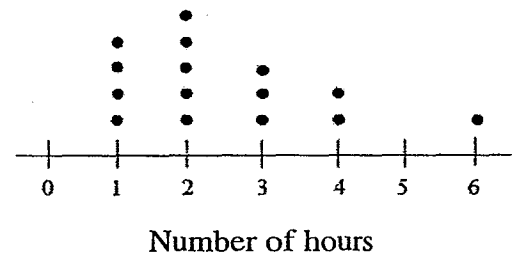
$$\begin{aligned} \text{Average Speed in m/s} &= \frac{144 \times 1000}{3600h} \dots\dots\dots [\text{M1, A1}] \\ &= \frac{40}{h} \end{aligned}$$

Answer..... $\frac{40}{h}$ m/s [2]

- 6 A survey was conducted to find out the number of hours that students spent on the internet on weekends and the data collected was displayed on a dot diagram.

Find

- (a) the range,
(b) the median number of hours.



Answer(a) 5..... hours[B1]

(b) 2..... hours[B1]

- 7 Express as a single fraction in its simplest form

$$\frac{2x}{x^2 - 4y^2} + \frac{1}{2y - x}$$

$$\begin{aligned} & \frac{2x}{x^2 - 4y^2} + \frac{1}{2y - x} \\ &= \frac{2x}{(x-2y)(x+2y)} - \frac{1}{(x-2y)} \dots\dots\dots [M1: a^2 - b^2 = (a-b)(a+b)] \\ &= \frac{2x - (x+2y)}{(x-2y)(x+2y)} \dots\dots\dots [M1: LCM] \\ &= \frac{x-2y}{(x-2y)(x+2y)} \\ &= \frac{1}{(x+2y)} \dots\dots\dots [A1] \end{aligned}$$

$$\text{Answer} \dots\dots\dots \frac{1}{(x+2y)} \dots\dots\dots [M1, M1, A1]$$

- 8 It is given that $72 = 2^3 \times 3^2$.

- (a) By expressing 540 as a product of prime factors, find the highest common factor of 72 and 540.
- (b) Find the smallest positive integer n such that $540n$ is a perfect cube.

$$\begin{aligned} \text{(a)} \quad & 72 = 2^3 \times 3^2 \\ & 540 = 2^2 \times 3^3 \times 5 \dots\dots\dots [B1] \\ & \text{HCF} = 2^2 \times 3^2 = 36 \dots\dots\dots [B1] \end{aligned}$$

$$\text{(b)} \quad n = 2 \times 5^2 = 50 \dots\dots\dots [B1]$$

$$\text{Answer(a). } 540 = 2^2 \times 3^3 \times 5, 36.. [B1, B1]$$

$$\text{Answer(b)} n = \dots\dots\dots 50 \dots\dots\dots [1]$$

9 A spacecraft at Mars is 78 billion metres from Earth.

- (a) Express 78 billion metres in standard form.
- (b) The spacecraft signals to Earth by emitting radio waves which travels at 1 metre in 3.3 nanoseconds. How many seconds do the radio waves take to travel from the spacecraft to Earth? Express your answer to the nearest second.

(a) $78 \text{ billion metres} = 7.8 \times 10^{10} \text{ metres} \dots\dots\dots [\text{B1}]$

(b) $1 \text{ m} \text{ ----- } 3.3 \times 10^{-9} \text{ s}$

No. of seconds it takes $= 7.8 \times 10^{10} \times 3.3 \times 10^{-9} \dots\dots\dots [\text{M1}]$

$= 257.4$

$= 257 \text{ (nearest second)} \dots\dots\dots [\text{A1}]$

Answer(a) 7.8×10^{10} metres [B1]

(b) 257..... seconds [M1, A1]

10 Solve the inequality $2x - 1 < 8 + x \leq 3x + 2$.

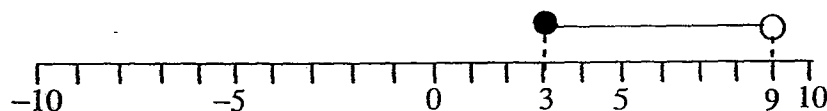
Show your solution on the number line in the answer-space.

$$\begin{array}{ll} 2x - 1 < 8 + x & 8 + x \leq 3x + 2 \\ x < 9 & \text{or} \quad 6 \leq 2x \\ & 3 \leq x \\ & x \geq 3 \\ & \dots\dots\dots [\text{M1}] \end{array}$$

$3 \leq x < 9 \dots\dots\dots [\text{A1}]$

$\dots\dots\dots [\text{f1}]$

Answer



[3]

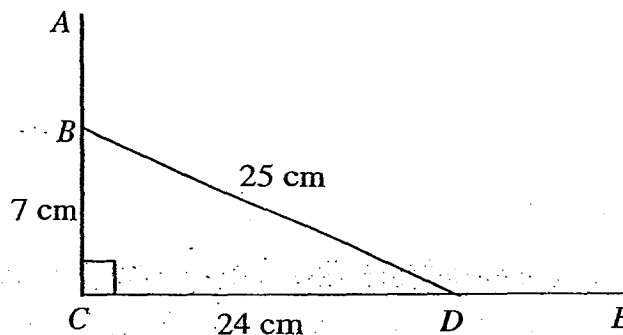
- 11 (i) The n th term of a sequence is given by $n^2 - 2$.
Write down the first 4 terms of the sequence.
- (ii) The first 4 terms of another sequence is given by 2, 7, 14, 23, ...
Write down an expression in terms of n , for the n th term of the sequence.
- (iii) A third sequence is formed by adding the first term of sequence in (i) to the first term of sequence in (ii), the second term of sequence in (i) to the second term of sequence in (ii) and so on. Write down an expression for the n th term in this third sequence in its simplest form.
- (i) First 4 terms: -1, 2, 7, 14 [B1]
- (ii) $(n + 1)^2 - 2$ [B1]
- (iii) Third sequence: 1, 9, 21, 37, ...
 n^{th} term = $n^2 - 2 + (n + 1)^2 - 2$
 $= 2n^2 + 2n - 3$ [B1]
- Answer(i) -1, 2, 7, 14 [1]
- (ii) $(n + 1)^2 - 2$ [1]
- (iii) $2n^2 + 2n - 3$ [1]

- 12 BCD is a right-angled triangle in which $CD = 24$ cm and $BD = 25$ cm.

CB is produced to A and CD is produced to E .

Express, as a fraction, the value of

- (a) $\sin \angle ABD$,
 (b) $\cos \angle BDE$,
 (c) $\tan (90^\circ - \angle CBD)$.



Answer(a) $\sin \angle ABD = \dots \frac{24}{25} \dots$ [B1]

(b) $\cos \angle BDE = \dots -\frac{24}{25} \dots$ [B1]

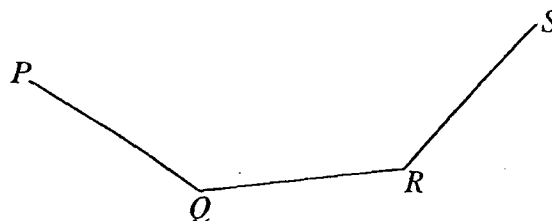
(c) $\tan (90^\circ - \angle CBD) = \dots \frac{7}{24} \dots$ [B1]

- 13 P, Q, R and S are the vertices of a regular polygon with 12 sides.

Calculate

(a) $\angle PQR$,

(b) $\angle QPR$.



$$(a) \angle PQR = \frac{10 \times 180^\circ}{12} \dots\dots [M1, A1]$$

$$= 150^\circ$$

$$(b) \angle QPR = (180 - 150) \div 2 = 15^\circ [B1]$$

Answer(a) $\angle PQR \dots\dots\dots 150 \dots\dots\dots^\circ [2]$

(b) $\angle QPR \dots\dots\dots 15 \dots\dots\dots^\circ [1]$

14

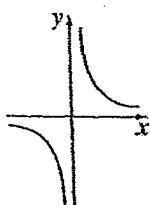


Figure 1

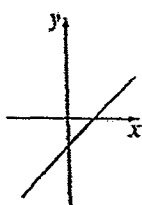


Figure 2

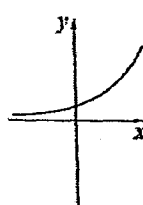


Figure 3

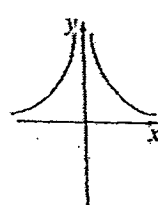


Figure 4

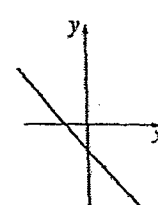


Figure 5

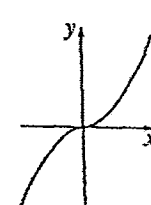


Figure 6

Which of the graphs shown above could be the graph of

(a) $y = \frac{1}{x}$,

(b) $y = -x - 3$,

(c) $y = 2^x$?

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

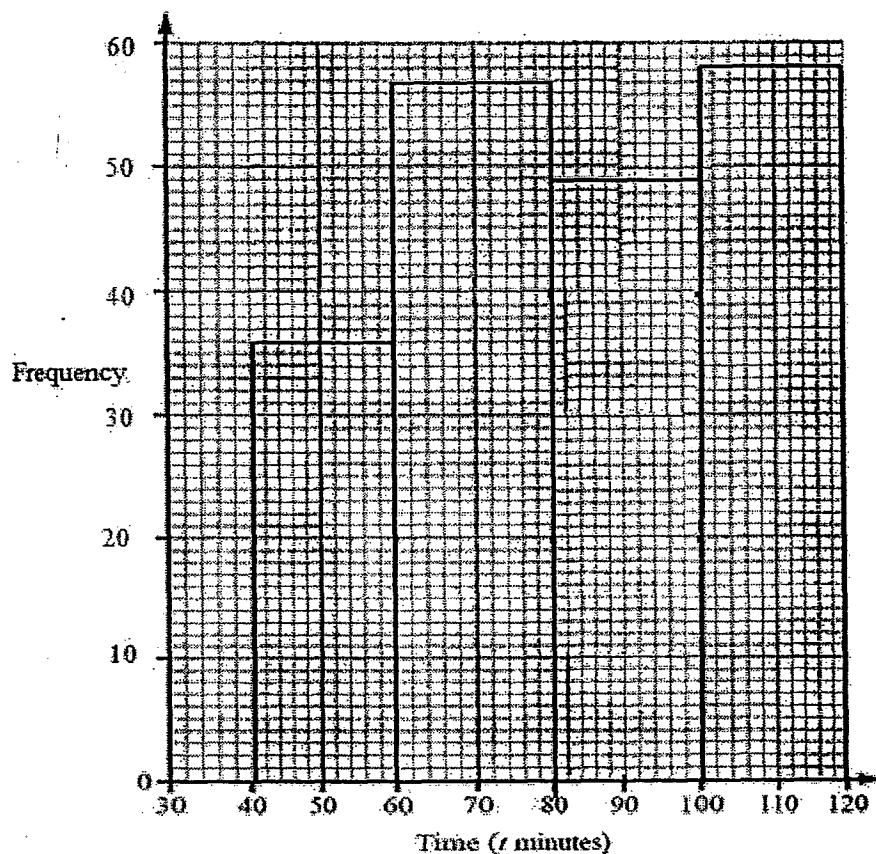
(b) Figure ...5 [1]

(c) Figure ...3 [1]

- 15 The distribution of the times spent by 200 customers at a coffee cafe one afternoon is shown in the table.

Time (t minutes)	$40 \leq t < 60$	$60 \leq t < 80$	$80 \leq t < 100$	$100 \leq t < 120$
Frequency	36	57	49	58

The diagram shows part of the histogram that represents this data.



- (a) Complete the histogram.

[1]

- (b) Find the estimated mean time.

$$\begin{aligned} \text{Mean} &= (36 \times 50) + (57 \times 70) + (49 \times 90) + (58 \times 110)/200 \\ &= 82.9 \text{ minutes} \end{aligned}$$

Answer (b) 82.9.....minutes [2]

- 16 (a) Simplify $2(y-4)^2 - y + 3$.
 (b) Hence solve the equation $2(y-4)^2 = y - 3$.

$$\begin{aligned}
 &2(y-4)^2 - y + 3 \\
 \text{(a)} \quad &2(y^2 - 8y + 16) - y + 3 \dots\dots [\text{M1}] : \text{expand } (y-4)^2 = y^2 - 8y + 16 \\
 &2y^2 - 16y + 32 - y + 3 \\
 &2y^2 - 17y + 35 \dots\dots [\text{A1}] \\
 \text{(b)} \quad &2y^2 - 17y + 35 = 0 \\
 &(2y-7)(y-5) = 0 \dots\dots [\text{M1}] \\
 &y = 3.5 \text{ or } 5 \dots\dots [\text{A1}]
 \end{aligned}$$

Answer(a). $2y^2 - 17y + 35$ [M1, A1]

(b) $y = \dots\dots 3.5 \text{ or } 5 \dots$ [M1, A1]

- 17 (a) Two unbiased dice are thrown together. Find the probability that
- (i) they show the same number,
 - (ii) the sum of the two numbers is at least 10.
- (b) Three unbiased dice are thrown together. Find the probability that
- (i) they all show different numbers,
 - (ii) at least two show the same number.

Answer(a)(i)..... $\frac{1}{6}$ [1]

(b)(ii) $1 - \frac{5 \times 4}{9 \times 9}$

(ii)..... $\frac{1}{6}$ [1]

(b)(i)..... $\frac{5}{9}$ [1]

(ii)..... $\frac{4}{9}$ [1]

- 18 (a) A team of thirty-five workers in a department must work 8 hours a day to complete a project in a given period of time. If 3 workers are transferred to another department before the project begins, how long should the remaining workers work a day to complete the project in the same period of time?

- (b) p is directly proportional to q^3 .
If q is increased by 20%, find the percentage increase in p .

(a)

<u>Workers</u>	:	<u>Hours</u>	:	<u>Project</u>
35	:	8	:	1
1	:	280	:	1
32	:	$280 \div 32$	:	1
		$= 8.75\text{h}$		[M1, A1]

- (b) $p = kq^3$

$$\text{New } q = 1.2q$$

$$\text{New } p = k(1.2q)^3$$

$$= 1.728kq^3 \quad \dots\dots\dots [\text{M1}]$$

$$\% \text{ increase in } p = (1.728 - 1) \times 100\%$$

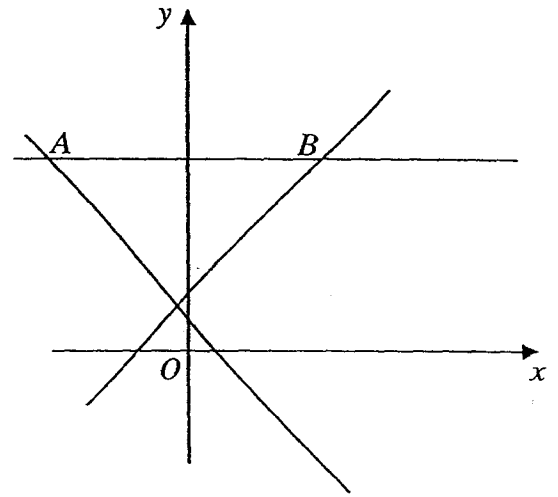
$$= 72.8 \quad \dots\dots\dots [\text{A1}]$$

Answer(a).....8.75..... hours [M1, A1]

(b).....72.8..... % [M1, A1]

- 19 The diagram, which is not drawn accurately, shows three lines $y=5$, $y=-2x+1$ and $2y=5+3x$. Find

- (a) the coordinates of A and B,
 (b) the gradient of the line $2y=5+3x$,
 (c) the equation of the line parallel to $y=-2x+1$, through the point (4, 3).



$$\begin{array}{ll} \text{(a)} & 5 = -2x + 1 & 2(5) = 5 + 3x \\ & 2x = -4 & 3x = 5 \\ & x = -2 & x = 5/3 \text{ or } 1\frac{2}{3} \end{array}$$

$$\begin{array}{l} \text{(b)} \quad y = \frac{1}{2}(5 + 3x) \\ \quad y = \frac{3}{2}x + \frac{5}{2} \end{array}$$

$$\begin{array}{l} \text{(c)} \quad y = -2x + c \\ \quad 3 = -2(4) + c \\ \quad c = 11 \\ \quad y = -2x + 11 \end{array}$$

Answer (a) A is (-2 , 5) [1]

B is ($1\frac{2}{3}$, 5) [1]

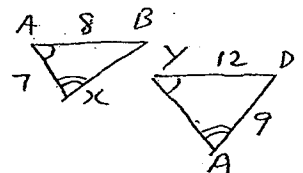
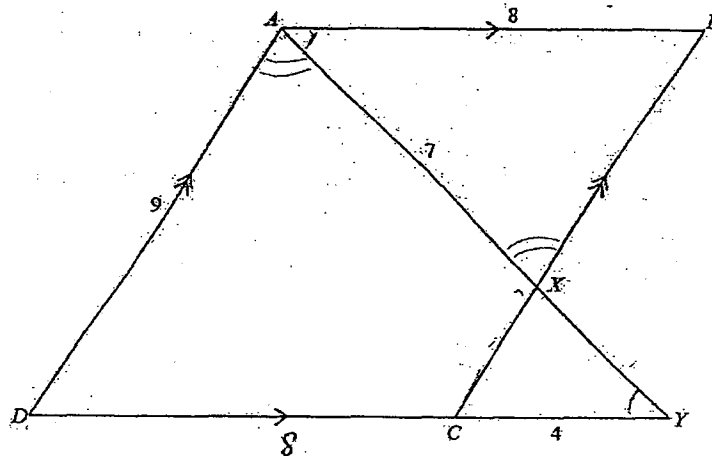
(b) $\frac{3}{2}$ or 1.5 or $1\frac{1}{2}$ [1]

(c) $y = -2x + 11$ [1]

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In the diagram, $ABCD$ is a parallelogram. X is a point on BC .
 AXY and DCY are straight lines. $AB = 8$ cm, $AX = 7$ cm, $AD = 9$ cm and $CY = 4$ cm.

(a) Show that triangles ABX and YDA are similar. Give a reason for each of your statements.

$$\angle BAX = \angle DYA \text{ (alt. } \angle\text{s)} \quad (A) \quad (M1)$$

$$\angle AXB = \angle YAD \text{ (alt. } \angle\text{s)} \quad (A) \quad (M1)$$

$$\therefore \angle ABX = \angle YDA \quad (A)$$

Hence $\triangle ABX$ is similar to $\triangle YDA$. (AAA) — *must write this conclusion if not minus 1 mark.*

[2]

(b) Calculate AY .

Since $\triangle ABX$ is similar to $\triangle YDA$.

$$\frac{8}{12} = \frac{7}{AY}$$

$$AY = \frac{12 \times 7}{8} \quad (M1)$$

$$= \frac{21}{2} = 10.5 \quad (A1)$$

Answer

(b)

10.5

cm [2]

21. Two corners, L and M , of a horizontal triangular field are 320 m apart. The diagram below is part of a scale drawing of the field.

- (a) Find the bearing of L from M , giving your answer to the nearest degree.

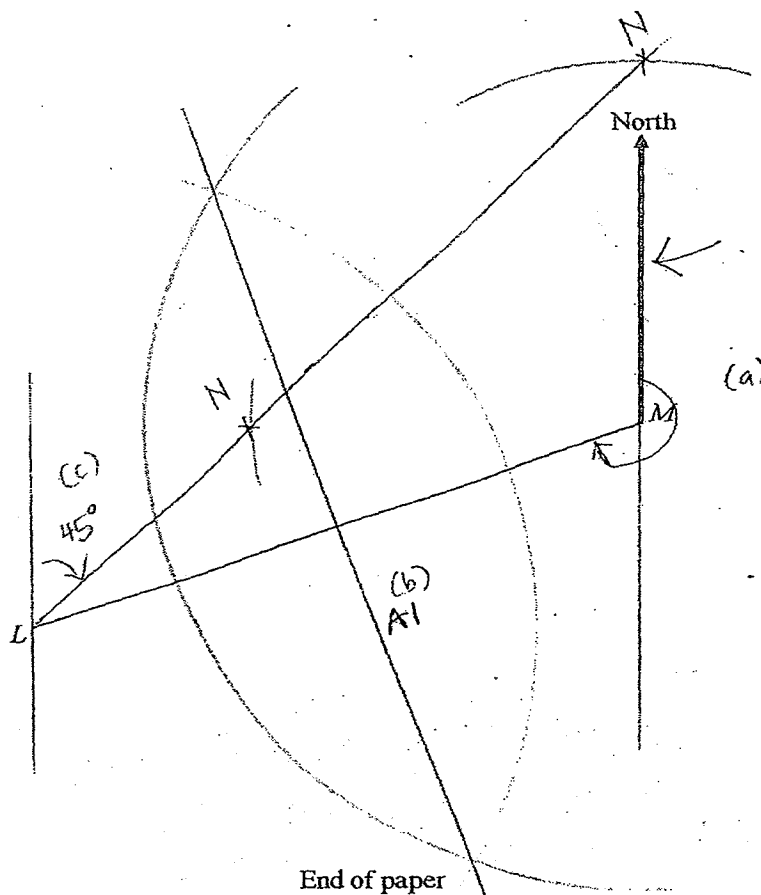
Answer (a) 250° [1]

- (b) Construct the perpendicular bisector of the line LM . [1]

- (c) The third corner, N , of the field is north-east of L and 192 m from M . Using ruler, protractor and compasses only, find and label the possible positions of N on the scale drawing. [2]

Answer (b) and (c).

$$\begin{aligned} 10 \text{ cm} &= 320 \text{ m} \\ 1 \text{ cm} &= 32 \text{ m} \\ \frac{192 \text{ m}}{32} &= 6 \text{ cm} \end{aligned}$$

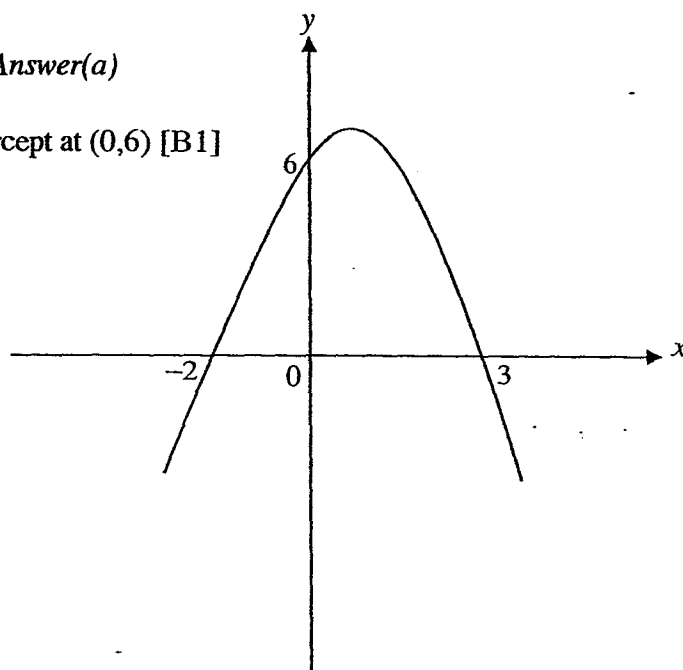


- 22 (a) Sketch the graph of $y = (3 - x)(2 + x)$.

Correct shape[B1]

x-intercepts at (3,0) and (-2,0), y-intercept at (0,6) [B1]

Answer(a)



[2]

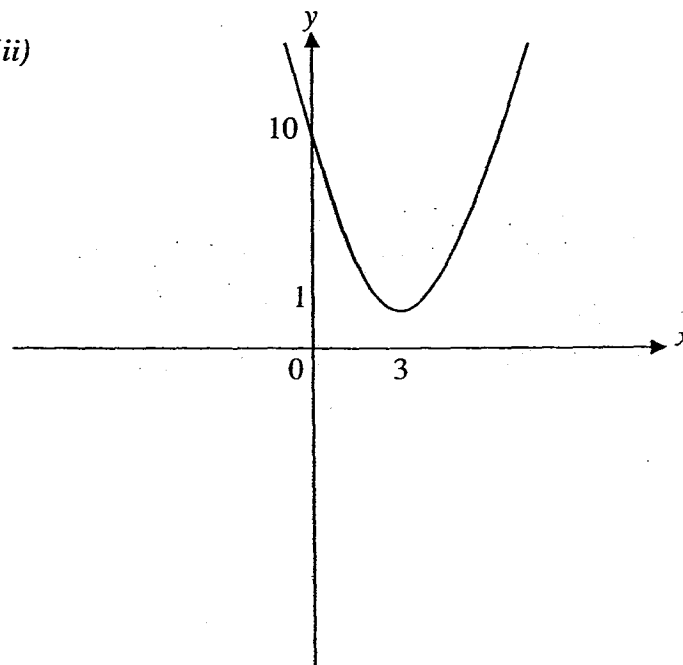
- (b) (i) Express $x^2 - 6x + 10$ in the form $(x + a)^2 + b$.
(ii) Sketch the graph of $y = x^2 - 6x + 10$.

$$\begin{aligned} & x^2 - 6x + 10 \\ \text{(bi)} \quad & = x^2 - 6x + (-3)^2 - (-3)^2 + 10 \\ & = (x - 3)^2 - 9 + 10 \\ & = (x - 3)^2 + 1 \end{aligned}$$

Answer(b)(i)..... $(x - 3)^2 + 1$ [B1]

(ii)

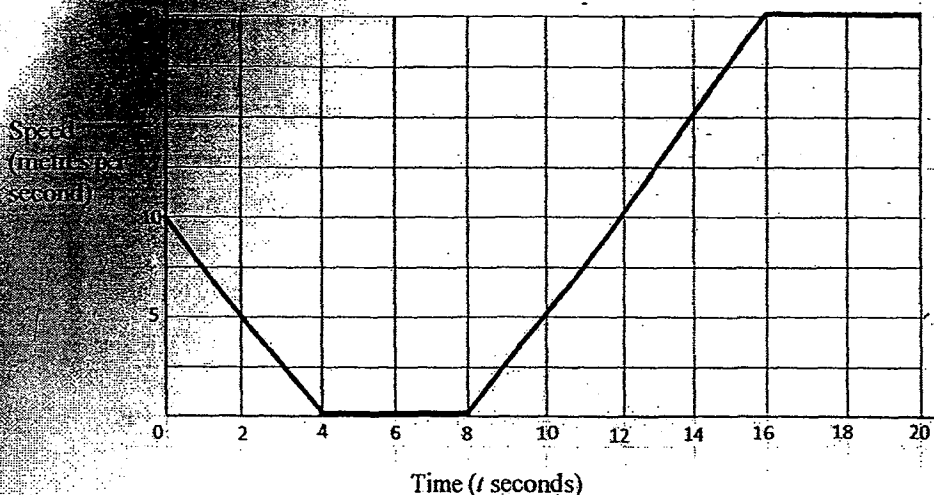
(ii) correct shape[B1]
Min pt (3, 1),
y-intercept at (0,10) [B1]



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The diagram shows the speed-time graph for the first 20 seconds of a car journey.

(a) Calculate

- (i) the acceleration of the car when $t = 10$,
 (ii) the total distance travelled in the first 20 seconds.

(a)(i) $\frac{5}{2} = 2.5$

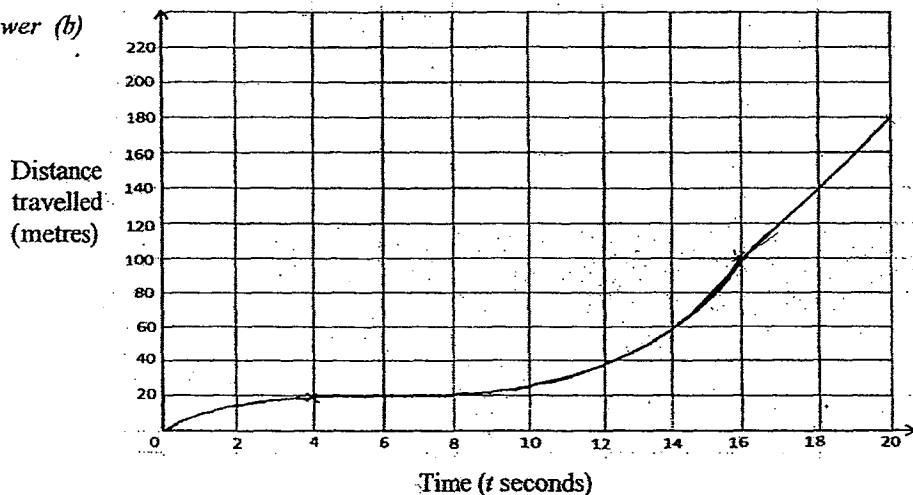
(ii) Total distance = $\frac{1}{2} \times 4 \times 10 + \frac{1}{2} \times (4 + 12) \times 20$
 $= 180 \text{ m}$

Answer (a)(i) 2.5 m/s^2 [1]

(ii) 180 m [1]

(b) Use the grid below to sketch the distance-time graph for the journey.

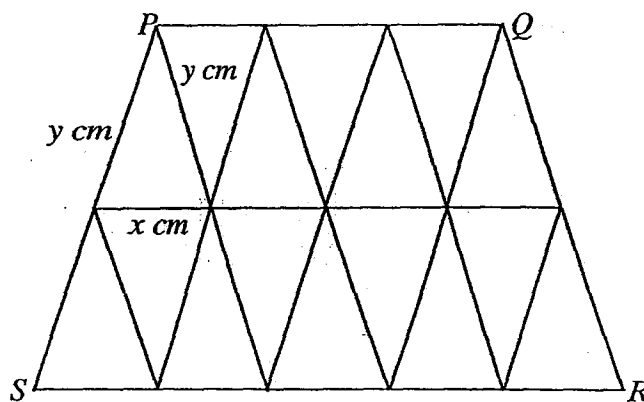
Answer (b)



[3]

- 24 The frame work shown in the figure is made from a piece of wire 114cm in length. The outer perimeter $PQRS$ is 36 cm long and all the 16 isosceles triangles are congruent. The lengths of the sides of each isosceles triangle are x cm and y cm respectively.

Given $PQ = 3x$ cm and $QR = 2y$ cm.



- (a) Use the above information to write down two equations in x and y .

$$2x + y = 9,$$

$$2x + 3y = 19.$$

[2]

- (a) Outer Perimeter = 36 cm

$$\Rightarrow 3x + 2y + 5x + 2y = 36 \dots\dots$$

$$\Rightarrow 8x + 4y = 36$$

$$\Rightarrow 2x + y = 9 \dots\dots[B1]$$

$$\text{Length of the entire model} = 114$$

$$\Rightarrow 3x + 2y + 5x + 2y + 14y + 4x = 114$$

$$\Rightarrow 12x + 18y = 114$$

$$\Rightarrow 2x + 3y = 19 \dots\dots[B1]$$

- (b) Solve the simultaneous equations.

- (c) Hence, find the area of trapezium $PQRS$.

$$(b) 2x + y = 9 \dots\dots (1)$$

$$2x + 3y = 19 \dots\dots (2)$$

$$(2) - (1): 2y = 10 \dots\dots[M1]$$

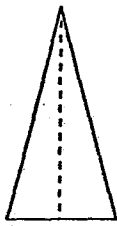
$$y = 5$$

$$x = 2 \dots\dots[A1]$$

$$\text{Answer(ii)} x = \dots\dots 2 \dots\dots$$

$$y = \dots\dots 5 \dots\dots [M1, A1]$$

24 (c)



$$\begin{aligned} \text{Height of an isosceles triangle} &= \sqrt{5^2 - 1^2} \dots\dots [\text{M1}] \\ &= \sqrt{24} \end{aligned}$$

$$\begin{aligned} \frac{1}{2} \times (3x + 5x) \times 2\sqrt{24} \\ \text{Area of trapezium} &= \frac{1}{2} \times (16) \times 2\sqrt{24} \dots\dots\dots [\text{M1, A1}] \\ &= 78.384 \\ &= 78.4 \text{ cm}^2 \end{aligned}$$

$$(iii) \dots\dots\dots 78.4 \dots\dots \text{ cm}^2 [\text{M2, A1}]$$

~ End Of Paper 1 ~

**FMS(S) SEC 4 EXPRESSPRELIMINARY EXAMINATION 2014
MATHEMATICS PAPER 2 MARKING SCHEME**

1 (a)	$3x + 1 + 3 + 2x - 5 = 89$ $5x = 90$ $x = 18$ $y = 100 - 89$ $y = 11$	M1 A1 B1
1 (b)	$n(A \cap B^1) = 3(18) + 1$ $= 55$	B1
2 (a)	$\angle QRP = 72 \div 2$ ($\angle$ at centre = $2 \angle$ at circumference) $= 36^\circ$	B1
2 (b)	$\angle QSP = 36^\circ$ ($\angle$ s in same segment)	B1
2 (c)	$\angle OPQ = (180 - 72) \div 2$ $= 54^\circ$ (base $\angle$ of Isos. Δ) $\angle QPA = 90 - 54$ $= 36^\circ$ (tan $\perp$ rad)	M1 A1
2 (d)	$\angle AQP = 180 - 36 - 37$ (sum of $\angle$ in Δ) $= 107^\circ$ $\angle RQP = 180 - 107$ ($\angle$ s on a straight line) $= 73^\circ$ $\angle PSR = 180 - 73$ (opp $\angle$ s in cyclic quad) $= 107^\circ$	M1 for finding $\angle$ AQP and $\angle$ RQP A1
3(a)	$\begin{pmatrix} 500 \\ 600 \\ 850 \\ 700 \end{pmatrix}$	B1
(b)	$\begin{pmatrix} 18050 \\ 18300 \\ 21700 \end{pmatrix}$	B1
(c)	M represents the total earnings in a week for Shops A, B and C respectively.	B1
d(i)	$(0.95 \ 0.95 \ 1.10)$	B1
(ii)	$(0.95 \ 0.95 \ 1.10) \begin{pmatrix} 18050 \\ 18300 \\ 21700 \end{pmatrix}$ $= (58402.50)$	M1 (multiplication) A1
4(a)	Let the midpoint of WZ be p.	

	$\sin \angle WXP = \frac{WP}{8}$ $0.69972 = \frac{WP}{8}$ $WP = 5.5977$ $WZ = 11.195$ $\sin \angle WYP = \frac{5.5977}{14}$ $\angle WYP = \sin^{-1} \frac{5.5977}{14}$ $= 0.411338 \text{ rad}$ $\angle WYZ = 2 \times 0.411338$ $= 0.823 \text{ rad (3sf)}$	[M1] [M1] [A1]
(b)	Area of shaded region $= \left[\frac{1}{2} (8^2) (1.55) - \frac{1}{2} (8^2) (\sin 1.55) \right] +$ $\left[\frac{1}{2} (14^2) (0.82268) - \frac{1}{2} (14^2) (\sin 0.82268) \right]$ $= 26.4 \text{ cm}^2$	[M1] [M1] [A1]
5(a)	$ac - 2bc + 3ad - 6bd$ $= c(a - 2b) + 3d(a - 2b)$ $= (a - 2b)(c + 3d)$	M1 A1
5(b)(i)	$c = \frac{\sqrt{h^2 - 4k^2}}{3m}$ $3mc = \sqrt{h^2 - 4k^2}$ $9m^2 c^2 = h^2 - 4k^2$ $4k^2 = h^2 - 9m^2 c^2$ $k^2 = \frac{h^2 - 9m^2 c^2}{4}$ $k = \pm \sqrt{\frac{h^2 - 9m^2 c^2}{4}} \text{ or } k = \pm \frac{\sqrt{h^2 - 9m^2 c^2}}{2}$	M1 for squaring both sides M1 for making k^2 the subject A1 for either answer
5(b)(ii)	± 3.35	B1
6 (a)	$\frac{1}{x}$	B1
6 (b)	$\frac{1}{3x+2}$	B1

6 (c)	$\frac{1}{x} + \frac{1}{3x+2} = \frac{1}{3}$ $\frac{x+3x+2}{x(3x+2)} = \frac{1}{3}$ $3x^2 + 2x - 3x - 9x - 6 = 0$ $3x^2 - 10x - 6 = 0$	M1- forming eqn M1 – same denominator AG1
6(d)	$x = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(3)(-6)}}{2(3)}$ $x = \frac{10 \pm \sqrt{172}}{6}$ $x = 3.85 \text{ or } x = -0.52$	M1 A1, A1 (Minus 1 mark if reject answer)
6 (e)	Tap B takes $(3(3.85248) + 2)$ hours to fill up balloon. $= 13.55744$ hours There will be $(13.557 - 3)$ hours more $= 10.557$ hours $= 10 \text{ h } 33 \text{ mins}$	M1 A1
7(a)	$2\pi(3.2)^2 + \pi(3.2)(18)$ Surface area = 245.2955 $= 245\text{cm}^2$	[M1] [A1]
(b)	Height of cone $= \sqrt{18^2 - 3.2^2}$ $= 17.713$ Volume of cone $= \frac{1}{3}\pi(3.2)^2(17.713)$ $= 189.942\text{cm}^2$ $\frac{V1}{V2} = \left(\frac{h1}{h2}\right)^3$ $\frac{189.942}{V2} = \left(\frac{17.713}{14.5}\right)^3$ $V2 = 104.1960$ $= 104\text{cm}^3 (3\text{sf})$	[M1] [M1] [M1] [A1]
(c)	Volume of sand in cone $= 104.1960 - \frac{2}{3}\pi(3.2)^3$ $= 35.56686$ $= 189.942 - 35.56686$ Volume of air in cone $= 154.375\text{cm}^3$ $\frac{154.375}{189.942} = \left(\frac{h1}{17.713}\right)^3$ $h1 = 16.530\text{cm}$ Volume of sand in shaker $= (17.713 - 16.530) \times 3.2$	 [M1] [M1] [M1]

	$= 4.38 \text{ cm (3sf)}$	[A1]
8	*Refer to Graph Paper attached	
9(a)(i)	$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$ $\begin{pmatrix} -9 \\ 4 \end{pmatrix} = \begin{pmatrix} -5 \\ 2 \end{pmatrix} - \overrightarrow{OA}$ $\overrightarrow{OA} = \begin{pmatrix} 4 \\ -2 \end{pmatrix}$ $A(4, -2)$ $(4, -2)$	B1
(ii)	$\begin{pmatrix} -9 \\ 4 \end{pmatrix} = p \begin{pmatrix} 15 \\ k \end{pmatrix}$ $p = -\frac{3}{5}$ $4 = -\frac{3}{5}k$ $k = -\frac{20}{3}$	B1
(iii)	$ \overrightarrow{XY} = \sqrt{15^2 + \left(-\frac{20}{3}\right)^2}$ $= 16.4 \text{ units}$	M1 A1
b(i)(a)	$\overrightarrow{DA} = -\frac{2}{5}\mathbf{c} + \mathbf{a}$	B1
(b)	$\overrightarrow{OB} = \frac{5}{2}\mathbf{a} + \mathbf{c}$	B1
(ii)	$\overrightarrow{DE} = \frac{1}{2}\left(-\frac{2}{5}\mathbf{c} + \mathbf{a}\right)$ $\overrightarrow{OE} = \overrightarrow{OD} + \overrightarrow{DE}$ $= \frac{2}{5}\mathbf{c} + \left(-\frac{1}{5}\mathbf{c} + \frac{1}{2}\mathbf{a}\right)$ $= \frac{1}{5}\mathbf{c} + \frac{1}{2}\mathbf{a}$ $\overrightarrow{OE} = \frac{1}{5}\overrightarrow{OB}$ $D, E \text{ and } B \text{ lie on the same straight line.}$	B1
(iii)(a)	$\frac{1}{2}$	B1

(b)	$\frac{ODE}{ABE} = \frac{ODE}{OEA} \times \frac{OEA}{ABE}$ $= 1 \times \frac{1}{4}$ $= \frac{1}{4}$	
10a(i)	Amount author received= $\left(\frac{5}{100} \times 2500\right)(22.80) + \left(\frac{8}{100} \times 3000\right)(22.80)$ $+ \left(\frac{10}{100}\right)(8239 - 5500)(22.80)$ $= \$14566.92$	M1 (addition) M1 A1
(ii)	First 2500 copies sold = \$2562.50 Next 3000 copies sold = \$4992 Number sold was more than 2500 but less than 5500 Let the number sold be x $2562.5 + \frac{8}{100}(x - 2500)(20.50) = 3648.18$ $1.64(x - 2500) = 1085.68$ $x - 2500 = 662$ $x = 3162$	M1, M1 A1
(iii)	Cost of each novel in SGD sold in Japan = $\frac{1940}{1000} \times 14$ $= \$27.16$ Total cost of novels sold in Japan = \$34547.52 $\% \text{ profit earned} = \frac{34547.52 - (1272)(22.80)}{(1272)(22.80)} \times 100$ $= 19.1\%$	M1 M1 A1
b	$6870.62 = P \left(1 + \frac{2.25}{100}\right)^{10}$ $6870.62 = P(1.2492)$ $P = 5500$	M1 A1
11(ai)	$\angle RQN_1 = 180 - 150$ $= 30^\circ \text{ (int } \angle \text{ on parallel lines)}$ Bearing of R from Q = $360 - 30$ $= 330^\circ \text{ (} \angle \text{ s at a point)}$	B1
11(aii)	$\angle PQR = 90 - 30$ $= 60^\circ$	B1
11(aiii)	$PR^2 = 185^2 + 320^2 - 2(185)(320) \cos 60$ $PR^2 = 77425$ $PR = 278.2535$ $PR = 278m$	M2 A1

11(aiv)	Area of triangle PQR = $\frac{1}{2}(185)(320) \sin 60$ = 25634.352 = 25 600 m ²	M1 A1																																																	
11(bi)	Let the shortest distance be d Area of triangle = 0.5 x d x 320 25634.352 = 0.5 x 320 x d d = 160.2146997 d = 160 m	B1																																																	
11(bii)	Let the angle of depression be θ $\tan \theta = \frac{35}{160}$ $\theta = \tan^{-1} \frac{35}{160}$ = 12.3°	M1 A1																																																	
12a(i)(a)	54	B1																																																	
b	\$550	B1																																																	
c	680-420 = 260	M1 A1																																																	
(ii)	$\left(\frac{10}{80} \times \frac{26}{79}\right) + \left(\frac{26}{80} \times \frac{10}{79}\right)$ $= \frac{13}{158}$	M1 A1																																																	
(iii)	The workers in Shipyard B earn a higher weekly wage than those in Shipyard A as they have a higher median wage. The spread of wages earned by the workers in Shipyard B is wider as they have a higher interquartile range.	B1 B1																																																	
b(i)	<table><tr><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>1</td><td></td><td>2,1</td><td>3,1</td><td>4,1</td><td>5,1</td><td>6,1</td></tr><tr><td>2</td><td>1,2</td><td></td><td>3,2</td><td>4,2</td><td>5,2</td><td>6,2</td></tr><tr><td>3</td><td>1,3</td><td>2,3</td><td></td><td>4,3</td><td>5,3</td><td>6,3</td></tr><tr><td>4</td><td>1,4</td><td>2,4</td><td>3,4</td><td></td><td>5,4</td><td>6,4</td></tr><tr><td>5</td><td>1,5</td><td>2,5</td><td>3,5</td><td>4,5</td><td></td><td>6,5</td></tr><tr><td>6</td><td>1,6</td><td>2,6</td><td>3,6</td><td>4,6</td><td>5,6</td><td></td></tr></table>		1	2	3	4	5	6	1		2,1	3,1	4,1	5,1	6,1	2	1,2		3,2	4,2	5,2	6,2	3	1,3	2,3		4,3	5,3	6,3	4	1,4	2,4	3,4		5,4	6,4	5	1,5	2,5	3,5	4,5		6,5	6	1,6	2,6	3,6	4,6	5,6		B1
	1	2	3	4	5	6																																													
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(ii)(a)	$\frac{1}{5}$	B1																																																	
(b)	$\frac{14}{15}$	B1																																																	
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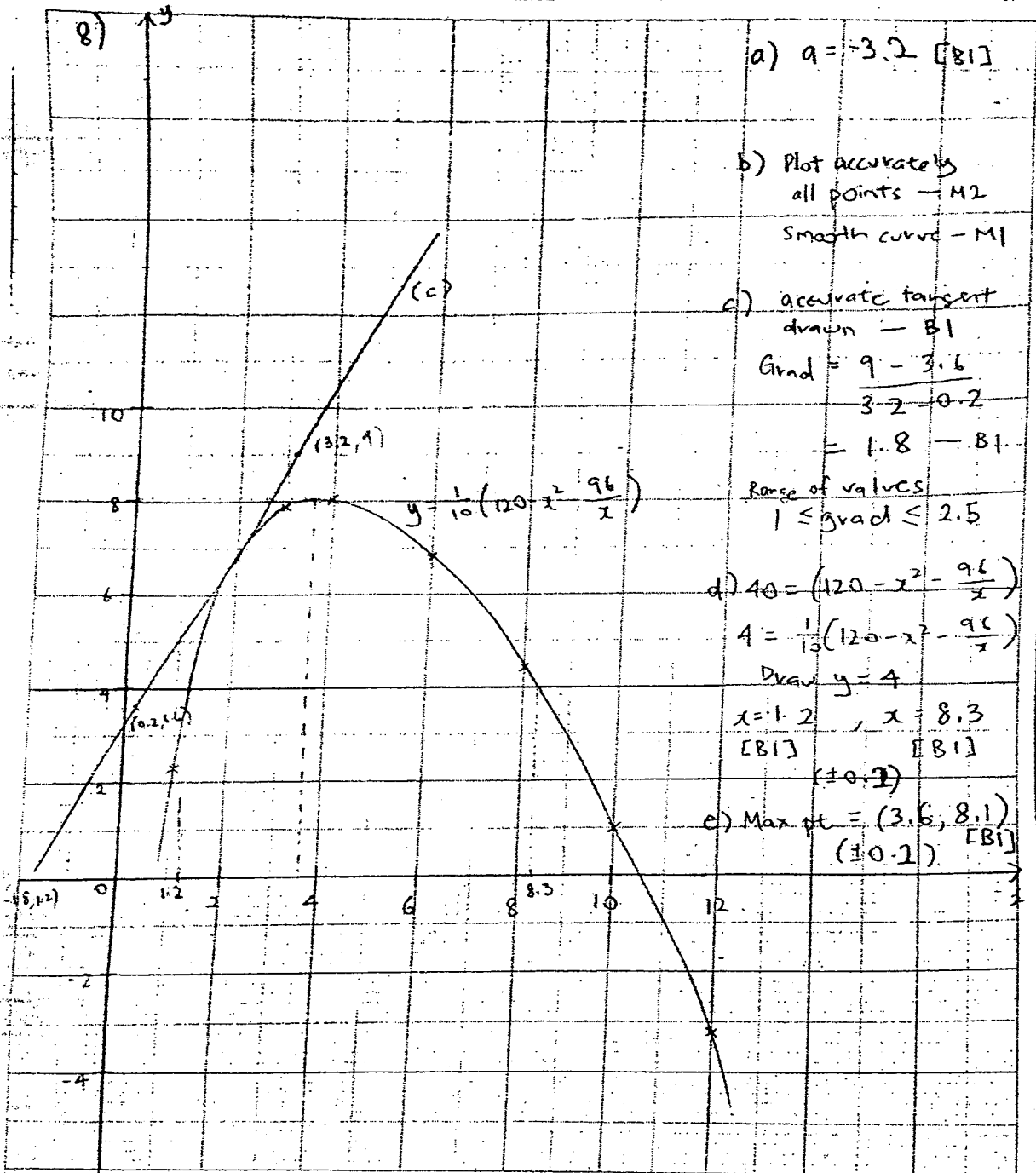
Name: _____

Index No: _____

Subject: _____

Class: _____

Date: _____



NAME: _____ ()

CLASS: _____

**FAIRFIELD METHODIST SCHOOL (SECONDARY)****PRELIMINARY EXAMINATION 2014****SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)****MATHEMATICS****4016/02****Date: 21 August 2014****Duration: 2 hours 30 minutes**

Additional Materials: Answer Paper
 Graph paper (1 sheet)

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, highlighters, 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 number of marks for this paper is 100.

At the end of the examination, fasten all your work securely together.

For Examiner's Use	
Total	/ 100

Setters: Mr Glen Tan and Mr Joel Li

This question paper consists of 12 printed pages including the cover page.

Name: _____ ()

Class: _____

*Mathematical Formulae**Compound interest*

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

Mensuration

$$\text{Curved surface area of a cone} = \pi r l$$

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

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

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

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

$$\text{Arc length} = r\theta, \text{ where } \theta \text{ is in radians}$$

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

Trigonometry

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

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

Statistics

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

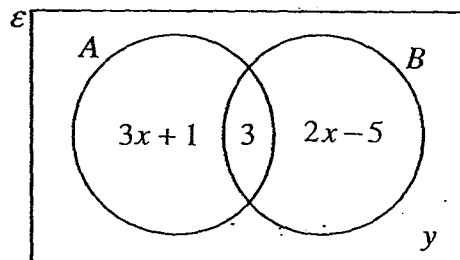
$$\text{Standard deviation} = \sqrt{\frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2}$$

Name: _____ ()

Class: _____

Answer **all** the questions.

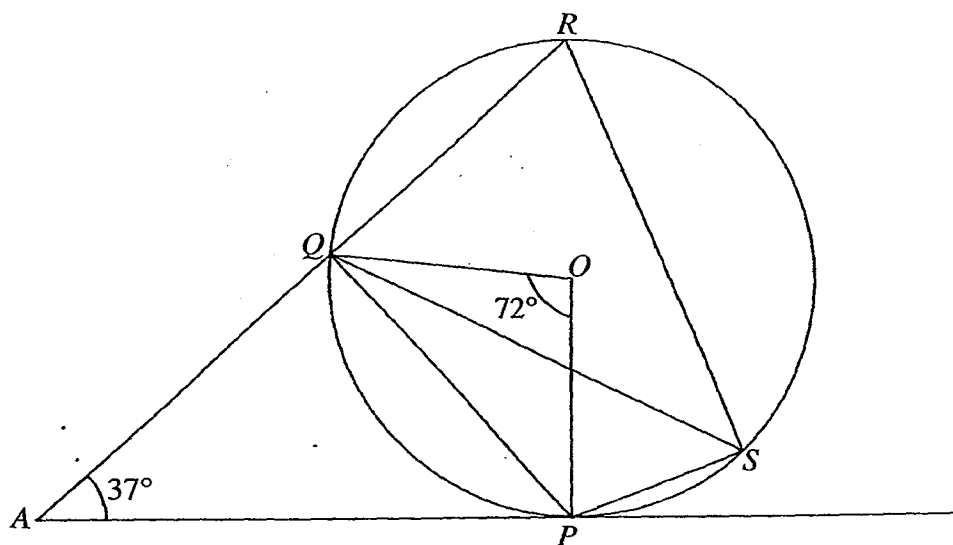
1. A and B are two sets and the number of elements in each set is shown in the Venn diagram below. Given that $n(A \cup B) = 89$ and $n(\mathcal{E}) = 100$.



Find

- (a) the value of x and of y , [3]
 (b) $n(A \cap B')$. [1]

2.



The diagram above shows a circle $PQRS$ with centre O . The straight line AR cuts the circle at Q and R . AP is a tangent to the circle at P .

Given that $\angle POQ = 72^\circ$ and $\angle PAQ = 37^\circ$. Stating your reasons clearly, calculate

- (a) $\angle QRP$, [1]
 (b) $\angle QSP$, [1]
 (c) $\angle QPA$, [2]
 (d) $\angle PSR$. [2]

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3. The sales of four brands of tablets by Shops A, B and C in a week is shown in the table below.

	Brand			
	Reno	Achter	Isus	Sheba
Shop A	4	6	13	2
Shop B	6	3	6	12
Shop C	11	8	6	9

Reno, Achter, Isus and Sheba cost \$500, \$600, \$850 and \$700 respectively.

The information for the number of tablets made available for sale can be represented as the matrix

$$\mathbf{P} = \begin{pmatrix} 4 & 6 & 13 & 2 \\ 6 & 3 & 6 & 12 \\ 11 & 8 & 6 & 9 \end{pmatrix}.$$

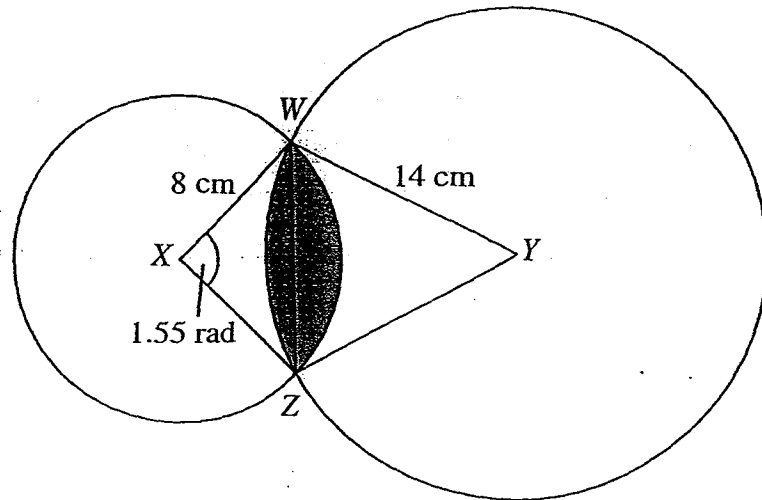
The information for the cost can be represented by a 4×1 matrix $\mathbf{N}$.

- (a) Write down the matrix $\mathbf{N}$. [1]
- (b) Evaluate the matrix $\mathbf{M} = \mathbf{PN}$. [1]
- (c) State what the elements of $\mathbf{M}$ represent. [1]
- (d) Shops A and B offer a 5% discount while Shop C increases its prices by 10%.
 - (i) Write down a matrix $\mathbf{R}$ such that product $\mathbf{RM}$ represents the total amount earned by all three shops in a week after the change in prices. [1]
 - (ii) Hence, evaluate $\mathbf{Q} = \mathbf{RM}$ [2]

Name: _____ ()

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4.



In the diagram, X and Y are the centres of two circles with radii 8 cm and 14 cm respectively. The two circles intersect at the points W and Z .

Angle $WXZ = 1.55$ radians

(a) Show that angle $WYZ = 0.823$ radians. [3]

(b) Calculate the area of the shaded region. [3]

5. (a) Factorise completely $ac - 2bc + 3ad - 6bd$. [2]

(b) (i) Given that $c = \frac{\sqrt{h^2 - 4k^2}}{3m}$, express k in terms of c , h and m . [3]

(ii) Hence, find the value of k when $c = -1$, $h = 9$ and $m = 2$. [1]

Name: _____ ()

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6. Helium Tap *A* can fill up a hot-air balloon in x hours.

Helium Tap *B* can fill up the same hot-air balloon in $(3x + 2)$ hours.

When both taps are used together, the same hot-air balloon can be filled up in 3 hours.

- (a) Write an expression, in terms of x , for the fraction of the balloon that is filled up by Tap *A* only in 1 hour. [1]
- (b) Write an expression, in terms of x , for the fraction of the balloon that is filled up by Tap *B* only in 1 hour. [1]
- (c) Form an equation in x and show that it reduces to $3x^2 - 10x - 6 = 0$. [3]
- (d) Solve the equation $3x^2 - 10x - 6 = 0$, giving your answers correct to 2 decimal places. [3]
- (e) If only tap *B* was used, calculate how much more time it will take to fill up the balloon compared to when 2 taps are used together. Leave your answer in hours and minutes. [2]

7. Figure 1 shows a shaker made from a cone and hemisphere.

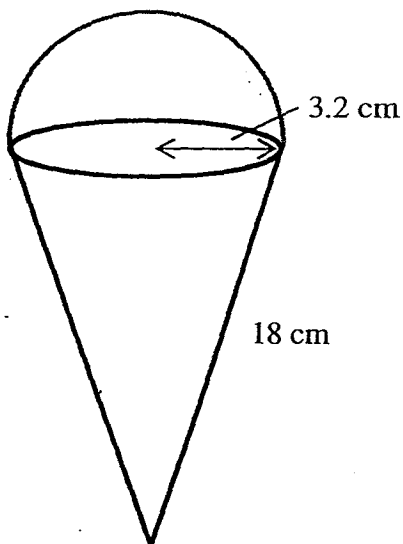


Figure 1

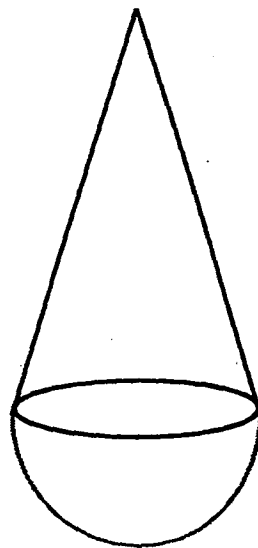


Figure 2

The cone and hemisphere both have radius 3.2 cm. The cone has a slant height of 18 cm.

- (a) Calculate the surface area of the shaker. [2]
- (b) (i) The shaker in Figure 1 is filled with sand up to a vertical height of 14.5 cm. Calculate the volume of sand in the shaker. [4]
- (ii) The shaker is inverted as shown in the Figure 2. Calculate the height of sand in the shaker. [4]

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8. Answer the whole of this question on a sheet of graph paper.The variables x and y are connected by the equation

$$y = \frac{1}{10} \left(120 - x^2 - \frac{96}{x} \right).$$

Some corresponding values of x and y are given in the table below.

x	1	2	3	4	6	8	10	12
y	2.3	6.8	7.9	8	6.8	4.4	1.0	a

- (a) Calculate the value of a . [1]
- (b) Using a scale of 1 cm to represent 1 unit, draw a horizontal x -axis for $0 \leq x \leq 12$.
Using a scale of 1 cm to represent 1 unit, draw a vertical y -axis for $-4 \leq y \leq 10$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) By drawing a tangent, find the gradient of the curve at (2, 6.8). [2]
- (d) Use your graph to find the solution(s) to the equation $40 = \left(120 - x^2 - \frac{96}{x} \right)$,
in the range $0 \leq x \leq 12$. [2]
- (e) Use your graph to find the coordinates of the maximum point of $y = \frac{1}{10} \left(120 - x^2 - \frac{96}{x} \right)$, in the range $0 \leq x \leq 12$. [1]

Name: _____ ()

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9. (a) It is given that $\overrightarrow{AB} = \begin{pmatrix} -9 \\ 4 \end{pmatrix}$.

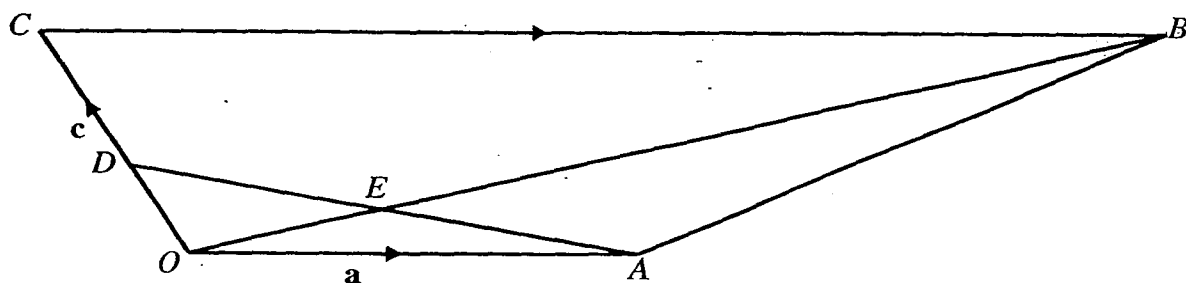
(i) Find the coordinates of the point A if B is the point $(-5, 2)$. [1]

$\overrightarrow{AB}$ is parallel to $\overrightarrow{XY}$. $\overrightarrow{XY} = \begin{pmatrix} 15 \\ k \end{pmatrix}$.

(ii) Find the value of k . [1]

(iii) Find the value of $|\overrightarrow{XY}|$. [2]

(b) The diagram shows a trapezium $OABC$ such that $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OC} = \mathbf{c}$, $2\overrightarrow{CB} = 5\overrightarrow{OA}$ and $2\overrightarrow{DC} = 3\overrightarrow{OD}$.



(i) Express, as simply as possible, in terms of $\mathbf{a}$ and $\mathbf{c}$,
 (a) $\overrightarrow{DA}$ [1]
 (b) $\overrightarrow{OB}$ [1]

(ii) Given that $\overrightarrow{DE} = \frac{1}{2}\overrightarrow{DA}$, write down one statement about the points O , E and B . [1]

(iii) Find the numerical value of
 (a) $\frac{\text{area of } ODE}{\text{area of } ODA}$, [1]
 (b) $\frac{\text{area of } ODE}{\text{area of } ABE}$. [2]

10. (a) A publishing company published a novel which was sold at \$22.80 per copy.

The company agreed to pay the author:

5% of the selling price for the first 2500 copies sold,

8 % of the selling price for the next 3000 copies sold and

10% of the selling price for the remaining copies sold.

- (i) If 8239 copies of the book were sold, calculate the amount that the author received. [3]

- (ii) Some copies of the book were translated into Chinese. The Chinese editions were sold at \$20.50. If the author received \$3648.18 from the sale of the Chinese editions, calculate the number of Chinese editions sold. [3]

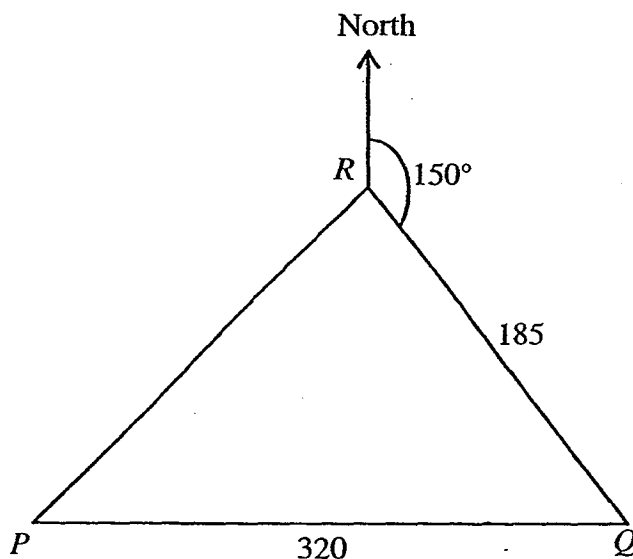
- (iii) 1272 copies of the novels were sold in Japan at a fixed price of 1940 yen each. The rate of exchange between Japanese yen and Singapore dollars (\$) was 1000 yen = \$14. Calculate, in Singapore dollars, the percentage profit earned from the sale of the novels in Japan. [3]

- (b) Jean borrowed a sum of money from a bank at 4.5% compound interest compounded half-yearly. After 5 years, she owed a total of \$6870.62. Calculate how much she borrowed. [2]

Name: _____ ()

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11. P , Q and R are three points on the ground. P is due west of Q , $PQ = 320$ m and $QR = 185$ m. The bearing of Q from R is 150° .

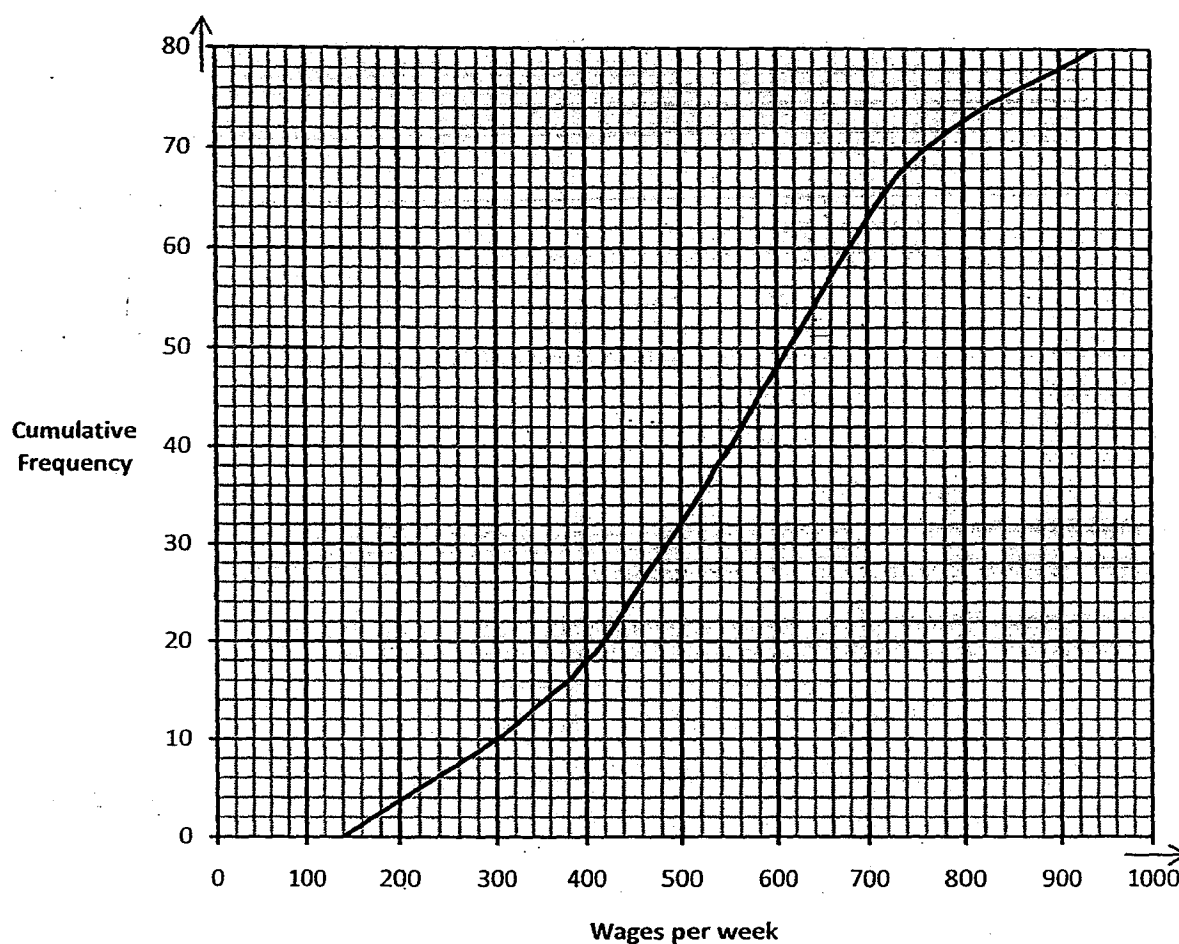


- (a) (i) Find the bearing of R from Q . [1]
- (ii) Find $\angle PQR$. [1]
- (iii) Calculate the distance PR . [3]
- (iv) Find the area of triangle PQR . [2]
- (b) A boy stands at the top of a vertical tower of height 35 m at R and looks at a bicycle travelling along PQ .
- (i) Calculate the shortest distance from R to the bicycle. [1]
- (ii) Find the greatest angle of depression from R to the bicycle. [2]

Name: _____ ()

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12. (a) The cumulative frequency graph shows the wages per week of 80 workers in shipyard A.

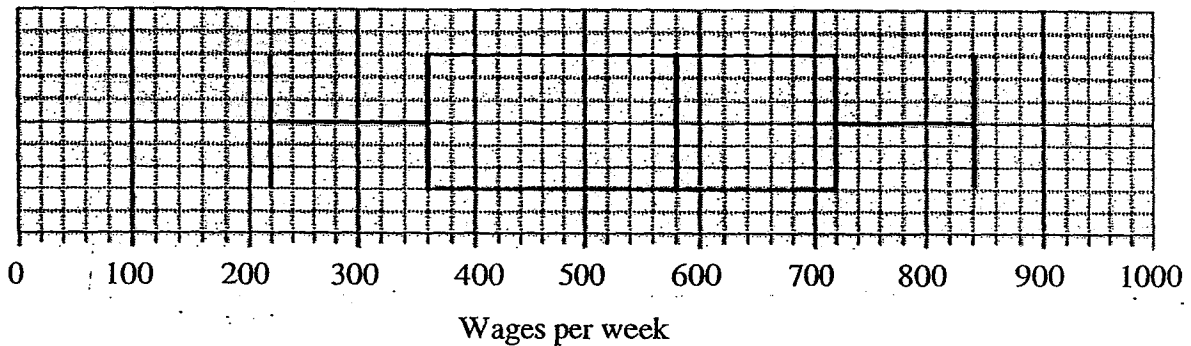


- (i) Use the graph to find
- (a) the number of workers who earn more than \$460 a week, [1]
 - (b) the median wage, [1]
 - (c) the interquartile range. [2]
- (ii) Two workers are selected at random. Find the probability that one earns less than \$300 and the other earns at least \$640. [2]

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- 12 (a) (iii) The box-and-whisker plot shows the distribution of wages per week of the workers in shipyard B.



Compare the weekly wages of the workers in the two factories in two [2]
different ways.

- (b) A box contains six cards numbered 1, 2, 3, 4, 5 and 6. Two cards are drawn at random, one after the other, from the box without replacement.

- (i) Draw a possibility diagram to show the outcome of the draw. [1]
- (ii) Find, in its simplest form, the probability that
- (a) neither card has an odd number, [1]
 - (b) the sum of the cards is at most 10, [1]
 - (c) the product of the cards drawn is a multiple of 4. [1]

- End of Paper -

FMS(S) SEC 4 EXPRESSPRELIMINARY EXAMINATION 2014
MATHEMATICS PAPER 2 Answer Key

1 (a)	$x = 18$ $y = 11$
1 (b)	55
2 (a)	36°
2 (b)	36°
2 (c)	36°
2 (d)	107°
3(a)	$\begin{pmatrix} 500 \\ 600 \\ 850 \\ 700 \end{pmatrix}$
(b)	$\begin{pmatrix} 18050 \\ 18300 \\ 21700 \end{pmatrix}$
(c)	M represents the total earnings in a week for Shops A, B and C respectively.
d(i)	$(0.95 \ 0.95 \ 1.10)$
(ii)	(58402.50)
4(b)	26.4cm^2
5(a)	$(a - 2b)(c + 3d)$
5(b)(i)	$k = \pm \sqrt{\frac{h^2 - 9m^2c^2}{4}}$ or $k = \pm \frac{\sqrt{h^2 - 9m^2c^2}}{2}$
5(b)(ii)	± 3.35
6 (a)	$\frac{1}{x}$
6 (b)	$\frac{1}{3x + 2}$
6(d)	$x = 3.85$ or $x = -0.52$
6 (e)	10 h 33 mins
7(a)	245cm^2
(b)	104cm^3
(c)	4.38 cm
8(a)	-3.2
(c)	1.8 (accept 1 to 2.5)
(d)	1.2, 8.3 (± 0.2)
(e)	(3.6, 8.1) (± 0.2)
9(a)(i)	A(4, -2)
(ii)	$k = -\frac{20}{3}$
(iii)	16.4 units

b(i)(a)	$\overrightarrow{DA} = -\frac{2}{5}\mathbf{c} + \mathbf{a}$																																																								
(b)	$\overrightarrow{OB} = \frac{5}{2}\mathbf{a} + \mathbf{c}$																																																								
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Name: _____

Index No.: _____

Subject: _____

Class: _____

Date: _____

8)

