

Name: _____

Register Number: _____

Class: _____



南僑中學

NAN CHIAU HIGH SCHOOL
MID-YEAR EXAMINATION 2019
SECONDARY FOUR EXPRESS

For Marker's Use

MATHEMATICS

4048/01

Paper 1

7 May 2019, Tuesday

Candidates answer on the Question Paper.

2 hours

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.

Write in dark blue or black pen.

You may use a 2B 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.

The use of an approved calculator is expected, 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 .

The number of marks is given in brackets [] at the end of each question or part question.

The total marks for this paper is 80.

This document consists of 19 printed pages including the cover page.

Answer all the questions.

- 1 Given that $64^k \times 16 = 1$, find the value of k .

Answer $k = \dots\dots\dots$ [1]

- 2 The stem-and-leaf diagram shows the Science quiz marks scored by a group of 15 students.

| | | | | | | | | |
|---|---|-----|---|---|---|---|---|--|
| 0 | 7 | | | | | | | |
| 1 | 2 | | | | | | | |
| 2 | 4 | X | | | | | | |
| 3 | 0 | 4 | 5 | 6 | | | | |
| 4 | 3 | 5 | 6 | 6 | 6 | 7 | 9 | |

Key: 0 | 7 represents 7 marks

Given that the median mark is twice the interquartile range, find the value of X .

Answer $X = \dots\dots\dots$ [2]

- 3 The LCM and HCF of p and q are 60 and 6 respectively. Given that both p and q are between 6 and 60 and $p < q$, find the value of p and of q .

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

- 4 A, B and C are three non-empty sets satisfying the following conditions:

$$A \subset B, A \cap C \neq \emptyset, A \not\subset C \text{ and } C \not\subset B.$$

Draw a clearly labelled Venn diagram to illustrate the above information.

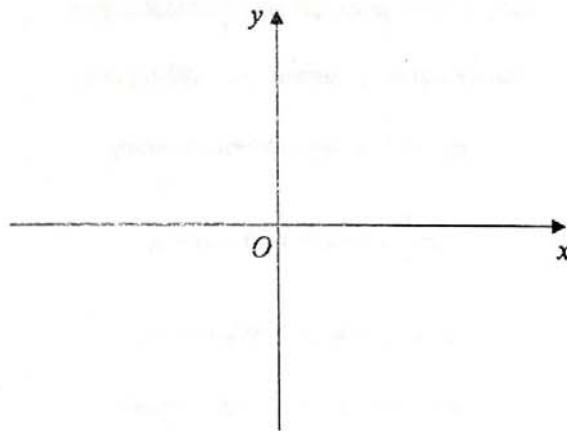
Answer

[2]

-
- 5 Sketch the graph of $y = (x + 2)(4 - x)$ on the axes below.

Indicate clearly the x -intercepts, y -intercept and the coordinates of the turning point.

Answer



[2]

- 6 Tide detergent is having its monthly promotion at MAMA Supermarket.



\$1.79 NETT

TIDE Travel Size
Turbo Clean Liquid
Laundry - Free & Gentle
Volume: 10 oz



ANY 2 @ \$17.90

TIDE
Turbo Clean Liquid
Laundry - Free & Gentle
Volume: 50 oz



OFFER \$26.85

TIDE
Turbo Clean Liquid
Laundry - Free & Gentle
Volume: 150 oz

Show that the cost of the detergent is directly proportional to its volume.

Answer

[2]

- 7 The employees of a company are offered a wage increment which is calculated according to one of the following schemes:

Scheme A: An increment of 5% of their present wages.

Scheme B: An increment of 3% of their present wages plus additional \$8 per week.

Employees earning \$ x per week at present will receive higher increment if they have chosen *Scheme A*. Find the range of values of x .

Answer [2]

8 Solve $\frac{1}{x} - \frac{3}{2x+1} = 1$.

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

9 Rearrange $y = \sqrt{\frac{2x+y}{3x-5}}$ to express x in terms of y .

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

- 10 Mr Lim invested \$10 000 in a fund that pays a compound interest of 2.75% per annum, compounded quarterly. Find the interest earned, correct to the nearest dollar, at the end of 3 years.

Answer \$..... [3]

- 11 The diagram shows a container in the shape of a prism with a triangular cross-section. Water is poured into the container until the depth of water is $\frac{3}{5}$ the height of the container.



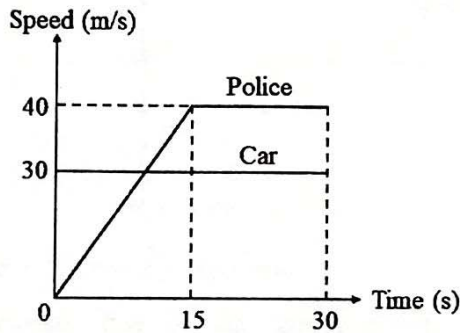
If the volume of the container is 200 ml, find the volume of water in the container.

Answer ml [3]

12 (a) Convert 80 km/h to m/s.

Answer m/s [1]

(b) In Marina Coastal Expressway (MCE), the speed limit of all vehicles is 80 km/h. A car is travelling at a constant speed of 30 m/s and passes a stationary traffic police motorcycle. The traffic police immediately gives chase, accelerating uniformly to reach a maximum speed of 40 m/s and continues with this speed until it overtakes the car.

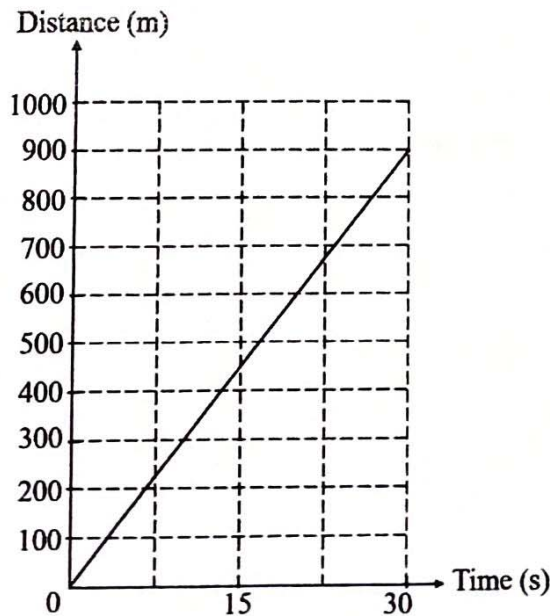


(i) Calculate the acceleration of the police motorcycle.

Answer m/s² [1]

(ii) In the axes below, draw the distance–time graph for the police motorcycle for the first 30 seconds. The distance–time graph for the car has been drawn for you.

Answer



[1]

- 13 $PQRS$ is a parallelogram.

$$\overrightarrow{PQ} = \begin{pmatrix} -3 \\ 4 \end{pmatrix}, \overrightarrow{PS} = \begin{pmatrix} 12 \\ 5 \end{pmatrix}.$$

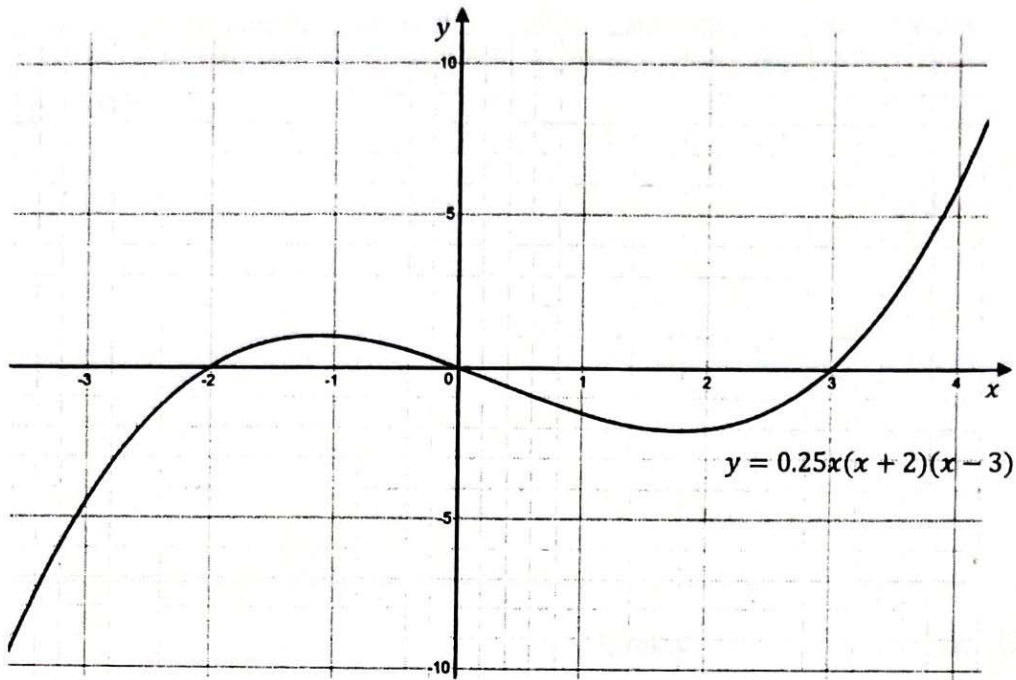
Calculate $|\overrightarrow{PR}|$.

Answer units [3]

- 14 By observing the pattern in the last digit of 3^n and of 8^n , where $n > 0$, find the last digit in the subtraction $3^{31} - 8^{16}$.

Answer [3]

15



The graph of $y = 0.25x(x + 2)(x - 3)$ was drawn.

By adding a suitable straight line on the graph above, solve the equation $x(x + 2)(x - 3) = 6x$.

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

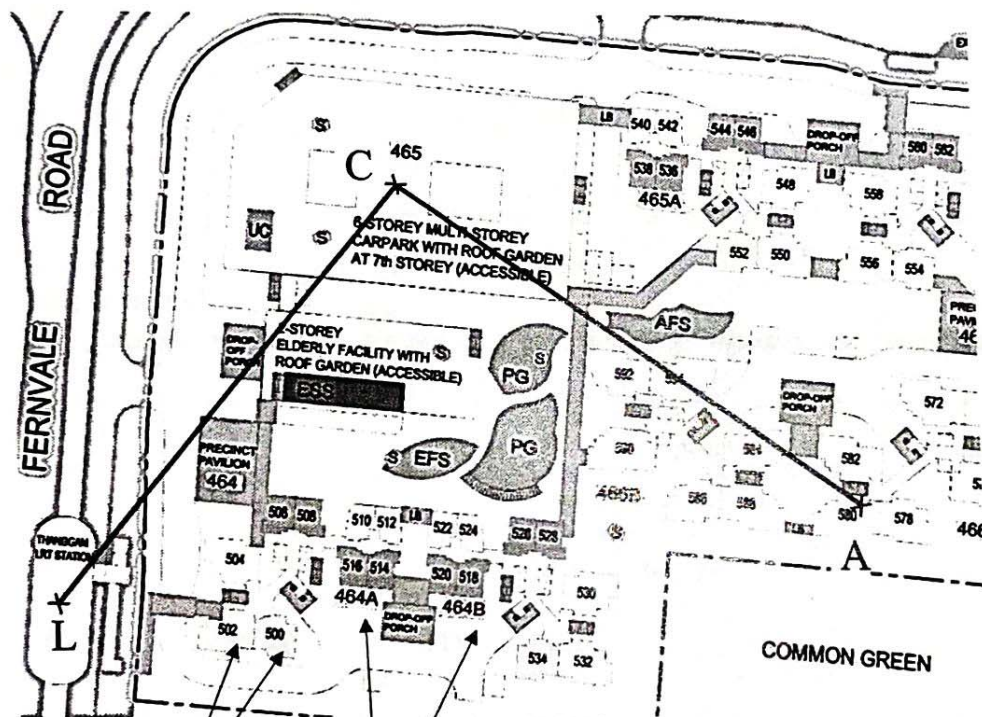
16 The diagram below shows part of a site map of the newly launched Build-To-Order (BTO) flats at Fernvale Road.

Andy and his parents applied for this BTO project under the Multi-Generation Priority Scheme which allows married children to make a joint application with their parents for two units in the same project.

Their application has gotten them a good queue number in the selection of units. Andy has chosen the unit 580, marked as *A*.

State the unit which Andy's parents should choose if they wish to satisfy the following criteria:

- equidistant from the multi storey carpark, *C*, and the LRT station, *L*, and
- equidistant from the line *LC* and *AC*.



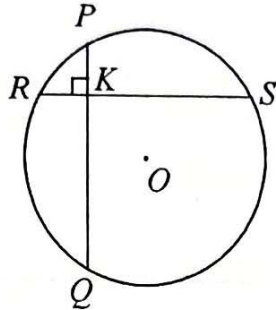
Source: [http://esales.hdb.gov.sg/bp25/launch/19feb/bto/19FEBBTOSK_page_6280/\\$file/map-plan.html#site-plan](http://esales.hdb.gov.sg/bp25/launch/19feb/bto/19FEBBTOSK_page_6280/$file/map-plan.html#site-plan)

Unit numbers 502 and 500
i.e. #02-502,
#02-500

Block numbers 464A and 464B
i.e. Blk 464A,
Blk 464B

Answer [3]

- 17 In the diagram, O is the centre of the circle with radius 13 cm. PQ and RS are perpendicular equal chords of length 24 cm and intersecting at K .



Calculate the length of OK .
Show your workings and give reasons.

Answer cm [3]

- 18 For a n -sided polygon, the largest interior angle is 100° and the smallest interior angle is 20° . Find the value(s) of n .

Answer $n = \dots\dots\dots$ [4]

- 19 (a) Factorise $(2x - 7)(x - 2) - 9$ completely.

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

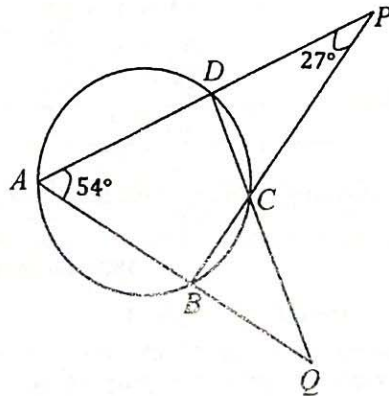
- (b) Hence, solve $2(y - 1)^2 - 11y + 16 = 0$.

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

- 20 When $x + 8$ is divided by y , the result is 4. When x is divided by y , its quotient is 2 and the remainder is 6. By forming two equations in terms of x and of y , solve for x and y .

Answer $x = \dots\dots\dots, y = \dots\dots\dots$ [4]

- 21 In the diagram, A, B, C and D lie on the circumference of the circle. ADP, ABQ, BCP and DCQ are straight lines. $\angle BAD = 54^\circ$ and $\angle CPD = 27^\circ$.

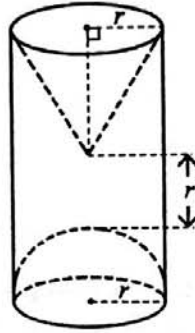


Find $\angle AQD$.

Show your working and give reasons.

Answer $\angle AQD = \dots\dots\dots^\circ$ [4]

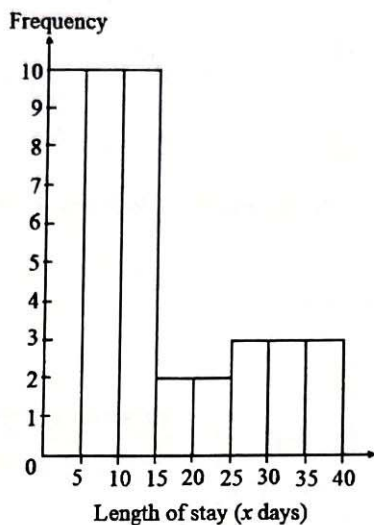
- 22 A carpenter wants to create a wooden toy for his son. He removed a right-angled cone and a hemisphere from a uniform cylindrical wood. The radius of the base of the cone and hemisphere are r cm. The distance between the top of the hemisphere and the vertex of the cone is also r cm.



Given that the curved surface area of the cone is equal to the curved surface area of the hemisphere, work out the volume of the toy, in terms of r .

Answercm³ [4]

- 23 The histogram illustrates the length of stay (in days) in Australia for a group of Singaporean tourists last year.



- (a) Complete the following table.

Answer

| Length of stay (days) | Numbers of tourists |
|-----------------------|---------------------|
| $0 < x \leq 5$ | |
| $5 < x \leq 10$ | |
| $10 < x \leq 15$ | |
| $15 < x \leq 20$ | |
| $20 < x \leq 25$ | |
| $25 < x \leq 30$ | |
| $30 < x \leq 35$ | |
| $35 < x \leq 40$ | |

[1]

- (b) Calculate the fraction of the Singaporean tourists who stayed in Australia longer than 15 days.

Answer [1]

- (c) Calculate an estimate for the mean and standard deviation of the length of stay.

Answer

Mean = days

Standard deviation = days [2]

- 24 (a) Explain why $(x - 2)^4(x^2 - 4x + 4)$ is both a perfect square and a perfect cube when x is an integer.

Answer

.....

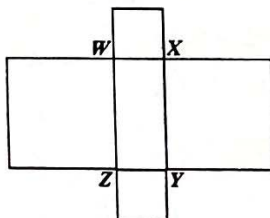
.....

.....

.....

[2]

- (b) The figure is made up of 2 big squares, 2 small squares and a rectangle $WXYZ$. The perimeter of rectangle $WXYZ$ is 20 cm. The total area of all the four squares is 140 cm^2 .



Find the area of $WXYZ$.

Answer cm^2 [4]

- 25 Mrs Tan sells three different types of cakes. The table below shows the number of cakes bought by Childcare Centre *A* and *B* for Children's Day Celebration.

| | Sponge | Chocolate | Cheese |
|---------------------------|--------|-----------|--------|
| Childcare Centre <i>A</i> | 32 | 27 | 20 |
| Childcare Centre <i>B</i> | 44 | 45 | 38 |

- (a) Represent this information in a 2×3 matrix, **P**.

$$\text{Answer } \mathbf{P} = \begin{pmatrix} & & \\ & & \end{pmatrix} \quad [1]$$

- (b) The selling price for each sponge cake, chocolate cake and cheese cake is \$3.20, \$4.50 and \$4.80 respectively.

The information can be represented as $\mathbf{Q} = \begin{pmatrix} 3.2 \\ 4.5 \\ 4.8 \end{pmatrix}$.

Evaluate the matrix **PQ**.

$$\text{Answer } \mathbf{PQ} = \begin{pmatrix} & \\ & \end{pmatrix} \quad [1]$$

- (c) Mrs Tan has a special promotion for cakes order for Children's Day celebration.

- Get the second sponge cake at half price.
- Buy three chocolate cakes for the price of two.
- Cheese cakes 1-for-1!

Write down a 3×3 matrix, **R**, such that **RQ** will give the discounted price for each type of cakes sold to Childcare Centre *A* and *B*.

$$\text{Answer } \mathbf{R} = \begin{pmatrix} & & \\ & & \\ & & \end{pmatrix} \quad [2]$$

25 (d) Evaluate matrix $S = PRQ$.

$$\text{Answer } S = \left(\begin{array}{c} \\ \end{array} \right) \quad [2]$$

(e) Describe what the elements in matrix S represents.

Answer

.....
.....
..... [1]

– End –

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MATHEMATICS

4048/02

Paper 2

9 May 2019, Thursday

Candidates answer on the Question Paper.

2 hours 30 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use a 2B 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.
The use of an approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

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 .

The number of marks is given in brackets [] at the end of each question or part question.
The total marks for this paper is 100.

This document consists of 25 printed pages including the cover page.

1. (a) Simplify $\frac{4b^3}{3a} \div \frac{(-4ab^3)^2}{2a^{-4}b^2}$. Give your answer in positive indices. [2]

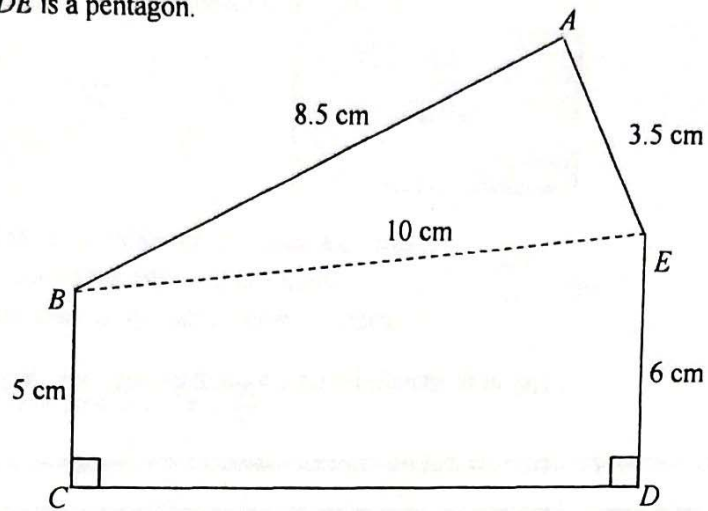
(b) Factorise $14xb + 3ay - 2xy - 21ab$ completely. [2]

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

(d) Simplify $\frac{2x(1-6x)}{4x^2-1} - \frac{2}{2x+1}$ [4]

- (e) Express $2x^2 + 6x - 15$ in the form $a(x + b)^2 + c$, where a , b and c are constants.
Hence, solve the equation $2x^2 + 6x - 15 = 0$, giving your answers correct to four decimal places. [4]

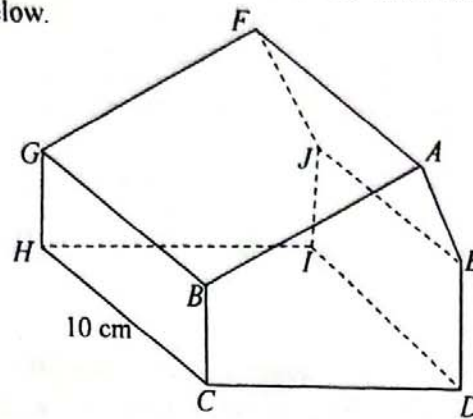
2. $ABCDE$ is a pentagon.



- (a) Calculate the area of the pentagon $ABCDE$.

[5]

- (b) The pentagon $ABCDE$ is a cross-section of a prism which is a model of a house as shown below.



- (i) Calculate the total surface area of the model, including the base. [2]

- (ii) Calculate the angle of depression of H from E . [3]

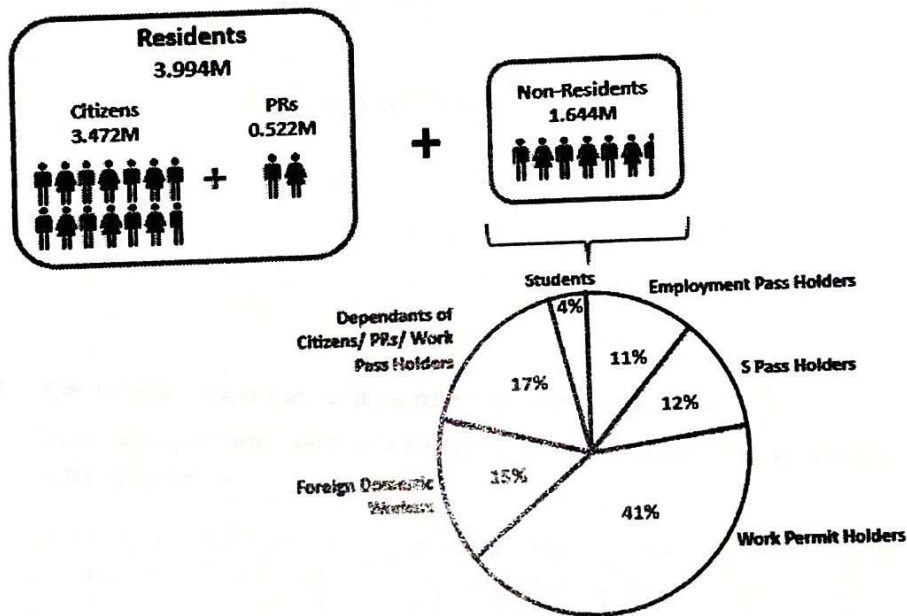
3. There was a newspaper article on Singapore's population published in 2018.

Singapore's population grows slightly to 5.638 million, with non-resident numbers stable.

Singapore's population rose 0.5 percent to 5.638 million from 2017 to 2018.

The slight increase over the past year was due to stable growth in citizen population, which rose 1 percent to 3.472 million citizens as of June 2018.

The 1 percent growth in citizens was due to citizen births and immigration.



Source: <https://www.channelnewsasia.com/news/singapore/singapore-s-population-grows-slightly-to-5-64m-with-non-resident-10763132>

- (a) Calculate the Singapore's total population in 2017.

[2]

(b) Express the number of Foreign Domestic Workers as a percentage of the Singapore's total population in 2018. [2]

(c) Based on the information shown in this article, do you agree that Singapore's total population will reach 6.3 million by 2030? Support your answer with appropriate workings and state an assumption that you have made in your calculation. [3]

(d) State one aspect of the diagram that may be misleading and explain how this may lead to a misinterpretation of information. [2]

4. The diagram shows a rectangular table top.



x m

The area of the table top is 5 square metres.

The length of the table top is x metres.

The perimeter of the table top is y metres.

- (a) Show that $y = 2x + \frac{10}{x}$. [2]

- (b) The variables x and y are connected by the equation $y = 2x + \frac{10}{x}$.
Some corresponding values of x and y , correct to one decimal place, are given in the table below.

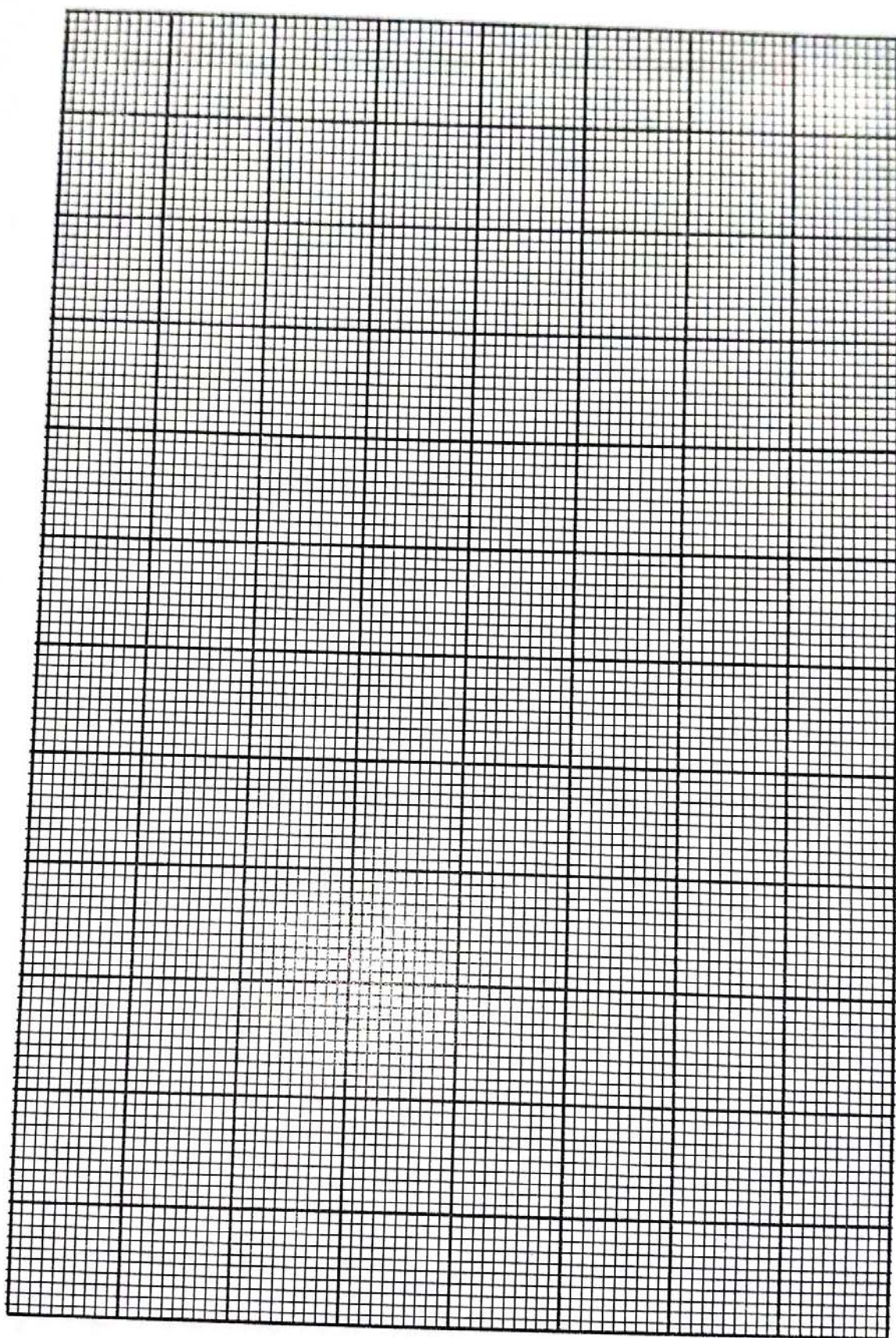
| | | | | | | | |
|-----|-----|----|-----|---|------|------|------|
| x | 0.5 | 1 | 1.5 | 2 | 4 | 6 | 8 |
| y | p | 12 | q | 9 | 10.5 | 13.7 | 17.3 |

- (i) Find the value of p and of q . [1]

- (ii) Using a scale of 1 cm to represent 1 m, draw a horizontal x -axis for $0 \leq x \leq 8$.

Using a scale of 1 cm to represent 1 m, draw a vertical y -axis for $0 \leq y \leq 22$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]



- (iii) Use your graph to find the length of the table top if the perimeter of the table top is 16 m. [2]

- (iv) By drawing a suitable straight line, find the x coordinate of the point at which the gradient of the curve is $\frac{1}{3}$. [2]

5. Given equation of a line L is $3x - 2y = 8$.

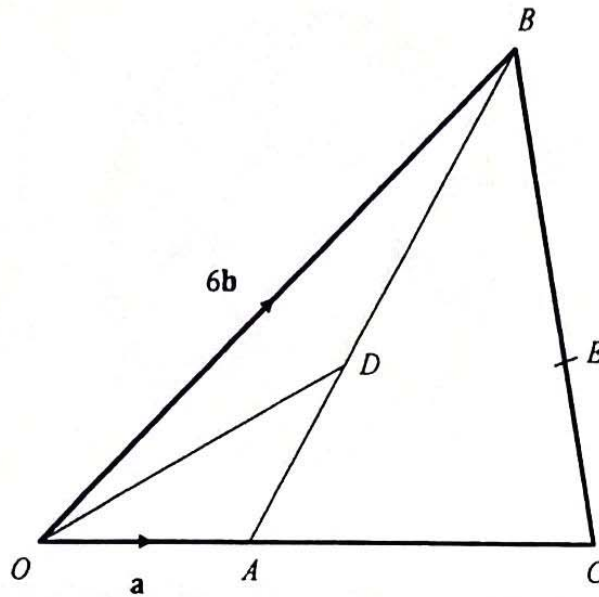
(a) State the gradient of line L . [1]

(b) If $P(k, -2)$ is a point on the line L , find the value of k . [1]

(c) Find the equation of another line that is parallel to the x -axis and passes through P . [1]

(d) Calculate the perpendicular distance from the origin, O , to the line L . [4]

6.



In the diagram, $\overrightarrow{OA} = \mathbf{a}$, $\overrightarrow{OB} = 6\mathbf{b}$ and $\overrightarrow{OA} = \frac{1}{3}\overrightarrow{OC}$.

D is a point on AB such that $3\overrightarrow{AD} = 2\overrightarrow{DB}$ and E is a point on BC such that $\overrightarrow{CE} : \overrightarrow{EB} = 4 : 5$.

(a) Express, as simply as possible, in terms of \mathbf{a} and \mathbf{b} ,

(i) \overrightarrow{BA} , [1]

(ii) \overrightarrow{OD} , [1]

(iii) \overrightarrow{CE} , [1]

(iv) \overrightarrow{AE} . [2]

- (b) Write down the relationship between OD and AE . Explain your answer. [2]



- (c) Find the ratio of

- (i) area of triangle CAE : area of triangle AOD , [2]

- (ii) area of triangle CAE : area of triangle AOB . [2]

7. (a) There are two boxes of sweets containing toffees and chocolates.
Box A contains 8 toffees and 4 chocolates, whereas box B contains 7 toffees and 3 chocolates.

Jolin loves chocolates.

One of the boxes is chosen at random and a sweet is taken out.

If she gets a chocolate, she will consume it.

If she did not get a chocolate from the first selection, she will place the sweet into the other box and she will select again from the other box.

Jolin limits herself to two selections.

Find, as a fraction in its simplest form, the probability that

- (i) Jolin will have her favourite chocolate from the first selection, [3]

- (ii) Jolin will have her favourite chocolate. [3]

- (b) Your friend, Kenton gives you a chance to win \$1000 by playing a game of “Guess the number”. There are two options of the game that he allows you to choose.

Option A

He uses a random number generator to choose a number from 1 to 8.

If you guess it correctly, you win.

Option B

You flip a fair coin.

If the coin lands on head, Kenton will roll a fair 6-sided die. If you manage to guess what it rolled, you win.

If the coin lands on tail, Kenton will use a random number generator to choose a random number from 1 to 8. If you guess the number correctly, you win.

Which option will you choose? Explain your answer.

[3]

8.

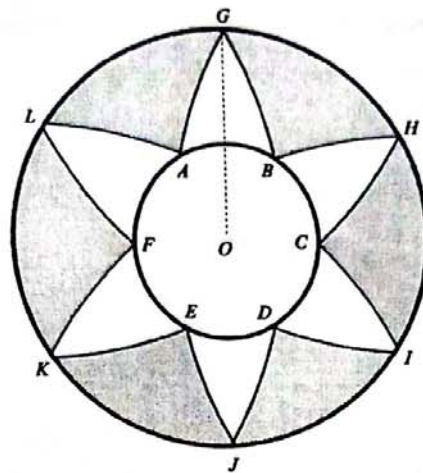


Figure 1

Figure 1 shows a dreamcatcher-inspired ornament which is made up of wire. The ornament consists of an inner circle $ABCDEF$ and an outer circle $GHIJKL$, both with centre O , and 6 identical “petal” designs such as AGB and BHC .

Team Hō‘ola will be making these ornaments to raise funds for their Voluntary Welfare Organisation.

To estimate the amount of wire to be purchased, Head of Fundraising team, Janice modelled the following:

- The arc AG is an arc of another circle with centre X , radius 18 cm and $\angle AXG = \frac{\pi}{6}$ radians.

This information is illustrated in Figure 2.

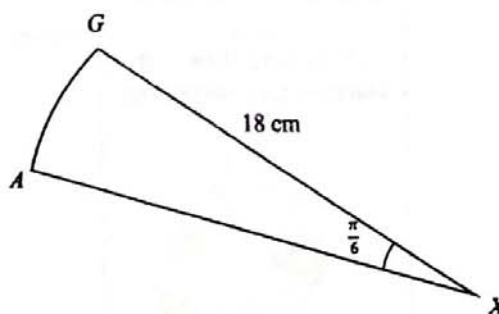


Figure 2

- A regular hexagon forms within the inner circle $ABCDEF$ with $OB = 5$ cm. This information is illustrated in Figure 3.

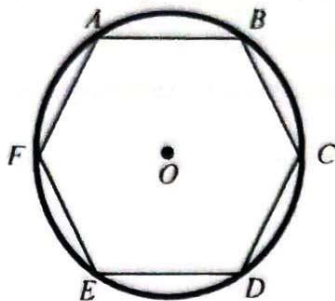


Figure 3

- (a) Show that the radius of the outer circle is 13.31 cm, correct to 2 decimal places. [6]

- (b) Team Hō'ola decided to make 50 dreamcatcher-inspired ornaments and Janice chanced upon the following promotion.



What is the estimated cost to make these ornaments?

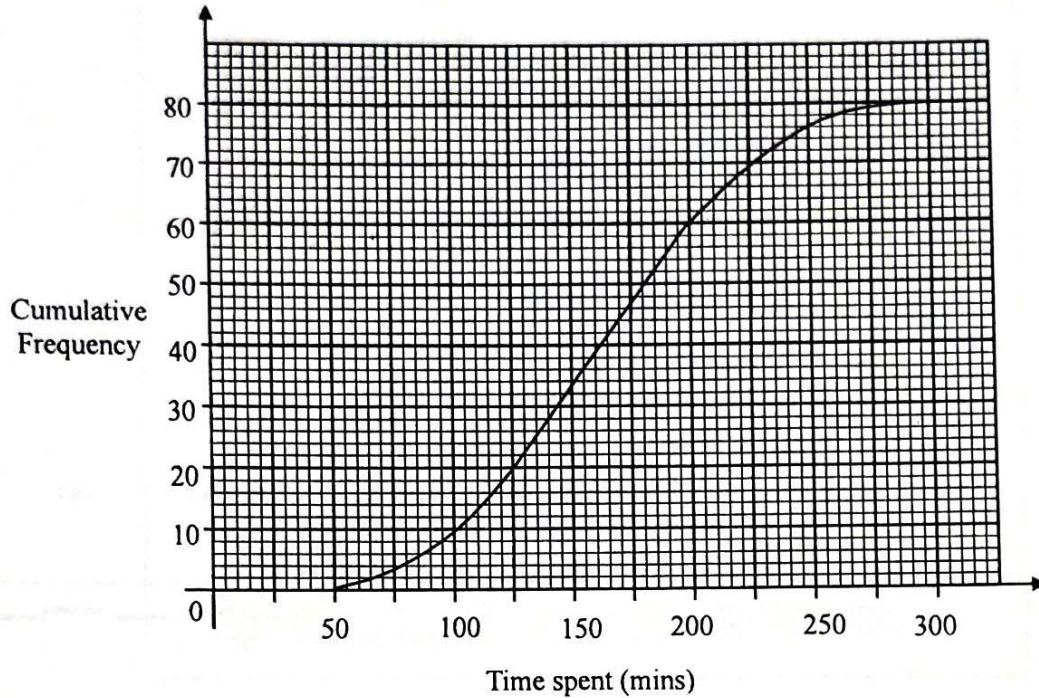
[5]

(c) Find the area of the shaded region as shown in Figure 1.

[5]



9. (a) The cumulative frequency curve below shows the time spent in minutes by a group of 80 teenagers on Instagram (a social media platform) on a particular day.



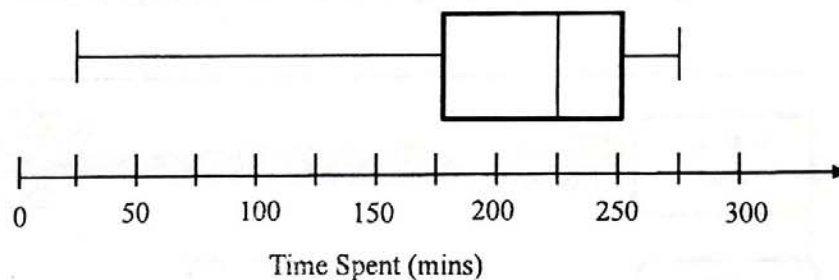
Use the curve to estimate

- (i) the median, [1]

- (ii) the interquartile range. [2]

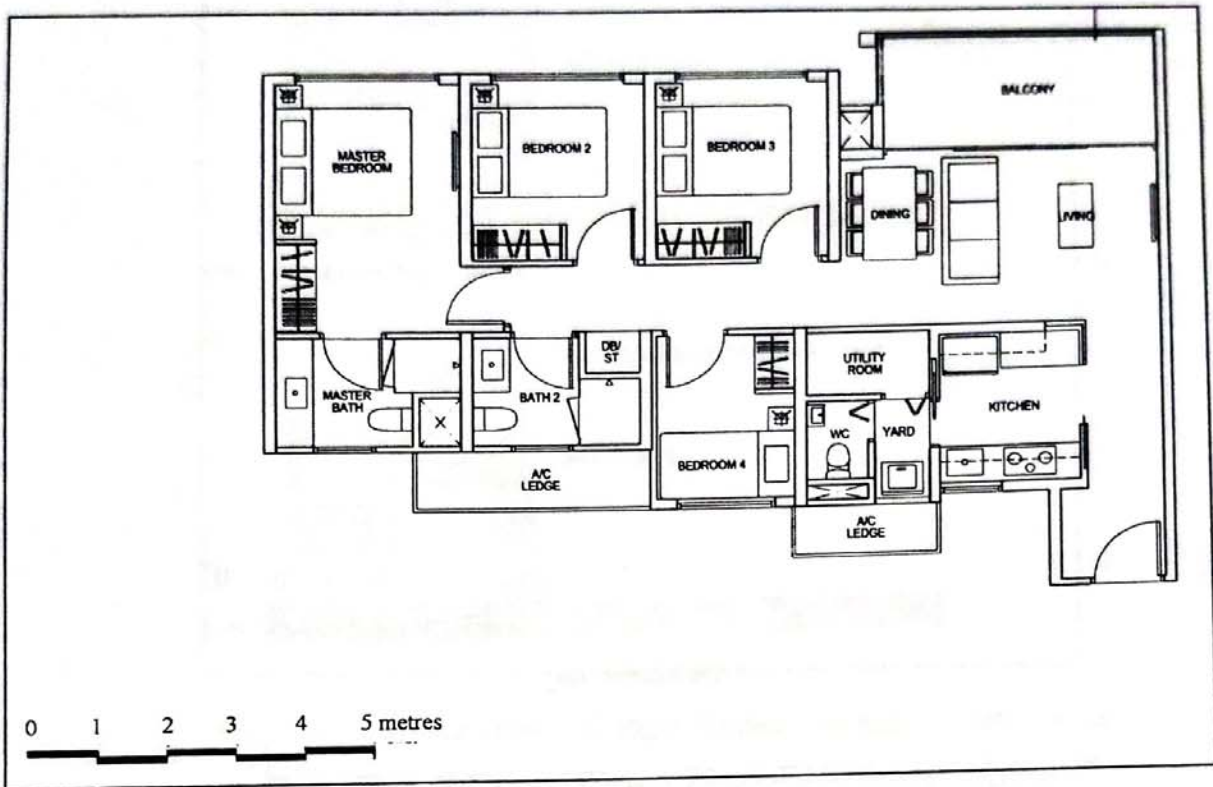
- (b) Through a market research, it was found out that the time spent on Facebook (another social media platform) is less popular and less consistent among the same group of 80 teenagers. A second cumulative frequency curve for the same group of 80 teenagers spending their time on Facebook is drawn. Describe how the second cumulative frequency curve may differ from the curve for Instagram. [2]

- (c) The box-and-whisker plot represents the distribution of the time spent for the same group of 80 teenagers on SnapChat (another social media platform).



- For this group of 80 teenagers, which of the social media platforms - Instagram, Facebook or Snapchat, is the most popular? Support your answer with an appropriate statistical measure. [2]

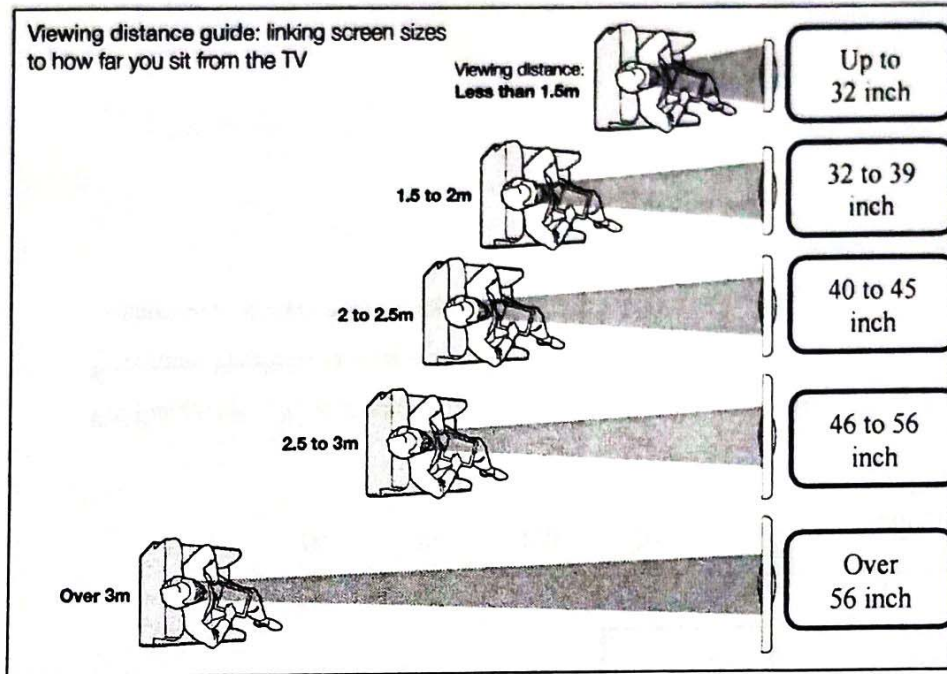
10. Ms Tan got her new home recently and the layout of her house is shown in the diagram below. The layout is drawn to scale.



- (a) Express the scale of the map in the form of $1:n$. [1]

(b) Ms Tan decides to get a television set for her living room.

She found the following infographic online.



What is the range of television size which Ms Tan should get for her living room?

[2]

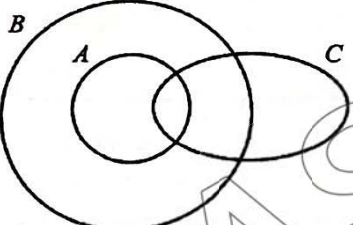
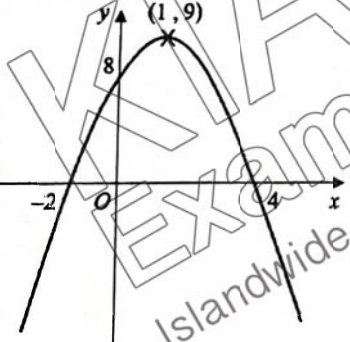
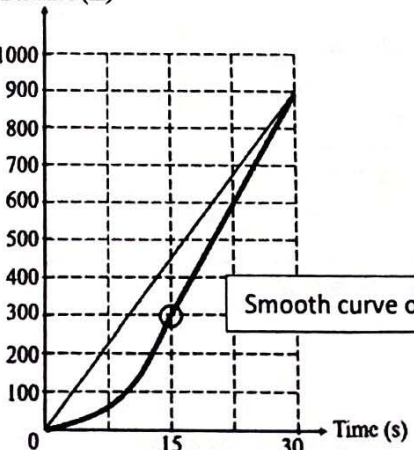
- (c) Ms Tan decided to shop for her television set online and she saw the following options:

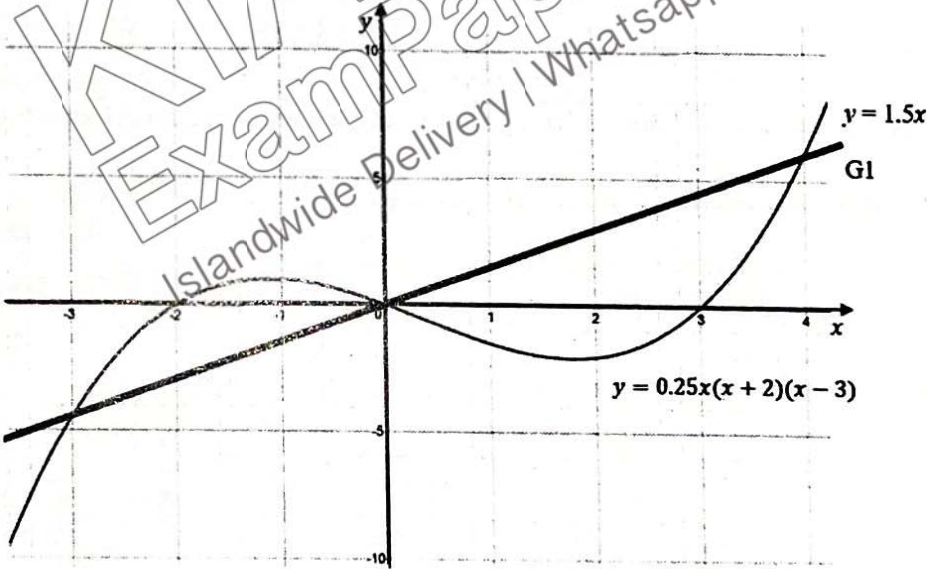
The screenshot displays two product listings for LG OLED 4K Smart TVs. The top listing is for the LG OLED55B8STB 55" OLED 4K SMART TV, priced at SGD2,988.00. The bottom listing is for the LG OLED65B8STB 65" OLED 4K SMART TV, priced at SGD4,988.00. Both listings feature the LG logo, a product image, the product name, the price, a quantity selector (set to 1), and an 'Add to Cart' button.

Ms Tan pays a downpayment of \$2 000 for her television set as suggested in (b). She pays the remaining amount over 3 months, with a simple interest rate of 7 % per annum. Calculate her monthly instalment. [3]

- End of Paper -

Answers

| | |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | $4^{3k} \times 4^2 = 4^0$ $3k + 2 = 0$ $k = -\frac{2}{3} \text{ exact only!}$ |
| 2 | Median = 36 Interquartile Range = 18 $Q_1 = 46 - 18 = 28$ $X = 8 \rightarrow$ digit in the ones place. |
| 3 | HCF = 6 = 2×3 LCM = 60 = $2^2 \times 3 \times 5$ $p = 2^2 \times 3 = 12$ $q = 2 \times 3 \times 5 = 30$ |
| 4 |  |
| 5 |  |
| 6 | $\frac{1.79}{10} = \frac{179}{1000}$ $\frac{17.9}{2 \times 50} = \frac{179}{1000}$ $\frac{26.85}{150} = \frac{179}{1000}$ <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 10px;"> Must show for all three! </div> <p>Since $\frac{\text{cost}}{\text{volume}} = \text{constant}$, the cost is directly proportional to its volume.</p> |
| 7 | $0.05x > 0.03x + 8 \text{ or } 1.05x > 1.03x + 8$ $0.02x > 8$ $x > 400$ |
| 8 | $\frac{2x+1-3x}{x(2x+1)} = 1$ $1 - x = 2x^2 + x$ $2x^2 + 2x - 1 = 0$ <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;"> Must show quad formula with values subbed in. </div> $x = \frac{-2 \pm \sqrt{(2)^2 - 4(2)(-1)}}{2(2)} = 0.366 \text{ or } -1.37$ |
| 9 | $y^2 = \frac{2x+y}{3x-5}$ $3xy^2 - 5y^2 = 2x + y$ $3xy^2 - 2x = 5y^2 + y$ $x(3y^2 - 2) = 5y^2 + y$ $x = \frac{y(5y+1)}{3y^2-2} \text{ or } \frac{5y^2+y}{3y^2-2} \text{ or } \frac{5y^2+y}{2-3y^2}$ |
| 10 | $10\,000 \left(1 + \frac{2.75-4}{100}\right)^{3 \times 4} - 10\,000$ $= 10\,856.92 - 10\,000$ $= 856.92$ $= \$857$ <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;"> Quarterly is 4 times! </div> |
| 11 | $\left(\frac{3}{5}\right)^2 = \frac{9}{25}$ $\frac{9}{25} \times 200 = 72 \text{ ml}$ <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;"> Not cube because one of the component is constant!! </div> |
| 12a | $\frac{80 \text{ km}}{1 \text{ h}} = \frac{80 \times 1000 \text{ m}}{3600 \text{ s}} = \frac{200}{9} = 22 \frac{2}{9}$ <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;"> Mixed number or 3sf only!! </div> |
| 12b | $\frac{40}{15} = 2 \frac{2}{3}$ |
| 12c | <p>Distance (m)</p>  <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 10px;"> Smooth curve only! </div> <p>Time (s)</p> |

| | | | | | | | | | | | | |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-----------|------------|------------|-------------|------------|--------------|-------------|---------------|--------------------------------------------------------------|
| 13 | $\overline{PR} = \overline{PQ} + \overline{QR} = \begin{pmatrix} -3 \\ 4 \end{pmatrix} + \begin{pmatrix} 12 \\ 5 \end{pmatrix} = \begin{pmatrix} 9 \\ 9 \end{pmatrix}$ $ \overline{PR} = \sqrt{9^2 + 9^2} = \sqrt{162} = 12.7 \text{ units}$ | <p>PQ is not perpendicular to PS!</p> <p>Length PR \neq length PQ + length QR!</p> | | | | | | | | | | |
| 14 | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">$3^1 = 3$</td> <td style="width: 50%;">$8^1 = 8$</td> </tr> <tr> <td>$3^2 = 9$</td> <td>$8^2 = 64$</td> </tr> <tr> <td>$3^3 = 27$</td> <td>$8^3 = 512$</td> </tr> <tr> <td>$3^4 = 81$</td> <td>$8^4 = 4096$</td> </tr> <tr> <td>$3^5 = 243$</td> <td>$8^5 = 32768$</td> </tr> </table> <p>Last digit for 3^n is 3, 9, 7, 1 Last digit for 8^n is 8, 4, 2, 6</p> <p>$\frac{31}{4} = 7\frac{3}{4} \rightarrow$ Remainder = 3 \rightarrow Last digit = 7</p> <p>$\frac{16}{4} = 4 \rightarrow$ Remainder = 0 \rightarrow Last digit = 6</p> <p>Last digit of $3^{31} - 8^{16} = 7 - 6 = 1$</p> | $3^1 = 3$ | $8^1 = 8$ | $3^2 = 9$ | $8^2 = 64$ | $3^3 = 27$ | $8^3 = 512$ | $3^4 = 81$ | $8^4 = 4096$ | $3^5 = 243$ | $8^5 = 32768$ | <p>We must see that you had chosen the digit "7" and "6"</p> |
| $3^1 = 3$ | $8^1 = 8$ | | | | | | | | | | | |
| $3^2 = 9$ | $8^2 = 64$ | | | | | | | | | | | |
| $3^3 = 27$ | $8^3 = 512$ | | | | | | | | | | | |
| $3^4 = 81$ | $8^4 = 4096$ | | | | | | | | | | | |
| $3^5 = 243$ | $8^5 = 32768$ | | | | | | | | | | | |
| 15 | <p>$\frac{1}{4}x(x+2)(x-3) = \frac{6}{4}x$ Plot $y = \frac{3}{2}x$</p> | <p>Equation of line must be seen in this page. Or else, we will take it as you use calculator mode 3, 4.</p>  <p>$x = -3$ or 0 or $4 \rightarrow$ only accept exact answers.</p> | | | | | | | | | | |

2019 MYE EM P1 Solutions

| | | |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16 | Draw perpendicular bisector of LC . Draw angle bisector of AC . Unit 518. | |
| 17 | Let M be the midpoint of RS . $OM = \sqrt{13^2 - 12^2} = 5$ (Perpendicular bisector of chord) $OK = \sqrt{5^2 + 5^2} = 7.07$ (Equal chords) | Leave answer in 3sf as you are finding length! |
| 18 | $20 \leq \frac{(n-2) \times 180 - 100 - 20}{n-2} \leq 100$ $20(n-2) \leq (n-2) \times 180 - 120 \leq 100(n-2)$ $20n - 40 \leq 180n - 360 - 120 \leq 100n - 200$ $20n - 40 \leq 180n - 480$ or $180n - 480 \leq 100n - 200$ $440 \leq 160n$ or $80n \leq 280$ $2.75 \leq n$ or $n \leq 3.5$ $2.75 \leq n \leq 3.5$ $n = 3$ | Guess & check allowed for this qn. |
| 19a | $2x^2 - 4x - 7x + 14 - 9 = 2x^2 - 11x + 5 = (2x - 1)(x - 5)$ | Factorise, not completing the square! Read carefully. |
| 19b | $2(y - 1)^2 - 11(y - 1) + 5 = 0$ $x = y - 1 \rightarrow$ must be seen! Read question. It says "Hence". $y - 1 = \frac{1}{2}$ or 5 $y = 1.5$ or 6 | |
| 20 | $\frac{x+8}{y} = 4$ $x + 8 = 4y$ $2y + 6 + 8 = 4y$ $2y = 14$ $y = 7$ $x = 20$ | Do not write mixed number for algebra!! Recall: dividend = (divisor)(quotient) + remainder |
| 21 | $\angle BCD = 180 - 54 = 126$ (\angle s in opp segment) $\angle DCP = 180 - 126 = 54$ (adj \angle on a straight line) $\angle ADC = 27 + 54 = 81$ (ext \angle of Δ) $\angle AQD = 180 - 54 - 81 = 45$ (\angle sum of Δ) | Easier method: $\angle ABP = 180 - 54 - 27 = 99$ (\angle sum of Δ) $\angle ADQ = 180 - 99 = 81$ (\angle s in opposite segment) $\angle AQD = 180 - 54 - 81 = 45$ (\angle sum of Δ) |
| 22 | $\pi r l = 2\pi r^2$ $l = 2r$ $h = \sqrt{(2r)^2 - r^2} = \sqrt{3}r$ Volume = $\pi r^2(\sqrt{3}r + 2r) - \frac{1}{3}\pi r^2(\sqrt{3}r) - \frac{2}{3}\pi r^3$ $= \pi r^3\left(\sqrt{3} + 2 - \frac{\sqrt{3}}{3} - \frac{2}{3}\right)$ $= 7.82r^3$ | Vertical height and slanted length are different! Refer to cover page if you had left your answers in π . |

2019 MYE EM P1 Solutions

| 23a | <table border="1"> <thead> <tr> <th>Length of stay (days)</th> <th>Numbers of tourists</th> </tr> </thead> <tbody> <tr> <td>$0 < x \leq 5$</td> <td>10</td> </tr> <tr> <td>$5 < x \leq 10$</td> <td>10</td> </tr> <tr> <td>$10 < x \leq 15$</td> <td>10</td> </tr> <tr> <td>$15 < x \leq 20$</td> <td>2</td> </tr> <tr> <td>$20 < x \leq 25$</td> <td>2</td> </tr> <tr> <td>$25 < x \leq 30$</td> <td>3</td> </tr> <tr> <td>$30 < x \leq 35$</td> <td>3</td> </tr> <tr> <td>$35 < x \leq 40$</td> <td>3</td> </tr> </tbody> </table> | Length of stay (days) | Numbers of tourists | $0 < x \leq 5$ | 10 | $5 < x \leq 10$ | 10 | $10 < x \leq 15$ | 10 | $15 < x \leq 20$ | 2 | $20 < x \leq 25$ | 2 | $25 < x \leq 30$ | 3 | $30 < x \leq 35$ | 3 | $35 < x \leq 40$ | 3 |
|------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------|----------------|----|-----------------|----|------------------|----|------------------|---|------------------|---|------------------|---|------------------|---|------------------|---|
| Length of stay (days) | Numbers of tourists | | | | | | | | | | | | | | | | | | |
| $0 < x \leq 5$ | 10 | | | | | | | | | | | | | | | | | | |
| $5 < x \leq 10$ | 10 | | | | | | | | | | | | | | | | | | |
| $10 < x \leq 15$ | 10 | | | | | | | | | | | | | | | | | | |
| $15 < x \leq 20$ | 2 | | | | | | | | | | | | | | | | | | |
| $20 < x \leq 25$ | 2 | | | | | | | | | | | | | | | | | | |
| $25 < x \leq 30$ | 3 | | | | | | | | | | | | | | | | | | |
| $30 < x \leq 35$ | 3 | | | | | | | | | | | | | | | | | | |
| $35 < x \leq 40$ | 3 | | | | | | | | | | | | | | | | | | |
| 23b | $\frac{13}{43}$ | | | | | | | | | | | | | | | | | | |
| 23c | <p>Mean = $13\frac{77}{86}$ or 13.9 SD = 11.0</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">3sf only! Do not round to nearest integer!</div> | | | | | | | | | | | | | | | | | | |
| 24a | <p>$(x-2)^4(x^2-4x+4) = (x-2)^4(x-2)^2 = (x-2)^6 \rightarrow$ must be seen!</p> <p>Since the power 6 is both a multiple of 2 and of 3, it is both a perfect cube and a perfect square.</p> | | | | | | | | | | | | | | | | | | |
| 24b | <p>$2x + 2y = 20$ $x + y = 10$</p> <p>$2x^2 + 2y^2 = 140$ $x^2 + y^2 = 70$</p> <p>$(x+y)^2 = x^2 + y^2 + 2xy$ $2xy = 100 - 70$ $xy = 15$</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Alternative method is to solve of x and y to get 8.16 or 1.84 and find $xy = 15.0 \text{ cm}^2$.</div> | | | | | | | | | | | | | | | | | | |
| 25a | $P = \begin{pmatrix} 32 & 27 & 20 \\ 44 & 45 & 38 \end{pmatrix}$ | | | | | | | | | | | | | | | | | | |
| 25b | $PQ = \begin{pmatrix} 319.9 \\ 525.7 \end{pmatrix}$ | | | | | | | | | | | | | | | | | | |
| 25c | <p>$R = \begin{pmatrix} \frac{3}{4} & 0 & 0 \\ 0 & \frac{2}{3} & 0 \\ 0 & 0 & \frac{1}{2} \end{pmatrix}$</p> <div style="border: 1px solid black; padding: 2px; display: inline-block;">Work with exact! This is percentage, not money hence, it should not be 2dp! Only accept exact or 3sf.</div> | | | | | | | | | | | | | | | | | | |
| 25d | $S = \begin{pmatrix} 32 & 27 & 20 \\ 44 & 45 & 38 \end{pmatrix} \begin{pmatrix} \frac{3}{4} & 0 & 0 \\ 0 & \frac{2}{3} & 0 \\ 0 & 0 & \frac{1}{2} \end{pmatrix} \begin{pmatrix} 3.2 \\ 4.5 \\ 4.8 \end{pmatrix} = \begin{pmatrix} 24 & 18 & 10 \\ 33 & 30 & 19 \end{pmatrix} \begin{pmatrix} 3.2 \\ 4.5 \\ 4.8 \end{pmatrix} = \begin{pmatrix} 205.8 \\ 331.8 \end{pmatrix}$ | | | | | | | | | | | | | | | | | | |
| 25e | <p>They represent the total money collected from Childcare Centre A and B respectively for the sales of cakes after discount.</p> | | | | | | | | | | | | | | | | | | |
| <p>Money collected from sales is not money earned! The word "earned/earnings" relates to profit.</p> | | | | | | | | | | | | | | | | | | | |

The End

Name: _____ Register Number: _____ Class: _____



南僑中學

NAN CHIAU HIGH SCHOOL

**MID-YEAR EXAMINATION 2019
SECONDARY FOUR EXPRESS**

MARKING SCHEME

| |
|------------------|
| For Marker's Use |
| |

MATHEMATICS

Paper 2

Candidates answer on the Question Paper.

4048/02

9 May 2019, Thursday

2 hours 30 minutes

2019 Sec 4 MYE EM P2 Solution

1. (a) Simplify $\frac{4b^3}{3a} \div \frac{(-4ab^3)^2}{2a^{-4}b^2}$. Give your answer in positive indices. [2]

$$\begin{aligned} & \frac{4b^3}{3a} \div \frac{(-4ab^3)^2}{2a^{-4}b^2} \\ &= \frac{4b^3}{3a} \times \frac{2a^{-4}b^2}{16a^2b^6} \quad \text{----- [M1] convert expression to multiplication \& use of power} \\ &= \frac{b^3}{3a} \times \frac{b^2}{2a^6b^6} \\ &= \frac{1}{6a^7b} \quad \text{----- [A1]} \end{aligned}$$

- (b) Factorise $14xb + 3ay - 2xy - 21ab$ completely. [2]

$$\begin{aligned} & 14xb + 3ay - 2xy - 21ab \\ &= 14xb - 2xy - 21ab + 3ay \\ &= 2x(7b - y) - 3a(7b - y) \quad \text{----- [M1] factorise common terms} \\ &= (7b - y)(2x - 3a) \quad \text{----- [A1]} \end{aligned}$$

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

$$\begin{array}{lll} \frac{3-2x}{4} \geq \frac{x+2}{3} & \text{and} & \frac{x+2}{3} > \frac{x}{5} \\ 3(3-2x) \geq 4(x+2) & \text{and} & 5(x+2) > 3x \\ 9-6x \geq 4x+8 & \text{and} & 5x+10 > 3x \\ 1 \geq 10x & \text{and} & 2x > -10 \\ x \leq \frac{1}{10} & \text{----- [M1] and} & x > -5 \quad \text{----- [M1]} \end{array}$$

$$-5 < x \leq \frac{1}{10} \quad \text{----- [A1]}$$

(d) Simplify $\frac{2x(1-6x)}{4x^2-1} - \frac{2}{2x+1}$

[3]

$$\begin{aligned} & \frac{2x(1-6x)}{4x^2-1} - \frac{2}{2x+1} \\ &= \frac{2x(1-6x)}{(2x+1)(2x-1)} - \frac{2(2x-1)}{(2x+1)(2x-1)} \quad \text{----- [M1] common denominator} \\ &= \frac{2x-12x^2-4x+2}{(2x+1)(2x-1)} \\ &= \frac{-12x^2-2x+2}{(2x+1)(2x-1)} \quad \text{----- [M1] simplify numerator} \\ &= \frac{-2(6x^2+x-1)}{(2x+1)(2x-1)} \\ &= \frac{-2(3x-1)(2x+1)}{(2x+1)(2x-1)} \quad \text{----- [M1] factorise numerator} \\ &= \frac{-2(3x-1)}{2x-1} \quad \text{----- [A1]} \end{aligned}$$

(e) Express $2x^2 + 6x - 15$ in the form $a(x + b)^2 + c$, where a , b and c are constants.

Hence, solve the equation $2x^2 + 6x - 15 = 0$, giving your answers correct to four decimal places.

[4]

$$\begin{aligned} & 2x^2 + 6x - 15 \\ &= 2\left(x^2 + 3x - \frac{15}{2}\right) \\ &= 2\left[\left(x + \frac{3}{2}\right)^2 - \frac{9}{4} - \frac{15}{2}\right] \quad \text{----- [M1] ability to do completing the square} \\ &= 2\left[\left(x + \frac{3}{2}\right)^2 - \frac{39}{4}\right] \\ &= 2\left(x + \frac{3}{2}\right)^2 - \frac{39}{2} \quad \text{----- [A1]} \end{aligned}$$

$$2x^2 + 6x - 15 = 0$$

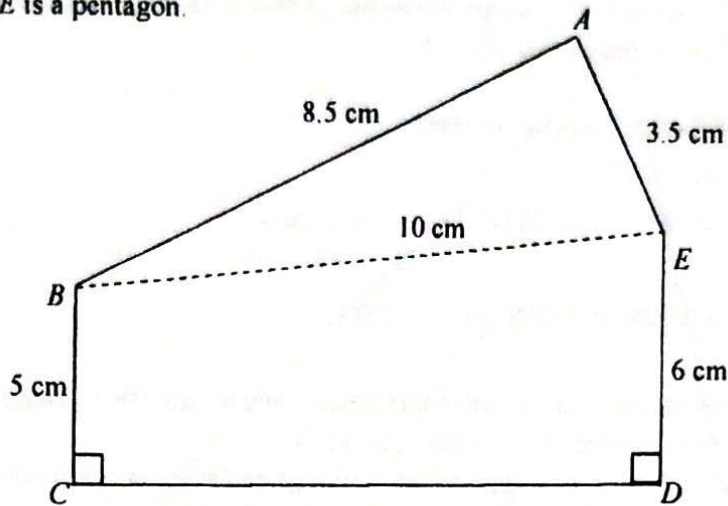
$$2\left(x + \frac{3}{2}\right)^2 - \frac{39}{2} = 0$$

$$\left(x + \frac{3}{2}\right)^2 = \frac{39}{4} \quad \text{----- [M1] solving using completing the square}$$

$$x + \frac{3}{2} = \pm \sqrt{\frac{39}{4}}$$

$$x = 1.6225 \text{ or } x = -4.6225 \quad \text{----- [A1]}$$

2. $ABCDE$ is a pentagon.



(a) Calculate the area of the pentagon $ABCDE$.

[5]

$$10^2 = 8.5^2 + 3.5^2 - 2(8.5)(3.5)\cos\hat{BAE} \text{ ----- [M1] use of cosine rule}$$

$$\cos\hat{BAE} = \frac{8.5^2 + 3.5^2 - 10^2}{2(8.5)(3.5)}$$

$$\cos\hat{BAE} = -0.260504$$

$$\alpha = 74.90^\circ$$

$$\hat{BAE} = 105.1^\circ \text{ or } 285.1^\circ \text{ (rej)} \text{ ----- [M1] ability to find angle } \hat{BAE}$$

Or

$$\hat{ABE} = 19.75^\circ \text{ or } 340.25^\circ \text{ (rej)}$$

$$\hat{BEA} = 55.15^\circ \text{ or } 304.85^\circ \text{ (rej)}$$

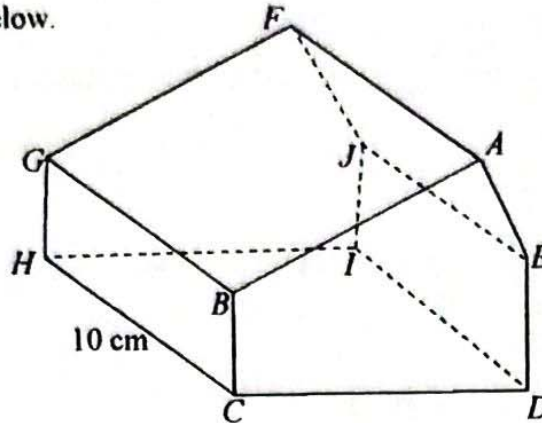
$$\begin{aligned} \text{area of } \triangle ABE &= \frac{1}{2}(8.5)(3.5)\sin 105.1^\circ \text{ ----- [M1] finding area of triangle} \\ &= 14.36 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} BE &= \sqrt{10^2 - 3.5^2} \\ &= \sqrt{99} \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{Area of } BCDE &= \frac{1}{2}(5 + 6)(\sqrt{99}) \text{ ----- [M1] finding area of trapezium} \\ &= 54.72 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Area of } ABCDE &= 14.36 + 54.72 \\ &= 69.1 \text{ cm}^2 \text{ ----- [A1]} \end{aligned}$$

- (b) The pentagon $ABCDE$ is a cross-section of a prism which is a model of a house as shown below.



- (i) Calculate the total surface area of the model, including the base. [2]

$$\begin{aligned}
 &\text{total surface area} \\
 &= 2(69.08) + 10(5 + 8.5 + 3.5 + 6 + \sqrt{99}) \\
 &= 468 \text{ cm}^2 \quad \text{----- [A1]}
 \end{aligned}$$

[M1] area of all surface area (excluding cross-sectional area)

- (ii) Calculate the angle of depression of H from E . [3]

Let the angle of depression be θ

Student use

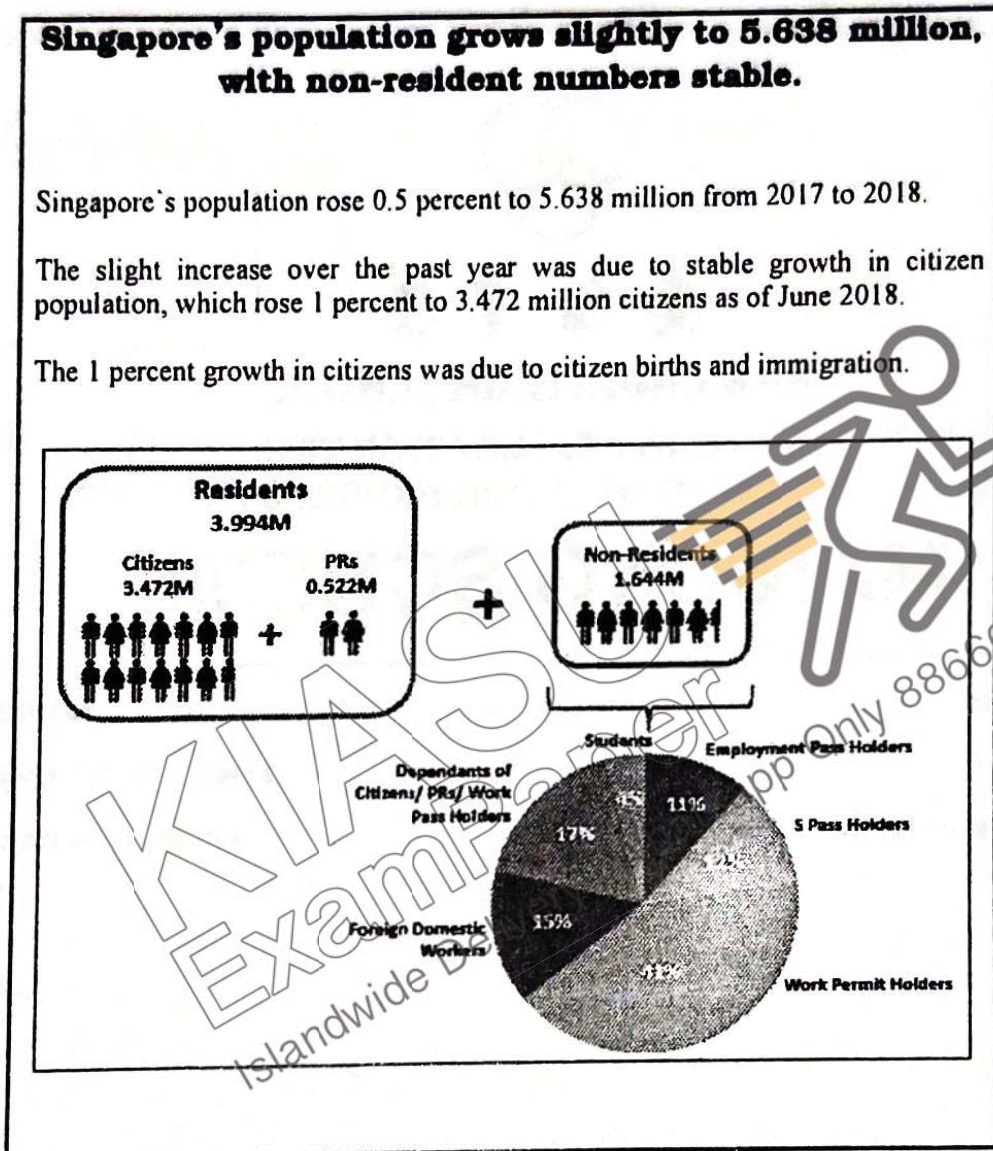
- (i) angle of depression = angle of elevation or
(ii) angle of depression = $90^\circ - 57.5^\circ$

$$\begin{aligned}
 HD &= \sqrt{10^2 + 99} \quad \text{----- [M1] finding length HD} \\
 &= \sqrt{199} \text{ cm}
 \end{aligned}$$

$$\tan \theta = \frac{6}{\sqrt{199}} \quad \text{----- [M1] finding relevant angle (either angle EHD or HED)}$$

$$\theta = 23.0^\circ \quad \text{----- [A1]}$$

3. There was a newspaper article on Singapore's population published in 2018.



Source: <https://www.channelnewsasia.com/news/singapore/singapore-s-population-grows-slightly-to-5-64m-with-non-resident-10763132>

- (a) Calculate the Singapore's total population in 2017. [2]

$$\begin{aligned}
 100.5\% &\rightarrow 5.638 \text{ million} \\
 100\% &\rightarrow \frac{100}{100.5} \times 5.638 \text{ million} \text{ ----- [M1] showing } \frac{100}{100.5} \times 5.638 \\
 &= 5.61 \times 10^6 \text{ ----- [A1] or } 5.61 \text{ million}
 \end{aligned}$$

- (b) Express the number of Foreign Domestic Workers as a percentage of the Singapore's total population in 2018. [2]

Number of foreign domestic workers

$$= \frac{15}{100} \times 1.644 \times 10^6$$

$$= 0.2466 \times 10^6 \text{ ----- [M1] must in } 10^6 \text{ or million}$$

$$\frac{0.2466 \times 10^6}{5.638 \times 10^6} \times 100\% = 4.37\% \text{ ----- [A1]}$$

- (c) Based on the information shown in this article, do you agree that "Singapore's total population will reach 6.3 million by 2030?"
Support your answer with appropriate workings and state an assumption that you have made in your calculation. [3]

$$2030 - 2018 = 12 \text{ years}$$

Population of citizen by 2030

$$= (1.01)^{12} \times 3.472 \times 10^6 \text{ ----- [M1] finding the increase of citizen only}$$

$$= 3.912 \times 10^6$$

total population by 2030

$$= (3.912 + 0.522 + 1.644) \times 10^6$$

$$= 6.08 \times 10^6 \text{ ----- [A1]}$$

Assumption:

There is no increase for PRs and Non-Residents or

There is a constant growth of citizens at 1% per year ----- [M1]

- (d) State one aspect of the diagram that may be misleading and explain how this may lead to a misinterpretation. [2]

Accept any logical answer

- (i) Pictogram used alternate of a male and female figure --- [B1]

[Reason] misleading readers that there is an equal number of male and female population. --- [B1]

- (ii) Inaccurate use of $\frac{1}{2}$ pictogram "figure" for "non-resident" & $\frac{3}{4}$ in "citizen" --- [B1]

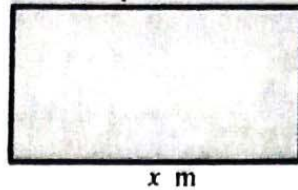
[Reason]

in PRs : if 1 figure \rightarrow 0.261 M

in citizen : 3.472 M should be represented by 13.3 figures

not $13 + \frac{3}{4}$ figure --- [B1]

4. The diagram shows a rectangular table top



The area of the table top is 5 square metres.
 The length of the table top is x metres.
 The perimeter of the table top is y metres.

- (a) Show that $y = 2x + \frac{10}{x}$. [2]

Width of table top = $\frac{5}{x}$ ----- [M1]

Perimeter, $y = x + \frac{5}{x} + x + \frac{5}{x}$ ----- [M1]

$$y = 2x + \frac{10}{x}$$

- (b) The variables x and y are connected by the equation $y = 2x + \frac{10}{x}$.

| | | | | | | | |
|-----|-----|----|-----|---|------|------|------|
| x | 0.5 | 1 | 1.5 | 2 | 4 | 6 | 8 |
| y | p | 12 | q | 9 | 10.5 | 13.7 | 17.3 |

Find the value of p and of q .

$p = 21$

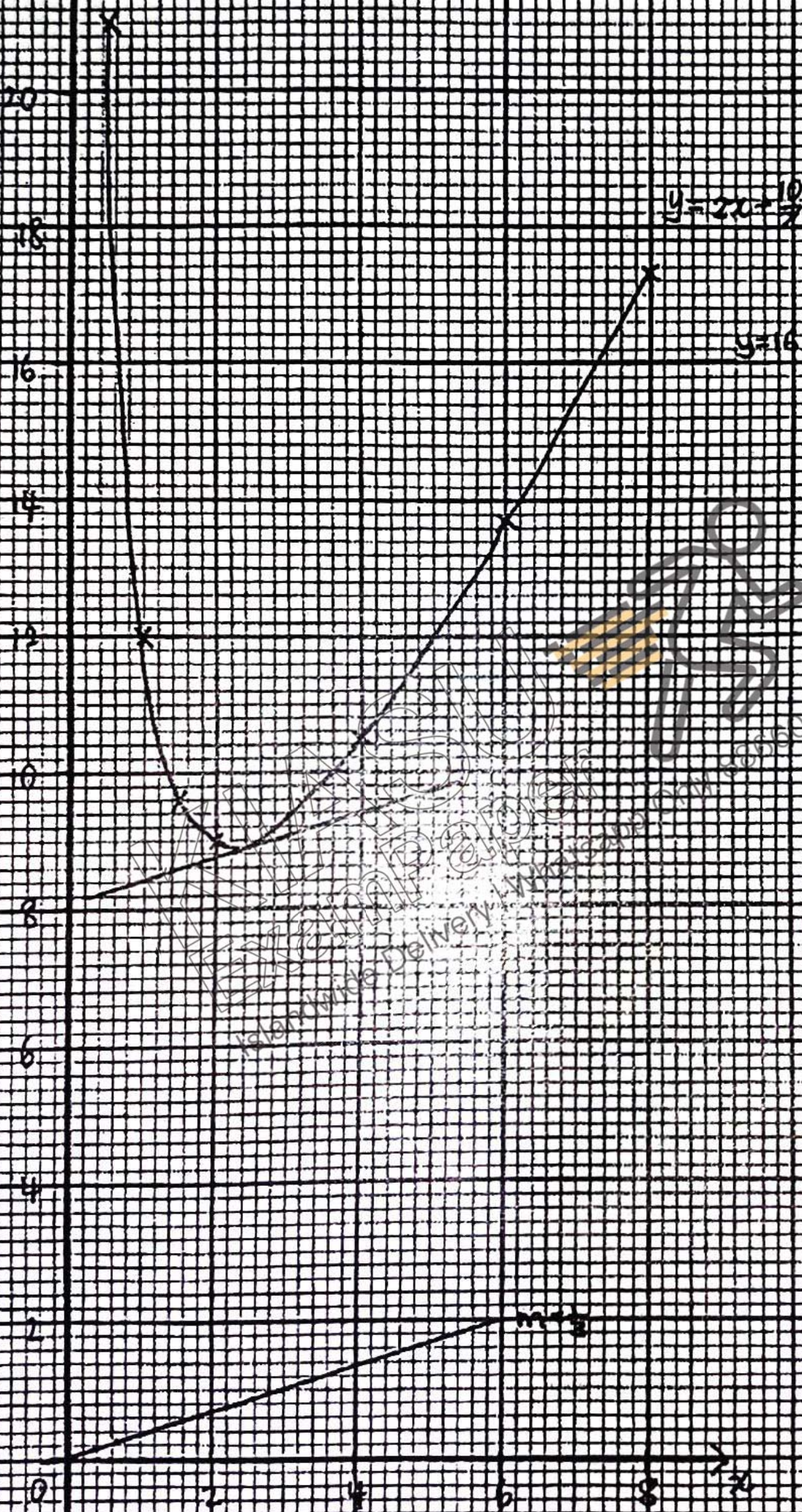
$q = 9.7$ (accept also 9.67) ----- [B1] for both answers

- (c) Using a scale of 1 cm to represent 1 unit, draw a horizontal x -axis for $0 \leq x \leq 8$.

Using a scale of 1 cm to represent 1 unit, draw a vertical y -axis for $0 \leq y \leq 22$.

On your axes, plot the points given in the table and join them with a smooth curve. [3]

22



- (d) Use your graph to find the possible width of the table top if the perimeter of the table top is 16 m. [2]

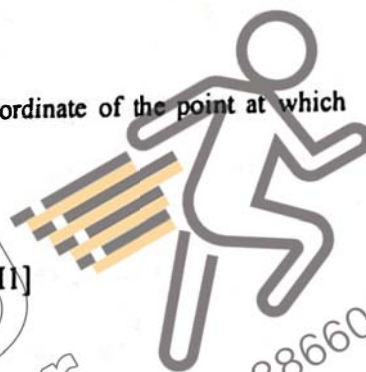
When $P = 16$,

$x = 0.7 (\pm 0.1)$ ----- [B1] answer must be rejected as length is longer
or $x = 7.3 (\pm 0.1)$ ----- [B1]

- (e) By drawing a suitable straight line, find the x-coordinate of the point at which gradient of the curve is $\frac{1}{3}$. [2]

Draw a line with grad = $\frac{1}{3}$ on the graph ----- [M1]

x-coordinate = 2.3 (± 0.1) ----- [A1]



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5. Given equation of a line L is $3x - 2y = 8$.

(a) State the gradient of line L .

[1]

$$2y = 3x - 8$$

$$y = \frac{3}{2}x - 4$$

$$\text{Gradient} = \frac{3}{2} \text{ ----- [B1]}$$

(b) If $P(k, -2)$ is a point on the line L , find the value of k .

[1]

$$3k - 2(-2) = 8$$

$$k = \frac{4}{3} \text{ ----- [B1]}$$

(c) Find the equation of another line that is parallel to the x -axis and passes through P .

[1]

$$y = -2 \text{ ----- [B1]}$$

(d) Calculate the perpendicular distance from the origin, O , to the line L .

[4]

$$3x - 2y = 8$$

$$\text{When } x = 0, y = -4 \quad (0, -4)$$

$$\text{When } y = 0, x = \frac{8}{3} \quad (\frac{8}{3}, 0)$$

----- [M1] finding relevant coordinates

Distance between 2 points

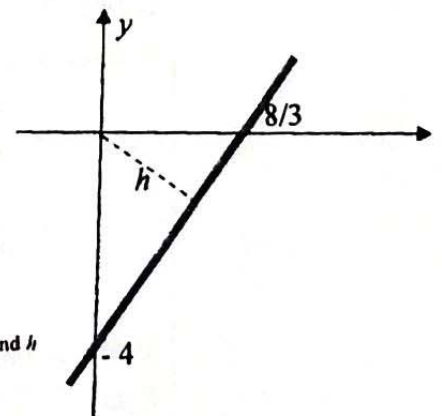
$$= \sqrt{(\frac{8}{3})^2 + (4)^2} \text{ ----- [M1]}$$

$$= 4.8074 \text{ units}$$

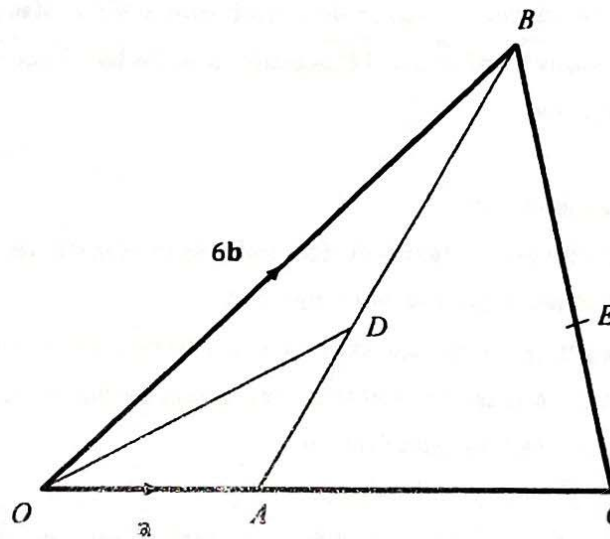
Let the perpendicular distance be h .

$$\frac{1}{2}(4)(\frac{8}{3}) = \frac{1}{2}(h)(4.8074) \text{ ----- [M1] suitable method to find } h$$

$$h = 2.22 \text{ units ----- [A1] accept } h = 2.21 \text{ units}$$



6.



In the diagram, $\vec{OA} = \mathbf{a}$, $\vec{OB} = 6\mathbf{b}$ and $\vec{OA} = \frac{1}{3}\vec{OC}$.

D is a point on AB such that $3\vec{AD} = 2\vec{DB}$ and E is a point on BC such that $\vec{CE} : \vec{EB} = 4 : 5$.

(a) Express, as simply as possible, in terms of \mathbf{a} and \mathbf{b} ,

(i) \vec{BA} ,

$$\begin{aligned} \vec{BA} &= \vec{OA} - \vec{OB} \\ &= \mathbf{a} - 6\mathbf{b} \end{aligned}$$

(ii) \vec{OD} ,

$$\begin{aligned} \vec{OD} &= \vec{OA} + \vec{AD} \\ &= \vec{OA} - \frac{2}{5}\vec{BA} \\ &= \mathbf{a} - \frac{2}{5}(\mathbf{a} - 6\mathbf{b}) \\ &= \frac{3}{5}(\mathbf{a} + 4\mathbf{b}) \end{aligned}$$

(iii) \overline{CB} ,

[1]

$$\begin{aligned}\overline{CB} &= \overline{OB} - \overline{OC} \\ &= 6b - 3a \\ &= 3(2b - a)\end{aligned}$$

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(iv) \overline{AE} ,

[2]

$$\begin{aligned}\overline{AE} &= \overline{AC} + \overline{CE} \\ &= 2a + \frac{4}{9}\overline{CB} \\ &= 2a + \frac{4}{9}(6b - 3a) \\ &= \frac{2}{3}(a + 4b)\end{aligned}$$

BI

(b) Write down the relationship between OD and AE . Explain your answer. [2]

$$\overline{OD} = \frac{3}{5}(a + 4b)$$

$$\overline{AE} = \frac{2}{3}(a + 4b)$$

Since

$$|\overline{OD}| = \frac{9}{10}|\overline{AE}|,$$

OD and AE are parallel lines.

M1 - Relationship between OD and AE

A1 - Parallel lines

(c) Find the ratio of

(i) area of triangle CAE : area of triangle AOD ,

[2]

$$\frac{\text{area of triangle } CAE}{\text{area of triangle } AOD} = \frac{\frac{1}{2}(CA)(AE) \sin \theta}{\frac{1}{2}(OA)(OD) \sin \theta}$$

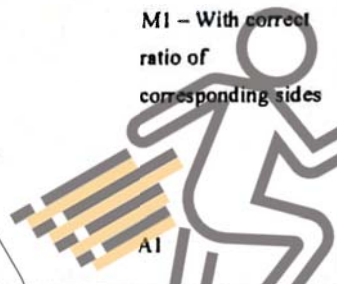
$$= \frac{AE}{OD} \times \frac{CA}{OA}$$

$$= \frac{10}{9} \times \frac{2}{1}$$

$$= \frac{20}{9}$$

20:9

M1 - With correct ratio of corresponding sides



(ii) area of triangle CAE : area of triangle AOB .

[2]

$$\frac{\text{area of triangle } CAE}{\text{area of triangle } AOB} = \frac{\text{area of triangle } CAE}{\text{area of triangle } AOD} \times \frac{\text{area of triangle } AOD}{\text{area of triangle } AOB}$$

$$= \frac{20}{9} \times \frac{\frac{1}{2}(h)(AD)}{\frac{1}{2}(h)(AB)}$$

$$= \frac{20}{9} \times \frac{2}{5}$$

$$= \frac{8}{9}$$

8:9

M1 - Common height relationship

A1

7. (a) There are two boxes of sweets containing toffees and chocolates.
 Box A contains 8 toffees and 4 chocolates, whereas box B contains 7 toffees and 3 chocolates.

Jolin loves chocolates.

One of the boxes is chosen at random and a sweet is taken out.

If she gets a chocolate, she will consume it.

If she did not get a chocolate from the first selection, she will place the sweet into the other box and she will select again from the other box.

Jolin limits herself to two selections.

Find, as a fraction in its simplest form, the probability that

- (i) Jolin will have her favourite chocolate from the first selection, [3]

$$\begin{aligned}
 P(\text{first selection}) &= P(\text{Box A}) + P(\text{Box B}) \\
 &= \left(\frac{1}{2}\right)\left(\frac{4}{12}\right) + \left(\frac{1}{2}\right)\left(\frac{3}{10}\right) \\
 &= \frac{19}{60}
 \end{aligned}$$

M1 - with $\frac{1}{2}$
 M1 - $4/12 + 3/10$
 (without $\frac{1}{2}$)
 A1

- (ii) Jolin will have her favourite chocolate. [3]

$$\begin{aligned}
 P(\text{favourite}) &= P(\text{at first}) + P(\text{at second}) \\
 &= \frac{19}{60} + P(\text{no A, yes B}) + P(\text{yes A, no B}) \\
 &= \frac{19}{60} + \left(\frac{1}{2}\right)\left(\frac{8}{12}\right)\left(\frac{3}{11}\right) + \left(\frac{1}{2}\right)\left(\frac{7}{10}\right)\left(\frac{4}{13}\right) \\
 &= \frac{4421}{8580}
 \end{aligned}$$

M1 - from (i)
 M1 - with $\frac{1}{2}$ and 2 cases for P(at second) correct
 A1

- (b) Your friend, Kenton gives you a chance to win \$1000 by playing a game of "Guess the number". There are two options of the game that he allows you to choose.

Option A

He uses a random number generator to choose a number from 1 to 8.
If you guess it correctly, you win.

Option B

You flip a fair coin.

If the coin lands on head, Kenton will roll a fair 6-sided die. If you manage to guess what it rolled, you win.

If the coin lands on tail, Kenton will use a random number generator to choose a random number from 1 to 8. If you guess the number correctly, you win.

Which option will you choose? Explain your answer.

[3]

Option A

$$P(\text{win}) = \frac{1}{8}$$

Option B

$$P(\text{win}) = P(\text{H, die}) + P(\text{T, No. Gen.})$$

$$= \left(\frac{1}{2}\right)\left(\frac{1}{6}\right) + \left(\frac{1}{2}\right)\left(\frac{1}{8}\right)$$

M1

$$= \frac{7}{48} \left(> \frac{1}{8}\right)$$

Since Option B has a higher probability,
Option B should be chosen.

A1 - with both
options' probability
correctly calculated.

- A regular hexagon forms within the inner circle $ABCDEF$ with $OB = 5$ cm. This information is illustrated in Figure 3.

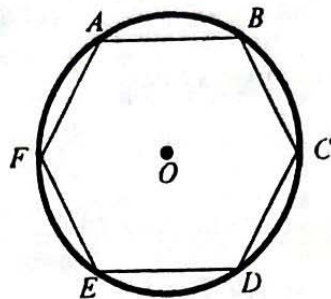


Figure 3

- (a) Show that the radius of the outer circle is 13.31 cm, correct to 2 decimal places. [6]

Let M be the midpoint of AB .

Consider $\triangle AGX$,

Using Cosine Rule,

$$AG^2 = 18^2 + 18^2 - 2(18)(18)\cos\frac{\pi}{6}$$

$AG = 9.31749$ cm M1 - finding line segment AG

Consider $\triangle AMO$,

$$\angle AOM = 360^\circ \div 12$$

$$= 30^\circ$$

$AM = 5 \sin 30^\circ$ M1 - finding angle AOX or $AOB = 60^\circ$

$MO = 5 \cos 30^\circ$ M1 - AX
M1 - XO

Consider $\triangle AGM$,

By Pythagoras theorem,

$$GM = \sqrt{AG^2 - AM^2}$$

$$= \sqrt{9.31749^2 - (5 \sin 30^\circ)^2}$$

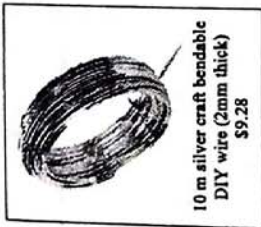
$$= 8.9758 \text{ cm}$$

Radius = $GM + MO$ M1 - $GX + XO$

$$= 8.9758 + 5 \cos 30^\circ$$

$$= \$111.36 \text{ (to 2dp)}$$

- (b) Team Hō'ola decided to make 50 dreamcatcher-inspired ornaments and Janice chanced upon the following promotion.



What is the estimated cost to make these ornaments? [5]

| | |
|------------------------------------------------|----------------------------------------------------|
| arc AG = $(18) \left(\frac{\pi}{6}\right)$ | MI |
| = 3π cm | |
| Petals = $12 \times 3\pi$ | |
| = 36π cm | |
| Circumference of small circle = $2\pi(5)$ | |
| = 10π | |
| Circumference of big circle = $2\pi(12.30597)$ | MI - Both circumference found. |
| = 26.6119π | |
| Amount of wire for 50 dreamcatchers | MI - Total circumference multiply by 50 |
| = $(26.6119\pi + 10\pi + 36\pi) \times 50$ | |
| = 3630.59π cm | |
| = 36.3059π m | |
| Rolls of wire needed | MI - Conversion from cm to m and rounded up. |
| = $\frac{36.3059\pi}{10}$ | |
| = 11.4058 | |
| = 12 (rounded up) | |
| Cost = $12 \times \$9.28$ | |

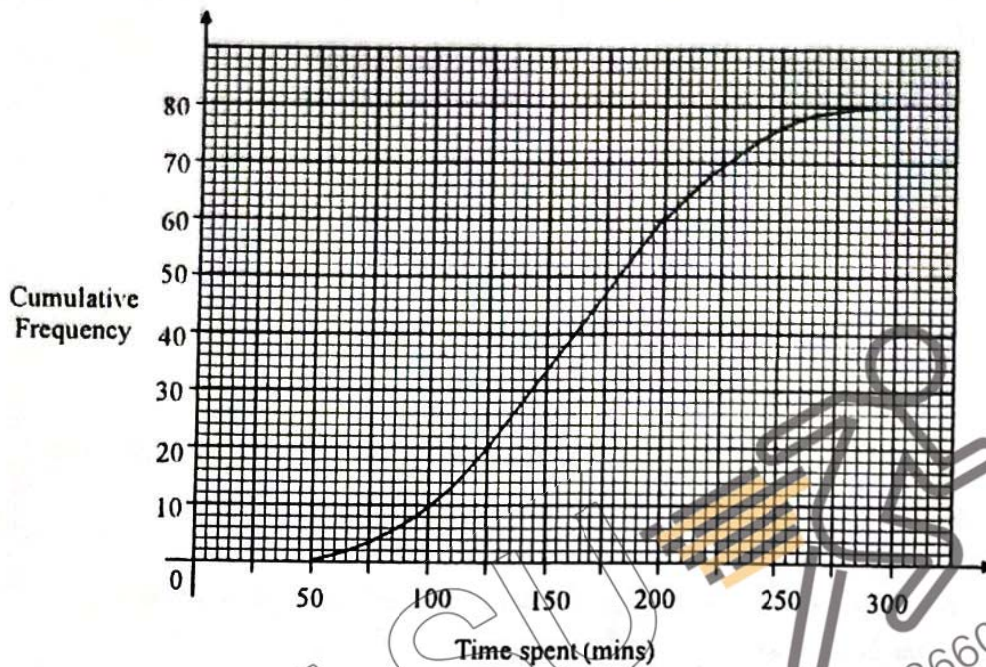
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(c) Find the area of the shaded region as shown in Figure 1.

[5]

| | |
|-------------------------------------------------------------------------------------------|----------------------|
| area of AG segment | |
| $= \frac{1}{2}(18)^2 \left(\frac{\pi}{6}\right) - \frac{1}{2}(18)(18) \sin \frac{\pi}{6}$ | M1 |
| $= 3.823 \text{ cm}^2$ | |
| area of $\triangle AGX = \frac{1}{2}(8.9758)(5 \sin 30^\circ)$ | M1 – area of right |
| $= 11.21975 \text{ cm}^2$ | angle triangle AGX. |
| area of $\triangle OXA = \frac{1}{2}(5 \cos 30^\circ)(5 \sin 30^\circ)$ | M1 – area of right |
| $= 5.41266 \text{ cm}^2$ | angle triangle OXA. |
| area of shaded region | |
| $= \pi(13.30597)^2 - 5.41266 \times 12$ | M1 – big circle area |
| $\quad - (3.823 + 11.21975) \times 12$ | |
| $= 310.7504 \text{ cm}^2$ | |
| $= 311 \text{ cm}^2$ | A1 |

9. (a) The cumulative frequency curve below shows the time spent in minutes by a group of 80 teenagers on Instagram (a social media platform) on a particular day.



Use the curve to estimate

- (i) the median,

[1]

$$\frac{N}{2} = 40$$

median = 162.5 min

B1

- (ii) the interquartile range.

[2]

$$\frac{N}{4} = 20$$

$$\frac{3N}{4} = 60$$

Q1 = 125 min

Q3 = 200 min

B1 – both Q1 and Q3 correct

Interquartile Range = Q3 – Q1

$$= 200 - 125$$

$$= 75 \text{ min}$$

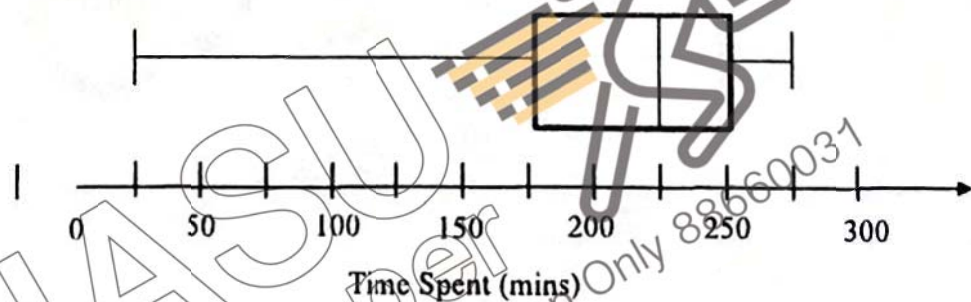
A1

- (b) Through a market research, it was found out that the time spent on Facebook (another social media platform) is less popular and less consistent among the same group of 80 teenagers. A second cumulative frequency curve for the same group of 80 teenagers spending their time on Facebook is drawn.

Describe how the second cumulative frequency curve may differ from the curve for Instagram. [2]

| | |
|-----------------------------------------|--------------------|
| The curve will <u>shift to the left</u> | B1 – shift to left |
| and has a <u>gentler slope</u> | B1 – Gentler slope |
| as compared to the given curve. | |

- (c) The box-and-whisker plot represents the distribution of the time spent for the same group of 80 teenagers on SnapChat (another social media platform).

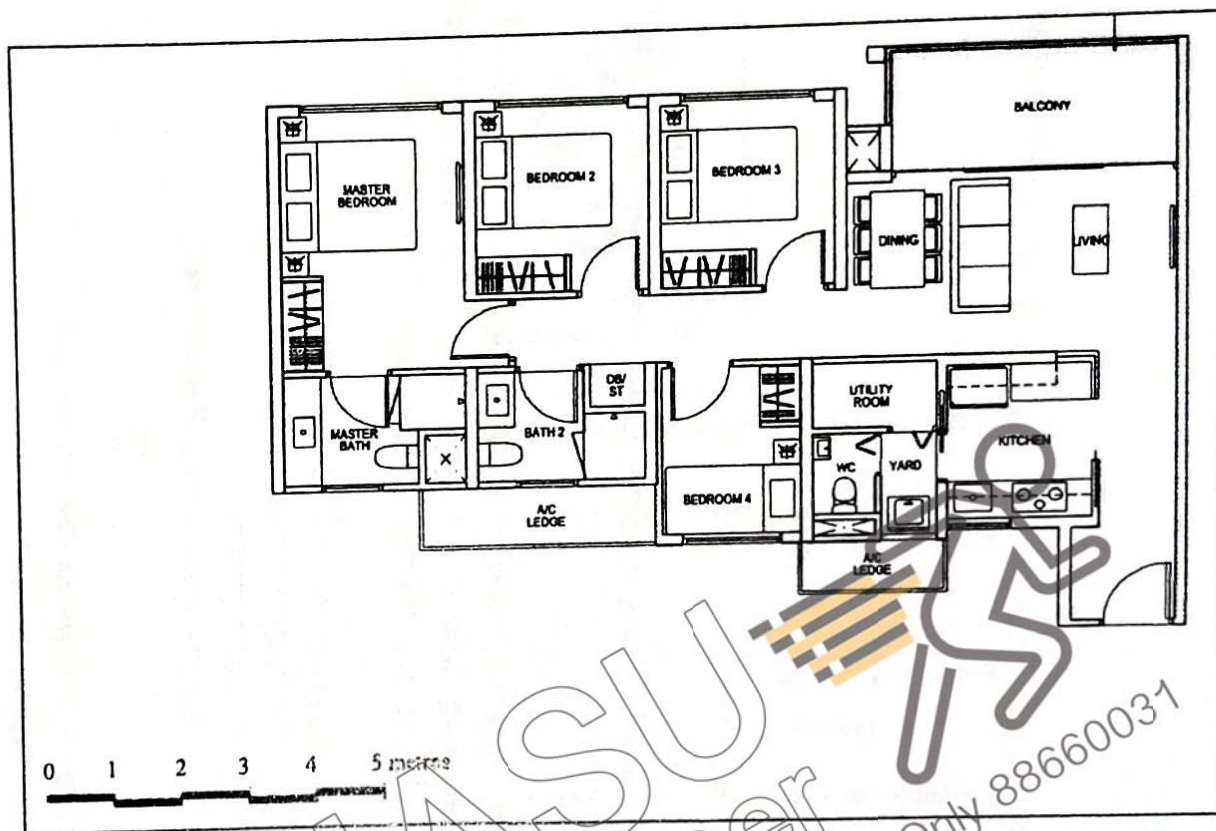


For this group of 80 teenagers, which of the social media platforms - Instagram, Facebook or Snapchat, is the most popular?

Support your answer with an appropriate statistical measure. [2]

| | |
|--------------------------------------------------------------------------------------|--------------------------------------------------|
| Median (Instagram) = 162.5 min | M1 – Evidence for median especially for SnapChat |
| Median (Facebook) < 162.5 min | |
| Median (SnapChat) = 225 min | |
| Since <u>Snapchat has the highest median</u> , it is the most popular. | A1 – Median as statistical comparison |
| *If students show no data evidence but mentioned about highest median, award 1 mark. | |

10. Ms Tan got her new home recently and the layout of her house is shown in the diagram below. The layout is drawn to scale.



- (a) Express the scale of the map in the form of 1:n [1]

$$1\text{cm} = 1\text{m}$$

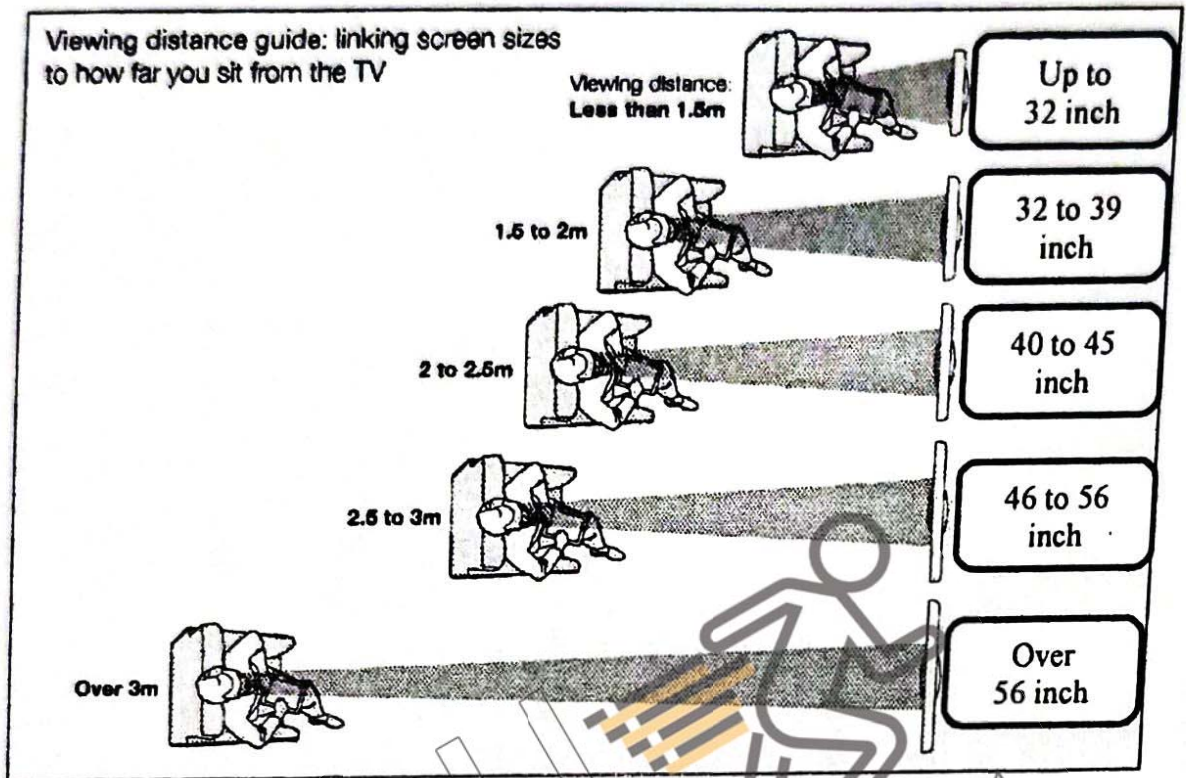
$$1\text{cm} = 100\text{cm}$$

$$1:100$$

BI

(b) Ms Tan decides to get a television set for her living room.

She found the following infographic online.



What is the range of television size which Ms Tan should get for her living room?

[2]

| | |
|-------------------------------------------|--------------------------------------------------------|
| Distance of Sofa from TV = 3.1 m × 100 cm | M1 - Measured distance can range from 2.3 cm to 3.1 cm |
| = 310 cm | |
| Range - 46 to 56 inch | A1 |

- (c) Ms Tan decided to shop for her television set online and she saw the following options:

The image shows two product listings for LG OLED 4K Smart TVs. The first listing is for a 55-inch model (LG OLED5588STB) priced at SGD2,988.00. The second listing is for a 65-inch model (LG OLED6588STB) priced at SGD4,988.00. Both listings include the LG logo, product name, price, and a quantity selector set to 1. There is a watermark of a person pushing a shopping cart over the listings.

Ms Tan pays a downpayment of \$2 000 for her television set as suggested in (b). She pays the remaining amount over 3 months, with a simple interest rate of 7% per annum.

Calculate her monthly instalment.

[3]

Ms Tan to purchase 55 inch TV.

$$\begin{aligned} \text{Remaining amount} &= \$2988 - \$2000 && \text{M1} \\ &= \$988 \end{aligned}$$

$$\begin{aligned} \text{Interest} &= \frac{988 \times 7 \times \frac{3}{12}}{100} && \text{M1 - with correct} \\ &= \$17.29 && \$988 \text{ and } 3/12 \end{aligned}$$

$$\begin{aligned} \text{Monthly instalment} &= \frac{\$988 + \$17.29}{3} && \text{A1} \\ &= \$335.10 \text{ (to 2dp)} \end{aligned}$$