HILLGROVE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR (NORMAL ACADEMIC)

CANDIDATE NAME	( )	CLASS	-
CENTRE NUMBER	S	INDEX NUMBER	

MATHEMATICS **4045/01**

Paper 1 **29 July 2022**

2 hours

Candidates answer on the Question Paper. **10.45 AM to 12.45 PM**

READ THESE INSTRUCTIONS FIRST

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

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

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 total marks for this paper is 80.

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, either use your calculator value or 3.142.

For Examiner's Use	
Total	/80

Parent's/ Guardian's Signature: _____

Setter: Mrs Valerie Loh

This document consists of **16** 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** questions.

1 Work out

(a) $\sqrt[3]{6784.5878 \div 0.003}$,

Answer ..... [1]

(b) $\frac{4.63^3}{395+0.445}$.

Answer ..... [1]

---

2 Solve $2(p + 7) - 3(p - 4) = 20$.

Answer $p =$ ..... [2]

---

3 Find the smallest integer y satisfying $14 \geq 25 - 3y$.

Answer ..... [2]

---

4 Simplify $\frac{2a^3b}{3ac^2} \div \frac{8a^5c}{9b^4}$.

Answer ..... [2]

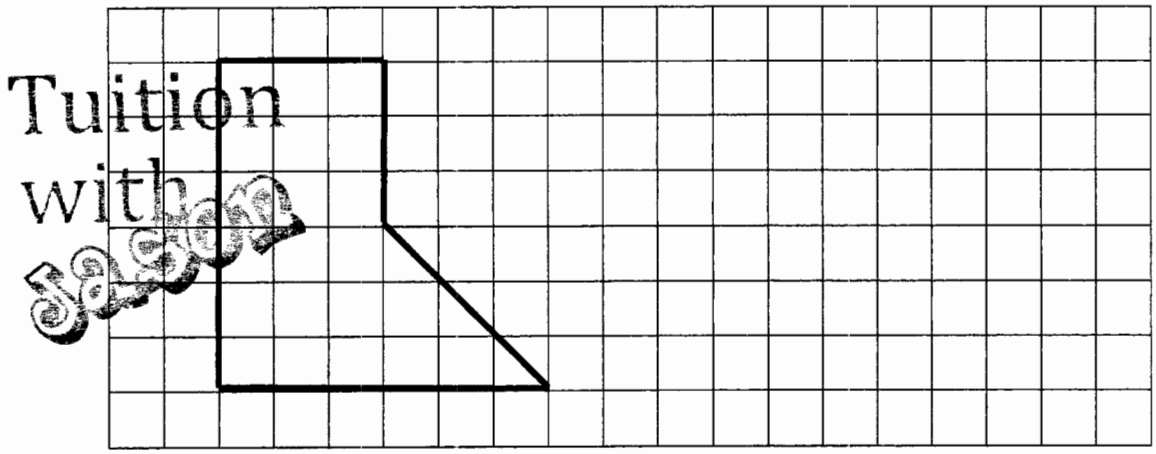
---

5 p is inversely proportional to the cube of r. Given that $p = 5$ for a certain value of r, find the value of p when r is doubled.

Answer $p =$ ..... [2]

---

6 Draw a reduction of this pentagon using the scale factor of $\frac{1}{3}$.



[2]

---

7 Given that $\frac{3}{9^0} \div 27 = \frac{1}{3^{-m}}$, find m.

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

---

8 The point E lies on the line DF.

$DE : EF = 3 : 4$.

(a) Write EF as a fraction of DF.

Answer ..... [1]

(b) EF is 48 cm.

Calculate DE.

Answer $DE =$ ..... cm [2]

---

9 15% of the hand area is 26.25 cm^2.

(a) Find the area of the whole hand?

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

(b) It is estimated that on our hand, there are 1500 bacterial living on each square centimetre of our skin. Find the amount of bacterial on the whole hand leaving your answer in standard form.

Answer ..... [2]

---

10 **(a)** Find angle A such that $cosA^\circ = -0.35$.

Answer A = ... [1]

(b) 690% 2π $\sqrt{\frac{98}{2}}$ $6.\dot{9}$

Write these numbers in order, starting with the largest.

Answer ....., ..., ..., ... [2]

---

11 **(a)** Simplify and factorise $15xy - 20x - 5yx + 12x$.

Answer ..... [2]

(b) Simplify $\frac{3q}{5} + \frac{5(q-1)}{3}$.

Answer ..... [2]

---

12 Simplify $\frac{3}{x-2} + \frac{5}{x^2-4}$.

Answer ..... [3]

---

13 Solve these simultaneous equations.

$$2x - 3y = 8,$$

$$3x = 5y - 3.$$

Show your working.

Answer $x =$ .....

$y =$ .....[3]

---

14 Sam needs to travel from Town A to Town B which is 190 km apart.

From Town A, he drove at an average speed of 70 km/h for 45 minutes.

He stopped at a rest station for half an hour and then continued his journey till he reached Town B.

(a) If his average speed is 95 km/h, find the total time he took for his journey.

Answer ..... h [2]

(b) What is the distance of Town A to the rest station?

Answer ..... km [2]

---

15 **(a)** Write 600 as a product of its prime factors.

Answer ..... [2]

(b) **(i)** Write down the lowest common multiple (LCM) of 21 and 600.

Give your answer as a product of its prime factors.

Answer ..... [1]

(ii) Is the lowest common multiple from **(bi)** a perfect square? Explain your answer.

Answer .....

..... [1]

---

16 **(a)** Express $x^2 - 12x + 8$ in the form $(x - a)^2 - b$.

Answer ..... [2]

(b) A quadratic graph has the equation $y = x^2 - 12x + 8$.

(i) Hence, write down the coordinate for the turning point of this graph.

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

(ii) Write down the equation of line of symmetry.

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

---

17 A set of heights in centimetre of 6 students are given.

158 169 188 164 177 164

(a) State the modal height.

Answer ..... *cm* [1]

(b) Find

(i) the mean height,

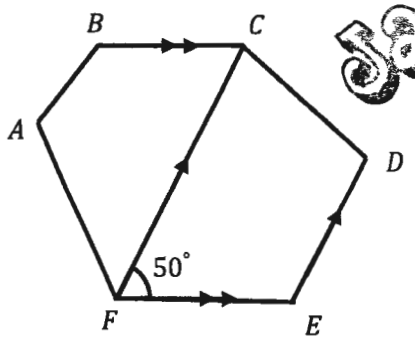
Answer ..... *cm* [2]

(ii) the median height.

Answer ..... *cm* [1]

18 The diagram shows a hexagon $ABCDEF$. FC is parallel to ED and BC is parallel to FE.

Angle $CFE = 50^\circ$.



(a) Find angle FED.

Answer .....° [1]

(b) Given that angle CDE is twice angle CFE, find angle FCD.

Answer .....° [1]

(c) Josh said that the sum of angle ABC + angle FAB + angle AFC is 230°.

Do you agree with him? Justify your answer with working.

Answer .....

.....

..... [2]

19 These are the first five terms of a sequence.

$$-13 \qquad -18 \qquad -23 \qquad -28 \qquad -33$$

(a) Write an expression, in terms of n, for the n^{th} term of this sequence.

Answer ..... [1]

(b) State whether -100 is a term in the sequence.

Answer .....

.....

..... [1]

(c) The sequence in part **(a)** is squared to form a new sequence.

Find the new sequence in terms of n.

Answer ..... [2]

20 DEF is a triangle with $DE = 8\ cm, EF = 10\ cm$ and $EDF = 100^{\circ}$.

(a) Construct the triangle DEF. DE has been drawn for you. [2]

(b) Construct a line that is equidistant from

(i) point D and point E, [1]

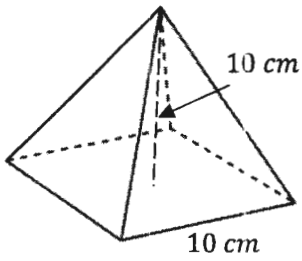
(ii) line DF and DE. [1]

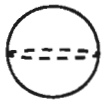
(c) X is the point where both the line from **(bi)** and **(bii)** intersect.

Measure XE.

Answer ..... *cm* [1]

21 A solid square pyramid has side and perpendicular height of length 10 cm .





Radius: 2 cm

(a) The square pyramid is melted to form spheres of radius 2 cm.

Calculate the number of complete spheres formed?

Answer ..... [2]

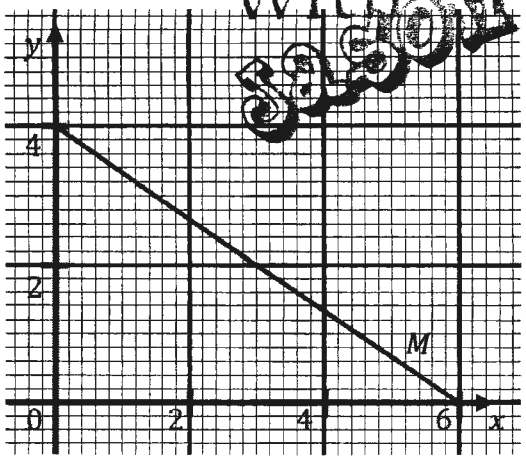
(b) All the spheres are painted with two coats of paint.

One tin of paint can paint an area of 100 cm^2.

How many tins are required to paint all the spheres?

Answer ..... [3]

22 Line M is shown on the grid.



(a) Linda says the gradient of the graph is $\frac{2}{3}$. John says the gradient of the graph is $-\frac{2}{3}$.

Whose answer is correct? Explain why.

Answer ..... is correct.

.....

.....

..... [2]

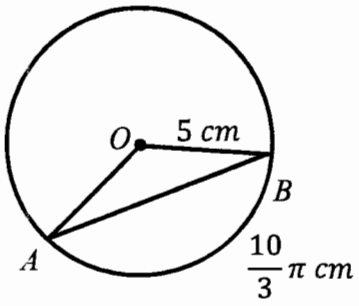
(b) Another line, Q, passes through the point (2, 2) on the grid. Line Q is parallel to line M. Find the equation of line Q.

Answer ..... [3]

(c) Find the distance between the points where the line M touches both the x-axis and y-axis.

Answer ..... [1]

23



The diagram shows a circle with radius 5 cm and minor arc length $\frac{10}{3}\pi\ cm$.

(a) Find obtuse angle AOB.

Answer .....° [2]

(b) Find the area of the minor segment.

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

(c) Find the probability that a point is drawn in the minor segment.

Give your answer to 3 decimal places.

Answer ..... [2]

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MATHEMATICS **4045/02**

Paper 2 **2 August 2022**

2 hours

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Section A
Answer **all** questions.

Section B
Answer **one** question.

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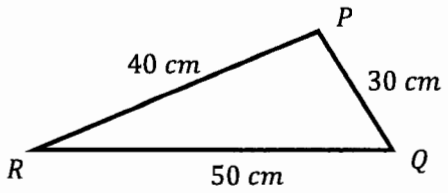
Section A (52 marks)

Answer **all** the questions in this section.

1 The diagram show triangle PQR with $PR = 40\ cm$, $PQ = 30\ cm$ and $QR = 50\ cm$.



(a) Determine if triangle PQR is a right-angled triangle.

[2]

(b) The line PQ is produced to a point E. Find the value of $\sin R\hat{Q}E$.

Answer .....[1]

---

2 A cat was found at the top of a tree that is 3.5 m.

A 5 m ladder is placed on the tree to help bring the cat down.

(a) What is the angle of elevation of the cat from the ground?

Answer .....° [2]

(b) Find the distance of the foot of the ladder to the tree.

Answer ..... m [2]

---

3 A playground is drawn in a map to the scale of 1 : 175.

(a) A slide and swing are 2.5 cm apart on the map.

Find the actual distance between the slide and swing.

Answer ..... m [2]

(b) The actual playground has an area of 280 m^2.

Find the area on the map.

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

4

$$3r = \sqrt{\frac{a}{b+1}}$$

(a) Rearrange the formula to make b the subject.

Answer b = ... [2]

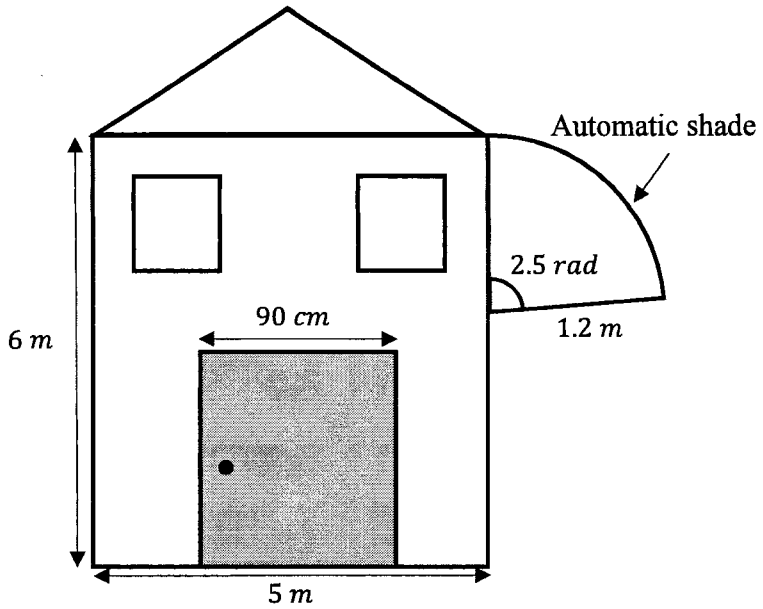
(b) Hence or otherwise, find the value of b when $a = 300$ and $r = 4.5$.

Leave your answer as a rational number.

Answer b = ... [2]

---

5 This is a front view of a house.



Front view of house

(a) The house has width 5 m and height of 6 m.

The door is similar to the front view of the house. The width of the door is 90 cm.

Calculate the height of the door. Give your answer in metres.

Answer ..... m [2]

(b) The owner is going to build an automatic shade.

The angle of the shade when fully opened is 2.5 rad . It has a radius of 1.2 m .

If the shade takes a minute to completely open, what is the speed at which it opens?

Give your answer in metre per seconds.

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

6 Jacky and family are going for a holiday to Japan.

He would like to change S$ 3250 to Japanese Yen (¥).

(a) If the exchange rate is S$ 100 : ¥9885.24, how much Japanese Yen will Jacky get?

Answer ¥ ..... [2]

(b) In Japan, Jacky saw a vintage radio selling at ¥ 25 000. There was a discount of 20%. Calculate how much Jacky will need to pay for this vintage radio.

Answer ¥ ..... [2]

(c) When he returned to Singapore, he sold the vintage radio to another friend at S$ 300 The exchange rate was ¥100 : S$1.05. Did he sell it at a profit or loss?
Justify your answer with working.

Answer He sold it at a ..... [2]

(d) Calculate the amount he paid in Singapore dollars as a percentage of the price he sold to his friend. Give your answer to the nearest percentage.

Answer ..... % [2]

7 The total cost for y number of mouse pad is \$100. The number of thumb drive is 3 less than the number of mouse pad. The total cost for all the thumb drives is \$170.

(a) Find in term of y the cost of

(i) one mouse pad,

Answer \$ ..... [1]

(ii) one thumb drive.

Answer \$ ..... [1]

(b) The total cost for one mouse pad and one thumb drive is \$15.

Write down an equation in y and show that it simplifies to $y^2 - 21y + 20 = 0$.

[3]

(c) Solve $y^2 - 21y + 20 = 0$.

Answer y = ... or ..... [2]

(d) Explain why one of the answer cannot be accepted.

Answer .....

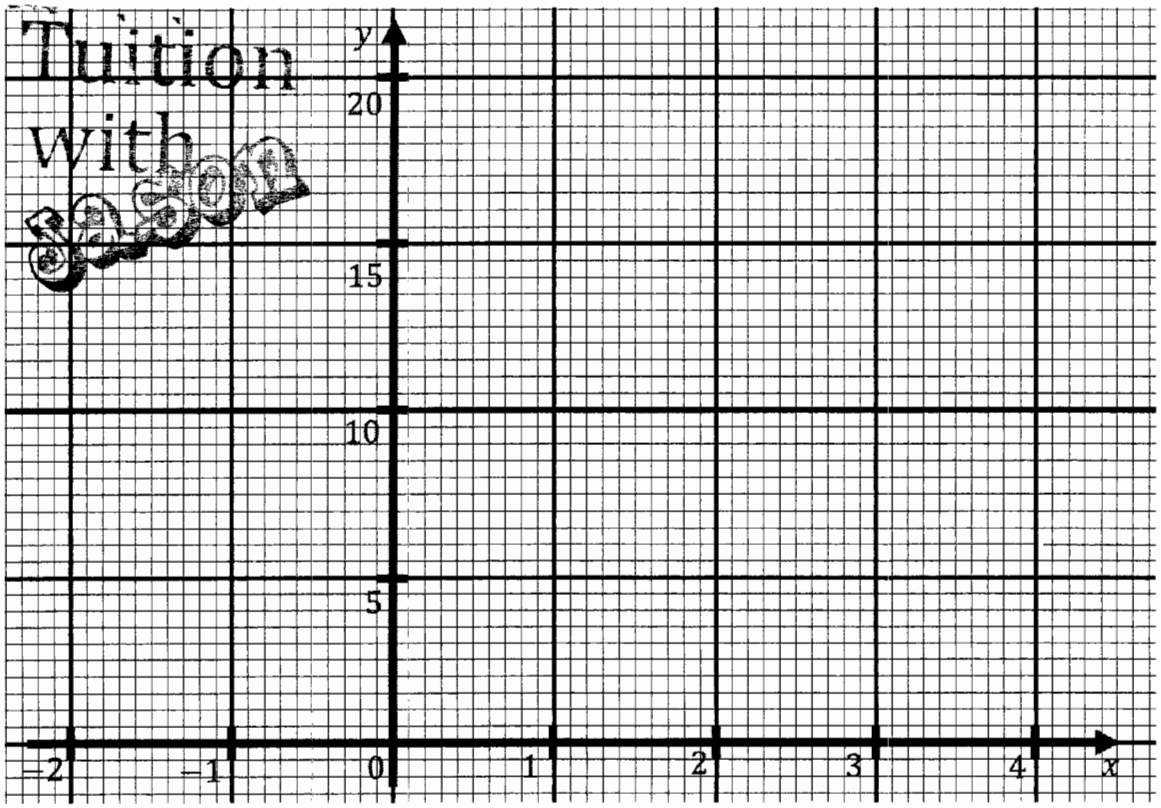
..... [1]

8 **(a)** Complete the table of values for $y = 2^x + 1$.

x	-2	-1	0	1	2	3	4
y	1.25	1.5	2	3	5		

[2]

(b) Draw the graph of $y = 2^x + 1$ for $-2 \leq x \leq 4$.



[3]

(c) By drawing a suitable line, find the value of x when $2^x - 2 = 0$.

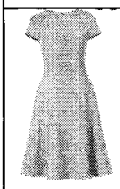
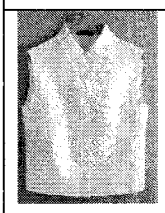
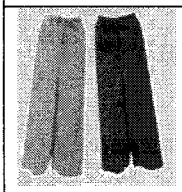
Answer x = ... [2]

(d) By drawing a suitable tangent, find the gradient of the curve when $x = 2$.

Answer x = ... [2]

9 The following shows some information on an online shopping portal.

Mrs Tan is a dance teacher and she is looking at the following costumes to be bought for her dancers.

Item	Price	Colours and Size
 Solid Hem Dress Review: 4 ★	$ 15.90 **SPECIAL:** White piece 7.7 sales: *$10 now* (10% off for more than 10 pieces for **all** colours)	Colour: Black, White, Pink and Blue Size: XS, S, M, L
 Cotton blouse Review: 3.4 ★	$9.00 (Buy 4 get one free)	Colour: Pink, Blue, Green, Black and White Size: XS, S, M, L
 Pants Review: 5 ★	$12.00	Colour: Green and Beige Size: XS, S, M, L
 Maxi Skirt Review: 5 ★	$20	Colour: Pink, Blue an Brown Size: XS, S, M, L

Discounts		
10% off On orders of $60 and above.	15% off On orders of $200 and above.	20% off On orders of $300 and above.
Points deduction	Every 100 points - $10 deduction.	
All purchases final cost will be round down to the nearest dollars		

Shipping	**Standard (> 2 weeks)**	**Express**
	$1.50	$ 2.00
(Shipping cost is based on final cost)	Free with purchases above $150 after any discount.	Free with purchases above $200 after discount.

(a) Mrs Tan needs to buy 5 pieces of each colour for the solid hem dress and she needs it to be delivered within 2 weeks. She has 300 points that she can use for deduction. Calculate the total cost for these dresses to be shipped over.

Answer $ ..... [5]

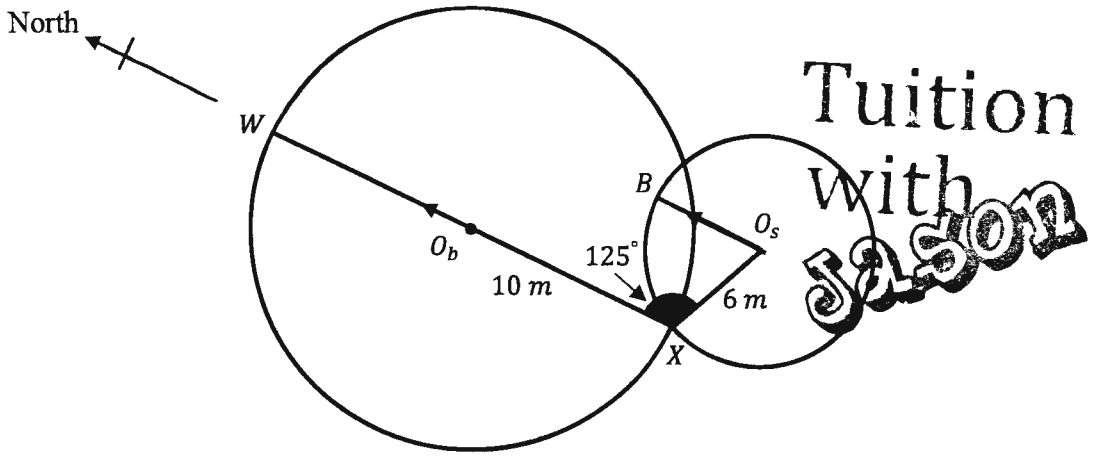
(b) Mrs Tan have a balance budget of $200. She would like to purchase 5 pink cotton blouse, 5 green pants and 5 blue maxi skirts. She has no more points to deduct after the purchase of the solid hem dress and she is not in a hurry to receive these items. Will the budget be enough for this purchase? What is the total cost for this purchase? Justify your answer with working.

Answer ..... the budget is enough, the total cost for this purchase is $..... [3]

Section B (8 marks)

Answer **one** question from this section. Each question carries 8 marks.

10 The following shows two radio towers O_b and O_s on level ground.



The radio tower are the centre of two circles.

The large circle has centre O_b and radius $10\ m$.

The small circle has centre O_s and radius $6\ m$.

The two circles touches at point X and WX is the diameter of the large circle.

XW is parallel to O_sB.

(a) Given that angle $WXO_s = 125^\circ$, calculate the distance between the centre of both the circles.

Answer ..... m [2]

(b) A person is located somewhere on the larger circle. He is 12 m from point W and 16 m away from point X. Determine which part of the circle is this person located.

[2]

(c) A point A is located on the circumference of the smaller circle. AB is the diameter of the small circle. Find angle XAB. Give reasons for your answers.

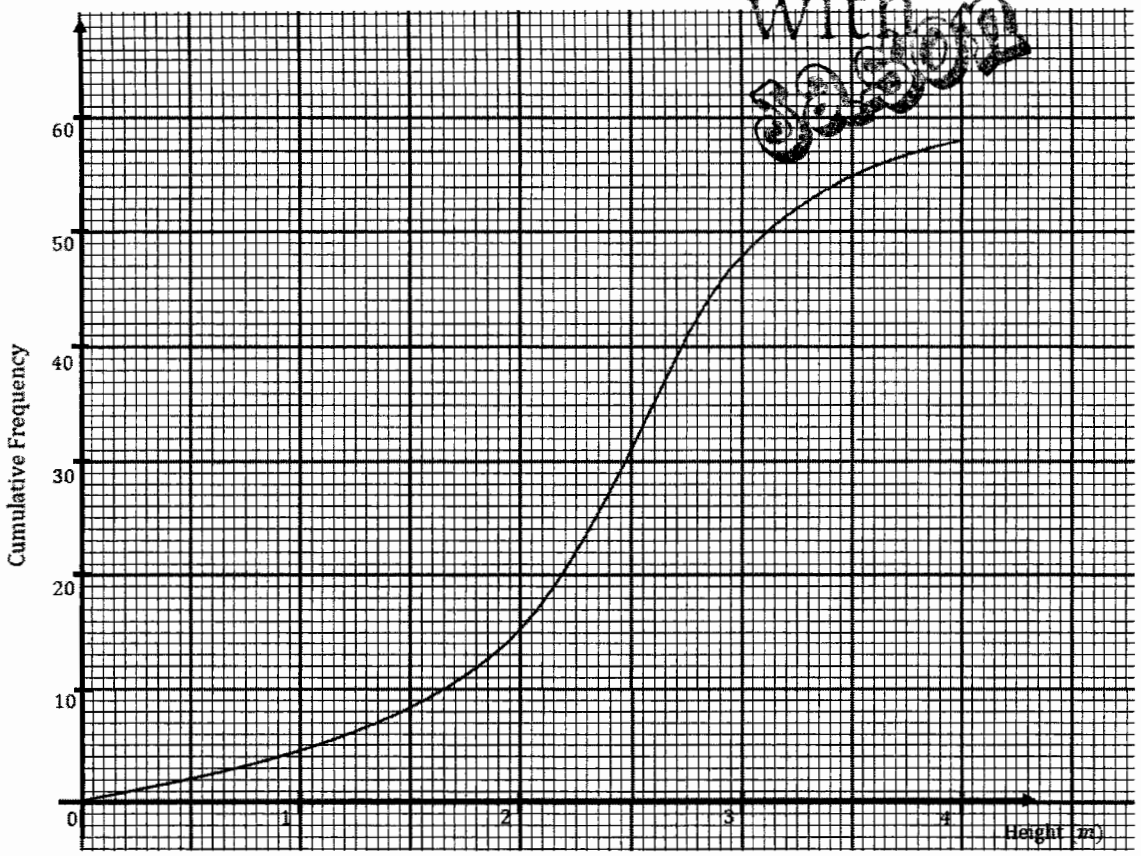
Answer .....° [3]

(d) Given that W is North of X, find the breaing of X from the centre of the small circle.

Answer .....° [1]

11 (a) A botanist measured the height of trees in the park *A*.

The cumulative frequency diagram shows the distribution of the height in metres.



Use the graph to find

(i) the inter-quartile range,

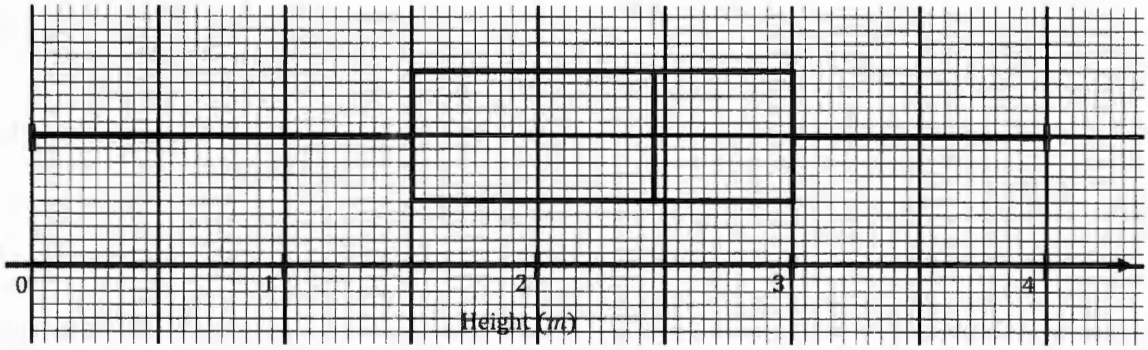
Answer ..... *m* [2]

(ii) the number of trees that are more than 2.15 *m*.

Answer ..... [1]

(iii) The box-and-whisker plot shows the height of trees in Park *B*.

Explain how the shape of the cumulative frequency diagram will differ as compared to the shape of the cumulative frequency diragram of Park *A*.



Answer .....

.....

.....

.....

..... [1]

(b) Box A have 3 cards with the number $2, 3$ *and* 5.

Box B have 4 cards with the number $1, 3, 5$ *and* 7.

(i) Complete the table below to show the possible sums.

Box B

Box A	+	1	3	5	7
	2	3	5	7	9
	3	4	6		
	5	6			

[2]

(ii) Find the probability that the sum of two cards is a prime number.

Answer ..... [1]

(iii) Find the probability that the sum of the the two cards is greater than 12.

Answer ..... [1]

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CANDIDATE NAME	ANSWER ( )	CLASS	[ ] - [ ]
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MATHEMATICS **4045/01**

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

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** questions.

1 Work out

(a) $\sqrt[3]{6784.5878 \div 0.003}$

$131.260505 \approx 131(3sf)$ *B1*

Answer ..... [1]

(b) $\frac{4.63^3}{395+0.445}$

$0.2509902692 \approx 0.251(3sf)$ *B1*

Answer ..... [1]

---

2 Solve $2(y + 7) - 3(y - 4) = 20$.

$2(y + 7) - 3(y - 4) = 20$

$2y + 14 - 3y + 12 = 20$ M1 – change sign correctly

$-y + 26 = 20$

$-y = 20 - 26$

$-y = -6$

$y = 6$ *A1*

Answer $y =$ ..... [2]

---

3 Find the smallest integer y satisfying $14 \geq 25 - 3y$.

$14 \geq 25 - 3y$

$14 - 25 \geq -3y$

$-11 \geq -3y$

$3\frac{2}{3} \leq y$ *A1* M1 – change sign

Smallest integer: 4 A1

Answer ..... [2]

---

4 Simplify $\frac{2a^3b}{3ac^2} \div \frac{8a^5c}{9b^4}$.

$$\frac{2a^3b}{3ac^2} \div \frac{8a^5c}{9b^4}$$

$$= \frac{2a^3b}{3ac^2} \times \frac{9b^4}{8a^5c} \quad M1 - KCF$$

$$= \frac{b}{ac^2} \times \frac{3b^4}{4a^2c}$$

$$= \frac{3b^5}{4a^3c^3} \quad A1$$

Answer ..... [2]

---

5 p is inversely proportional to the cube of r. Given that $p = 5$ for a certain value of r, find the value of p when r is doubled.

$$p = \frac{k}{r^3} \qquad p = \frac{k}{(2r)^3}$$

$$5 = \frac{k}{r^3} \qquad p = \frac{k}{8r^3} \quad M1$$

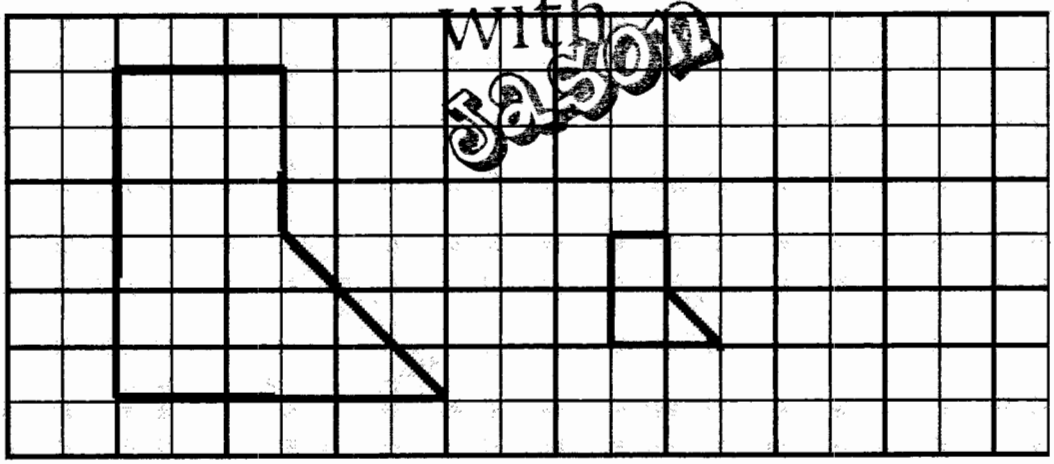
$$p = \frac{1}{8} \times 5$$

$$p = \frac{5}{8} \quad A1$$

Answer p = ... [2]

---

6 Draw a reduction of this pentagon using the scale factor of $\frac{1}{3}$.



[2]

---

7 Given that $\frac{3}{9^0} \div 27 = \frac{1}{3^{-m}}$, find m.

$\frac{3}{9^0} \div 27 = \frac{1}{3^{-m}}$

$\frac{3}{1} \times \frac{1}{3^3} = 3^m$ $M1 - either\ power\ zero\ to\ 1\ OR\ negative\ poswe\ to\ positive\ power$

$3^{-2} = 3^m$ or $\frac{1}{3^2} = \frac{1}{3^{-m}}$

$m = -2$ $A1$

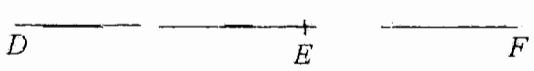
Answer m = ... [2]

---

8 The point E lies on the line DF.

$DE : EF = 3 : 4$.

(a) Write EF as a fraction of DF.

$\frac{4}{7}$ $B1$ 

Answer ..... [1]

(b) EF is 48 cm.

Calculate DE. $\frac{DE}{48} = \frac{3}{4}$

$DE = \frac{3}{4} \times 48$ $M1$

$DE = 36\ cm$ $A1$

Answer DE = ... cm [2]

---

9 15% of the hand area is 26.25 cm^2.

(a) Find the area of the whole hand?

15% – 26.25 cm^2

100% – 175 cm^2 *B1*

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

(b) It is estimated that on our hand, there are 1500 bacterial living on each square centimetre of our skin. Find the amount of bacterial on the whole hand leaving your answer in standard form.

175×1500

$= 262500$ *M1*

$= 2.625 \times 10^5$ (*Exact*) *A1*

Answer ..... [2]

---

10 **(a)** Find angle A such that $cosA^\circ = -0.35$.

$110.487351 \approx 110.5^\circ$ *B1*

Answer $A =$ ..... [1]

(b) 690% 2π $\sqrt{\frac{98}{2}}$ $6.\dot{9}$

Write these numbers in order, starting with the largest.

$\sqrt{\frac{98}{2}}$, $6.\dot{9}$, 690%, 2π *B1*

Answer ....., ..., ..., ... [2]

---

11 **(a)** Simplify and factorise $15xy - 20x - 5yx + 12x$.

$10xy - 8x$

$10xy - 8x$ *M1*

$= 2x(5y - 4)$ *A1*

Answer ..... [2]

(b) Simplify $\frac{3q}{5} + \frac{5(q-1)}{3}$.

$$\frac{3q}{5} + \frac{5(q-1)}{3}$$

$$= \frac{3(3q) + 25(q-1)}{15} \quad M1 - Common\ denominator$$

$$= \frac{9q + 25q - 25}{15}$$

$$= \frac{34q - 25}{15} \quad A1$$

Answer ..... [2]

---

12 Simplify $\frac{3}{x-2} + \frac{5}{x^2-4}$.

$$\frac{3}{x-2} + \frac{5}{x^2-4}$$

$$= \frac{3}{x-2} + \frac{5}{(x-2)(x+2)} \quad M1 - Factorise\ denominator$$

$$= \frac{3(x+2) + 5}{(x-2)(x+2)} \quad M1 - Common\ denominator$$

$$= \frac{3x + 6 + 5}{(x-2)(x+2)}$$

$$= \frac{3x + 11}{(x-2)(x+2)} \quad A1$$

Answer ..... [3]

---

13 Solve these simultaneous equations.

$$2x - 3y = 8,$$

$$3x = 5y - 3.$$

Show your working.

$2x - 3y = 8 \quad (1)$

$3x - 5y = -3 \quad (2)$

$(1) \times 3: 6x - 9y = 24 \quad (1N)$

$(2) \times 2: 6x - 10y = -6 \quad (2N)$

$(1N) - (2N)$:

$6x - 9y - 6x + 10y = 24 + 6 \quad M1$

$y = 30 \quad A1$

Sub $y = 30$ into (1)

$2x - 3(30) = 8$

$2x - 90 = 8$

$2x = 98$

$x = 49 \quad A1$

Answer $x =$ .....

$y =$ .....[3]

---

14 Sam needs to travel from Town A to Town B which is 190 km apart.

From Town A, he drove at an average speed of 70 km/h for 45 minutes.

He stopped at a rest station for half an hour and then continued his journey till he reached Town B.

(a) If his average speed is 95 km/h, find the total time he took for his journey.

$$\frac{190}{T} = 95 \quad M1$$

$T = 2$ hours $A1$

Answer ..... h [2]

(b) What is the distance of Town A to the rest station?

$D = 70 \times \frac{3}{4} \quad M1 - convert\ min \quad to\ hr$

$D = 52\frac{1}{2}\ km \quad A1$

Answer ..... km [2]

---

15 **(a)** Write 600 as a product of its prime factors.

2	600
2	300
2	150
3	75
5	25
5	5
	1

M1

$600 = 2^3 \times 3 \times 5^2$ *A1*

Answer ..... [2]

(b) **(i)** Write down the lowest common multiple (LCM) of 21 and 600.

Give your answer as a product of its prime factors.

$2^3 \times 3^2 \times 5^2 \times 7$ B1

Answer ..... [1]

(ii) Is the lowest common multiple from **(b i)** a perfect square? Explain your answer.

Answer ..... No, it is not a perfect square because the power of the base 2 and 7 are not multiple of 2 OR even number. B1 ..... [1]

---

16 **(a)** Express $x^2 - 12x + 8$ in the form $(x - a)^2 - b$.

$x^2 - 12x + 8$

$= x^2 - 12x + \left(\frac{-12}{2}\right)^2 - \left(\frac{-12}{2}\right)^2 + 8$ *M1*

$= (x - 6)^2 - 36 + 8$

$= (x - 6)^2 - 28$ *A1*

Answer ..... [2]

(b) A quadratic graph has the equation $y = x^2 - 12x + 8$.

(i) Hence, write down the coordinate for the turning point of this graph.

$(6, -28)$ B1

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

(ii) Write down the equation of line of symmetry.

$x = 6$ B1

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

---

17 A set of heights in centimetre of 6 students are given.

158 169 188 164 177 164

Rearrange: 158 164 164 169 177 188

(a) State the modal height.

164 cm B1

Answer ..... *cm* [1]

(b) Find

(i) the mean height,

$$\frac{158+169+188+164+177+164}{6} \quad M1$$

$$=\frac{1020}{6}$$

$$=170 \quad A1$$

Answer ..... *cm* [2]

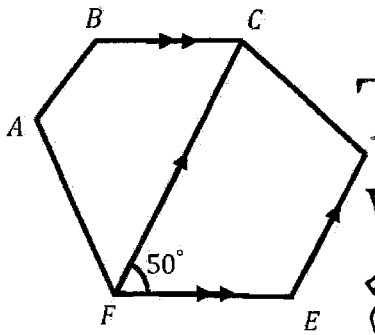
(ii) the median height.

$$\frac{164+169}{2}=166.5 \quad B1$$

Answer ..... *cm* [1]

18 The diagram shows a hexagon $ABCDEF$. FC is parallel to ED and BC is parallel to FE.

Angle $CFE = 50^\circ$.



(a) Find angle FED.

$180^\circ - 50^\circ$ (int angles, FC // ED)

$= 130^\circ$ B1

Answer ..... $^\circ$ [1]

(b) Given that angle CDE is twice angle CFE, find angle FCD.

$ange\ CDE = 100^{\circ\circ}$

$angle\ FCD = 360^\circ - 130^\circ - 100^\circ - 50^\circ = 80^\circ$ B1

Answer ..... $^\circ$ [1]

(c) Josh said that the sum of angle ABC + angle FAB + angle AFC is 230°.

Do you agree with him? Justify your answer with working.

$ange\ BCF = 50^\circ$ (Alt angles, BC//FE)

$Sum\ of\ int\ angle\ of\ hexagon = 720^\circ$

$sum\ of\ 3\ angles = 720^\circ - 360^\circ - 50^\circ = 310^\circ$ B1

Answer .....

..... No, the sum of the three angles is 310°. B1 .....

.... [2]

19 These are the first five terms of a sequence.

$$-13 \quad -18 \quad -23 \quad -28 \quad -33$$

(a) Write an expression, in terms of n, for the n^{th} term of this sequence.

$-5n - 8$ B1

Answer ..... [1]

(b) State whether -100 is a term in the sequence.

$$-5n - 8 = -100$$

$$-5n = -92$$

$$n = 18\frac{2}{5}$$

Answer .....

No, since n is not a positive integer, hence -100 is not a term in the sequence. B1

OR

The term -100 does not have the last digit as 8, the pattern shows that all terms in sequence has last digit 8. Hence -100 is not a term in the sequence.

[1]

(c) The sequence in part **(a)** is squared to form a new sequence.

Find the new sequence in terms of n.

$(-5n - 8)^2$

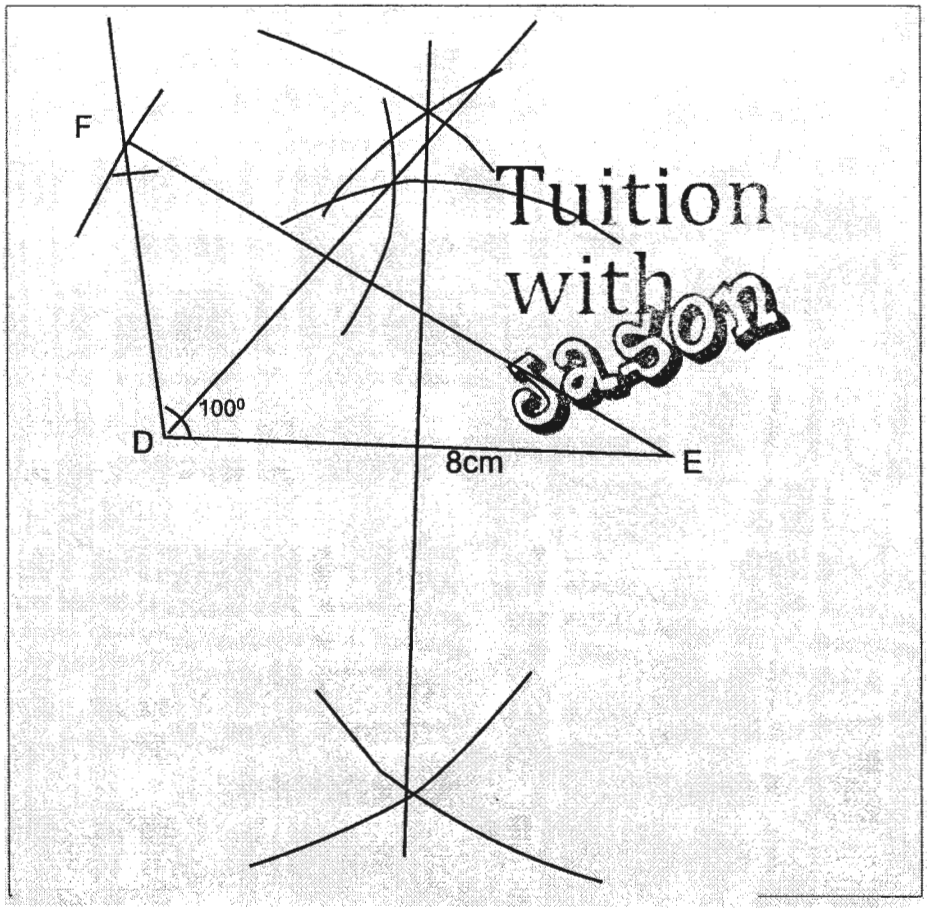
$= (-5n - 8)(-5n - 8)$

$= 25n^2 + 40n + 40n + 64$ *M1*

$= 25n^2 + 80n + 64$ *A1*

Answer ..... [2]

20 DEF is a triangle with $DE = 8\ cm, EF = 10\ cm$ and $EDF = 100^{\circ}$.



(a) Construct the triangle DEF. DE has been drawn for you. [2]

(b) Construct a line that is equidistant from

(i) point D and point E, [1]

(ii) line DF and DE. [1]

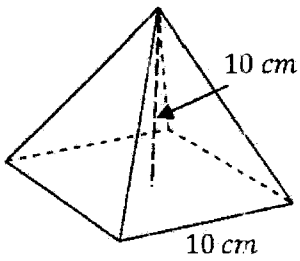
(c) X is the point where both the line from **(bi)** and **(bii)** intersect.

Measure XE.

6.2 cm B1

Answer ..... *cm* [1]

21 A solid square pyramid has side and perpendicular height of length $10\ cm$.




Radius: 2 cm

(a) The square pyramid is melted to form spheres of radius $2\ cm$.

Calculate the number of complete spheres formed?

$$Volume\ of\ square\ pyramid: \frac{1}{3} \times 10^2 \times 10 = 333\frac{1}{3}\ cm^3$$

$$Volume\ of\ sphere: \frac{4}{3}\pi r^3 = \frac{4}{3} \times \pi \times 2^3 = 33.51032164 \quad M1$$

$$No.\ of\ Sphere: \frac{333\frac{1}{3}}{33.51032164} = 9.947183943 \approx 9\ complete\ spheres \quad B1$$

Answer ..... [2]

(b) All the spheres are painted with two coats of paint.

One tin of paint can paint an area of $100\ cm^2$.

How many tins are required to paint all the spheres?

$$Total\ surface\ area\ of\ one\ sphere: 4\pi r^2 = 4 \times \pi \times (2)^2 = 50.26548246\ cm^2 \quad M1$$

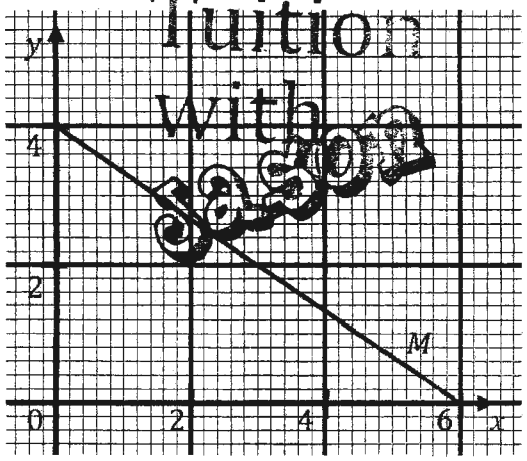
$$Total\ surface\ area\ of\ 9\ spheres\ with\ 2\ coats\ of\ paint:$$

$$9 \times 2\ coat \times 50.26548246 = 904.7786842\ cm^2 \quad M1$$

$$No\ of\ tin: \frac{904.7786842}{100} = 9.047786842 \approx 10\ tins\ (round\ up) \quad A1$$

Answer ..... [3]

22 Line M is shown on the grid.



(a) Linda says the gradient of the graph is $\frac{2}{3}$. John says the gradient of the graph is $-\frac{2}{3}$.

Whose answer is correct? Explain why.

Answer John B1 is correct.

John is correct because the line is downward sloping. This means it is a negative gradient. B1

[2]

(b) Another line, Q, passes through the point (2, 2) on the grid. Line Q is parallel to line M. Find the equation of line Q.

$y = -\frac{2}{3}x + c$

$2 = -\frac{2}{3}(2) + c$ M1

$2 + \frac{4}{3} = c$

$c = 3\frac{1}{3}$ M1

$y = -\frac{2}{3}x + 3\frac{1}{3}$ A1

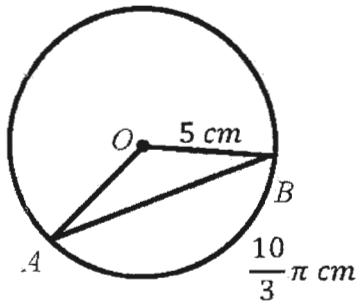
Answer ..... [3]

(c) Find the distance between the points where the line M touches both the x-axis and y-axis.

$\sqrt{(0-6)^2 + (4-0)^2} = 7.211102551 \approx 7.21(3sf)$ B1

Answer ..... [1]

23



The diagram shows a circle with radius 5 cm and minor arc length $\frac{10}{3}\pi$ cm.

(a) Find obtuse angle AOB.

$$\frac{\theta^\circ}{360^\circ} \times 2 \times \pi \times 5 = \frac{10}{3}\pi \quad M1$$

$$\theta^\circ = 120^\circ \quad A1$$

Answer .....° [2]

(b) Find the area of the minor segment.

$$Area\ of\ sector: \frac{120^\circ}{360^\circ} \times \pi \times 5^2 = \frac{25}{3}\pi = 26.17993878\ cm^2 \quad M1$$

$$Area\ of\ triangle\ AOB = \frac{1}{2} \times 5^2 \times sin120^\circ = 10.82531755\ cm^2\ M1$$

$$Area\ of\ minor\ segment: 26.17993878 - 10.82531755$$

$$= 15.35462123 \approx 15.4\ cm^2 (3sf) \quad A1$$

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

(c) Find the probability that a point is drawn in the minor segment.

Give your answer to 3 decimal places.

$$\pi \times 25 = 78.53981634\ cm^2 \quad M1$$

$$Probabilty: \frac{15.35462123}{78.53981634} = 0.1955011094 \approx 0.195(3dp) \quad A1$$

Answer ..... [2]

HILLGROVE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR (NORMAL ACADEMIC)

CANDIDATE NAME	ANSWER ( )	CLASS	[ ] - [ ]
CENTRE NUMBER	S [ ] [ ] [ ] [ ]	INDEX NUMBER	[ ] [ ] [ ] [ ]

MATHEMATICS **4045/02**

Paper 2 **2 August 2022**

2 hours

Candidates answer on the Question Paper. **8.10 AM to 10.10 AM**

READ THESE INSTRUCTIONS FIRST

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

Section A
Answer **all** questions.

Section B
Answer **one** question.

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

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 total number of marks for this paper is 60.

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, either use your calculator value or 3.142.

For Examiner's Use	
Total	/ 60

Parent's/ Guardian's Signature: _____

Setter: Mrs Valerie Loh

This document consists of **15** 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

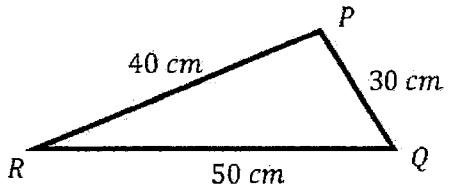
$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$

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

Section A (52 marks)

Answer **all** the questions in this section.

1 The diagram show triangle PQR with $PR = 40\ cm$, $PQ = 30\ cm$ and $QR = 50\ cm$.



(a) Determine if triangle PQR is a right-angled triangle.

$40^2 + 30^2 = 2500$

$50^2 = 2500$ $M1$

$Since\ 50^2 = 40^2 + 30^{\circ}$, by the converse of pythagras' theorem, triangle PQR is a right-angled triangle. A1

[2]

(b) The line PQ is produced to a point E. Find the value of $\sin R\hat{Q}E$.

$\frac{40}{50} = \frac{4}{5}$ $B1$

Answer .....[1]

---

2 A cat was found at the top of a tree that is 3.5 m.

A 5 m ladder is placed on the tree to help bring the cat down.

(a) What is the angle of elevation of the cat from the ground?

$\sin\theta^{\circ} = \frac{3.5}{5}$

$\theta^{\circ} = sin^{-1}\left(\frac{3.5}{5}\right)$ $M1$

$\theta^{\circ} = 44.427004 \approx 44.4^{\circ}(1dp)$ $A1$

Answer .....° [2]

(b) Find the distance of the foot of the ladder to the tree.

By Pythagoras' Theorem: $x = \sqrt{5^2 - 3.5^2}$

$5^2 = x^2 + 3.5^2$ $M1$

$x^2 = 5^2 - 3.5^2$

$x = 3.570714214$

$x \approx 3.57\ m(sf)\ A1$

Answer ..... m [2]

---

3 A playground is drawn in a map to the scale of 1 : 175.

(a) A slide and swing are 2.5 cm apart on the map.

Find the actual distance between the slide and swing.

$1\ cm : 1.75\ m$

$2.5\ cm : 1.75 \times 2.5 = 4.375\ m$ M1 / A1 - exact

Answer ..... m [2]

(b) The actual playground has an area of 280 m^2.

Find the area on the map.

$(1\ cm)^2 : (1.75\ m)^2$

$1\ cm^2 : 3.0625\ m^2$ M1

$\frac{1}{3.0625} \times 280 = 91\frac{3}{7}\ cm^2 : 280\ m^2$ A1

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

---

4 $$3r = \sqrt{\frac{a}{b+1}}$$

(a) Rearrange the formula to make b the subject.

$3r = \sqrt{\frac{a}{b+1}}$ $\quad 9r^2(b+1) = a$ M1

$(3r)^2 = \frac{a}{b+1}$ M1 $\quad b + 1 = \frac{a}{9r^2}$

$9r^2 = \frac{a}{b+1}$ $\quad b = \frac{a}{9r^2} - 1$ A1

Answer b = ... [2]

(b) Hence or otherwise, find the value of b when $a = 300$ and $r = 4.5$.

Leave your answer as a rational number.

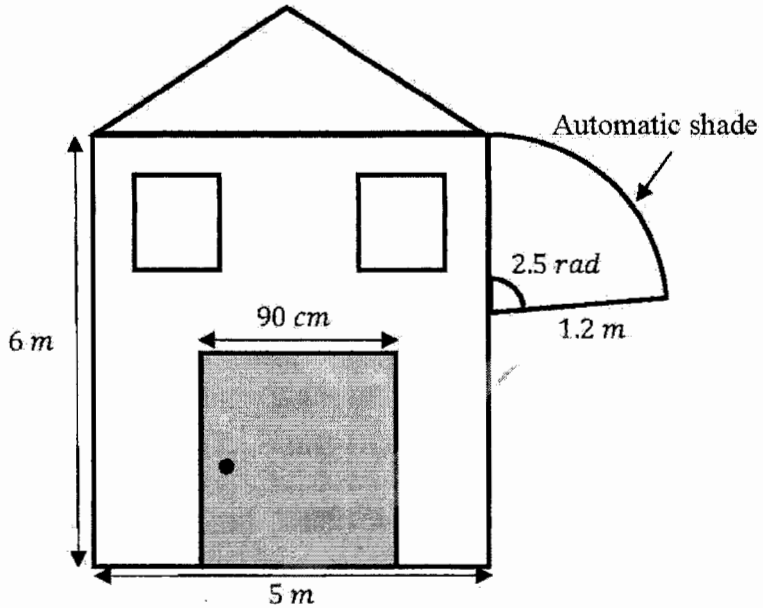
$b = \frac{300}{9(4.5)^2} - 1$ M1 – *show substitution*

$b = \frac{157}{243}$ A1

Answer b = ... [2]

---

5 This is a front view of a house.



Front view of house

(a) The house has width 5 m and height of 6 m.

The door is similar to the front view of the house. The width of the door is 90 cm.

Calculate the height of the door. Give your answer in metres.

$$\frac{h}{6} = \frac{0.9}{5}$$

$$h = \frac{0.9}{5} \times 6$$

$h = 1.08\ m$ A1

Answer ..... m [2]

(b) The owner is going to build an automatic shade.

The angle of the shade when fully opened is 2.5 rad. It has a radius of 1.2 m.

If the shade takes a minute to completely open, what is the speed at which it opens?

Give your answer in metre per seconds.

Arc length: $1.2 \times 2.5 = 3\ m$ M1

$Speed = \frac{3}{60} = 0.05\ m/s$ A1

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

6 Jacky and family are going for a holiday to Japan.

He would like to change S$ 3250 to Japanese Yen (¥).

(a) If the exchange rate is S$ 100 : ¥9885.24, how much Japanese Yen will Jacky get?

$S\$100 : Yen\ 9685.23$

$S\$3250: \frac{9885.24}{100} \times 3250 = Yen\ 321270.3 \approx Yen\ 321270.30\ (2\ dp) \quad M1, A1$

Answer ¥..... [2]

(b) In Japan, Jacky saw a vintage radio selling at ¥ 25 000. There was a discount of 20%. Calculate how much Jacky will need to pay for this vintage radio.

$100\% : yen\ 25\ 000$

$80\%: \frac{25000}{100} \times 80 = yen\ 20\ 000 \quad M1, A1$

Answer ¥..... [2]

(c) When he returned to Singapore, he sold the vintage radio to another friend at S$ 300 The exchange rate was ¥100 : S$1.05. Did he sell it at a profit or loss? Justify your answer with working.

$Yen\ 100 : S\$1.05$

$Yen\ 20\ 000 = \frac{1.05}{100} \times 20\ 000 = \$210 \quad M1$

$Sold\ at\ a\ prof \quad A1$

Answer He sold it at a ..... [2]

(d) Calculate the amount he paid in Singapore dollars as a percentage of the price he sold to his friend. Give your answer to the nearest percentage.

$\frac{328.125}{300} \times 100\% = 109.375 \approx 109\%\ M1, A1$

Answer ..... % [2]

7 The total cost for y number of mouse pad is \$100. The number of thumb driveis 3 less than the number of mouse pad. The total cost for all the thumb drives is \$170.

(a) Find in term of y the cost of

(i) one mouse pad,

$\frac{100}{y}$ *B1*

Answer \$ ..... [1]

(ii) one thumb drive.

$\frac{170}{(y-3)}$ *B1*

Answer \$ ..... [1]

(b) The total cost for one mouse pad and one thumb drive is \$15.

Write down an equation in y and show that it simplifies to $y^2 - 21y + 20 = 0$.

$$\frac{100}{y} + \frac{170}{(y-3)} = 15 \quad M1$$

$$\frac{100(y-3) + 170y}{y(y-3)} = 15$$

$$100y - 300 + 170y = 15y(y-3) \quad M1$$

$$270y - 300 = 15y^2 - 45y$$

$$0 = 15y^2 - 270y - 45x + 300$$

$$15y^2 - 315y + 300 = 0$$

$$y^2 - 21y + 20 = 0\ (Shown) \quad A1$$ [3]

(c) Solve $y^2 - 21y + 20 = 0$.

$y^2 - 21y + 20 = 0$ $y = 1$ *or* $y = 20$ *A1*

y	-1	$-y$
y	-20	$-20y$
y^2	20	$-21y$

M1 for factorisation

$(y-1)(y-20) = 0$

Answer y = ... or ..... [2]

(d) Explain why one of the answer cannot be accepted.

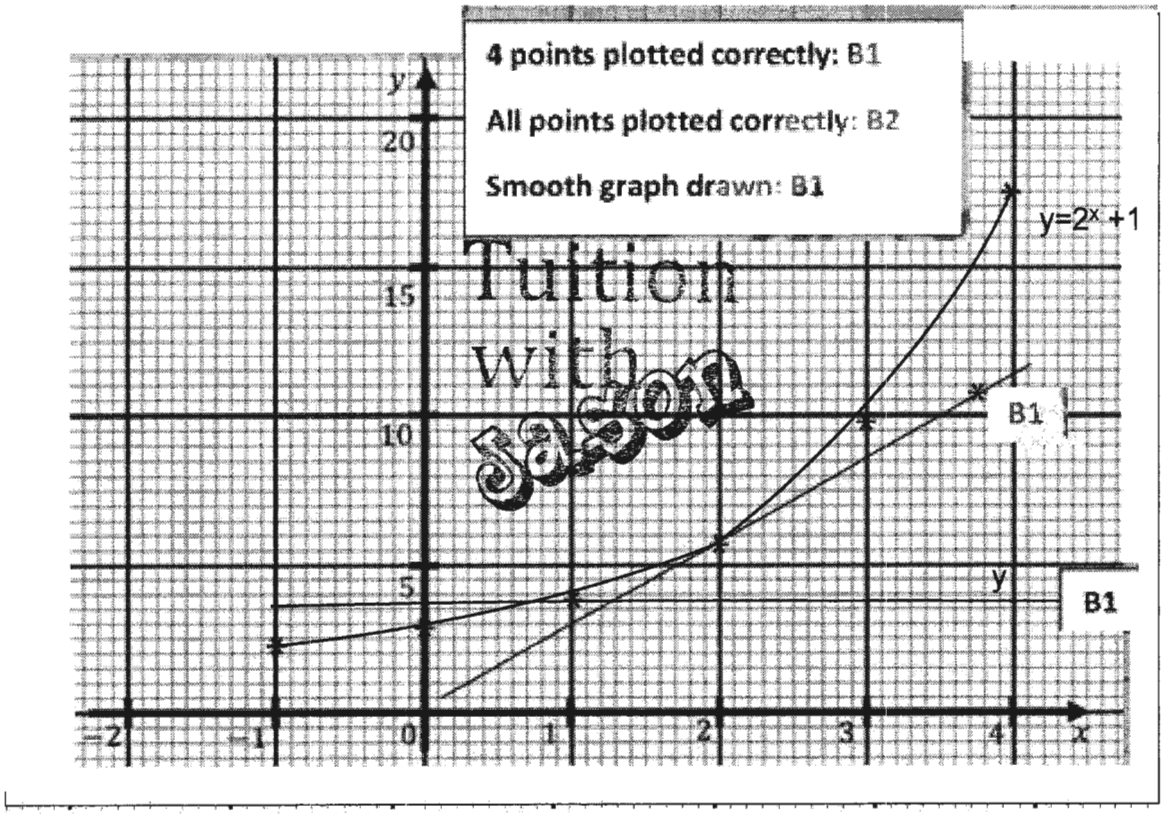
Answer .. When 1 subtract 3 it will get a negative number. The number of pointer cannot be negative. B1 .... [1]

8 **(a)** Complete the table of values for $y = 2^x + 1$.

x	-2	-1	0	1	2	3	4
y	1.25	1.5	2	3	5	**9**	**17**

[2]

(b) Draw the graph of $y = 2^x + 1$ for $-2 \leq x \leq 4$.



[3]

(c) By drawing a suitable line, find the value of x when $2^x - 2 = 0$.

$2^x - 2 + 3 = 3$

$2^x + 1 = 3$

$y = 3 \quad B1 - draw\ line\ on\ graph$

$x = 1 \quad B1$

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

(d) By drawing a suitable tangent, find the gradient of the curve when $x = 2$.

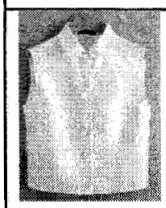
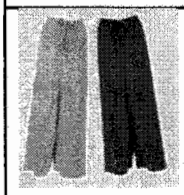
$\frac{10 - 1}{3.8 - 0.5} = 2.727272727 \approx 2.73(3sf) \quad B1$

Draw tangent on graph ---- B1

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

9 The following shows some information on an online shopping portal.

Mrs Tan is a dance teacher and she is looking at the following costumes to be bought for her dancers.

Item	Price	Colours and Size
 Solid Hem Dress Review: 4 ★	$ 15.90 **SPECIAL:** White piece 7.7 sales: *$10 now* (10% off for more than 10 pieces for **all** colours)	Colour: Black, White, Pink and Blue Size: XS, S, M, L
 Cotton blouse Review: 3.4 ★	$9.00 (Buy 4 get one free)	Colour: Pink, Blue, Green, Black and White Size: XS, S, M, L
 Pants Review: 5 ★	$12.00	Colour: Green and Beige Size: XS, S, M, L
 Maxi Skirt Review: 5 ★	$20	Colour: Pink, Blue an Brown Size: XS, S, M, L

Discounts		
10% off On orders of $60 and above.	15% off On orders of $200 and above.	20% off On orders of $300 and above.
Points deduction	Every 100 points - $10 deduction.	
All purchases final cost will be round down to the nearest dollars		

Shipping	**Standard (> 2 weeks)**	**Express**
(Shipping cost is based on final cost)	$1.50	$ 2.00
	Free with purchases above $150 after any discount.	Free with purchases above $200 after discount.

(a) Mrs Tan needs to buy 5 pieces of each colour for the solid hem dress and she needs it to be delivered within 2 weeks. She has 300 points that she can use for deduction. Calculate the total cost for these dresses to be shipped over.

White colour: \$10 × 5 = \$50

Other colours: \$15.90 × 3 *colour* × 5 *pieces each colour* = \$238.50

Total: \$50 + \$238.50 = \$288.50 *M*1

Discounted price for dress: 90% × \$2388.50 = \$259.65 *M*1

Discounted price for over \$200: 85% × \$259.65 = \$220.7025 *M*1

Minus the points deduction: \$220.7025 − \$30 = \$190.7025 ≈ \$190 *M*1

Total plus express shipping cost: \$190 + \$2 = \$192 *A*1

Answer \$ ..... [5]

(b) Mrs Tan have a balance budget of \$200. She would like to purchase 5 pink cotton blouse, 5 green pants and 5 blue maxi skirts. She has no more points to deduct after the purchase of the solid hem dress and she is not in a hurry to receive these items. Will the budget be enough for this purchase? What is the total cost for this purchase? Justify your answer with working.

5 *blouse*: \$9 × 4 = \$36

5 *pants*: \$12 × 5 = \$60

5 *Maxi skirts* = \$20 × 5 = \$100

M1-the cotton blouse to x by 4 OR any one of the item amount is correct

Total: \$36 + \$60 + \$100 = \$196 *M*1

Discounted price for over \$60: 90% × \$196 = \$176.40 ≈ \$176 *A*1

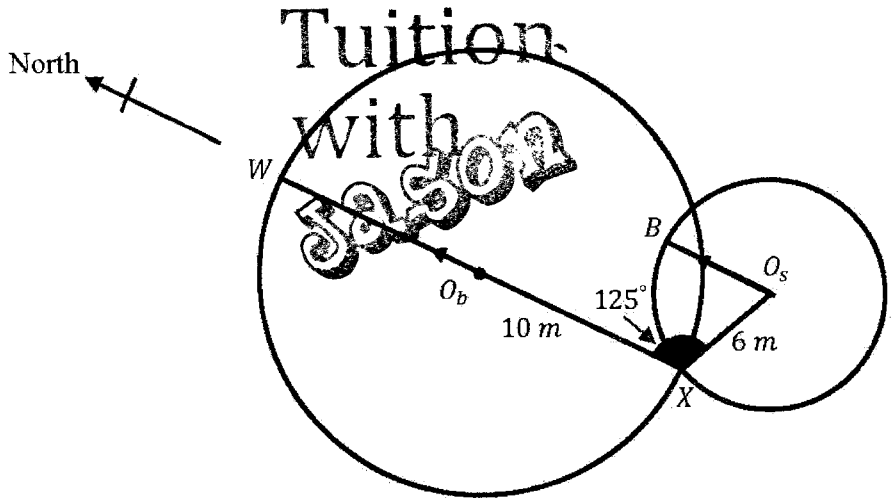
Free shipping

Answer ..... the budget is enough, the total cost for this purchase is \$..... [3]

Section B (8 marks)

Answer **one** question from this section. Each question carries 8 marks.

10 The following shows two radio towers O_b and O_s on level ground.



The radio tower are the centre of two circles.

The large circle has centre O_b and radius 10 m.

The small circle has centre O_s and radius 6 m.

The two circles touches at point X and WX is the diameter of the large circle.

XW is parallel to O_sB.

(a) Given that angle $WXO_s = 125^\circ$, calculate the distance between the centre of both the circles.

Let y be the distance between the two centre.

By cosine rule:

$y^2 = 10^2 + 6^2 - 2(10)(6)cos125^\circ$ $M1$

$y^2 = 136 - 120cos125^\circ$

$y^2 = 204.8291724$

$y = \sqrt{204.8291724}$

$y = 14.31185426 \approx 14.3\ m\ (3sf)$ $A1$

Answer ..... m [2]

(b) A person is located somewhere on the larger circle. He is 12 m from point W and 16 m away from point X. Determine which part of the circle is this person located.

$20^2 = 400$

$16^2 + 12^2 = 400$ *M1*

Since $20^2 = 16^2 + 12^2$,

by the converse of pythagoras theorem,

WPX is a right-angled triangle. *A1*

The person is on the circumference of the large circle because angle in a semi circle is90 deg. A1

By Cosine rule:

$20^2 = 16^2 + 12^2 - 2(10)(12)\cos\theta$

$400 = 256 + 144 - 384\cos\theta$

$0 = -384\cos\theta$

$\cos\theta = 0$

$\theta = 90^\circ$

[2]

(c) A point A is located on the circumference of the smaller circle. AB is the diameter of the small circle. Find angle XAB. Give reasons for your answers.

angle $XO_2B = 180^\circ - 125^\circ = 55^\circ$ *M1 (int angle, XW//O2B)*

angle $XAB = \frac{55^\circ}{2} = 27.5^\circ$ *A1* (angle at centre is twice angle at circumference)

Correct reason – M1

Answer ..... ° [3]

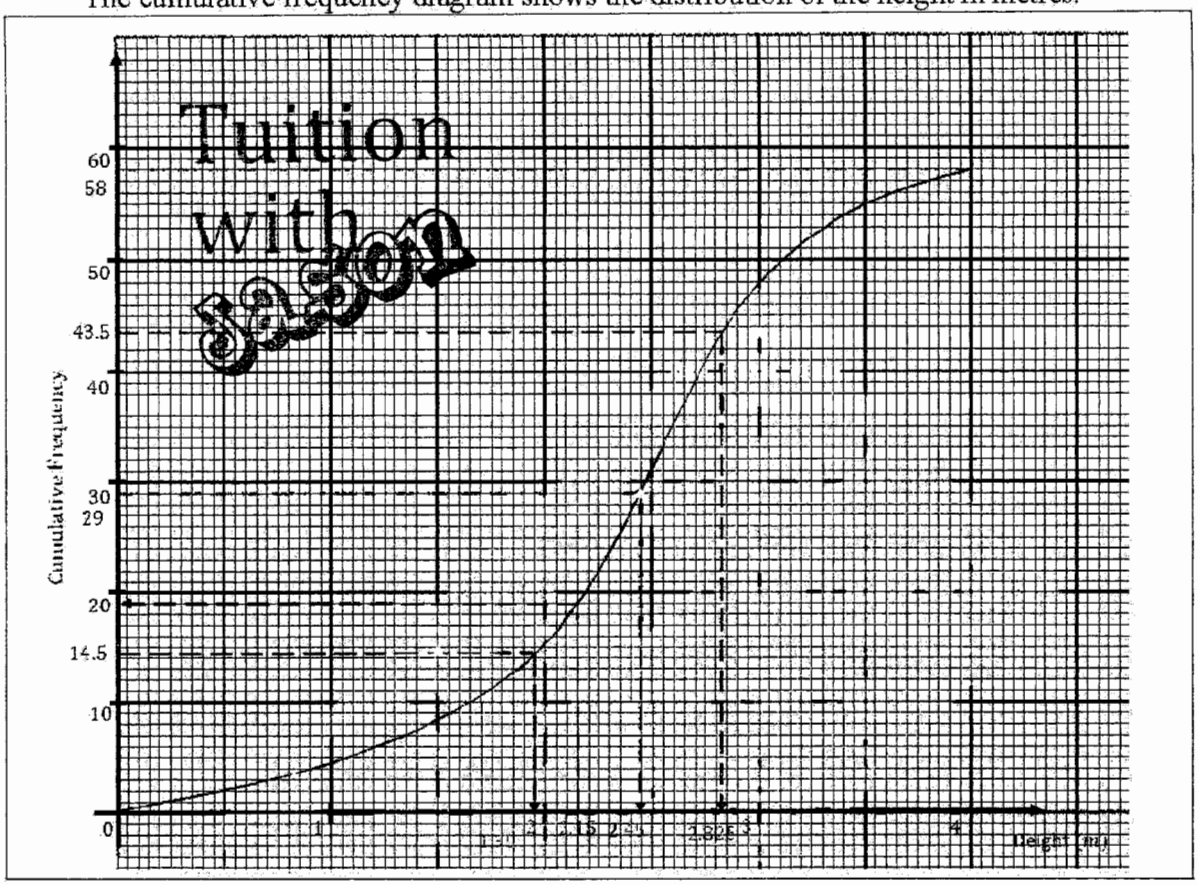
(d) Given that W is the North of X, find the breaing of X from the centre of the small circle.

Bearing of X from $O_2 = 180^\circ + 125^\circ = 305^\circ$ *B1*

Answer ..... ° [1]

11 **(a)** A botanist measured the height of trees in the park A.

The cumulative frequency diagram shows the distribution of the height in metres.



Use the graph to find

(i) the inter-quartile range,

UQ: $\frac{75}{100} \times 58 = 43.5$ $\quad$ $UQ\ height$: 2.825

LQ: $\frac{25}{100} \times 58 = 14.5$ $\quad$ $LQ\ height$: 1.957 $\quad$ M1 – find either UQ or LQ

$Interquartile\ range$: $2.825 - 1.95 = 0.875$ or $\frac{7}{8}$ $\quad$ $A1$

Answer ..... m [2]

(ii) the number of trees that are more than 2.15 m.

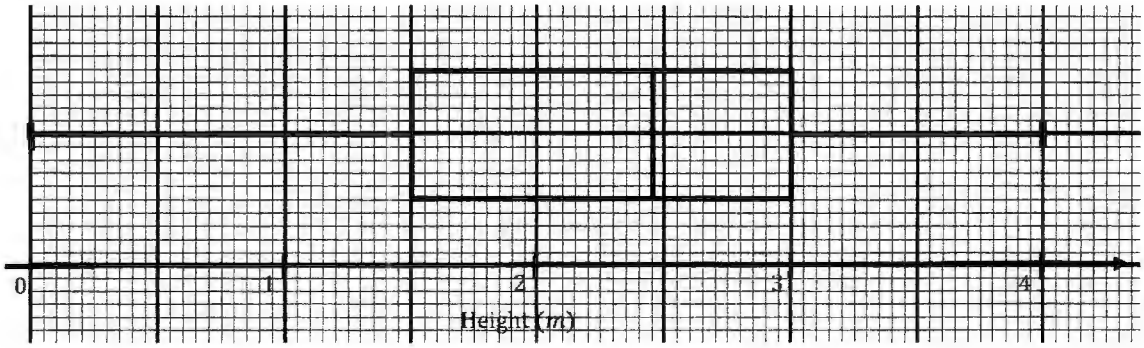
Trees less than 2.15 m: 19

Trees more than 2.15 m: 58 – 19 = 39 B1

Answer ..... [1]

(iii) The box-and-whisker plot shows the height of trees in Park B.

Explain how the shape of the cumulative frequency diagram will differ as compared to the shape of the cumulative frequency diragram of Park A.



Answer ... As the lower quartile is lower than Park A, the graph will be on the left side of original graph. Both median are the same hence it will pass through the same median. As the upper quartile is larger than Park B, the graph will be to the right of the original graph. Park B graph will also end at the same point as the original graph. B1 ... [1]

(b) Box *A* have 3 cards with the number 2, 3 *and* 5.

Box *B* have 4 cards with the number 1, 3, 5 *and* 7.

(i) Complete the table below to show the possible sums.

Box *B*

Box *A*	+	1	3	5	7
	2	3	5	7	9
	3	4	6	**8**	**10**
	5	6	**8**	**10**	**12**

[2]

(ii) Find the probability that the sum of two cards is a prime number.

$\frac{3}{12} = \frac{1}{4}$ *B1*

Answer ..... [1]

(iii) Find the probability that the sum of the the two cards is greater than 12.

0 *B1*

Answer ..... [1]