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- 1 (a) Calculate $\frac{-5 + 7 \times \sqrt[3]{-8} + 10 \div 3}{3}$, giving your answer correct to 1 decimal place.

Answer [1]

- (b) Express 0.00106 in standard form.

Answer [1]

- (c) Round off 8999 to 3 significant figures.

Answer [1]

2 $\xi = \{x : x = 0.\dot{3}, 1, 2, \sqrt{5}, \sqrt{9}, \pi, 33, 2^3\}$

$A = \{x : x \text{ is a prime number}\}$

$B = \{x : x \text{ is a factor of } 16\}$

List the elements in

- (a) A ,

Answer [1]

- (b) B ,

Answer [1]

- (c) $(A \cap B)'$.

Answer [1]

- 3 These are the first five terms in a sequence.

1.2 2.3 3.4 4.5 5.6

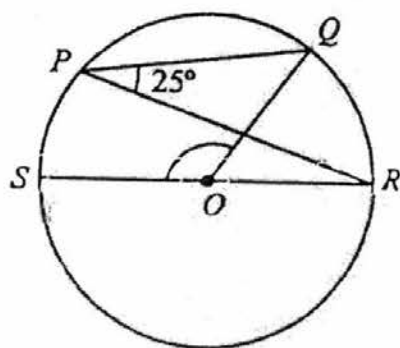
- (a) Write down the ninth term in the sequence.

Answer [1]

- (b) Write down an expression, in terms of n , for the n th term in the sequence.

Answer [1]

4



In the diagram, P , Q , R and S are points on the circumference of a circle, centre O . SR is the diameter of the circle. Angle $QPR = 25^\circ$.

Find angle QOS . State your reasons clearly.

Answer $\angle QOS =$ $^\circ$ [2]

- 5 (a) Express $x^2 - 3x - 4$ in the form $(x - p)^2 + q$.

Answer [2]

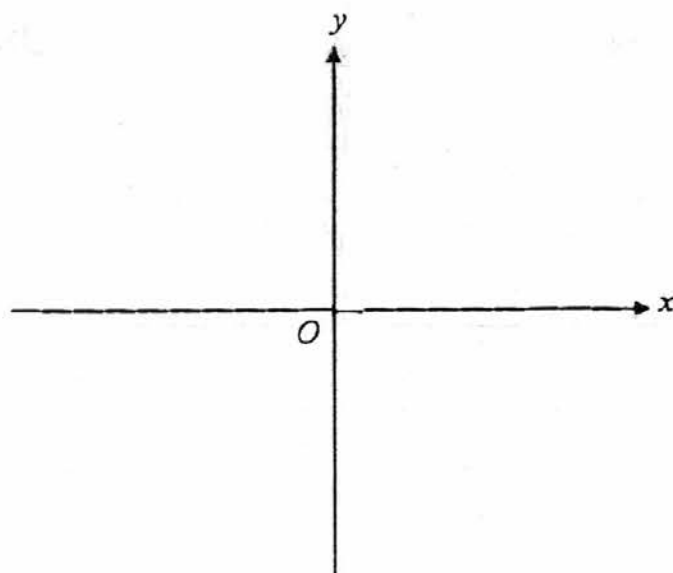
- (b) State the coordinates of the turning point of the graph $y = x^2 - 3x - 4$.

Answer (.....,) [1]

- (c) Sketch the graph of $y = x^2 - 3x - 4$.

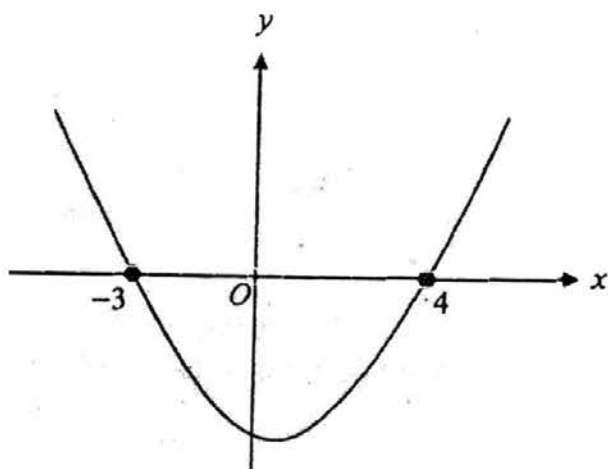
Answer (c)

[2]



- 6 The diagram shows a sketch of the graph of $y = x^2 - px - q$.

Answer (c)



- (a) Calculate the values of p and q .

Answer $p = \dots\dots\dots$, $q = \dots\dots\dots$ [2]

- (b) Write down the equation of the line of symmetry of the graph $y = x^2 - px - q$.

Answer $\dots\dots\dots$ [1]

- (c) Sketch on the same diagram, the graph of $y = -x^2 + px + q$. [2]

7 Factorise completely

(a) $9x^3 - 25xy^2$,

Answer [2]

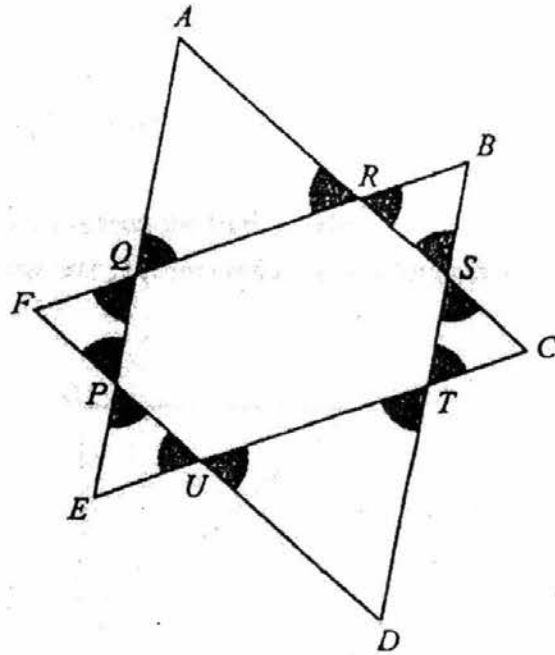
(b) $x^2 + 2xy + y^2 - 4$.

Answer [2]

8 Solve the equation $\frac{3x}{2} - \frac{15 - 4x}{3} - 7 = 0$.

Answer $x =$ [3]

- 9 The diagram shows two triangles AEC and DBF .



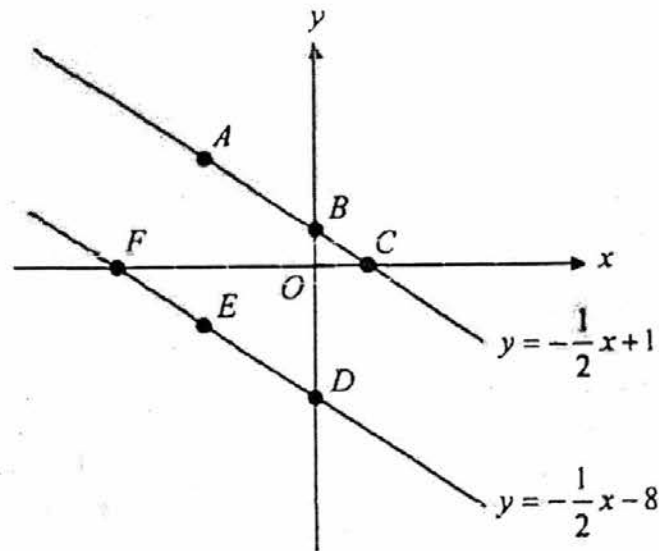
- (a) Calculate the sum of the shaded angles.

Answer° [2]

- (b) Name the geometrical figure, $PQRTU$, formed by the overlap of triangles AEC and DBF .

Answer [1]

- 10 The diagram shows the sketches of two straight lines $y = -\frac{1}{2}x + 1$ and $y = -\frac{1}{2}x - 8$.



- (a) What are the coordinates of point F ?

Answer $F(\dots\dots\dots, \dots\dots\dots)$ [1]

- (b) Calculate the length of the line segment FB .

Answer $\dots\dots\dots$ units [2]

- (c) Show that triangle OCB is similar to triangle OFD .
State your reasons clearly.

Answer (c)

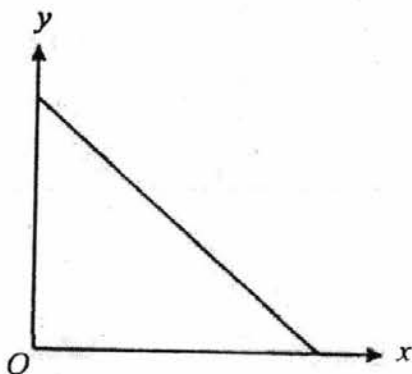
- 11 Given that $1 < y < 2$, simplify and arrange the following expressions in ascending order of magnitude.

$$\frac{1}{y^{-2}} \div \frac{1}{y^3}, \quad \frac{1}{(y-3)^3} \times \frac{(y-3)^2}{1}, \quad \frac{y^{-2}}{4y^{-1}}.$$

Answer

[4]

- 12 The diagram shows a graph of y against x .



Sally concludes from the graph that “ y is inversely proportional to x ”.
Do you agree with Sally? Give a reason for your answer.

Answer because

[2]

- 13 Two bottles have capacities of 1.5 litres and 2 litres respectively.
The height of the smaller bottle is 75% that of the height of the larger bottle.
Show that the two bottles are not geometrically similar.

Answer

[2]

- 14 Four candidates took part in an election.
The tables below represent the polling results from two polling stations.
The candidate with the highest number of total votes from both polling stations wins the election.

Candidate	Votes received
1	28%
2	22%
3	20%
4	30%

Polling Station 1

Candidate	Votes received
1	50%
2	15%
3	25%
4	10%

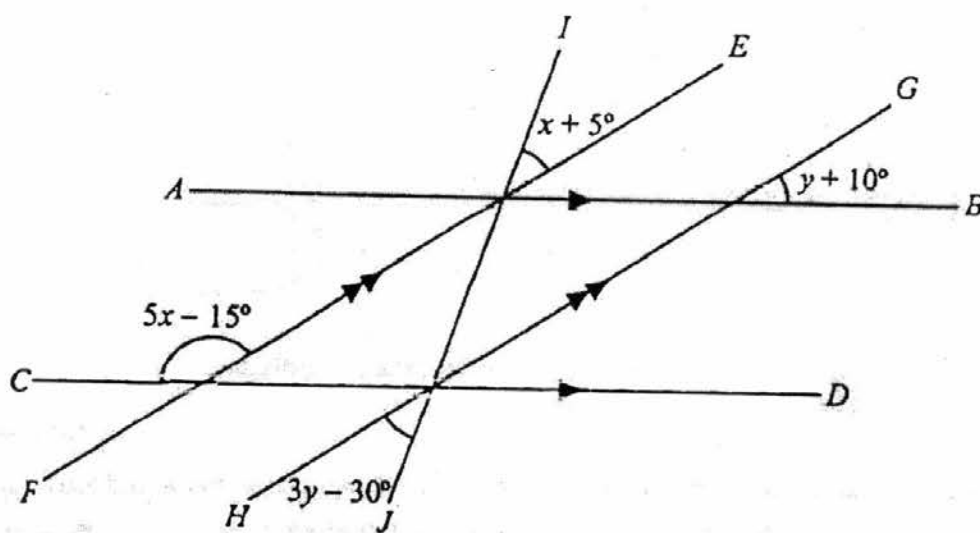
Polling Station 2

Do you agree that Candidate 1 has the most number of votes? Explain your answer.

Answer

[2]

- 15 In the diagram, AB is parallel to CD and EF is parallel to GH .
 IJ is a straight line.



- (a) Write down a pair of simultaneous equations in terms of x and y .

Answer

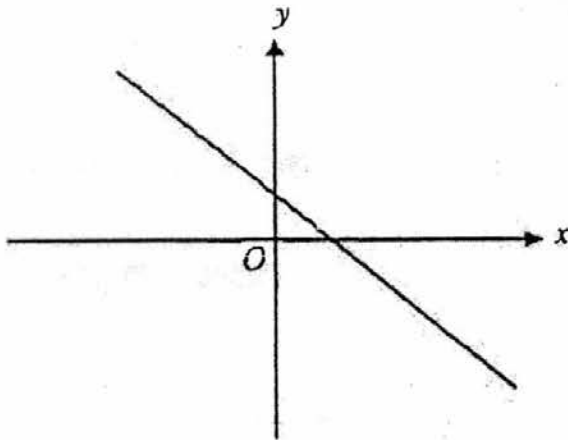
[2]

- (b) Hence solve for the values of x and y .

Answer $x = \dots, y = \dots$ [3]

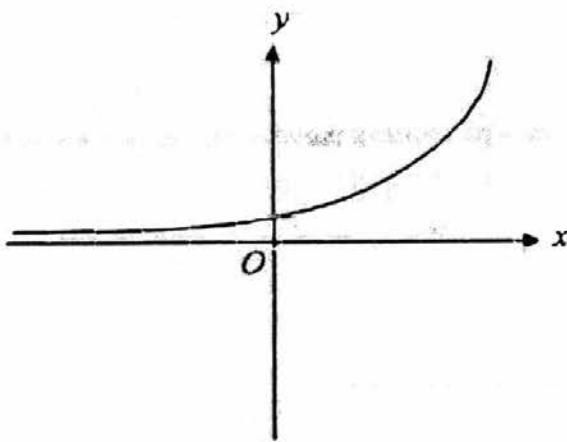
16 Write down a possible equation for each of the following graphs.

(a)



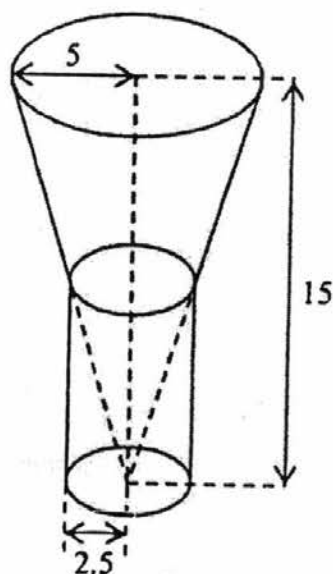
Answer [2]

(b)



Answer [2]

- 17 A container is made up of a cylinder and a conical frustum. The height of the container is 15 cm, and the radii of the cylinder and conical frustum are 2.5 cm and 5 cm respectively.



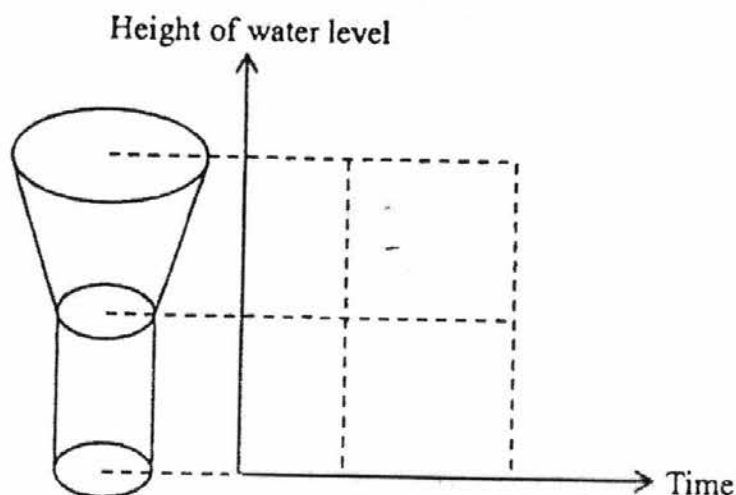
- (a) Calculate the volume of the container.

Answer [3]

- (b) Water is poured at a constant rate into the container from the top. On the axes provided, sketch the graph of the change in height of water level over time.

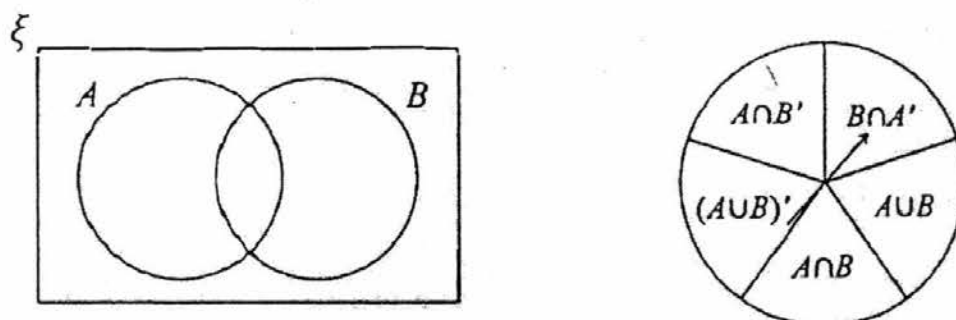
Answer (b)

[2]



- 18 The Venn diagram shows a universal set ξ and two sets A and B .

A circular card is divided into 5 equal sectors. The card has a pointer pivoted at its centre. Each time the pointer is spun, it is equally likely to stop at any of the sectors.

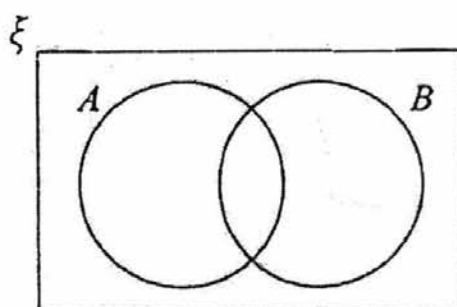


Andrea spins the wheel twice and shades the corresponding region(s) where the pointer stops.

- (a) Given that the pointer lands on $A \cap B'$ and $B \cap A'$ on the first and second spin respectively, shade the region(s) in the Venn diagram below.

Answer (a)

[1]



Giving your answer as a fraction in its simplest form, find the probability that Andrea shades the following regions.

- (b) $A \cap B$,

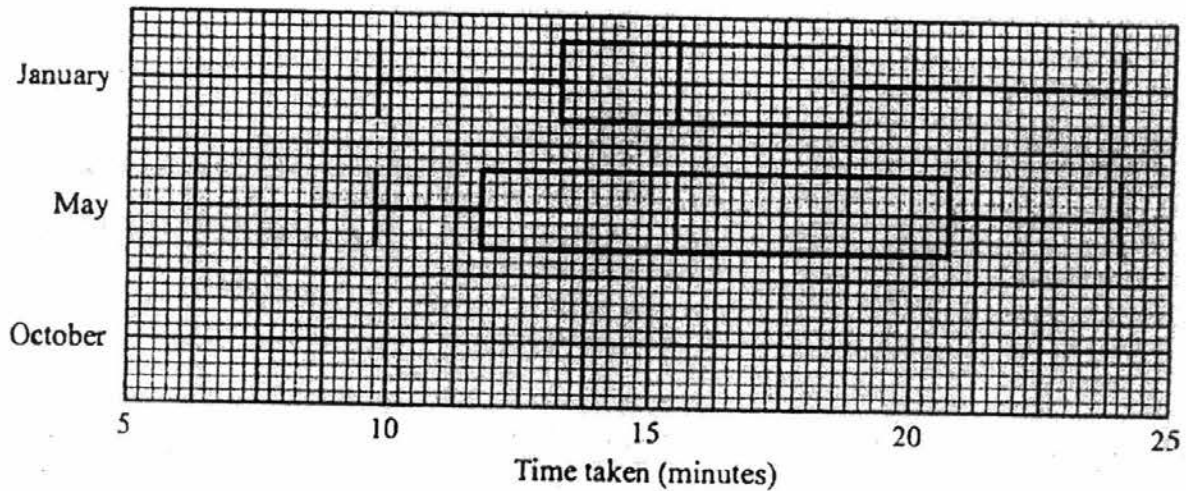
Answer [1]

- (c) $A \cup B'$.

Answer [1]

- 19 The box plot represents the distributions of the time taken by a group of students to complete their fitness run in January and May.

Answer (c)



- (a) Find the interquartile range for May.

Answer mins [2]

- (b) Do you agree that the students' performance has improved from January to May?
Justify your answer.

Answer because

[2]

In order to pass the fitness run, students have to attain timing of 12 minutes and below.

- (c) It is given that more than 50% of the students passed the test in October.
Sketch a possible box plot in the grid above for the distribution of the time taken by the group of students to complete their run in October.

[1]

- 20 The cash price of a television is \$2899. During the Great Singapore Sale, there was a 20% discount provided. The hire-purchase price of the television is a deposit of 15% of the selling price and a monthly instalment of \$90.50 for 2 years.

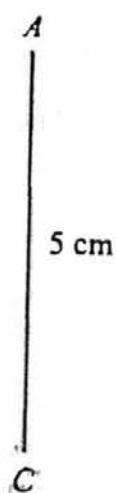
Calculate the hire-purchase price.

Answer \$ [3]

- 21 A plot of land in the shape of a kite has been selected for housing development. An architect is constructing a scale drawing of the land by drawing two circles of radii 2 cm and 5 cm, centre at points A and C respectively.

- (a) Construct the kite $ABCD$, labelling the vertices in an anti-clockwise direction.

Answer (a)



[3]

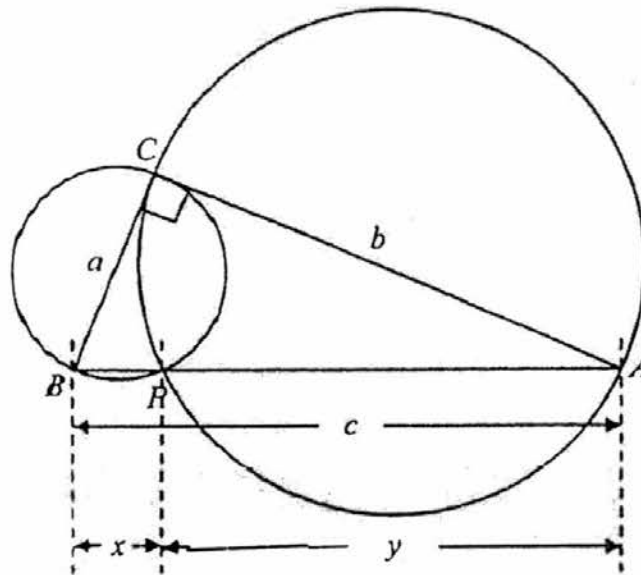
It is given that A is north of C .

- (b) Measure the bearing of B from C .

Answer

[2]

- 22 The diagram shows two circles with diameters AC and BC .
Angle ACB is a right angle. The two circles intersect at points C and P .



- (a) By considering the angle properties of circle, show that BPA forms a straight line.

Answer (a)

[2]

- (b) State two triangles similar to triangle ABC .

Answer and [1]

- (c) Using (b), show that $a^2 = xc$ and $b^2 = yc$ and hence show that $a^2 + b^2 = c^2$.

Answer (c)

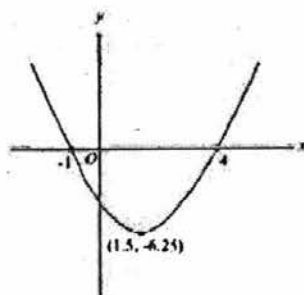
[2]

- END OF PAPER -

- 1 (a) -5.2
(b) 1.06×10^{-3}
(c) 9000
- 2 (a) 2, $\sqrt{9}$
(b) 1, 2, 2^3
(c) $0.\dot{3}$, 1, $\sqrt{5}$, $\sqrt{9}$, π , 33, 2^3
- 3 (a) 10
(b) $1.1\pi + 0.1$ o.e.
- 4 130°
- 5 (a) ($p =$) 1.5 o.e.
($q =$) -6.25 o.e.

- (b) (1.5, -6.25)

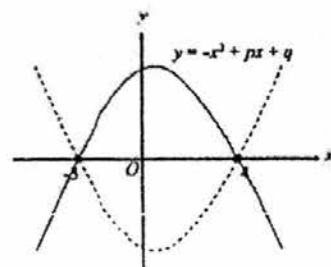
(c)



- 6 (a) ($p =$) 1, ($q =$) 12

(b) $x = \frac{1}{2}$

(c)



- 7 (a) $x(3x - 5y)(3x + 5y)$

(b) $(x + y - 2)(x + y + 2)$

8 $x = 4\frac{4}{17}$

- 9 (a) 720°

(b) Hexagon

- 10 (a) (-16, 0)

(b) 16.0 units

11 $\frac{1}{(y-3)^3} \times \frac{(y-3)^2}{1}, \frac{y^{-2}}{4y^{-3}}, \frac{1}{y^{-2}} + \frac{1}{y^3}$

Disagree

If y is inversely proportional to x , then $y = \frac{k}{x}$, where k is a constant. The graph will be a curve not touching the axes.

- 14 Percentage is used to represent data – Does not allow for accurate judgement of which candidate has more votes absolutely.

- 15 (a) $x + 5^\circ = 3y - 30^\circ$ --- Eqⁿ 1

$(5x - 15^\circ) + (y + 10^\circ) = 180^\circ$ --- Eqⁿ 2

(b) $y = 22.5^\circ, x = 32.5^\circ$

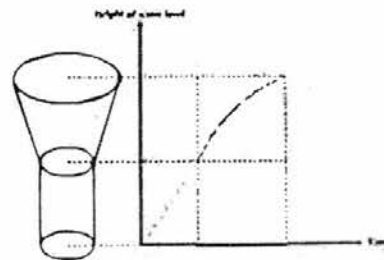
- 16 (a) $y = -2x + 3$ or any equation of the form $y = mx + c$, where $m < 0, c > 0$

(b) $y = 2^x$ or any equation of the form

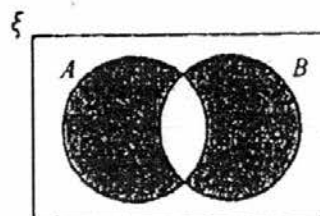
$y = ka^{bx} + c$, where $k > 0, a > 1, b > 0, c \geq 0$

- 17 (a) 491 cm^3

(b)



- 18 (a)



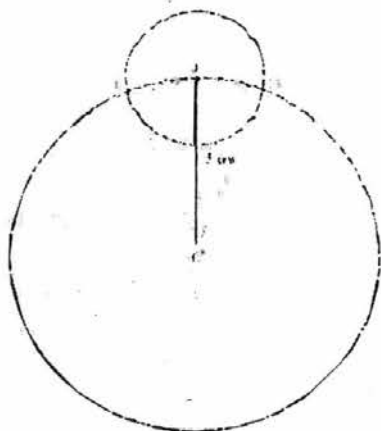
(b) $\frac{1}{25}$

(c) 0

- 19 (a) 9 mins
 (b) Do not agree:
 Median remains the same.
 (c) Q_2 is drawn before 12 mins.

20 \$2519.88

21 (a)

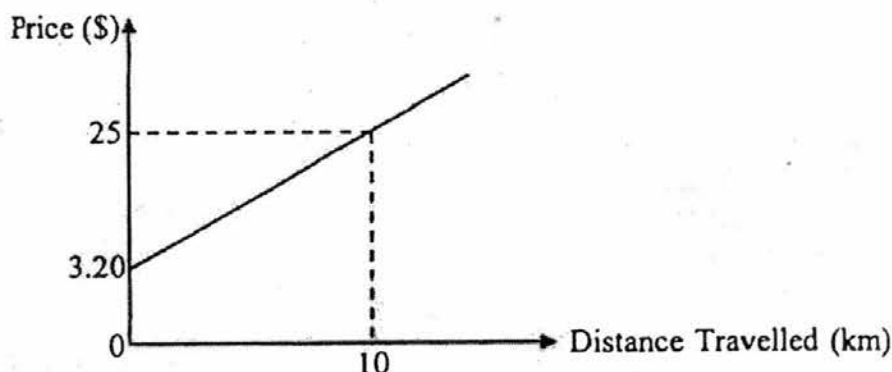


- (b) Measure from construction
 Bearing = $360^\circ - \angle ACB$

22 (b) CBP and ACP

Answer all questions.

1. (a) The price charges of Rushford Taxi Company can be represented in the graph below.



- (i) Using P to represent the price in dollars and S to represent the distance travelled in kilometres, write down an equation to represent the pricing of Rushford Taxi Company. [2]

- (ii) Speedton Taxi Company charges their customers an initial fee of \$2.30. In addition, they charge \$3.10 per kilometre travelled.
Find the minimum distance that a customer must travel such that Rushford Taxi Company charges will be at least equivalent or cheaper than Speedton Taxi Company charges. [3]

- (b) The selling price of each taxi, excluding goods and services tax (GST), is \$95000.
A 7% GST is chargeable on the selling price of the taxi.
Speedton Taxi Company intends to buy 15 taxis on hire purchase.
The company pays a downpayment of 20% and the remaining will be paid by monthly instalments for the next 5 years at a simple interest rate of 2.5% per annum.
Calculate the monthly instalment. [4]

2. (a) Simplify $\sqrt[3]{64m^9n^{\frac{1}{3}}}$. [1]

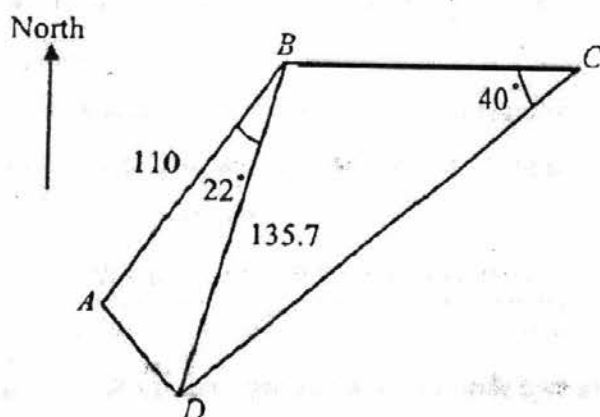
(b) Simplify $\frac{2x+5}{4x^2-2x-30} \div \frac{x+1}{3x^2-27}$. [3]

(c) Solve the inequality $\frac{2x-3}{4} \leq \frac{3x+1}{5}$. [2]

(d) Solve the equation

$$\frac{4}{x-3} - \frac{8x-1}{2x^2-5x-3} = \frac{1}{3}. \quad [5]$$

3.



$ABCD$ is the search area for a hiker missing in the forest.

$AB = 110$ km, $BD = 135.7$ km, $\angle ABD = 22^\circ$ and $\angle BCD = 40^\circ$.

C is due east of B and the bearing of B from A is 043° .

- Calculate AD . [3]
- Calculate the bearing of D from B . [2]
- Calculate BC . [3]
- Calculate the search area $ABCD$. [2]
- The hiker used a red flare to signal his position.

The red flare shoots vertically upwards to a maximum height of 400 m.

A rescuer at D measured that the maximum angle of elevation of the red flare from D is 6° .

Calculate the shortest distance that the rescuer needs to travel in order to reach the survivors. [2]

4. (a) Eric bought a new car.

His car comes with two different drive modes.

An Eco-Mode which saves fuel and a Sport-Mode which consumes more fuel.

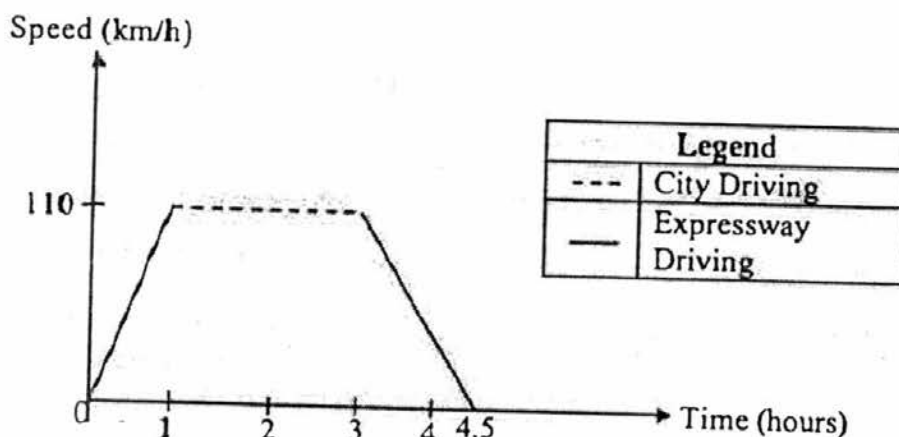
The fuel consumption of the car is also dependent on whether the car is cruising along an expressway or in city traffic.

This information can be represented by the following table.

	Distance Travel per Litre of Fuel (<i>km/l</i>)	
	Expressway	City
Eco-Mode	25	14
Sport-Mode	15	9

- (i) Represent the information on the table by a 2×2 matrix F . [1]
- (ii) Eric's daily commute to work and back home consists of 20% expressway driving and 80% city driving. Represent these percentages in a 2×1 matrix C .
Hence evaluate the matrix $Z = FC$. [2]
- (iii) State what the elements of Z represent. [1]
- (iv) Eric will enable the eco-mode whenever he drives.
Eric's car is able to hold 40 litres of fuel.
Calculate the maximum distance the car can travel before requiring a refuel, assuming that he only uses his car to commute to work and back home. [1]

- 4 (b) Eric is driving to Kuala Lumpur (KL). The speed time graph of his journey is illustrated below.



Eric took 4.5 hours to complete his journey from Singapore to KL.

He used Sport-Mode throughout this journey.

Assuming that his car's petrol tank was full before the journey, can Eric reach KL without refuelling his car? Show your workings clearly.

[4]

5. Ash decided to hike up a hill on his quest for Pokemons.

The path up the hill is 16 km long.

He hiked up along this path at an average speed of x km/h.

- (a) Write an expression, in terms of x , for the number of hours he took to reach the summit of the hill.

[1]

- (b) He decided to explore a different path down the hill.

The length of the path down the hill is 22 km.

His average speed walking down the hill was 3 km/h faster than his average speed going up the hill.

It took Ash 1.5 hours less to come down than to go up the hill.

Write down an equation in x , and show that it simplifies to $x^2 + 7x - 32 = 0$.

[4]

- (c) Solve the equation $x^2 + 7x - 32 = 0$.

[2]

- (d) Calculate the total time Ash took to hike up and down the hill.

[2]

6. Answer the whole of this question on a sheet of graph paper.

The variables x and y are connected by the equation

$$y = x^2(5 - x) - 5.$$

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

x	-2	-1	0	1	2	3	3.5	4	4.5	5
y	23	q	-5	-1	7	13	13.4	11	5.1	-5

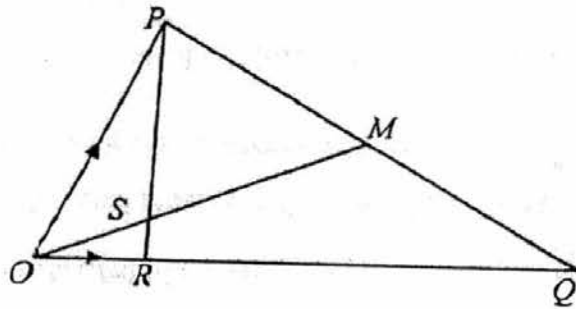
- (a) Find the value of q . [1]
- (b) Using a scale of 2 cm to represent 1 unit, draw a horizontal axis for $-2 \leq x \leq 5$.
Using a scale of 1 cm to represent 2 units, draw a vertical axis for $-8 \leq y \leq 26$.
On your axes, plot the points given in the table and join them with a smooth curve. [3]
- (c) For $-2 \leq x \leq 5$, find the range of values of p for which $x^2(5 - x) - 5 = p$ has exactly three solutions. [2]
- (d) By drawing a tangent, find the gradient of the curve at (4.5, 5.1). [2]
- (e) By drawing a suitable straight line, solve $-x^3 + 5x^2 - 6x - 11 = 0$. [3]

7. OPQ is a triangle.

$$\overrightarrow{OP} = \mathbf{p} \text{ and } \overrightarrow{OR} = \mathbf{r}.$$

M is the midpoint of PQ .

$$OR : RQ = 1 : 4 \text{ and } \overrightarrow{RS} = \frac{1}{6} \overrightarrow{RP}.$$



(a) Express, as simply as possible, in terms of $\mathbf{p}$ and/or $\mathbf{r}$,

(i) $\overrightarrow{OQ}$,

[1]

(ii) $\overrightarrow{RS}$.

[1]

(b) Find the position vector of M in terms of $\mathbf{p}$ and/or $\mathbf{r}$.

[2]

(c) (i) Show that $\overrightarrow{OM} = k\overrightarrow{OS}$, where k is a constant.

[1]

(ii) What can be deduced about the points O, S, M ?

[1]

(d) Find the value of

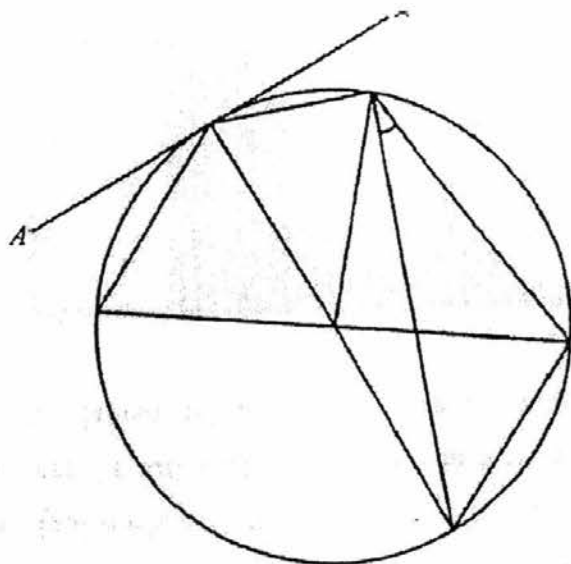
(i) $\frac{\text{Area of } \triangle ORS}{\text{Area of } \triangle ORP},$

[1]

(ii) $\frac{\text{Area of } \triangle ORS}{\text{Area of } \triangle OPQ}.$

[2]

(a)



Line AC is a tangent to the circle at point B .

BG and HE are diameters of the circle.

Points H, B, D, E and G are on the circumference of the circle.

Angle $EDG = 29^\circ$ and angle $OFD = 76^\circ$.

(i) Find

(a) angle OHB ,

[2]

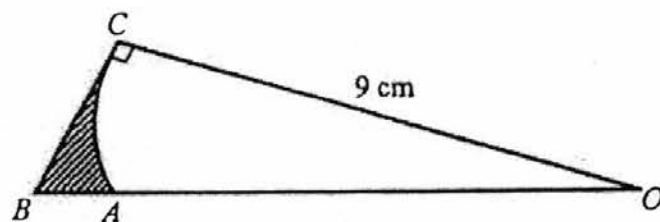
(b) angle CBD .

[3]

(ii) Given that the radius of the circle is 6 cm, calculate the length of minor arc DE .

[3]

(b)



The diagram shows a right angle triangle OBC and a sector of a circle OAC .

$OC = 9$ cm and the arc length $AC = 4$ cm.

Calculate

(i) angle AOC in radians,

[1]

(ii) the area of the shaded region.

[3]

9. The marks distribution of a mathematics test of a class of 20 students is shown in the stem-and-leaf diagram.

<u>Boys</u>				<u>Girls</u>		
8	7	6	0	9		
9	4	1	1	2	8	8
	8	3	2	3	6	6
	5	1	3	1	1	6
Key (Boys)				Key (Girls)		
2 1 means 12				1 2 means 12		

- (a) State the median marks for the girls in the class. [1]
- (b) Calculate the
- (i) mean marks of the test for the boys, [1]
- (ii) standard deviation of the test for the boys. [1]
- (c) The statistical results for the girls in the class are summarized below.

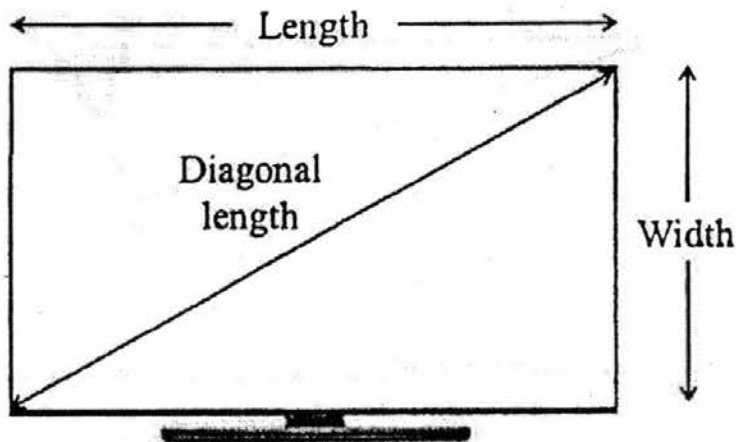
Mean	23
Standard Deviation	8.26

A student commented that "Girls did better than boys as the standard deviation for girls is lower than that of boys".

Do you agree or disagree with the student's statement. Please explain your answer. [2]

- (d) The passing mark for this particular test is 18.
- (i) A student was selected at random from the class. Find the probability that the student selected passed the mathematical test. [1]
- (ii) Two students were selected at random. Find the probability that at least one student passed the test. [2]

10. Jonathan intends to buy a television for his new house. The television will be placed in his living room. Jonathan went to a local electronics store and the salesperson gave Jonathan a brief introduction about the things he should take note of when buying a television. Firstly, Jonathan should take note of the aspect ratio of a television. A typical high definition television comes with an aspect ratio of 16:9 for better viewing experience. Aspect ratio is the ratio of the length of the screen to the width of the screen.



- (a) Jonathan's living room can accommodate a television with a maximum length of 2 metres. If he buys a television with an aspect ratio of 16:9, find the maximum width of the television. [1]
- (b) Next, Jonathan should note that television screen size refers to the diagonal length of the screen, measured in inches.

Calculate the maximum screen size that his living room can accommodate. Correct your answer to the nearest inches. (1 inch = 0.0254 m) [2]

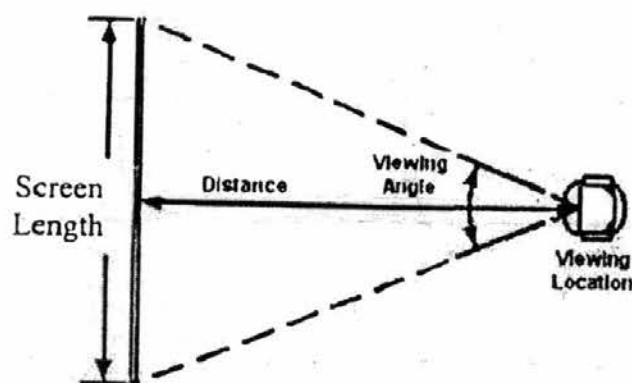
- (c) Jonathan has a movie which he wishes to play. The movie has an aspect ratio of 4:3. If the movie uses the full width of a television screen with aspect ratio 16:9 (as illustrated in the diagram below), calculate the percentage of the television screen that is not used.



[2]

- (d) Lastly, Jonathan has to consider the viewing angle. The optimal viewing angle at eye level is between 30° and 45° .

An illustration of the viewing angle is shown below.



Top view

Screen size (inch)	Screen length (m)	Screen width (m)
40	0.89	0.50
55		
65	1.32	0.74

Table 1

Jonathan's sofa will be located 2.4 metres away from his television.

Jonathan has shortlisted three 16:9 aspect ratio televisions of varying screen sizes.

Copy and complete the table above in the writing paper provided.

Using the information in the table, suggest which television Jonathan should buy.

Support your answer with mathematical reasoning.

[5]

End of Paper

2016 EM Prelim S4Exp/5NA P2 (100 marks): One Page Answer

Qn	Answer Scheme
1(ai)	$\therefore P = 2.18S + 3.20$
1(aii)	$s = 0.978km$
1(b)	\$22871.25
2(a)	$4m^3n^{\frac{1}{9}}$
2(b)	$\frac{3(x+3)}{2(x+1)}$
2(c)	$x \geq -9\frac{1}{2}$
2(d)	$x = 4\frac{1}{2}$ or -2
3(a)	$AD = 53.239 \approx 53.2km$
3(b)	201°
3(c)	$BC = 102.349$ $BC \approx 102 km$
3(d)	9279.013 $\approx 9280 km^2$
3(e)	$x = 3805.746$ $x \approx 3810 m$
4(ai)	$F = \begin{pmatrix} 25 & 14 \\ 15 & 9 \end{pmatrix}$
4(aii)	$Z = \begin{pmatrix} 16.2 \\ 10.2 \end{pmatrix}$
4(aiii)	Fuel consumption for the eco-mode and sport-mode respectively with a travel pattern of 20% expressway and 80% city.

4(aiv)	$16.2 \times 40 = 648 \text{ km}$
4(b)	$\therefore \text{Fuel consumption for sport-mode} = 11.31 \text{ km/l}$ $\therefore \frac{357.5}{11.31} \approx 31.27$ There is no need for a refuel as his car has a capacity for 40 litres. He is able to complete his journey on a single full tank.
5(a)	$\frac{16}{x}$
5(b)	Shown
5(c)	$x = 3.15 \text{ or } -10.2$
5(d)	8.6566 $\approx 8.66 \text{ hrs}$
6	Refer to graph paper
7(ai)	$\overline{OQ} = 5r$
7(aii)	$\overline{RS} = -\frac{1}{6}r + \frac{1}{6}p$
7(b)	$\overline{OM} = \frac{1}{2}(p + 5r)$
7(ci)	$\overline{OM} = 3(p + 5r)$ (shown)
7(cii)	The points are collinear.
7(di)	$\frac{1}{6}$
7(dii)	$\frac{1}{30}$
7(aia)	$\angle OHB = 61^\circ$
7(aib)	$\angle CBD = 18^\circ$
7(aii)	Arc Length = 9.01 cm

8(bi)	$\theta = \frac{4}{9} \text{ rad}$
8(bii)	Shaded Area = $1.287 \approx 1.29 \text{ cm}^2$
9(a)	Median = 24.5
9(bi)	Mean = 18.2
9(bii)	$\sigma = 10.0678 \approx 10.1$
9(c)	I disagree with the statement. This is because standard deviation measures the consistency of the results rather than the performances of the girls and boys respectively. The student can use the median instead.
9(di)	$\frac{13}{20}$
9(dii)	$\frac{169}{190}$
10(a)	$x = 1.125\text{m}$
10(b)	$y = 90.34 \approx 90 \text{ inches}$
10(c)	% Wastage = 25%
10(d)	To complete the table : Length = 1.22m Width = 0.68m Jonathan should choose the 65 inches television as the viewing angle falls inside the optimal range.