AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2021

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

Name:	Class:	Register No.:

MATHEMATICS
Paper 1

4048/01
23 August 2021
2 hours

Candidates answer on the Question Paper.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any questions 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.
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
/80

This document consists of **21** printed pages.

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 Insert one pair of brackets to make the statement correct.

$$5-2+3\times2=-5$$

[1]

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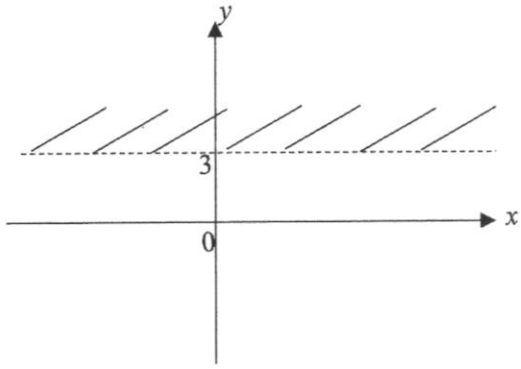
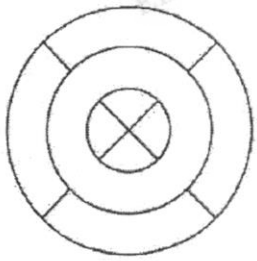
2 Write down an inequality that defines the points in the shaded region.



Answer ..... [1]

3



For the diagram above, write down

(a) the number of lines of symmetry

Answer ..... [1]

(a) the order of rotational symmetry.

Answer ..... [1]

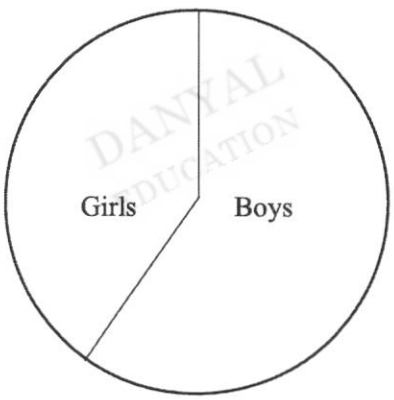
---

4 The bearing of a lighthouse from a coastguard station is 115°.
What is the bearing of the coastguard station from the lighthouse?

Answer ..... [2]

5 The pie chart shows the number of girls and boys who scored full marks in a Mathematics test.
Based on the chart, June concluded that on average, boys did better than girls in Mathematics.
Explain why June made that conclusion and why she may be wrong.

Students who scored full marks in Mathematics



Answer .....

.....

.....

.....

..... [2]

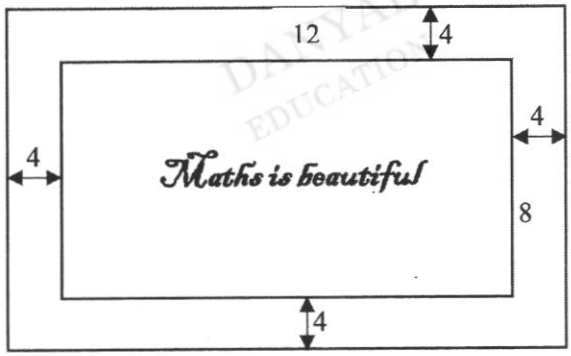
6 A is the point (3, 6) and B is the point (m, n) where m and n are both positive integers less than 10.

The length of the line segment is $\sqrt{34}$ units.

Find the coordinates of one of the possible positions for B.

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

7



A rectangular poster with the words "Maths is beautiful", 12 cm long and 8 cm wide, fits into a rectangular frame so that there is a border of 4 cm wide all the way round it.

Use calculations to determine whether the two rectangles are similar.

Answer

[2]

8 A boy who was asked to find $3\frac{1}{2}\%$ of a sum of money misread the question and found $5\frac{1}{2}\%$ of it.
His answer was \$247.10.
Calculate what the answer should be.

Answer \$..... [2]

---

9 Mr Heng goes on a holiday for x days and takes \$$f$ with him to spend.
He spends \$$g$ each day for the first y days.
Write down expressions for

(a) the number of dollars he has left after y days,

Answer \$..... [1]

(b) the number of dollars he may spend each day for the rest of his holiday, without running out of money.

Answer \$..... [1]

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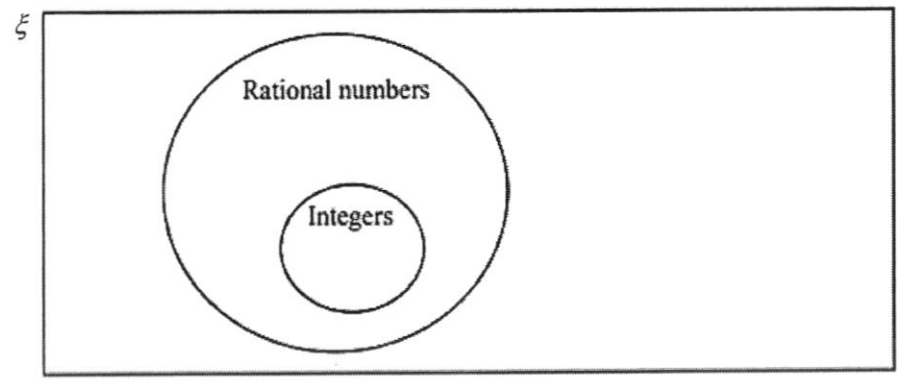
10 (a)



On the Venn Diagram above, write each of these numbers in the appropriate subsets.

$2.6,\ \frac{4}{17},\ \sqrt{12},\ \sqrt{\frac{112}{7}}$ [2]

(b) Three sets A, B and C are such that $A \subset C$, $B \subset C$ and $A \cap B = \varnothing$
Draw a Venn diagram to show this information.

[1]

11 **(a)** $2^8 = 4^x + 4^x + 4^x + 4^x$.
Find the value of x.

Answer $x =$ ..... [2]

(b) Write down the positive square root of $\frac{4x^2 - 12x + 9}{25x^{16}}$.

Answer ..... [1]

---

12 **(a)** Find the prime factors of 4410, giving your answer in index form.

Answer ..... [2]

(b) The highest common factor of two numbers is 245.
The lowest common multiple of these two numbers is 4410.
Both numbers are greater than their highest common factor.
Find the two numbers.

Answer ..... and ..... [2]

---

13 The mean and median of four numbers are 54 and 56 respectively.
Find the mean of the largest and the smallest numbers.

Answer .....[3]

14 Consider the number pattern below.

$$\frac{1}{11} = 0.090909..... = 0.\dot{0}\dot{9}$$

$$\frac{2}{11} = 0.181818..... = 0.\dot{1}\dot{8}$$

$$\frac{3}{11} = 0.272727..... = 0.\dot{2}\dot{7}$$

$$\frac{4}{11} = 0.363636..... = 0.\dot{3}\dot{6}$$

•

•

•

$$\frac{x}{11} = 636.3636..... = 636.\dot{3}\dot{6}$$

(i) Write down the 5th line of the pattern.

Answer ..... [1]

(ii) Find the value of x.

Answer $x =$ ..... [2]

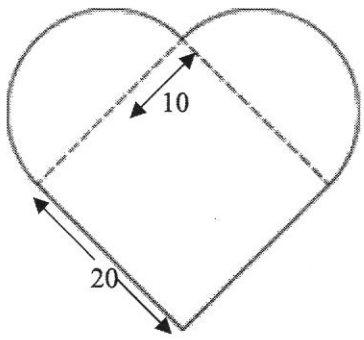
15 **(a)** Factorise fully $(a-b+c)^2-(b-c+a)^2$.

Answer ..... [2]

(b) Calculate the value of k if x^2-6x+k is a perfect square.

Answer $k=$ ..... [2]

16



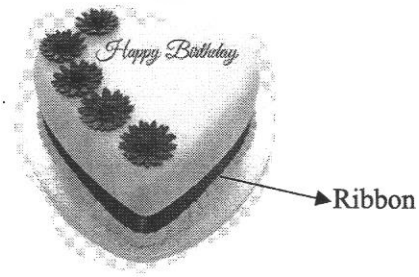
Instructions for baking a heart-shaped cake.

- Bake a square cake of side 20 cm.
- Bake two semicircle cakes of radius 10 cm.
- Join the two halves to the square cake, as shown in the diagram.

(a) Find the area of the top view of the cake.

Answer ..... cm^2 [1]

(b)



A red ribbon is fixed around the sides for the heart-shaped cake with the sides overlapping by 3 cm.
Find the length of ribbon required.

Answer ..... cm [2]

17 The safe speed, v m/s, at which a train can go round a curve of radius r m is directly proportional to the square root of r.
It is given that the safe speed at which a train can go round a curve of radius 121m is 22 m/s.

(i) Find the safe speed if the curve has a radius of 81m.

Answer ..... m/s [2]

(i) A change in the safe speed produces a change in the radius.
When the safe speed is halved, the value of radius changes by factor m.
Find m.

Answer $m =$..... [2]

18 In this question, the weather is either wet or dry.

When the weather is dry, the probability that Sarah will go walking is $\frac{3}{5}$.

When the weather is wet, the probability that Sarah will go walking is $\frac{1}{10}$.

The probability of a dry day is $\frac{2}{3}$.

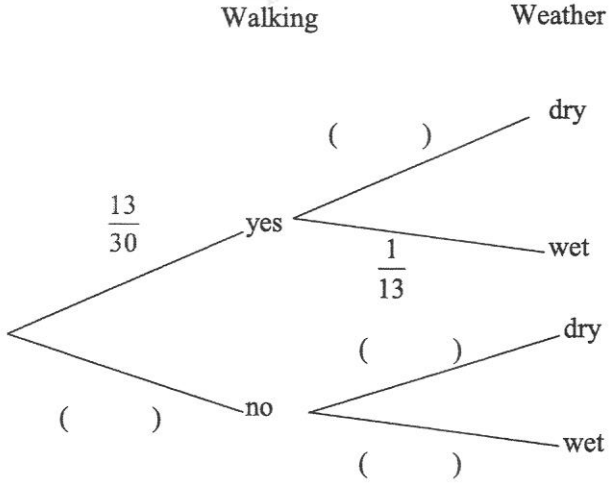
(a) Show that the probability that Sarah goes walking is $\frac{13}{30}$.

Answer

[2]

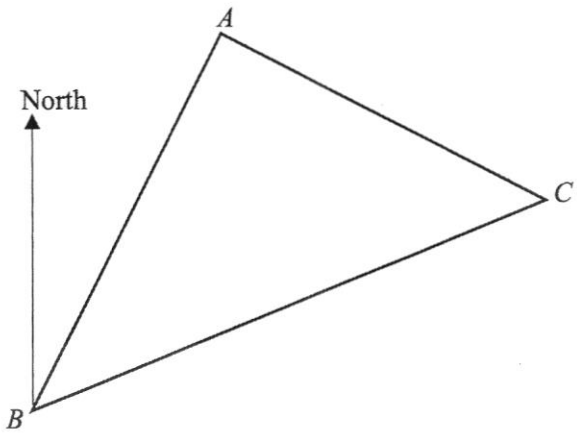
(b) The probability that Sarah does not go walking when the weather is wet is $\frac{9}{30}$.

Complete the tree diagram to show this information.



[2]

19



The diagram is a plan of a triangular field ABC, drawn to a scale of 1cm to 50 m.
A tree, T, in the field is 150 m from A and is equidistant from BA and BC.

(a) By making appropriate constructions on the diagram, indicate clearly the position of T. [2]

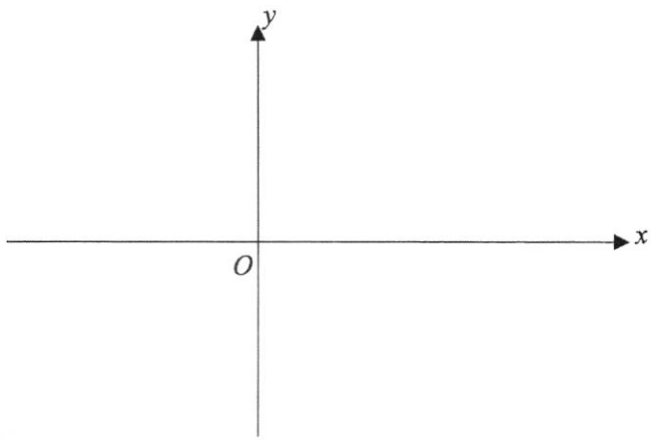
(b) Use the diagram to find

(i) the distance, in metres, from T to B, [1]

(ii) the bearing of T from B. [1]

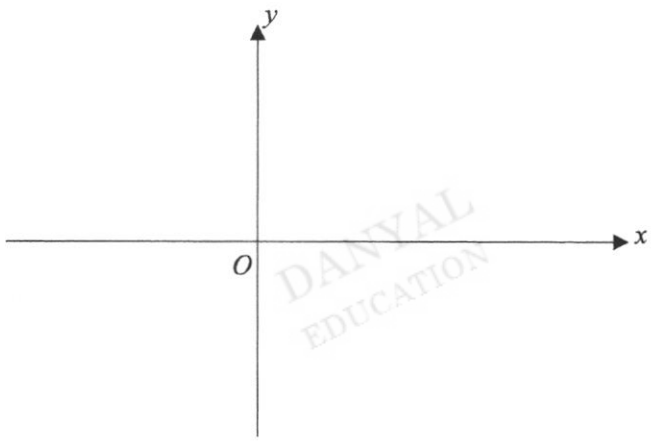
20 **(a)** On the axes below, sketch the graphs, indicating clearly the x and y intercepts if any.

(i) $y = 3^x$



[1]

(ii) $y = -3x^2$



[1]

(b) Hence, state the number of solution(s) to the equation $3^x + 3x^2 = 0$.
Explain your answer.

Answer .....

.....

.....

..... [2]

21 **(a)** The solution of the inequality $\frac{ax-1}{7} \leq \frac{3a+x}{4}$ is $x \leq 46$.

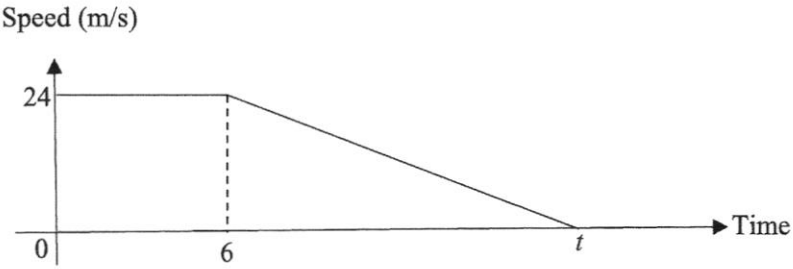
Show that $a = 2$.

[3]

(b) Hence, find a possible value of x if x is a perfect square and satisfies the simultaneous inequalities $\frac{ax-1}{7} \leq \frac{3a+x}{4} < \frac{x-5}{2}$.

Answer $x =$ ..... [2]

22



The diagram shows the speed-time graph of an object which travels at a constant speed of 24 m/s for 6 seconds before slowing down at a rate of 2 m/s^2 and coming to a rest after t seconds.

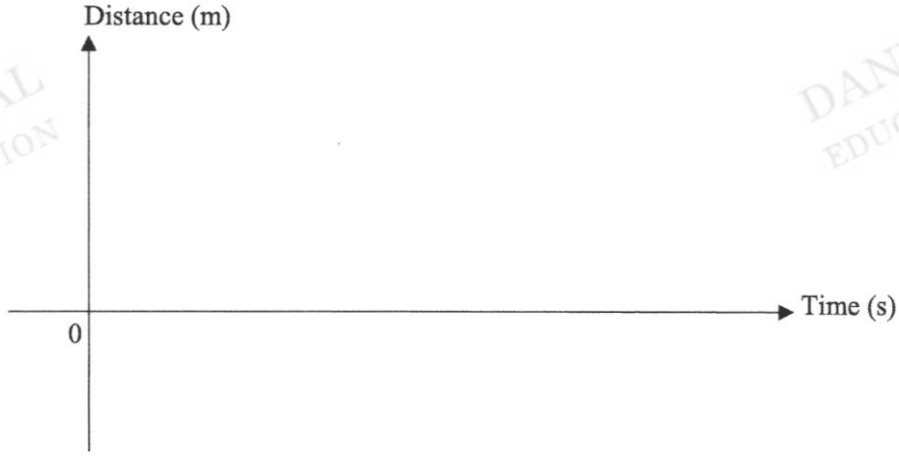
(a) Find the value of t.

Answer t =..... [2]

(b) Calculate the average speed for the whole journey.

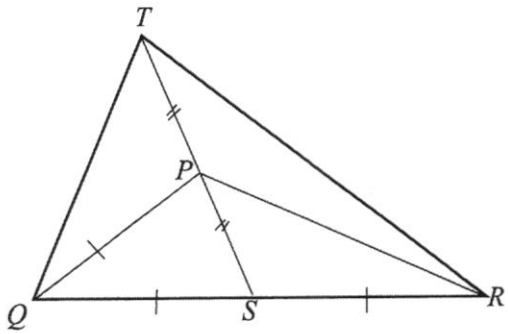
Answer .....m/s [2]

(c) Sketch the distance-time graph of the object for the whole journey on the axes below.



[2]

23



TQR is a triangle with $SP = PT$ and $QP = QS = SR$.

(a) Explain why angle $TPQ =$ angle PSR.

Answer

[2]

(b) Show that $TQ = PR$.
Give a reason for each statement you made.

Answer

[3]

(c) Show that triangle QPS and triangle PSR are equal in area.

Answer

[2]

24 Before the Chinese New Year (CNY) celebration, Mr Lee puts a combination of \$2 and \$10 notes into four types of red packets.
Friends and relatives who visited Mr Lee during the CNY period are then given the appropriate red packets.

Design A contains x \$2 notes and no \$10 notes.
Design B contains equal number of \$2 notes and \$10 notes. Its number of \$2 notes is fewer than that of Design A by 2.
Design C contains twice as many \$10 notes as Design B. There are no \$2 notes in Design C.
Design D contains three times as many \$2 notes as Design A. The number of \$10 notes in Design D is equal to the number of \$10 notes in Design B.

(a) (i) Complete the following table using the given information.

	Design			
	A	**B**	**C**	**D**
Number of \$2 notes				
Number of \$10 notes				

[1]

(ii) Represent the data in the above table by a 2×4 matrix **N**.

Answer **N** = [1]

(b) The number of designs A, B, C and D red packets that were given away during the CNY period can be represented by $\mathbf{M} = \begin{pmatrix} 20 \\ 10 \\ 6 \\ 5 \end{pmatrix}$.

(i) Find, in terms of x, the matrix **NM**.

Answer **NM** = [2]

(iii) State what each element in matrix **NM** represents.

Answer .....

.....

.....

.....[1]

(c) The matrix $\mathbf{D} = \begin{pmatrix} 2 & 10 \end{pmatrix}$.
Find, in terms of x, the matrix **DNM**.

Answer **DNM** = [1]

(d) Find the value of x if the total amount of red packet money given away was \$500.

Answer x = ... [1]

End of Paper

Setter: Mrs Foo SG

AHMAD IBRAHIM SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021

SECONDARY 4 EXPRESS / 5 Normal (Academic)

Name:	Class:	Register No.:

MATHEMATICS **4048/02**
Paper 2 **25 Aug 2021**
2 hours 30 minutes

Candidates answer on the Question Paper.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any questions 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.
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.

For Examiner's Use
/100

This document consists of **23** printed pages.

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 **(a)** Write as a single fraction in its simplest form $\frac{5}{5-2y}-\frac{2}{y+5}$.

Answer ..... [2]

(b) It is given that $\frac{a}{h}=b\left(1+\frac{k}{h}\right)$, express h in terms of a, b and k.

Answer $h =$ ..... [3]

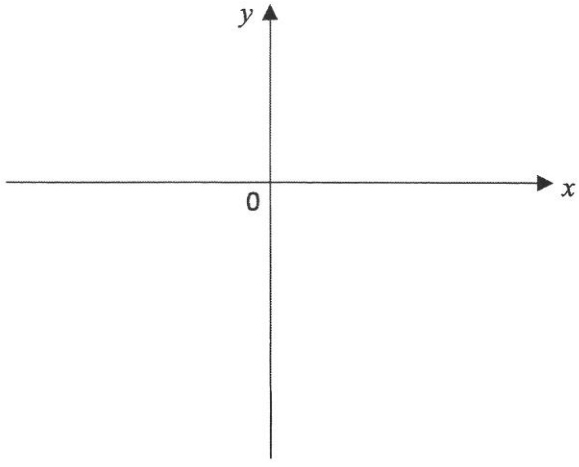
(c) Solve the equation $\frac{6}{x-6} = 2 - \frac{1}{x-8}$.

Answer $x =$ ..... or ..... [3]

(d) **(i)** Express $-25 + 3x + x^2$ in the form $p + (q + x)^2$.

Answer ..... [1]

(ii) Hence sketch the graph of $y = -25 + 3x + x^2$ on the axes below.
Indicate clearly the coordinates of the points where the graph crosses the axes and the turning point on the curve. [2]



2 **(a)** Mr Tan owns several cake shops in Singapore and Malaysia.
The price of a one-kilogram cake is \$35 in Singapore.
The price of the same cake in Malaysia is MYR 96.
The exchange rate between Singapore dollars (\$) and Malaysian Ringgit (MYR) is \$1 = MYR 3.06.

Calculate how much more expensive the cake is in Singapore than in Malaysia.

Answer \$ ..... [1]

(b) Mr Tan is planning to expand his cake shop business in Singapore.
His business manager has provided the visitor arrival data from the Singapore Tourism Board.
In 2019, the total visitor arrivals to Singapore was 185.3×10^5.

(i) Calculate the mean number of visitor arrivals to Singapore each day in 2019.
Give your answer in standard form, correct to 3 significant figures.

Answer ..... [1]

(ii) From 2018 to 2019, the number of visitor arrivals to Singapore decreased by 21.2%.
Calculate the number of visitor arrivals to Singapore in 2018.
Give your answer in millions, correct to 3 significant figures.

Answer ..... millions [2]

(c) In January 2020, Mr Tan invested as sum of money in a bank paying a compound interest at 2.8% per annum.
After one year, he received $95776.75 from his investment.

Calculate the total interest he received in January 2021, giving your answer to the nearest dollar.

Answer $ ..... [3]

(d) Mr Tan needs to pay his Malaysia supplier MYR 2000 for the cake ingredients.
The transportation fees for the ingredients were MYR 60.
A 7% Goods and Services Tax (GST) is payable on the cost of goods and transportation that exceeds $400.

Calculate the amount of money, in Singapore dollars, that Mr Tan must pay to import the ingredients.

Answer $ ..... [2]

3 **(a)** Complete the table of values for $y = 3x^2 + \frac{5}{x} - 4$.

Find the value of p correct to 2 decimal places.

x	0.4	0.6	0.8	1.0	1.2	1.4	1.6
y	8.98	5.41	4.17	4.00	4.49	p	6.81

Answer $p =$ ..... [1]

(b) On the grid opposite, draw the graph of $y = 3x^2 + \frac{5}{x} - 4$ for $0.4 \leq x \leq 1.6$. [3]

(c) Explain why the equation $3x^2 + \frac{5}{x} - 4 = k$ does not have solutions for some values of k. [2]

Answer

.....

.....

.....

.....

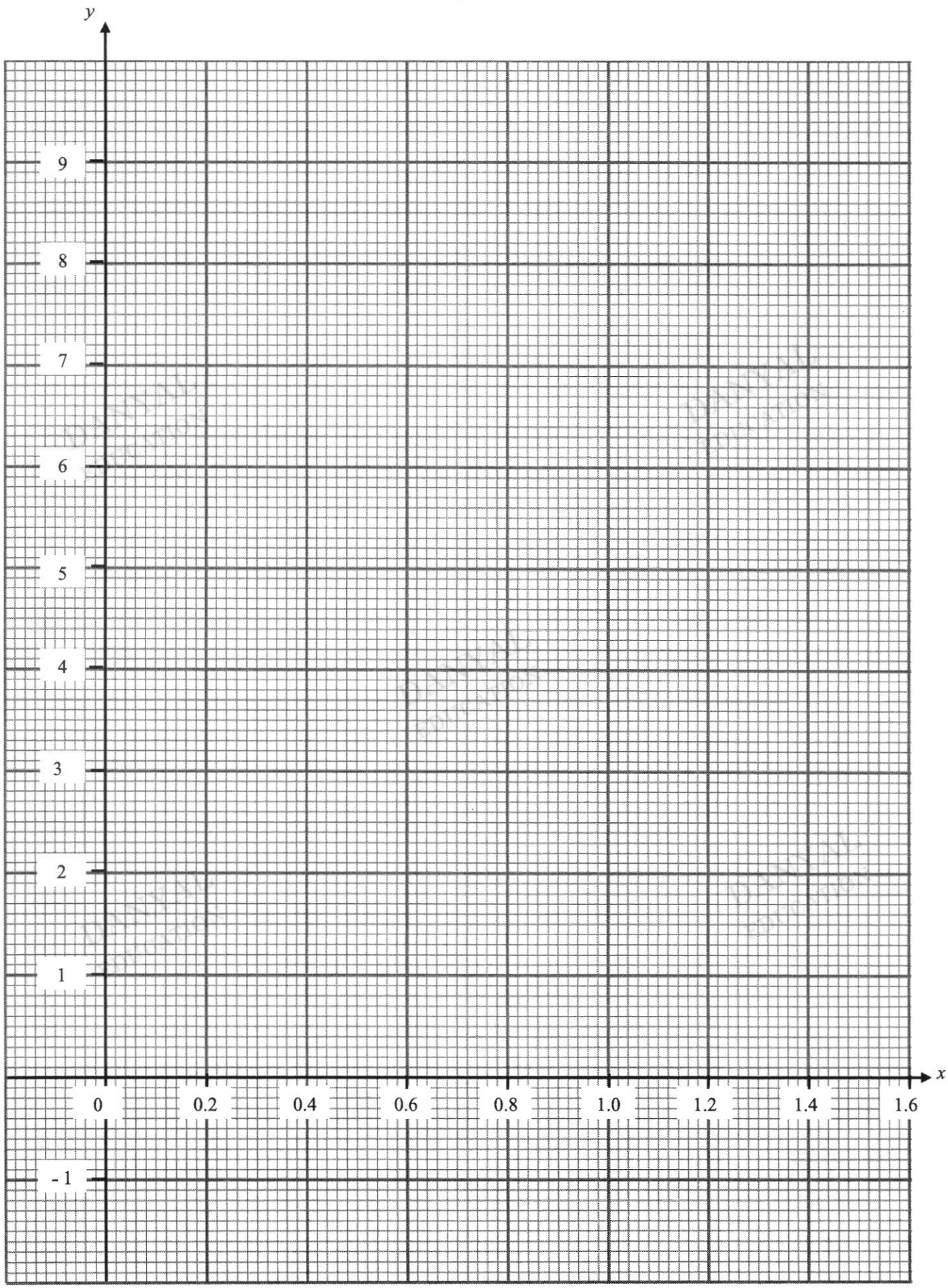
(d) The equation $3x^3 - 2x^2 - 9x + 5 = 0$ can be solved by drawing a suitable straight line on the grid.

(i) Find the equation of the straight line.

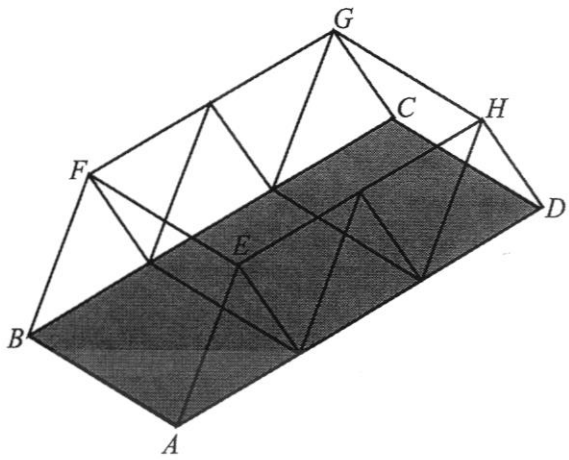
Answer ..... [1]

(ii) By drawing this straight line, solve the equation $3x^3 - 2x^2 - 9x + 5 = 0$ for $0.4 \leq x \leq 1.6$.

Answer $x =$ ..... [2]


y
9
8
7
6
5
4
3
2
1
- 1
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
x

4



The figure shows a drawing of a bridge.
Each side of the bridge is made up of 5 equilateral triangles.
The shaded rectangular area $ABCD$ is the base of the bridge.
$HD = 5.5$ m.

(a) Calculate DE.

Answer ..... m [3]

A point, X, lies on BC and is vertically below point G.

(b) **(i)** Angle $AXD = 79.5^\circ$ and angle $ADX = 65.0^\circ$.
Show that $AX = 15.2$ m, correct to 3 significant figures.

Answer

[2]

(ii) Calculate the angle of elevation of G from A.

Answer ..... [3]

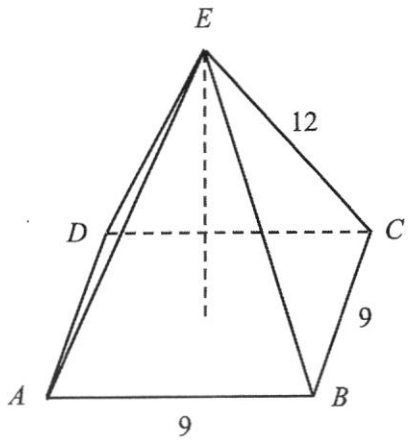
(c) The greatest angle of elevation of G from a point along AD occurs at Y.
Describe the relationship between XY and AD.

Answer

.....

..... [1]

5



The diagram shows a pyramid $ABCDE$.
The base of the pyramid is a square of side 9 cm.
E is vertically above the centre of the square base.
$AE = BE = CE = DE = 12$ cm.

(a) Find the total surface area of the pyramid $ABCDE$.

Answer ..... cm^2 [3]

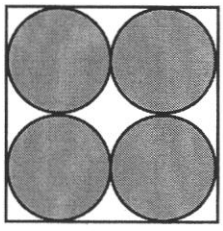
The volume of the pyramid is 275 cm^3.
This metal solid is melted and molded into two identical spherical metal balls.

(b) Find the radius of each metal ball.

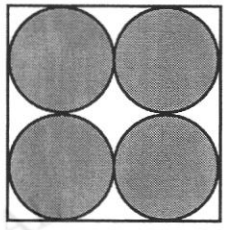
Answer ..... cm [2]

(c) Given that one bucket of paint is able to paint an area of 1200 cm^2, how many buckets of paint are needed to paint 1500 of such metal balls?

Answer ..... [3]



Top view



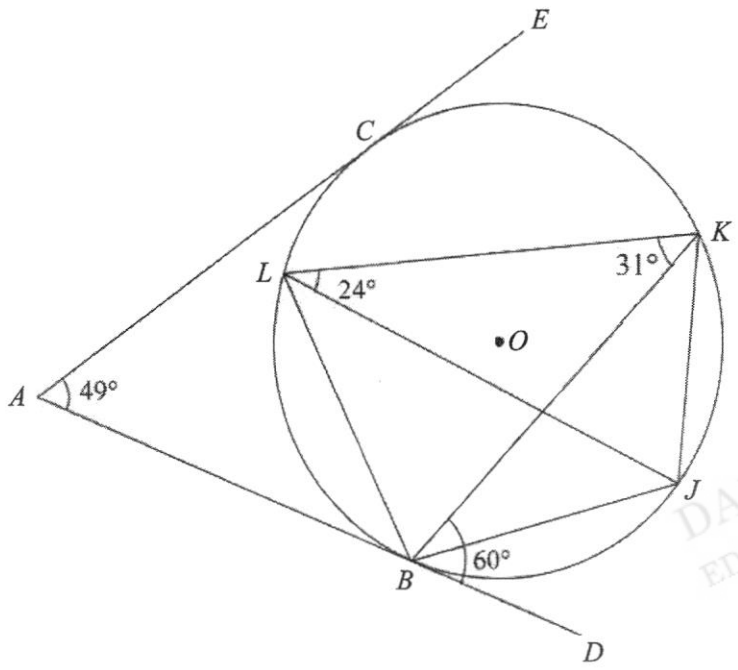
Side view

The diagram shows the top and side view of a box holding some spherical balls.
The box is in the shape of a cube and the spherical balls just fit into the box.

(d) Calculate the volume of empty space in the box.

Answer ..... cm^3 [3]

6 **(a)**



B, C, J, K and L are points on the circle, centre O.
AE and AD are tangents to the circle.
Angle JLB is equal to angle JBD.
Angle $BAC = 49°$, angle $JLK = 24°$, angle $KBD = 60°$ and angle $BKL = 31°$.

Find, giving reasons for each answer,

(i) angle JBK,

Answer ..... [1]

(ii) angle KBL,

Answer ..... [2]

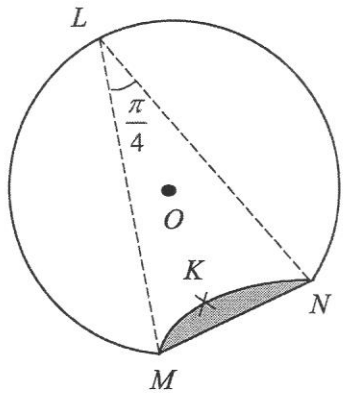
(iii) reflex angle KOL,

Answer ..... [2]

(iv) angle *COB*.

Answer ..... [2]

(b)



The diagram shows a circle made of paper with centre *O*.

A segment of the circle is folded inwards.

Angle $MLN = \frac{\pi}{4}$ radians and arc length $MKN = 6$ cm

Calculate the length of the major arc *MLN*.

Answer ..... cm [4]

7 Two groups of students were surveyed on their weekly screen time in hours.
The results are shown in the table.

14	32	55	24	56
23	48	17	36	59

Group 1

42	23	29	25	19
23	90	45	35	29

Group 2

(a) 20% of students in Group 2 recorded a screen time of at least x hours. Find x.

Answer ..... hours [1]

(b) Complete the table below. [2]

	Group 1	Group 2
Median	34	
Interquartile Range		19

(c) Make a comparison between the screen times of the students in these two groups.

Answer

.....

.....

..... [1]

(d) Explain why median is a better measure for average screen time for the two groups of students compared to the mean.

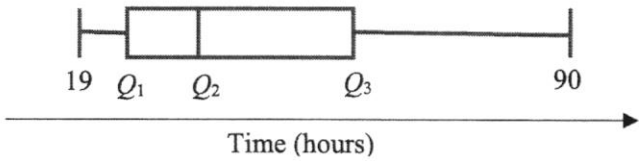
Answer

.....

.....

..... [1]

(e) **(i)** The box-and-whisker plot for the distribution of screen time for students in Group 2 is drawn in the grid below. Write down the value for Q_1, Q_2 and Q_3.



Answer Q_1 = ... hours

Q_2 = ... hours

Q_3 = ... hours [2]

(ii) Due to a recording error, the recorded amount of screen time for Group 1 is 1 hour more than the actual screen time.

State how the median and standard deviation of the screen times have been affected by this error.

Answer

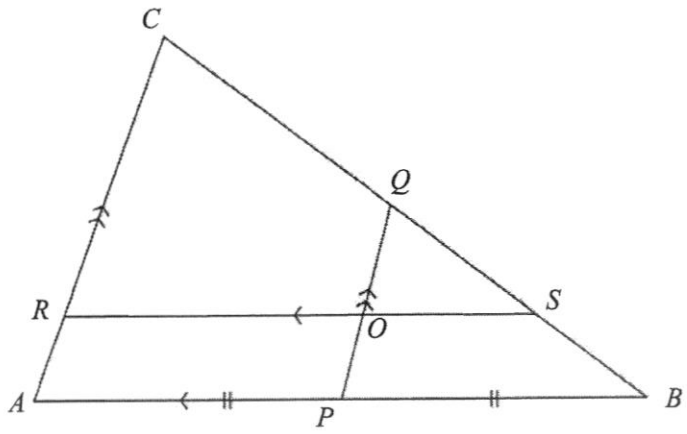
.....

.....

.....

..... [2]

8 **(a)**



In the diagram, SR is parallel to BA and PQ is parallel to AC.
P is the midpoint of AB and $BS : SC = 1 : 4$.

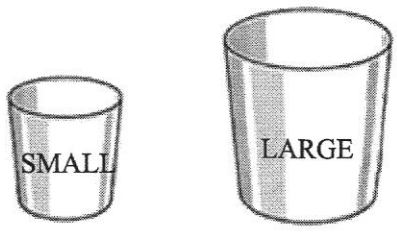
(i) Prove that triangles CRS and CAB are similar. [2]

Answer

(ii) If the area of triangle $ABC = 120$ cm^2, find the area of $RSBA$.

Answer ..... cm^2 [2]

(b)



The diagram shows two geometrically similar can.
A soup manufacturer wants to fill the cans with soup.
The ratio of the heights of two geometrically similar cans is 4 : 9.
The surface area of the small can is 240 cm^2.

By considering the materials and volume of the soup the cans can hold, determine which can is more cost effective for the soup manufacturer.
Use calculations to justify your answer. [4]

Answer

9 **(a)** The first three terms in a sequence of numbers are given below.

$$Q_1 = 2^3 + 3 = 11$$
$$Q_2 = 2^4 + 5 = 21$$
$$Q_3 = 2^5 + 7 = 39$$

(i) Find an expression, in terms of n, for Q_n.

Answer ..... [2]

(ii) Explain why the value of Q_n must be odd for all values of n.

Answer

.....

..... [1]

(iii) Show that $2^{n-2} - 2^{n-3} = 2^{n-3}$.

Answer ..... [2]

(b) In a sequence, the same number is subtracted each time to obtain the next term.
The first five terms of the sequence are

$$p, q, 2, r, -16$$

(i) Write down an expression for the nth term of this sequence.

Answer ..... [2]

(ii) The sum of the mth term and its previous term is -167.
Find the value of m.

Answer ..... [2]

(c) The table gives information about the ages of the members in the *Fitness First* club in Singapore.

	Members aged under 40	Members aged 40 or over
Male	40	24
Female	32	34

(i) One of these members is selected at random.
Find, as a fraction in its lowest terms, the probability that he or she is under 40.

Answer ..... [1]

(ii) Two of the members are selected at random.
Find the probability that

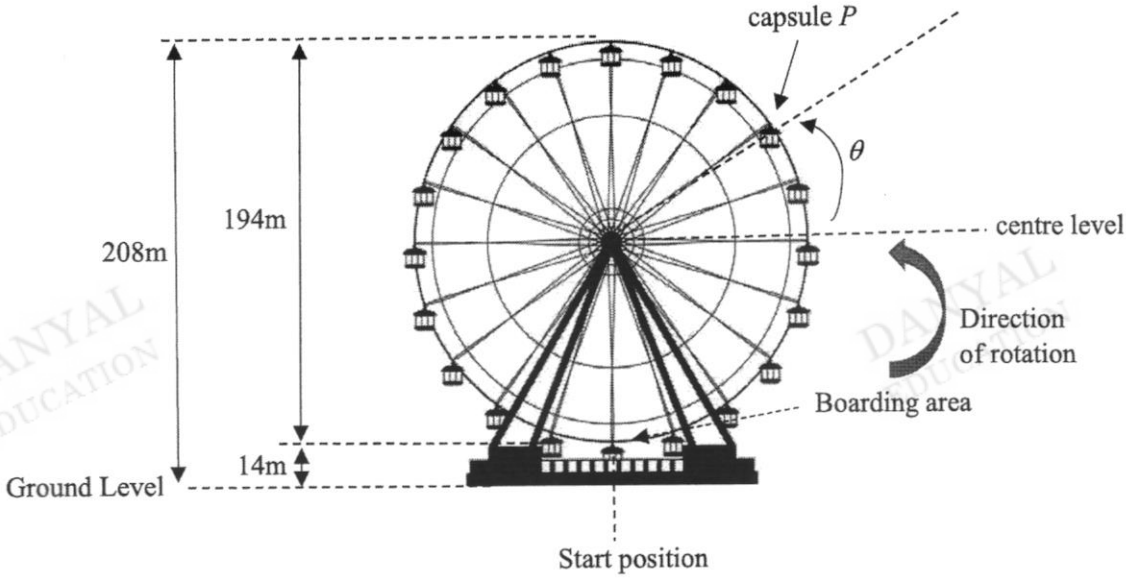
(a) both members are female,

Answer ..... [2]

(b) they are both aged 40 or over, but only one is a male member.

Answer ..... [2]

10 The Beijing Great Wheel is the world's largest Giant Observation Wheel and one of East Asia's biggest tourist attractions.
The Giant Observation Wheel has a height of 208 m and a diameter of 194 metres.
It rotates at the speed of 0.3 m/s.
Angle of rotation is measured from the start position in an anti-clockwise direction.



(a) Find the time taken by a capsule to complete 1 revolution.
Express your answer in minutes and seconds, correct to the nearest second.
Take π as 3.142.

Answer ..... minutes ..... seconds [2]

(b) The state square garden is 1km away from the Great Observation Wheel.
There are fireworks displays at the garden from 8.45 pm to 8.50 pm and the best view for the fireworks occurs when the capsule P is at least 170 metres above the ground.

(i) Find angle θ when capsule P is exactly 170 meters above the ground level.

Answer $\theta =$ ..... [2]

(ii) Find the angle from the start position to the best viewing point where capsule P is.

Answer ..... [1]

(c) A tourist family wants to get the best view of the **FULL** length of the fireworks display. They board the capsule at 8.32 pm and claims that they can enjoy the full length of fireworks display.

Do you agree with the claim?
Show working to support your answer and state one assumption that you made. [4]

End of Paper

Setter: Mr Tee Hong Heng

AHMAD IBRAHIM SECONDARY SCHOOL
GCE O-LEVEL PRELIMINARY EXAMINATION 2021

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC

Name: MARKING SCHEME	Class:	Register No.:

MATHEMATICS **4048/01**
Paper 1 **23 August 2021**
2 hours

Candidates answer on the Question Paper.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any questions 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.
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
/80

This document consists of **21** printed pages.

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

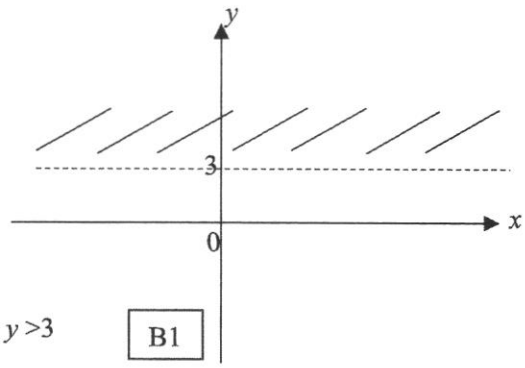
1 Insert one pair of brackets to make the statement correct.

$5-(2+3)\times 2=-5$ B1

[1]

---

2 Write down an inequality that defines the points in the shaded region.



$y>3$ B1

Answer ..... [1]

3

For the diagram above, write down

(a) the number of lines of symmetry 4 B1

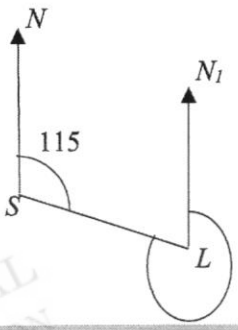
Answer ..... [1]

(a) the order of rotational symmetry. 4 B1

Answer ..... [1]

---

4 The bearing of a lighthouse from a coastguard station is 115 °.
What is the bearing of the coastguard station from the lighthouse?



$\angle SLN_1 = 180° - 115°$(int angles, $SN // N_1L$) M1

$= 65°$

Required bearing = 360°-65° (angles at a point)

$=295^{\circ}$ A1

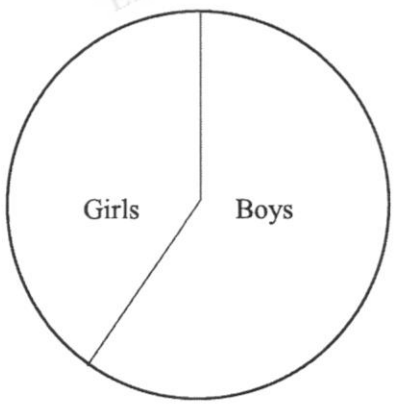
NOTE: no reasons or not stating what they are finding – minus 1 mark

Answer ..... [2]

---

5 The pie chart shows the number of girls and boys who scored full marks in a Mathematics test.
Based on the chart, June concluded that on average, boys did better than girls in Mathematics.
Explain why June made that conclusion and why she may be wrong.

Students who scored full marks in Mathematics



Reason: From the pie – chart, angle/ area of the sector/ portion of circle representing boys who scored full marks is bigger than the angle of the sector representing girls who scored full marks.

B1

Why wrong: It only shows that there are more boys than girls who scored full marks but we cannot infer the performance of the boys as compared to the girls with just this information. B1

---

6 A is the point (3, 6) and B is the point (m, n) where m and n are both positive integers less than 10.

The length of the line segment is $\sqrt{34}$ units.

Find the coordinates of one of the possible positions for B.

$\sqrt{(m-3)^2+(n-6)^2}=\sqrt{34}$

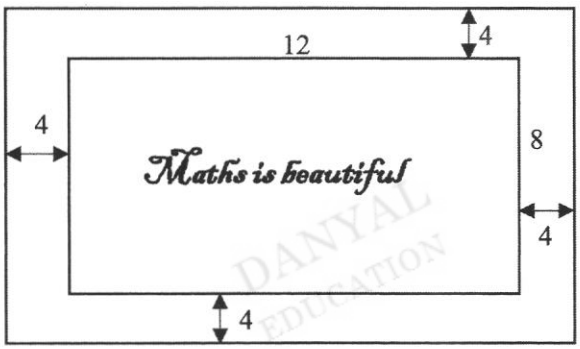
$(m-3)^2+(n-6)^2=34$ M1

$(8-3)^2+(9-6)^2=34$

B (8, 9) or (8, 3) or (6,1) A1

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

7



A rectangular poster with the words "Maths is beautiful", 12 cm long and 8 cm wide, fits into a rectangular frame so that there is a border of 4 cm wide all the way round it.

Use calculations to determine whether the two rectangles are similar.

Answer

$\frac{20}{16}\neq\frac{12}{8}$ or $\frac{20}{12}\neq\frac{16}{8}$ M1

The two rectangles are not similar because the ratio of their corresponding sides are not equal. (need to state the highlighted very clearly)

A1

8 A boy who was asked to find $3\frac{1}{2}\%$ of a sum of money misread the question and found $5\frac{1}{2}\%$ of it.
His answer was \$247.10.
Calculate what the answer should be.

Let sum of money = x

$\frac{5.5}{100}x = 247.10$ M1

$x = 4492.727273$

Answer $= \frac{3.5}{100} \times \$4492.727273$ A1

$= \$157.25$ (2 d.p)

NOTE: if leave answer to 3 s.f, minus 1 mark from whole paper

Answer \$..... [2]

9 Mr Heng goes on a holiday for x days and takes \$$f$ with him to spend.
He spends \$$g$ each day for the first y days.
Write down expressions for

(a) the number of dollars he has left after y days,

Spent = \$$gy$

Left = $\$(f - gy)$ B1

Answer \$..... [1]

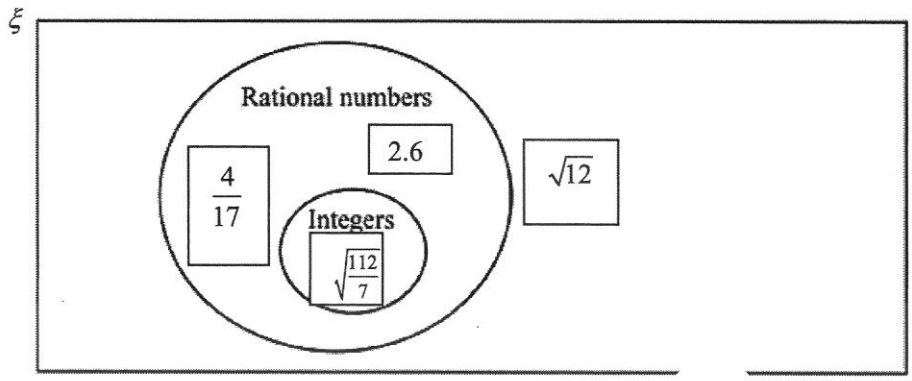
(b) the number of dollars he may spend each day for the rest of his holiday, without running out of money.

Number of days left = $x - y$

Amount he can spend each day = $\$\left(\frac{f - gy}{x - y}\right)$ B1

Answer \$..... [1]

10 (a)



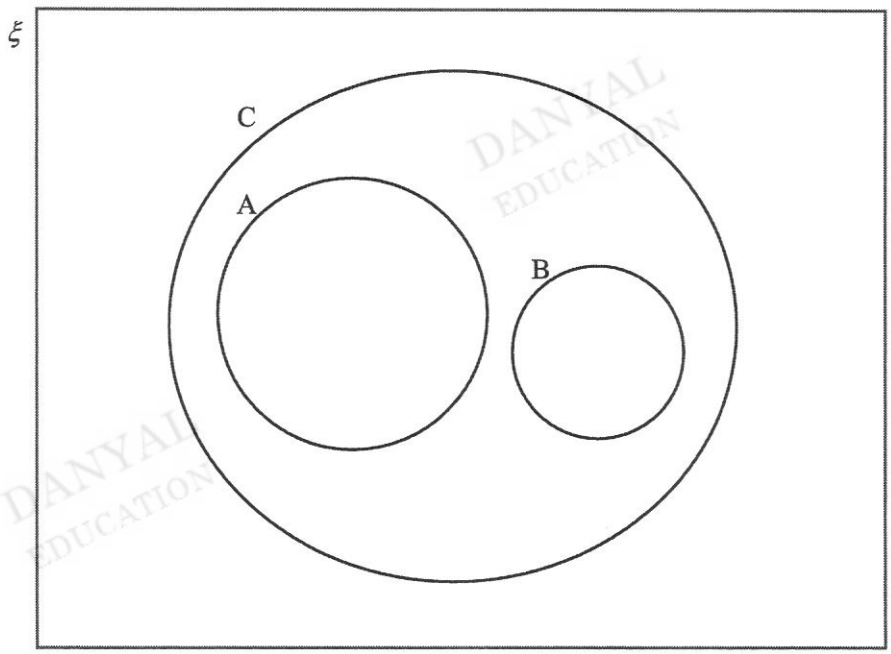
On the Venn Diagram above, write each of these numbers in the appropriate subsets.

$2.6,\ \frac{4}{17},\ \sqrt{12},\ \sqrt{\frac{112}{7}}$

B2, all correct
B1, 2 correct

[2]

(b) Three sets A, B and C are such that $A \subset C$, $B \subset C$ and $A \cap B = \varnothing$
Draw a Venn diagram to show this information.



B1

[1]

11 **(a)** $2^8 = 4^x + 4^x + 4^x + 4^x$.
Find the value of x.

$2^8 = 4(4^x)$
$2^8 = 2^2(2^{2x})$
$2^8 = 2^{2+2x}$
$8 = 2 + 2x$
$2x = 6$
$x = 3$ A1

Answer x=..... [2]

(b) Write down the positive square root of $\frac{4x^2 - 12x + 9}{25x^{16}}$.

$\frac{2x-3}{5x^8}$ B1,B1

Answer ..... [1]

---

12 **(a)** Find the prime factors of 4410, giving your answer in index form.

$4410 = 2 \times 3^2 \times 5 \times 7^2$ A1

M1 (ladder method or other method

Answer ..... [2]

(b) The highest common factor of two numbers is 245.
The lowest common multiple of these two numbers is 4410.
Both numbers are greater than their highest common factor.
Find the two numbers.

$4410 = 2 \times 3^2 \times 5 \times 7^2$
$245 = 5 \times 7^2$
$x = 5 \times 7^2 \times 2 = 490$ B1
$y = 5 \times 7^2 \times 3^2 2205$ B1

Answer ..... and ..... [2]

---

13 The mean and median of four numbers are 54 and 56 respectively.
Find the mean of the largest and the smallest numbers.

$a \quad b \quad c \quad d$

mean = 54

total = 216 M1

median = 56

$\frac{b+c}{2} = 56$

$b+c = 112$ M1

$a+d = 216-112$

$= 104$

Mean of $a+d = \frac{104}{2}$

$= 52$ A1

Answer .....[3]

14 Consider the number pattern below.

$$\frac{1}{11} = 0.090909..... = 0.\dot{0}\dot{9}$$

$$\frac{2}{11} = 0.181818..... = 0.\dot{1}\dot{8}$$

$$\frac{3}{11} = 0.272727..... = 0.\dot{2}\dot{7}$$

$$\frac{4}{11} = 0.363636..... = 0.\dot{3}\dot{6}$$

$$\vdots$$

$$\frac{x}{11} = 636.3636..... = 636.\dot{3}\dot{6}$$

(i) Write down the 5th line of the pattern.

$$\frac{5}{11} = 0.454545..... = 0.\dot{4}\dot{5}$$ B1

Answer ..... [1]

(ii) Find the value of x.

$$\frac{x}{11} = 636.3636 = 636 + 0.3636$$

$$\frac{x}{11} = 636 + \frac{4}{11}$$ M1

$$x = 11(636) + 4$$

$$x = 7000$$ A1

Answer $x =$ ..... [2]

15 **(a)** Factorise fully $(a-b+c)^2-(b-c+a)^2$.

$(a-b+c)^2-(b-c+a)^2$

$=(a-b+c+b-c+a)(a-b+c-b+c-a)$ M1

$=(2a)[(2)(c-b)]$

$=4a(c-b)$ A1

Answer ..... [2]

(b) Calculate the value of k if x^2-6x+k is a perfect square.

x^2-6x+k

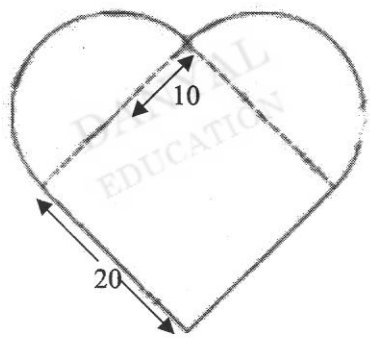
$=(x-3)^2$ M1

$=x^2-6x+9$

$k=9$ A1

Answer $k=$ ..... [2]

16



Instructions for baking a heart-shaped cake.

- Bake a square cake of side 20 cm.
- Bake two semicircle cakes of radius 10 cm.
- Join the two halves to the square cake, as shown in the diagram.

(a) Find the area of the top view of the cake.

Area $=20^2+\pi(10)^2$

$=400+100\pi$ B1

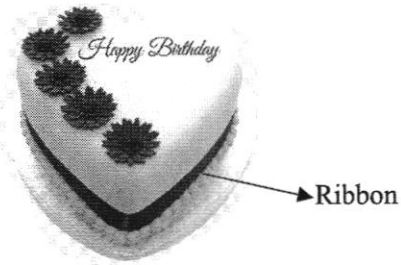
$=714.16$

$=714$ cm^2

NOTE: If answer not rounded off to 3 s.f.- minus 1 from overall marks

Answer ..... cm^2 [1]

(b)



A red ribbon is fixed around the sides for the heart-shaped cake with the sides overlapping by 3 cm.
Find the length of ribbon required.

Perimeter of cake $= 2(20)+2\pi(10)$

$= (40+20\pi)$cm M1

Length of ribbon required $= 40+20\pi+3$

$=106$ cm A1

NOTE: If answer not rounded off to 3 s.f.- minus 1 from overall marks

Answer ..... cm [2]

---

17 The safe speed, v m/s, at which a train can go round a curve of radius r m is directly proportional to the square root of r.
It is given that the safe speed at which a train can go round a curve of radius 121m is 22 m/s.

(i) Find the safe speed if the curve has a radius of 81m,

$$v = k\sqrt{r}$$
$$22 = k\sqrt{121}$$
$$k = \frac{22}{\sqrt{121}}$$
$$k = \frac{22}{11}$$
$$k = 2$$
$$v = 2\sqrt{r}$$
$$v = 2\sqrt{81}$$
$$=18 \text{ m/s}$$

Answer ..... m/s [2]

(i) A change in the safe speed produces a change in the radius.
When the safe speed is halved, the value of radius changes by factor m.
Find m.

$$v = 2\sqrt{r}$$

$$\sqrt{r} = \frac{v}{2}$$

$$r = \frac{v^2}{4}$$

when speed is halved,

$$\text{New radius} = \frac{\left(\frac{1}{2}v\right)^2}{4}$$

$$= \frac{1}{4}\left(\frac{v^2}{4}\right)$$

$$m = \frac{1}{4}$$

Answer $m =$..... [2]

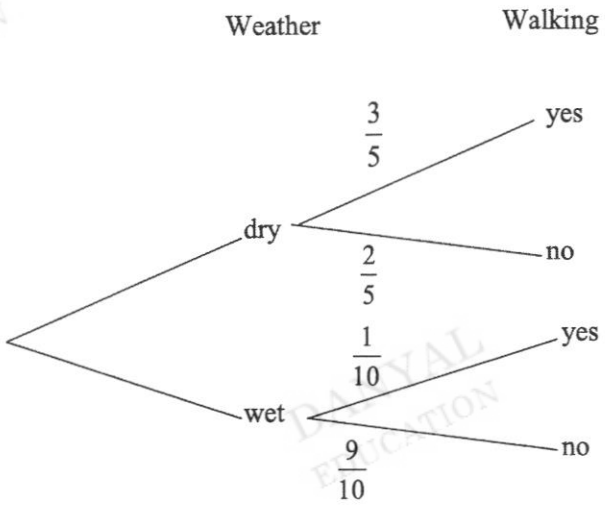
8 **In this question, the weather is either wet or dry.**

When the weather is dry, the probability that Sarah will go walking is $\frac{3}{5}$.

When the weather is wet, the probability that Sarah will go walking is $\frac{1}{10}$.

The probability of a dry day is $\frac{2}{3}$.

(a) Show that the probability that Sarah goes walking is $\frac{13}{30}$.



$$P(\text{walking}) = \left(\frac{2}{3}\times\frac{3}{5}\right)+\left(\frac{1}{3}\times\frac{1}{10}\right) \qquad \boxed{\text{M1}}$$

$$= \frac{2}{5}+\frac{1}{30}$$

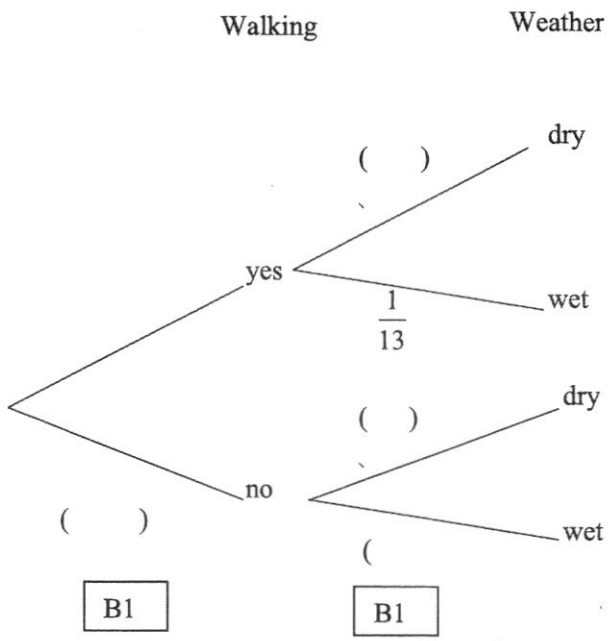
$$= \frac{12}{30}+\frac{1}{30}$$

$$= \frac{13}{30} \text{ (shown)} \qquad \boxed{\text{A1}}$$

The probability that Sarah does not go walking when the weather is wet is $\frac{9}{30}$.

Complete the tree diagram to show this information.

(b)



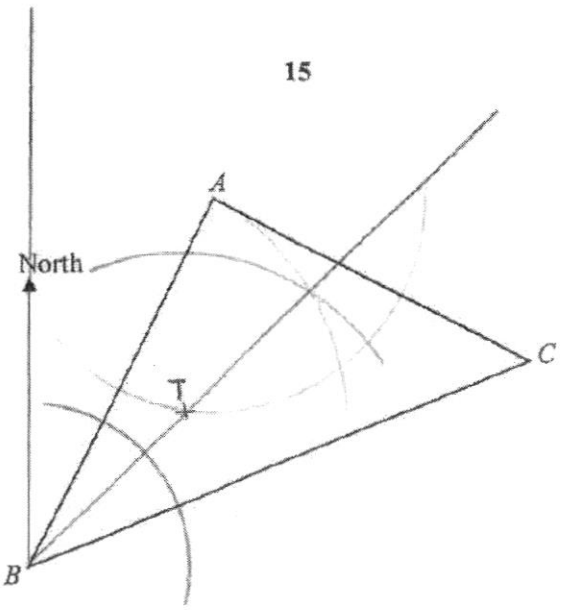
B1 B1 [2]

P(does not go walking)$=\frac{17x}{30}=\frac{9}{30}$

$x=\frac{9}{30}\times\frac{30}{17}$

$=\frac{9}{17}$

19



The diagram is a plan of a triangular field ABC, drawn to a scale of 1cm to 50 m.
A tree, T, in the field is 150 m from A and is equidistant from BA and BC.

(a) By making appropriate constructions on the diagram, indicate clearly the position of T.

B1 correct angle bisector of angle B	B1 correct position T	[2]

(b) Use the diagram to find

(i) the distance, in metres, from T to B,

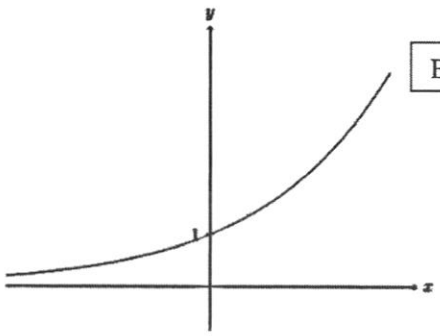
$155\text{m} \leq TB \leq 160\text{m}$ [1]

(ii) the bearing of T from B. [1]

$46° \pm 2$

20 (a) On the axes below, sketch the graphs, indicating clearly the x and y intercepts if any.

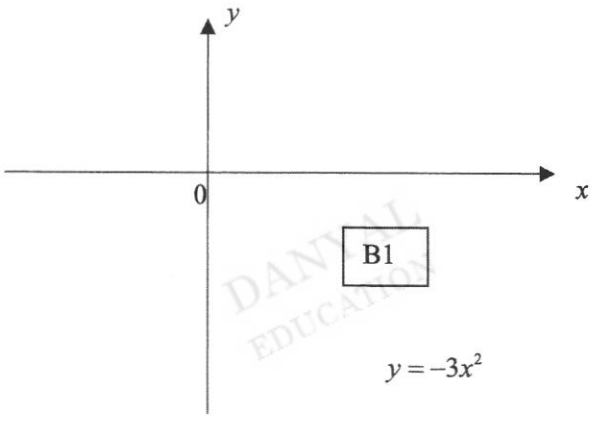
(i) $y = 3^x$



B1

[1]

(ii) $y = -3x^2$



B1

[1]

(b) Hence, state the number of solution(s) to the equation $3^x + 3x^2 = 0$.
Explain your answer.

Answer $3^x = -3x^2$

B1

Since the graph of $y = 3^x$ is always positive and the graph of $y = -3x^2$ lies below the x-axis, the two graphs will not intersect and hence there will be no solutions to the given equation.

B1

[2]

21 **(a)** The solution of the inequality $\frac{ax-1}{7} \leq \frac{3a+x}{4}$ is $x \leq 46$.

Show that $a = 2$.

$\frac{ax-1}{7} \leq \frac{3a+x}{4}$

$4ax - 4 \leq 21a + 7x$

$4ax - 7x \leq 21a + 4$

$x(4a-7) \leq 21a + 4$

$x \leq \frac{21a+4}{4a-7}$ M1

$\frac{21a+4}{4a-7} = 46$ M1

$21a + 4 = 184a - 322$

$326 = 163a$

$a = 2$ (shown) A1

[3]

(b) Hence, find a possible value of x if x is a perfect square and satisfies the simultaneous inequalities $\frac{ax-1}{7} \leq \frac{3a+x}{4} < \frac{x-5}{2}$.

$\frac{6+x}{4} < \frac{x-5}{2}$

$12 + 2x < 4x - 20$

$32 < 2x$

$2x > 32$

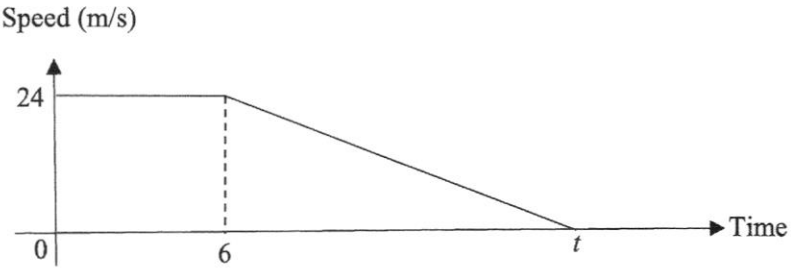
$x > 16$ M1

$16 < x \leq 46$

$x = 25$ or 36 A1

Answer $x =$ ..... [2]

22



The diagram shows the speed-time graph of an object which travels at a constant speed of 24 m/s for 6 seconds before slowing down at a rate of 2 m/s^2 and coming to a rest after t seconds.

(a) Find the value of t.

$$\frac{24-0}{6-t} = -2$$ M1

$$24 = -12 + 2t$$

$$2t = 36$$

$$t = 18$$ A1

Answer $t =$ ..... [2]

(b) Calculate the average speed for the whole journey.

$$\text{Total distance} = (6 \times 24) + \left(\frac{1}{2} \times 12 \times 24\right)$$

$$= 144 + 144$$

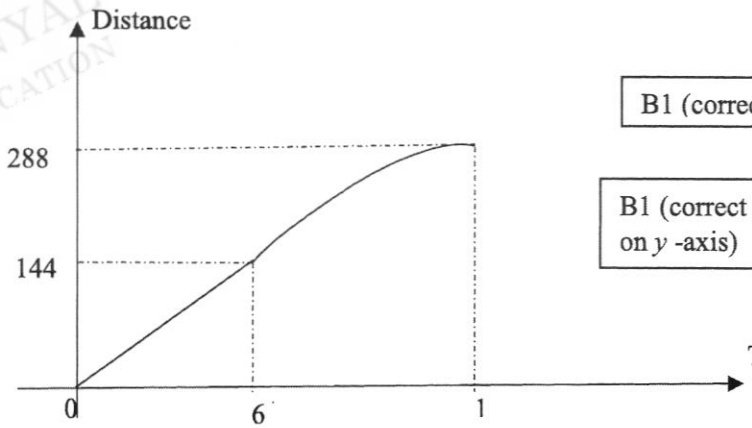
$$= 288 \text{ m}$$ M1

$$\text{Average speed} = \frac{288}{18}$$

$$= 16 \text{ m/s}$$ A1

Answer .....m/s [2]

(c) Sketch the distance-time graph of the object for the whole journey on the axes below.

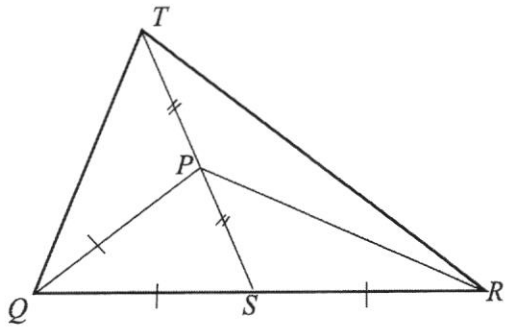


B1 (correct line and curve)

B1 (correct distances indicated on y -axis)

[2]

23



TQR is a triangle with $SP = PT$ and $QP = QS = SR$.

(a) Explain why angle $TPQ =$ angle PSR.

Answer

$\angle QPS = \angle QSP$ (base angle of isos triangle) M1

$\angle TPQ = 180° - \angle QPS$ (adjacent angles on a straight line)

$= 180° - \angle QSP$

$= \angle PSR$ A1

(b) Show that $TQ = PR$.
Give a reason for each statement you made.

Answer

$\angle TPQ = \angle PSR$ (from (a))

$ST = PT$ $(given)$ M1

$QP = RS$ $(given)$

Hence, $\Delta TPQ \equiv \Delta PSR$ (SAS) M1

$TQ = PR$ (corresponding side of congruent triangles) A1

[3]

(c) Show that triangles QPS and triangle PSR are equal in area.
Give a reason for each statement you made.

$$\frac{\text{area of } \Delta QPS}{\text{area of } \Delta PSR} = \frac{\frac{1}{2} \times QS \times h}{\frac{1}{2} \times SR \times h} \quad \text{M1}$$

$$= \frac{QS}{SR}$$

$$= \frac{1}{1}$$

Since the ratio of the area of ΔQPS to area of ΔPSR is 1:1, the two triangles are equal in area.

A1

[2]

24 Before the Chinese New Year (CNY) celebration Mr Lee put a combination of \$2 and \$10 notes into four types of red packets.
Friends and relatives who visited Mr Lee during the CNY period are then given the appropriate red packets.

Design A contains x \$2 notes and no \$10 notes.
Design B contains equal number of \$2 notes and \$10 notes. Its number of \$2 notes is fewer than that of Design A by 2.
Design C contains twice as many \$10 notes as Design B. There are no \$2 notes in Design C.
Design D contains three times as many \$2 notes as Design A. The number of \$10 notes in Design D is equal to the number of \$10 notes in Design B.

(a) (i) Complete the following table using the given information.

	Design			
	A	**B**	**C**	**D**
Number of \$2 notes	x	$x-2$	0	$3x$
Number of \$10 notes	0	$x-2$	$2x-4$	$x-2$

[1]

B1

(ii) Represent the data in the above table by a 2×4 matrix **N**.

$$\mathbf{N} = \begin{pmatrix} x & x-2 & 0 & 3x \\ 0 & x-2 & 2x-4 & x-2 \end{pmatrix}$$

B1

Answer **N** = [1]

(b) The number of designs A, B, C and D red packets that were given away during the CNY period can be represented by $\mathbf{M} = \begin{pmatrix} 20 \\ 10 \\ 6 \\ 5 \end{pmatrix}$.

(i) Find, in terms of x, the matrix **NM**.

$$\mathbf{NM} = \begin{pmatrix} x & x-2 & 0 & 3x \\ 0 & x-2 & 2x-4 & x-2 \end{pmatrix} \begin{pmatrix} 20 \\ 10 \\ 6 \\ 5 \end{pmatrix}$$

$$= \begin{pmatrix} 20x+10x-20+15x \\ 10x-20+12x-24+5x-10 \end{pmatrix}$$

M1

$$= \begin{pmatrix} 45x-20 \\ 27x-54 \end{pmatrix}$$

A1

Answer **NM** = [2]

(iii) State what each element in matrix **NM** represents.

$45x-20$ represents the total number of \$2 notes that Mr Lee gave away. [1]
$27x-45$ represents the total number of \$10 notes that Mr Lee gave away.

B1

(c) The matrix $\mathbf{D} = \begin{pmatrix} 2 & 10 \end{pmatrix}$.
Find, in terms of x, the matrix **DNM**.

$$\mathbf{DNM} = \begin{pmatrix} 2 & 10 \end{pmatrix} \begin{pmatrix} 45x-20 \\ 27x-54 \end{pmatrix}$$

$$= \begin{pmatrix} 360x-580 \end{pmatrix}$$ B1

Answer **DNM** = [1]

(d) The total amount of red packet money given away was \$500.
Find the value of x.

$360x-580=500$
$360x=1080$
$x=3$ A1

Answer $x=$ ..... [1]

End of Paper

Mrs Foo SG

MARKING SCHEME

AHMAD IBRAHIM SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2021

SECONDARY 4 EXPRESS / 5 Normal (Academic)

Name:	Class:	Register No.:

MATHEMATICS **4048/02**
Paper 2 **25 Aug 2021**
2 hours 30 minutes

Candidates answer on the Question Paper.

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 an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.
If working is needed for any questions 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.
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.

For Examiner's Use
/100

This document consists of **23** printed pages.

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

1 **(a)** Write as a single fraction in its simplest form $\frac{5}{5-2y}-\frac{2}{y+5}$.

$$\frac{5}{5-2y}-\frac{2}{y+5}$$

$$=\frac{5(y+5)-2(5-2y)}{(5-2y)(y+5)}$$

$$=\frac{5y+25-10+4y}{(5-2y)(y+5)} \quad \text{M1}$$

$$=\frac{9y+15}{(5-2y)(y+5)}=\frac{3(3y+5)}{(5-2y)(y+5)} \quad \text{A1}$$

Answer ..... [2]

(b) It is given that $\frac{a}{h}=b\left(1+\frac{k}{h}\right)$, express h in terms of a, b and k.

$$\frac{a}{h}=b\left(1+\frac{k}{h}\right)$$

Expand M1

$$\frac{a}{h}=b+\frac{bk}{h}$$

$$\frac{a}{h}-\frac{bk}{h}=b$$

$$\frac{a-bk}{h}=b$$

Isolate h M1

$$h=\frac{a-bk}{b} \text{ or } \frac{a}{b}-k$$

A1

$$\frac{a}{h}=b\left(1+\frac{k}{h}\right)$$

$$\frac{a}{b}=h\left(1+\frac{k}{h}\right)$$

swop b and h M1

$$\frac{a}{b}=h+k$$

expand M1

$$h=\frac{a-bk}{b} \text{ or } \frac{a}{b}-k$$

Answer $h=$ ..... [3]

(c) Solve the equation $\frac{6}{x-6}=2-\frac{1}{x-8}$.

$6(x-8)=2(x-6)(x-8)-(x-6)$

$6x-48=2\left(x^2-14x+48\right)-x+6$

$6x-48=2x^2-29x+102$

$2x^2-35x+150=0$ M1

$(2x-15)(x-10)=0$

$x=7.5$ or 10 A2

Answer $x=$ ..... or ..... [3]

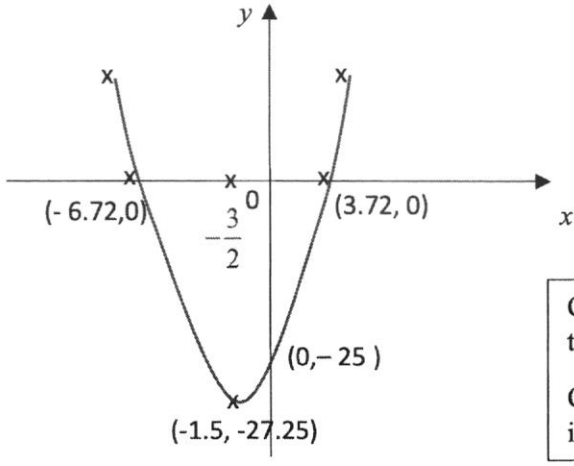
(d) **(i)** Express $-25+3x+x^2$ in the form $p+(q+x)^2$.

$=x^2+3x+\left(\frac{+3}{2}\right)^2-\left(\frac{+3}{2}\right)^2-25=\left(x+\frac{3}{2}\right)^2-\frac{109}{4}$

$=-\frac{109}{4}+\left(\frac{3}{2}+x\right)^2$ A1 OR $-27.25+(1.5+x)^2$

Answer ..... [1]

(ii) Hence sketch the graph of $y=-25+3x+x^2$ on the axes below.
Indicate **clearly the coordinates** of the points where the graph crosses the axes and the turning point on the curve. [2]



Correct Shape thru turning point – B1

Correct x and y-intercept – B1

2 (a) Mr Tan owns several cake shops in Singapore and Malaysia.
The price of a one-kilogram cake is $35 in Singapore.
The price of the same cake in Malaysia is MYR 96.
The exchange rate between Singapore dollars ($) and Malaysian Ringgit (MYR) is $1 = MYR 3.06.

Calculate how much more expensive the cake is in Singapore than in Malaysia.

Price of cake in Malaysia in S$ = $\frac{96}{3.06}$ = $31.37 (2 d.p.)

Price difference = $35 - $31.37 = $3.63 (nearest cent) B1

Answer $ ..... [1]

(b) Mr Tan is planning to expand his cake shop business in Singapore.
His business manager has provided the visitor arrival data from the Singapore Tourism Board.
In 2019, the total visitor arrivals to Singapore was 185.3×10^5.

(i) Calculate the mean number of visitor arrivals to Singapore each day in 2019.
Give your answer in standard form, correct to 3 significant figures.

Number of visitors

$= \frac{185.3\times10^5}{365} = 5.08\times10^4$ B1

Answer ..... [1]

(ii) From 2018 to 2019, the number of visitor arrivals to Singapore decreased by 21.2%.
Calculate the number of visitor arrivals to Singapore in 2018.
Give your answer in millions, correct to 3 significant figures.

78.8% - 185.3×10^5

100 % - 23515228 = $185.3 \times 10^5 \times (100/78.8)$ M1

= 23.5 millions (3 s.f.) A1

Answer ..... millions [2]

(c) In January 2020, Mr Tan invested a sum of money in a bank paying a compound interest at 2.8% per annum.
After one year, he received \$95776.75 from his investment.

Calculate the total interest he received in January 2021, giving your answer to the nearest dollar.

$95\,776.75 = P\left(1+\frac{2.8}{100}\right)^1$ M1

$P = \frac{95776.75}{\left(1+\frac{2.8}{100}\right)}$ M1

$P = \$\,93168.00475$

Interest = 95 776.75 – 93 168.00475

$= \$\,2\,608.705253 = \$\,2\,609$ (nearest dollar) A1

Answer \$ ..... [3]

(d) Mr Tan needs to pay his Malaysia supplier MYR 2000 for the cake ingredients.
The transportation fees for the ingredients were MYR 60.
A 7% Goods and Services Tax (GST) is payable on the cost of goods and transportation that exceeds \$400.

Calculate the amount of money, in Singapore dollars, that Mr Tan must pay to import the ingredients.

Amount of money

$= \left(\frac{2000+60}{3.06}\right)\times 1.07$ M1

$= 673\frac{31}{153}\times 1.07$

$= 720.3267974 = \$\,720.33$ (2 d.p.) A1

Answer \$ ..... [2]

3 **(a)** Complete the table of values for $y = 3x^2 + \frac{5}{x} - 4$.

Find the value of p correct to 2 decimal places.

x	0.4	0.6	0.8	1.0	1.2	1.4	1.6
y	8.98	5.41	4.17	4.00	4.49	p	6.81

$p = 5.45$	B1

Answer $p =$ ..... [1]

(b) On the grid opposite, draw the graph of $y = 3x^2 + \frac{5}{x} - 4$ for $0.4 \le x \le 1.6$. [3]

(c) Explain why the equation $3x^2 + \frac{5}{x} - 4 = k$ does not have solutions for some values of k. [2]

Answer

The minimum value of y is 4.	B1	
For $k < 4$, the horizontal line $y = k$ does not intersect with the curve.	B1	

(d) The equation $3x^3 - 2x^2 - 9x + 5 = 0$ can be solved by drawing a suitable straight line on the grid.

(i) Find the equation of the straight line.

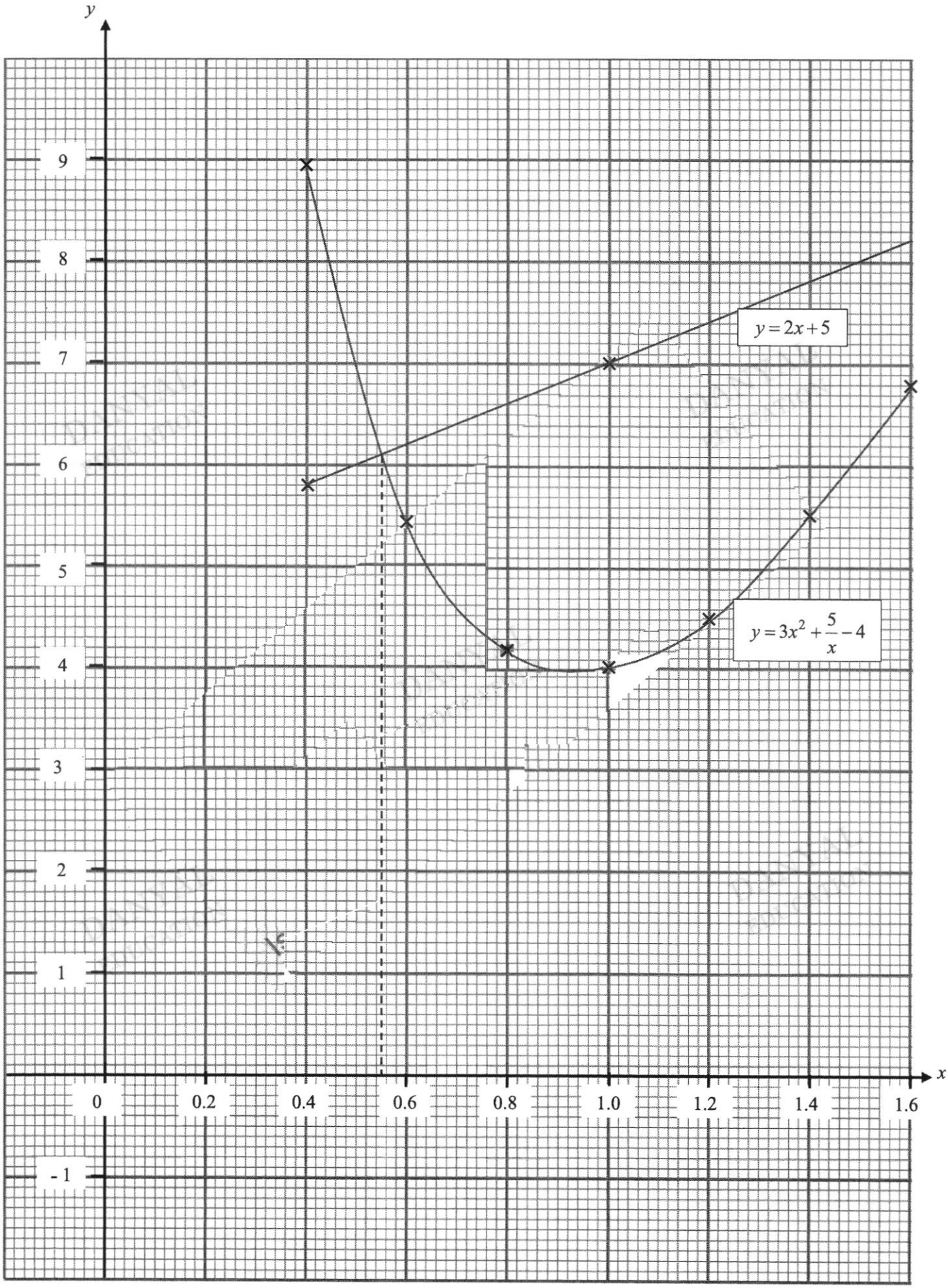
$3x^3 - 2x^2 - 9x + 5 = 0$	
$3x^2 - 2x - 9 + \frac{5}{x} = 0$	
$3x^2 + \frac{5}{x} - 9 = 2x$	
$3x^2 + \frac{5}{x} - 9 + 5 = 2x + 5$	
$y = 2x + 5$	A1

Answer ..... [1]

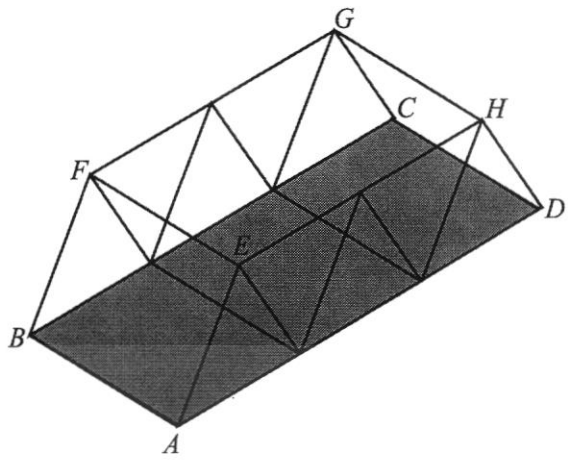
(ii) By drawing this straight line, solve the equation ..... for $0.4 \le x \le 1.6$.

Draw the line	B1
$x = 0.54 \pm 0.02$	B1

Answer $x =$ ..... [2]


y
9
8
7
6
5
4
3
2
1
- 1
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
x
$y = 2x + 5$
$y = 3x^2 + \frac{5}{x} - 4$

4



The figure shows a drawing of a bridge.
Each side of the bridge is made up of 5 equilateral triangles.
The shaded rectangular area *ABCD* is the base of the bridge.
$HD = 5.5$ m.

(a) Calculate *DE*.

$\angle DHE = 120^\circ$ (angles in an equilateral triangle)

$EH = 2 \times 5.5 = 11$ m (angle or length) M1

$DE^2 = HD^2 + EH^2 - 2(HD)(EH)\cos 120^\circ$

$DE = \sqrt{5.5^2 + 11^2 - 2(5.5)(11)\cos 120^\circ}$ M1

$DE = \sqrt{211\frac{3}{4}} = 14.55163221 = 14.6$ m (3 s.f.) A1

Alternative solution:

Let M be vertically below E.

$EM = \sqrt{5.5^2 - 2.75^2} = 4.7631$ M1

$MD = 2 \times 5.5 + 2.75 = 13.75$

$DE = \sqrt{13.75^2 + 4.7631^2} = 14.6$m M1, A1

Alternative solution:

In triangle *EAD*,

$DE = \sqrt{5.5^2 + 16.5^2 - 2(5.5)(16.5)\cos 60^\circ}$ M1, M1, A1

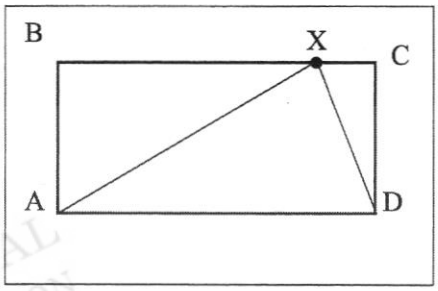
$= 14.6$

Answer ..... m [3]

A point, X, lies on BC and is vertically below point G.

(b) **(i)** Angle $AXD = 79.5^\circ$ and angle $ADX = 65.0^\circ$.
Show that $AX = 15.2$ m, correct to 3 significant figures.

Answer



$$\frac{AX}{\sin 65^\circ} = \frac{AD}{\sin 79.5^\circ} \quad \text{M1}$$

$$AX = \frac{3 \times 5.5}{\sin 79.5^\circ} \times \sin 65^\circ$$

$$= 15.20875042$$

$$= 15.2 \text{ m (3 s.f.)} \quad \text{A1}$$

[2]

Alternative solution

$$\sin 54.5 = \frac{BX}{AX} \quad \text{M1}$$

$$AX = \frac{5.5 + 5.5 + 2.75}{\sin 54.5} \quad \text{A1}$$

$$= 16.9m$$

(ii) Calculate the angle of elevation of G from A.

$$GC^2 = XG^2 + XC^2$$

$$XG = \sqrt{5.5^2 - 2.75^2} = 4.763139721 \text{ m} \quad \text{M1}$$

$$\tan \angle GAX = \frac{GX}{AX} = \frac{4.76314}{15.2088} \quad \text{M1}$$

Angle of Elevation $= \angle GAX$

$$= \tan^{-1}\left(\frac{4.76314}{15.2088}\right) = 17.4^\circ \text{ (1 d.p)} \quad \text{A1}$$

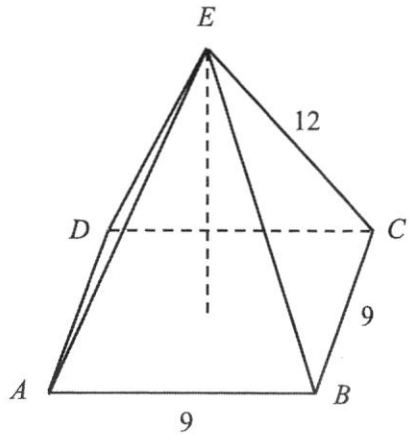
Answer ..... [3]

(c) The greatest angle of elevation of G from a point along AD occurs at Y.
Describe the relationship between XY and AD.

Answer

.....	Y is a point on AD such that XY is perpendicular to AD.	.....
	OR XY is the shortest distance from X to AD. B1	
.....		..... [1]

5



The diagram shows a pyramid $ABCDE$.
The base of the pyramid is a square of side 9 cm.
E is vertically above the centre of the square base.
$AE = BE = CE = DE = 12$ cm.

(a) Find the total surface area of the pyramid $ABCDE$.

Let X be the mid-point of BC. $BX = 4.5$ cm

Slant Height $EX = \sqrt{12^2 - 4.5^2} = 11.12428773$ cm M1

Surface Area $= 9 \times 9 + 4 \times \frac{1}{2} \times 9 \times 11.1243$ M1

$= 281.2371791$ cm^3

$= 281$ cm^2 (3 s.f.) A1

Answer ..... cm^2 [3]

The volume of the pyramid is 275 cm^3.
This metal solid is melted and molded into two identical spherical metal balls.

(b) Find the radius of each metal ball.

Volume of 1 spherical metal balls $= \frac{275}{2} = 137.5$ cm^3

$\frac{4}{3} \times \pi \times r^3 = 137.5$ M1

$r = 3.201877382 = 3.20$ cm (3 s.f.) A1

Answer ..... cm [2]

(c) Given that one bucket of paint is able to paint an area of 1200 cm^2, how many buckets of paint are needed to paint 1500 of such metal balls?

Surface Area of 1 spherical ball

$= 4 \times \pi \times 3.20188^2 = 128.8306674 cm^2$ M1

Total Surface Area of 1500 metal balls

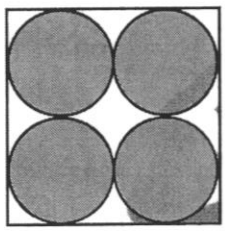
$= 1500 \times 128.8306674 = 193246.0011\ cm^2$ M1

No. of buckets of paint required

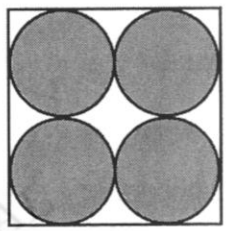
$= \frac{193246.0011}{1200} = 161.0383342$

$= 162$ (nearest bucket) A1

Answer ..... [3]



Top view



Side view

The diagram shows the top and side view of a box holding some spherical balls.
The box is in the shape of a cube and the spherical balls just fit into the box.

(d) Calculate the volume of empty space in the box.

Length of one side of cube $= 3.201877382 \times 4 = 12.8075$ cm

Volume of the cube $= 12.8075^3 = 2100.84056 cm^3$ M1

Volume of 8 spherical balls $= 8 \times 137.5$

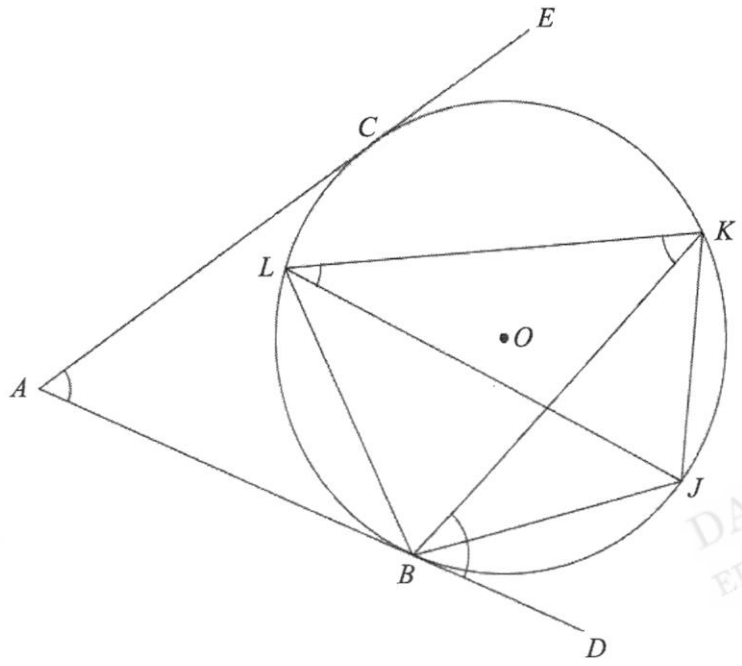
$= 1100\ cm^3$ M1

Volume of empty space $= 2100.84056 - 1100$

$= 1000.84056 = 1000\ cm^3$ (3 s.f.) A1

Answer ..... cm^3 [3]

6 (a)



B, C, J, K and L are points on the circle, centre O.
AE and AD are tangents to the circle.
Angle JLB is equal to angle JBD.
Angle $BAC = 49°$, angle $JLK = 24°$, angle $KBD = 60°$ and angle $BKL = 31°$.

Find, giving reasons for each answer,

(i) angle JBK,

$\angle JBK = 24^\circ$ (angles in same segment) B1

Answer ..... [1]

(ii) angle KBL,

$\angle JBD = 60^\circ - 24^\circ = 36^\circ$ M1
$\angle JLB = \angle JBD$ (Given)
$\angle KBL = 180^\circ - 31^\circ - 24^\circ - 36^\circ$ ($\angle$sum of ΔKBL)
$= 89^\circ$ A1

Answer ..... [2]

(iii) reflex angle KOL,

$\angle KOL = 360^\circ - 2 \times 89^\circ$ (angle at centre = 2 × angle at circumference)
$= 182^\circ$ M1, A1

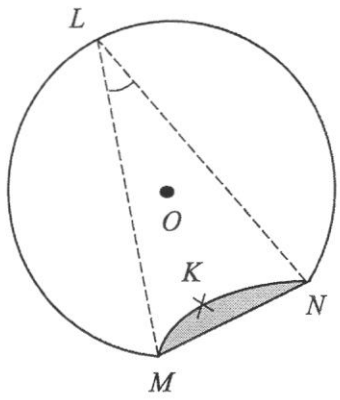
Answer ..... [2]

(iv) angle *COB*.

$\angle ACO = \angle ABO = 90^\circ$ (tangent perpendicular to radius) M1
$\angle COB = 360^\circ - 90^\circ - 90^\circ - 49^\circ$ (sum of angles in quadrilateral)
$= 131^\circ$ A1

Answer ..... [2]

(b)



The diagram shows a circle made of paper with centre *O*.

A segment of the circle is folded inwards.

Angle $MLN = \frac{\pi}{4}$ radians and arc length $MKN = 6$ cm

Calculate the length of the major arc *MLN*.

$\angle MON = 2 \times \frac{\pi}{4} = \frac{\pi}{2}$ M1

Reflex $\angle MON = 2\pi - \frac{\pi}{2} = \frac{3\pi}{2}$ M1

Major Arc length *MLN*

$= \frac{3\pi}{2} \times 3.819$ M1

$= 17.998596$ cm

$= 18.0$ cm (3 s.f.) A1

Arc length $MKN = 6$

$r \times 2 \times \frac{\pi}{4} = 6$ M1

$r = 3.819$ cm (correct to 4 d.p.) A1

Major Arc length *MLN*

$= 2\pi \times 3.819 - 6$ M1

$= 17.998596$ cm

$= 18.0$ cm (3 s.f.) A1

Answer ..... cm [4]

7 Two groups of students were surveyed on their weekly screen time in hours.
The results are shown in the table.

14	32	55	24	56
23	48	17	36	59

Group 1

42	23	29	25	19
23	90	45	35	29

Group 2

(a) 20% of students in Group 2 recorded a screen time of at least x hours. Find x.

$\frac{20}{100} \times 10 = 2$ students

$x = 45$ hours A1

Answer ..... hours [1]

(b) Complete the table below. [2]

	Group 1	Group 2
Median	34	
Interquartile Range		19

Median $= \frac{29+29}{2}$ 29 B1

IQR $= 55 - 23 = 32$ B1

(c) Make a comparison between the screen times of the students in these two groups.

Answer

Group 2 students has shorter screen time since they have a smaller median of 29h compared to 34h for median of Group 1.

Or Group 2 students has less spread out screen time than Group 1 students as their interquartile range (19h) is less than Group 1's 32h.

B1 [1]

(d) Explain why median is a better measure for average screen time for the two groups of students compared to the mean.

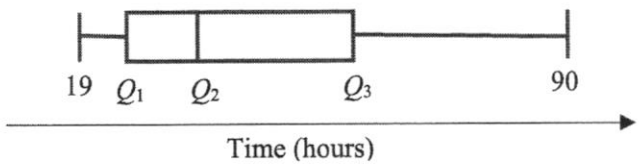
Answer

There are extreme values, such as 90, present in Group 2, which will affect the calculation of the mean but not the median.

B1

..... [1]

(e) **(i)** The box-and-whisker plot for the distribution of screen time for students in Group 2 is drawn in the grid below. Write down the value for Q_1, Q_2 and Q_3.



1-2 mistakes (deduct 1 mark)
3 mistakes (deduct 2 marks)
$Q_1 = 23$, $Q_2 = 29$,
$Q_3 = 42$

Answer Q_1 = ... hours

Q_2 = ... hours

Q_3 = ... hours [2]

(ii) Due to a recording error, the recorded amount of screen time for Group 1 is 1 hour more than the actual screen time.

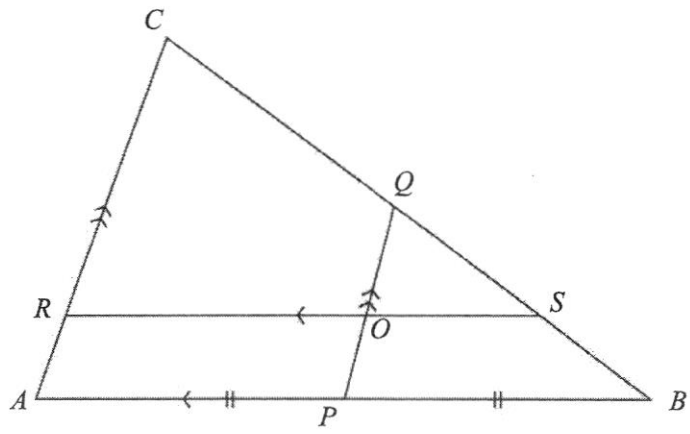
State how the median and standard deviation of the screen times have been affected by this error.

Answer

The actual median will decrease by 1 hour from 34h to 33h.	B1	
The standard deviation remains the same.	B1	

..... [2]

8 (a)



In the diagram, SR is parallel to BA and PQ is parallel to AC.
P is the midpoint of AB and $BS : SC = 1 : 4$.

(i) Prove that triangles CRS and CAB are similar. [2]

Answer

B1 (either statement), B1 (property)

(ii) If the area of triangle $ABC = 120$ cm^2, find the area of $RSBA$.

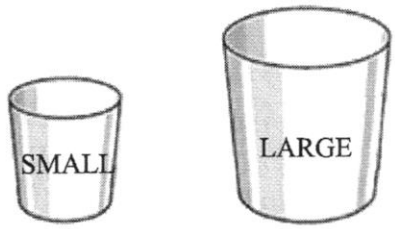
$$\frac{\text{Area of } \Delta CRS}{\text{Area of } \Delta CAB} = \left(\frac{4}{5}\right)^2$$

Area of $\Delta CRS = \left(\frac{4}{5}\right)^2 \times 120 = 76.8$ cm^2 M1

Area of $RSBA = 120 - 76.8 = 43.2$ cm^2 A1

Answer ..... cm^2 [2]

(b)



The diagram shows two geometrically similar can.
A soup manufacturer wants to fill the cans with soup.
The ratio of the heights of two geometrically similar cans is 4 : 9.
The surface area of the small can is 240 cm^2.

By considering the materials and volume of the soup the cans can hold, determine which can is more cost effective for the soup manufacturer.
Use calculations to justify your answer. [4]

Answer

$$\frac{240}{\text{Area of Large Can}} = \left(\frac{4}{9}\right)^2$$

Area of Large Can = 1215 cm^2 M1

$$\frac{V_{small}}{V_{large}} = \left(\frac{4}{9}\right)^3 = \frac{64}{729}$$ M1

Ratio of volume of soup per cm^2 of material for small can

= 64 parts ÷ 240 cm^2 ≅ 0.267

Ratio of volume of soup per cm^2 of material for large can

= 729 parts ÷ 1215 cm^2 ≅ 0.6 M1 (either ratio)

Hence the large can is more cost effective since it has a larger ratio of volume of soup to area of material needed.

A1

9 **(a)** The first three terms in a sequence of numbers are given below.

$Q_1 = 2^3 + 3 = 11$

$Q_2 = 2^4 + 5 = 21$

$Q_3 = 2^5 + 7 = 39$

(i) Find an expression, in terms of n, for Q_n.

$2^3, 2^4, 2^5 \ldots\ldots \quad T_n = 2^{n+2}$	B1 (either series)
$3, 5, 7, \ldots\ldots \quad T_n = 3 + (n-1)2 = 2n+1$	
$Q_n = 2^{n+2} + 2n + 1$	A1

Answer ..... [2]

(ii) Explain why the value of Q_n must be odd for all values of n.

Answer

Since $2^{n+2} + 2n$ is even for all values of n and 1 is odd, the sum of an even and odd number is odd.	B1

..... [1]

(iii) Show that $2^{n-2} - 2^{n-3} = 2^{n-3}$.

$2^{n-2} - 2^{n-3} = 2^{n-3}(2-1) = 2^{n-3}$	M1, A1
Or $2^{n-2} - 2^{n-3} = \frac{2^n}{4} - \frac{2^n}{8} = \frac{2^{n+1} - 2^n}{8}$ $= \frac{2^n(2-1)}{2^3} = 2^{n-3}$	M1, A1

Answer ..... [2]

(b) In a sequence, the same number is subtracted each time to obtain the next term.
The first five terms of the sequence are

$p, q, 2, r, -16$

(i) Write down an expression for the nth term of this sequence.

Let the same number be 'd'.		
$2 - d = r$		
$r - d = -16$		
$d = 9$	or common difference = –9	M1
$T_n = 29 - 9n$		A1

Answer ..... [2]

(ii) The sum of the mth term and its previous term is –167.
Find the value of m.

$T_m = 29 - 9m$

$T_{m-1} = 29 - 9(m-1)$

$29 - 9m + [29 - 9(m-1)] = -167$ M1

$m = 13$ A1

Answer ..... [2]

(c) The table gives information about the ages of the members in the *Fitness First* club in Singapore.

	Members aged under 40	Members aged 40 or over
Male	40	24
Female	32	34

(i) One of these members is selected at random.
Find, as a fraction in its lowest terms, the probability that he or she is under 40.

P(< 40 yrs)
$= \frac{40+32}{40+32+24+34} = \frac{72}{130} = \frac{36}{65}$ B1

An [1]

(ii) Two of the members are selected at random.
Find the probability that

(a) both members are female,

P (both are female)
$= \frac{32+34}{130} \times \frac{32+33}{129}$
$= \frac{66}{130} \times \frac{65}{129}$ M1
$= \frac{11}{43}$ A1

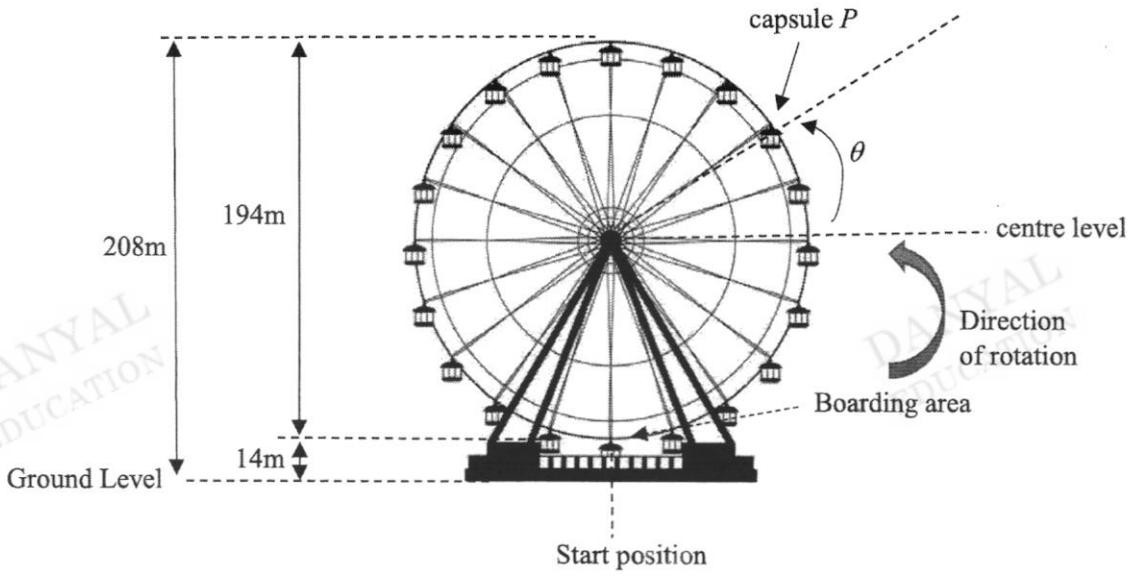
Answer ..... [2]

(b) they are both aged 40 or over, but only one is a male member.

P (> 40 yrs, only 1 male)
$= \frac{24}{130} \times \frac{34}{129} + \frac{34}{130} \times \frac{24}{129}$ M1
$= \frac{272}{2795}$ A1

Answer ..... [2]

10 The Beijing Great Wheel is the world's largest Giant Observation Wheel and one of East Asia's biggest tourist attractions.
The Giant Observation Wheel has a height of 208 m and a diameter of 194 metres.
It rotates at the speed of 0.3 m/s.
Angle of rotation is measured from the start position in an anti-clockwise direction.



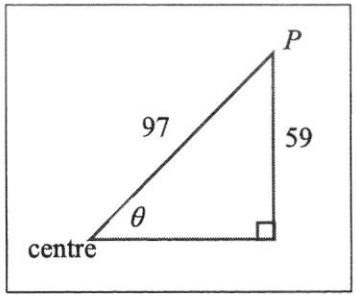
(a) Find the time taken by a capsule to complete 1 revolution.
Express your answer in minutes and seconds, correct to the nearest second.
Take π as 3.142.

Time Taken $= \frac{\pi \times 194}{0.3}$ secs	M1
$= 2031.826667$ secs	
$= 33.86377778$ min	
$= 33$ min 52 secs	A1

Answer ..... minutes ..... seconds [2]

(b) The state square garden is 1km away from the Great Observation Wheel. There are fireworks displays at the garden from 8.45 pm to 8.50 pm and the best view for the fireworks occurs when the capsule P is at least 170 metres above the ground.

(i) Find angle θ when capsule P is exactly 170 meters above the ground level.



Let angle from the centre level of the wheel to a height of 170m from the ground be θ.

$\sin\theta = \frac{59}{97}$	M1
$\theta = 37.46289^\circ$	A1

Answer θ = ... [2]

(ii) Find the angle from the start position to the best viewing point where capsule P is.

Angle from start to best viewing point at 170 m above ground
$= 90^\circ + 37.46289^\circ = 127.4629^\circ = 127.5^\circ$

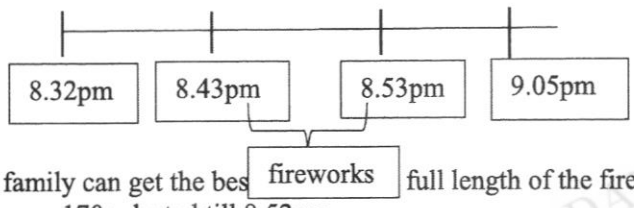
Answer ..... [1]

(c) A tourist family wants to get the best view of the **FULL** length of the fireworks display. They board the capsule at 8.32 pm and claims that they can enjoy the full length of fireworks display.

Do you agree with the claim?
Show working to support your answer and state one assumption that you made. [4]

Time to reach 170 m from start position $= \frac{127.4629}{360} \times 2031.826667$
$= 719.3958181$ secs
$= 11.9899303$ min $= 11$ min 49 sec
M1

Or Time for the fireworks to be in view
$= \frac{105.07422^\circ}{360^\circ} \times 33.86377778 = 9.88$ min $= 9$ min 53 s



Conclusion: Yes, the family can get the bes full length of the fireworks display since the ride over 170m lasted till 8.52pm.
B1

Assumption: The capsule moves at constant speed throughout B1

End of Paper

Setter: Mr Tee Hong Heng