YUAN CHING SECONDARY SCHOOL
Secondary Four Normal (Academic) Course
Preliminary Examination 2024

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS **4045/01**

Paper 1 **5 August 2024**

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 staple, paper clips, highlighters, 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 number of marks for this paper is 70.

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.

	MARKS
Total	/ 70

This paper consists of **20** printed pages.

[Turn Over]

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Answer **all** the questions.

1 $-4.4 \quad -2.1^2 \quad \pi \quad \frac{22}{7} \quad \sqrt[3]{27}$

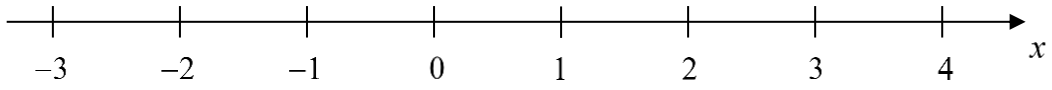
Write these numbers in order of size, starting with the smallest.

Answer ……, ……, ……, ……, …… [2]
smallest

---

2 **(a)** Represent $-1 < x \leq 3$ on the number line below.

Answer



[1]

(b) Solve the inequality $-3x \leq 7$.

Answer …… [1]

(c) State the smallest integer that satisfy $-3x \leq 7$.

Answer …… [1]

---

3 2940 expressed as a product of its prime factors is $2^2 \times 3 \times 5 \times 7^2$.

(a) Express 504 as a product of its prime factors.

Answer ..... [1]

(b) Find the lowest common multiple of 2940 and 504.

Answer ..... [1]

(c) Find the smallest integer *k* such that 2940k is a perfect square.

Answer ..... [1]

---

4 Which of these ratio(s) are equivalent to the ratio $a:b$?

$a^b : b^a$ $\quad$ $a^2 : b^2$ $\quad$ $4a : 4b$ $\quad$ $\frac{1}{b} : \frac{1}{a}$ $\quad$ $a+2 : b+2$

Answer ..... [2]

---

5 Gracia has a map drawn to a scale $1:25\,000$.

(a) Rewrite the scale in the form 1 cm to x km.

Answer ……cm to ……..…km [1]

(b) A road on the map is 13 cm long.
Find the actual length of the road in kilometres.

Answer …… km [1]

(c) A plot of land has an area of 120 km^2.
Find the area of the plot of land on the map in square centimetres.

Answer …… cm^2 [2]

6 $x^2 + 6x - 2 = (x + a)^2 + b$

(a) Find the value of a and b.

Answer a = ……, b = …… [2]

(b) Hence, solve $x^2 + 6x - 2 = 0$.
Give your answers correct to 2 decimal places.

Answer x = ……, x = …… [2]

7 $v = 3w + 8u^2$

(a) Find v when $w = 4$ and $u = -2$.

Answer $v =$ ..... [1]

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

Answer ..... [2]

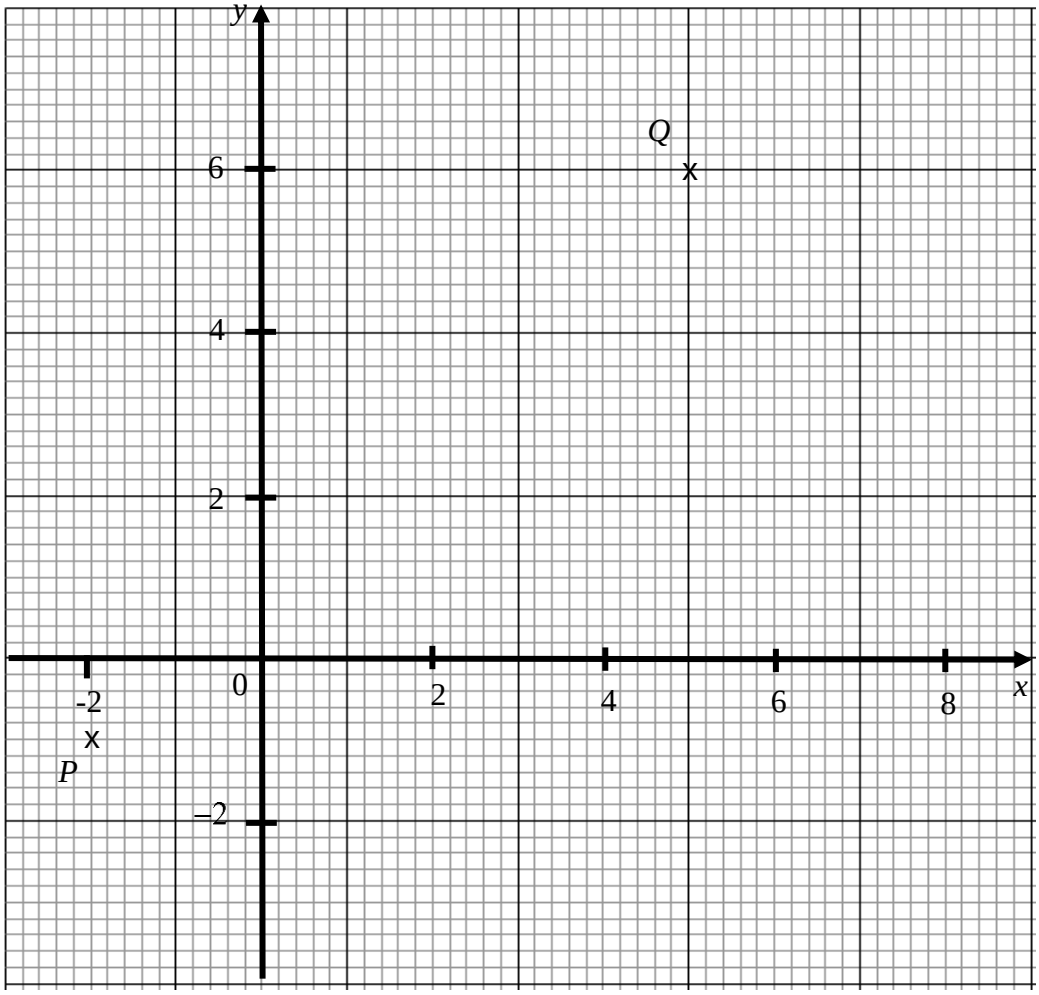
---

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

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

---

9 P is the point $(-2,-1)$ and Q is the point $(5,6)$.



(a) Find the length of PQ.

Answer ..... units [1]

(b) R is the point $(8,k)$.
Given that the gradient of QR is -3, find the value of k.

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

(c) Find the equation of line QR.

Answer ..... [2]

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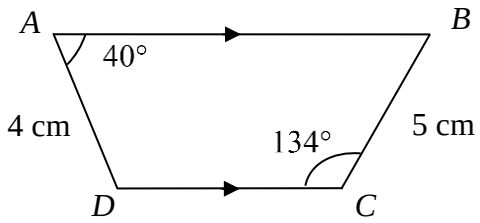
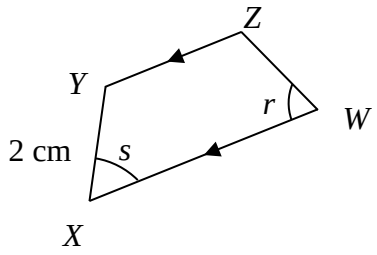
10 In the diagram below, $ABCD$ is similar to $WXYZ$.
AB is parallel to CD.





(a) Find the value of r.

Answer $r =$ .....° [1]

(b) Find the value of s.

Answer $s =$ .....° [1]

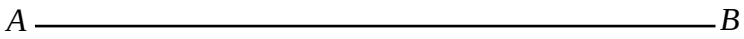
(c) Find the length of WZ.

Answer ..... cm [2]

---

11 ABC is a triangle with AB = 9 cm, angle $BAC = 45°$ and angle $ABC = 70°$.

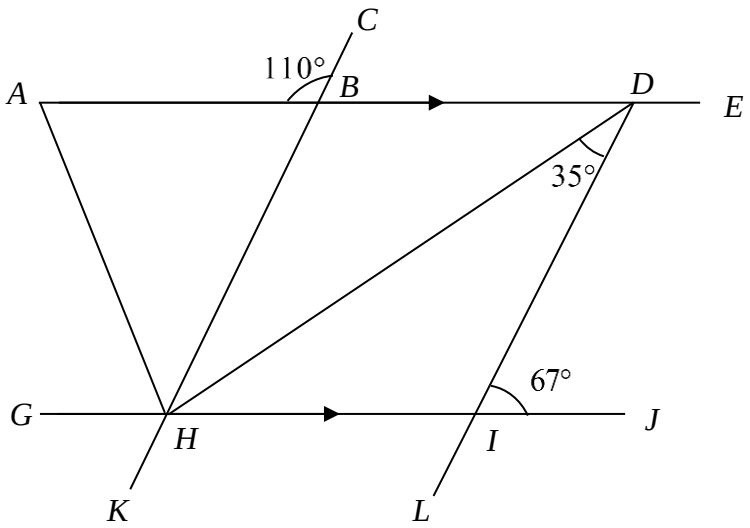
(a) Construct triangle ABC.
AB has been drawn for you.



[2]

(b) The perpendicular bisector of AB and the angle bisector of ACB meet at point T.
Label point T. [2]

12 *AE*, *GJ*, *CK* and *DL* are straight lines.
AE and *GJ* are parallel to each other.
Angle $DIJ = 67°$, angle $HDI = 35°$, angle $ABC = 110°$.



Find, stating reasons,

(a) **(i)** angle *HBD*,

Answer ..... ° [1]

(ii) angle *DHI*.

Answer ..... ° [2]

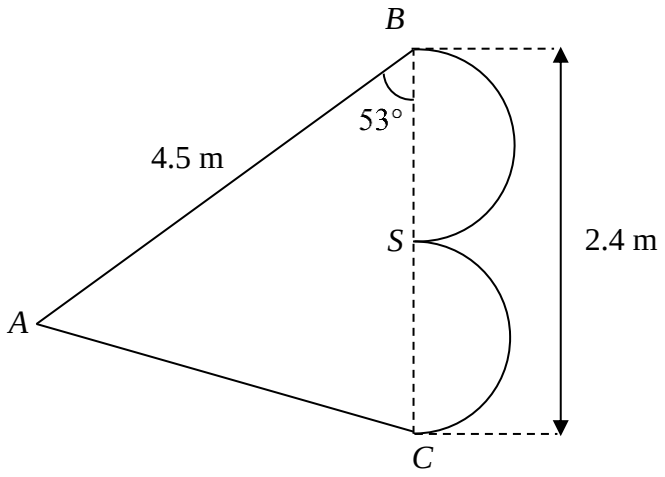
(b) Is *BDIH* a parallelogram?
Explain and show your working clearly.
Answer

.....

.....

..... [1]

13 A playground is made up of a triangle *ABC* and two congruent semicircles with diameter *BS* and *SC* respectively.
Angle $ABC = 53°$, $AB = 4.5$ m and $BC = 2.4$ m.



(a) Calculate the perimeter of the playground.

Answer …… m [3]

(b) (i) Calculate the area of the playground.

Answer …… m^2 [3]

(ii) Convert your answer in **(b)(i)** to cm^2.

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

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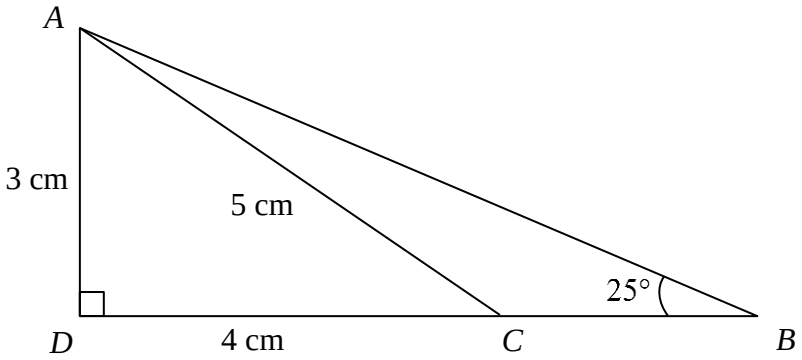
14 In the diagram below, angle $ADB = 90°$, angle $ABD = 25°$.
$AC = 5$ cm, $AD = 3$ cm and $DC = 4$ cm.



(a) Find the exact value of $\cos ACB$.

Answer ..... [1]

(b) Calculate *BC*.

Answer ..... cm [2]

---

15 Mrs Leow wishes to invest $5000 in the bank for 6 years.
She has researched and found two options.

Bank A	Bank B
Simple interest at 2.5% per annum.	Compound interest at 2.4% per annum, compounded yearly.

Which bank should Mrs Leow invest in?
Show your working to support your answer.

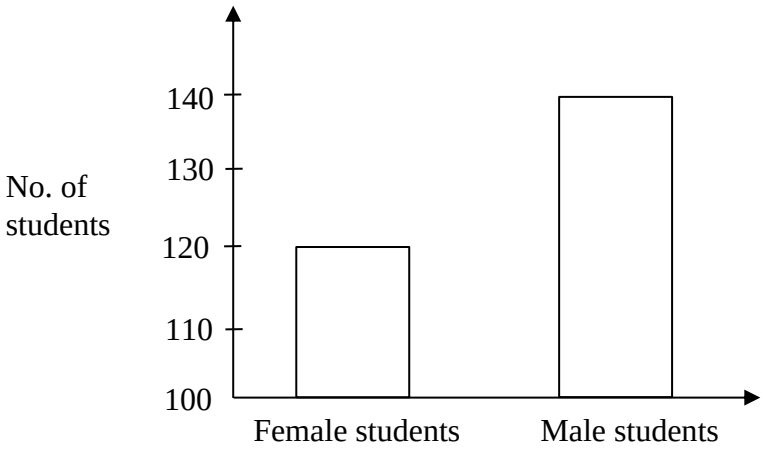
Answer

Mrs Leow should invest in Bank …… because …….

…….

……. [4]

16 The following bar graph shows the number of male and female students who spends more than five hours on their phones per day.



State one feature of the bar graph that is misleading and explain why.

Answer

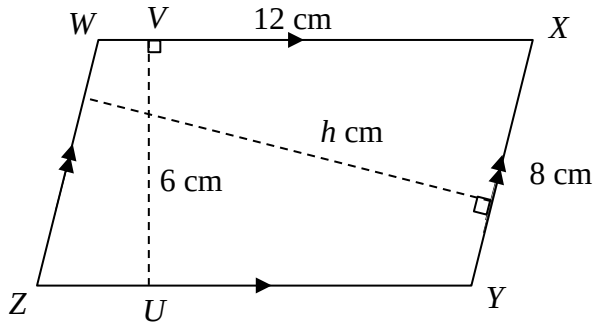
……

……

…… [1]

---

17 The diagram shows parallelogram *WXYZ*.
$WX = 12$ cm, $XY = 8$ cm and $VU = 6$ cm.
Find the length of *h*.



Answer …… cm [2]

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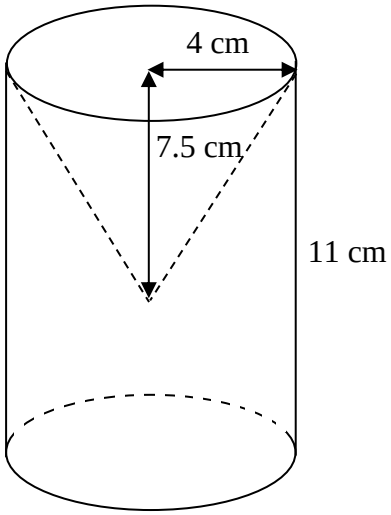
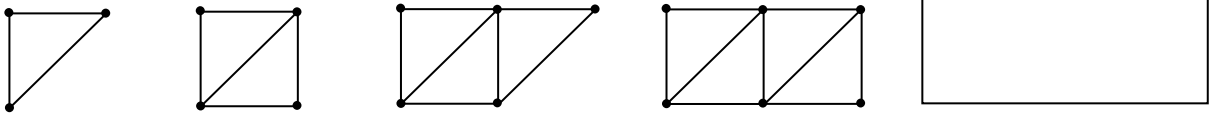
18 The diagram shows a solid formed by removing a cone from a cylinder.



The cylinder and the cone have a common radius of 4 cm.
The height of the cone is 7.5 cm, and the height of the cylinder is 11 cm.
Calculate the volume of the solid.

Answer …… cm^3 [3]

19 The diagram below shows a pattern created using match sticks.



Pattern 1 Pattern 2 Pattern 3 Pattern 4 Pattern 5

(a) Draw pattern 5 in the box above. [1]

(b) Write down an expression, in terms of n, for the number of sticks in pattern n.

Answer …… [1]

(c) Will there be a pattern number with 100 match sticks?
If yes, find the pattern number.
Otherwise, explain why no such pattern number exists.

Answer

……

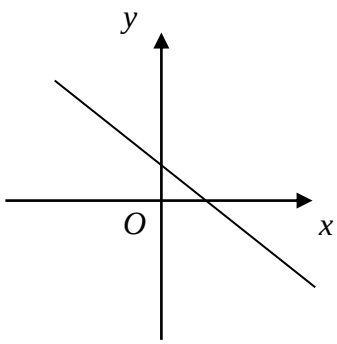
……

…… [1]

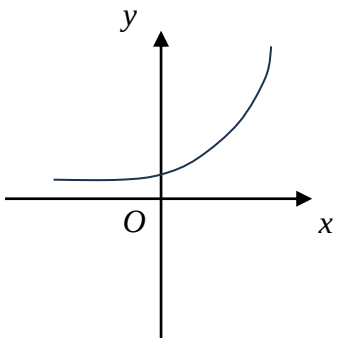
20 Match the following functions to their graphs.

A: $y = -\frac{3}{x}$

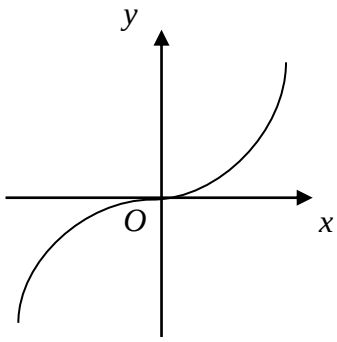
B: $y = 2^x$



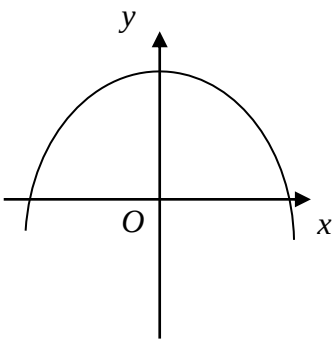
Graph 1



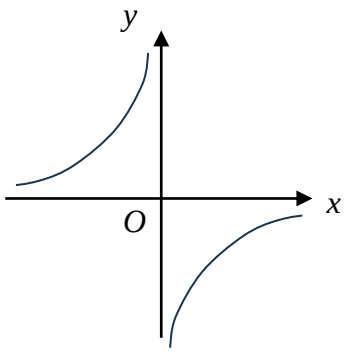
Graph 2



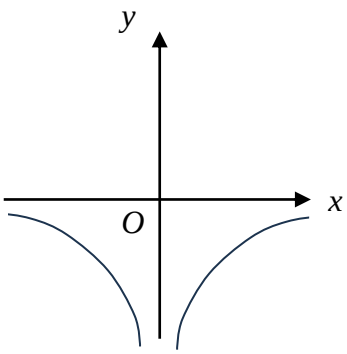
Graph 3



Graph 4



Graph 5

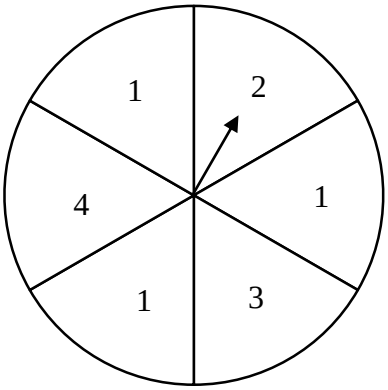


Graph 6

Answer **A:** Graph …… [1]

B: Graph …… [1]

21 A stall runs a spinner game at a fair.



Each player will spin the wheel twice.
Find the probability that

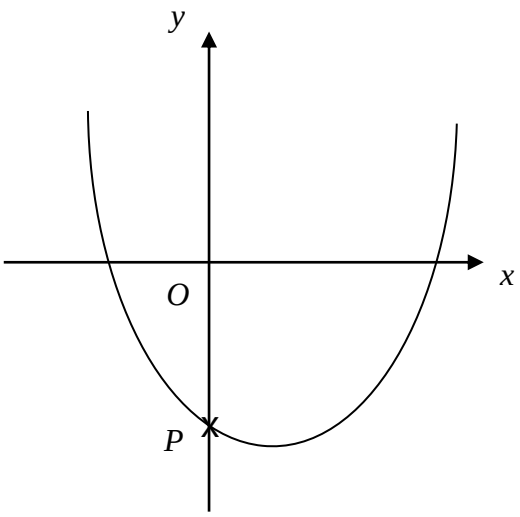
(a) the spinner will land on odd numbers on both spins.

Answer …… [1]

(b) the total score of both spins is greater than 6.

Answer …… [2]

22 The diagram shows a sketch of the graph $y = (x+3)(x-5)$.



(a) Find the coordinates of point P.

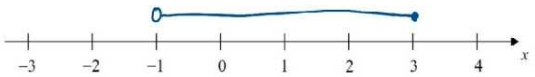
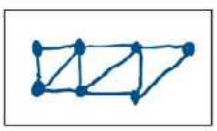
Answer P (…….. , ……..) [1]

(b) State the equation of the line of symmetry of the graph.

Answer …… [1]

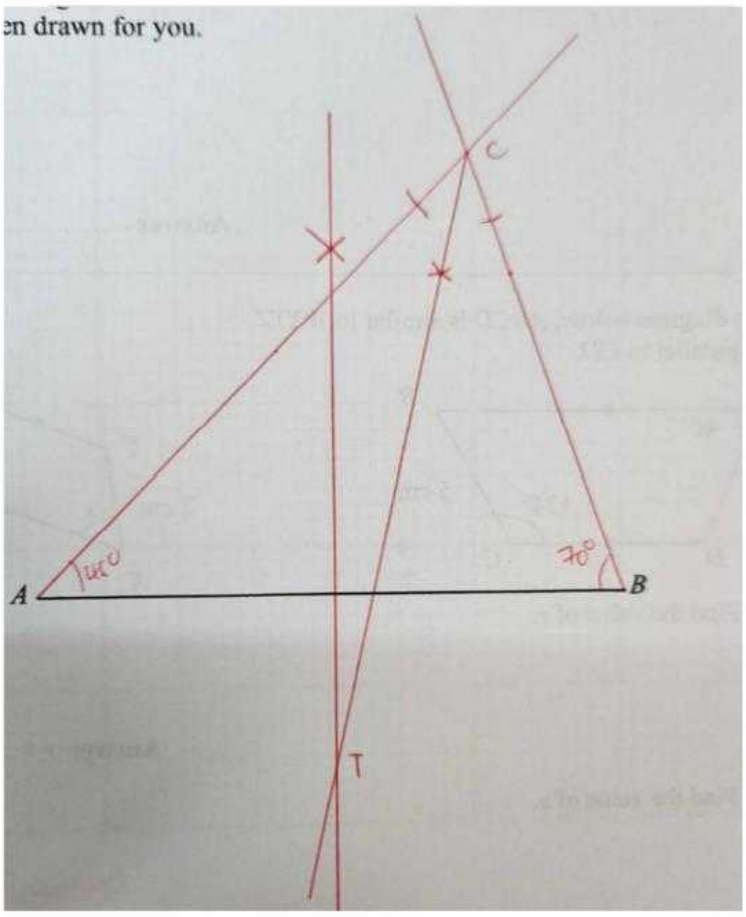
----- END OF PAPER -----

Efforts Today, Rewards Tomorrow

Q1	$-2.1^2, -4.4, \sqrt[3]{27}, \pi, \frac{22}{7}$	**Q10**	**a)** 40
Q2	Answer **i)**  		**b)** 46
	ii) $x \geq -2\frac{1}{3}$		**c)** 1.6
	iii) -2	**Q11**	See below
Q3	**a)** $2^3 \times 3^2 \times 7$	**Q12**	**ai)** 110
	b) 17640		**aii)** 32
	c) 15		**b)** No
Q4	$4a : 4b, \frac{1}{b} : \frac{1}{a}$	**Q13**	**a)** 11.9
Q5	**a)** $1 : 0.25$		**b)** 5.44
	b) 3.25		**c)** 54 400
	c) 1920	**Q14**	**a)** $-\frac{4}{5}$
Q6	**a)** $a = 3, b = -11$		**b)** 2.43
	b) $x = 0.32, x = -6.32$	**Q15**	Bank B
Q7	**a)** $v = 44$	**Q16**	Vertical axis does not start from 0
	b) $u = \pm\sqrt{\frac{v - 3w}{8}}$	**Q17**	9
Q8	$x = 12$	**Q18**	427
Q9	**a)** 9.90	**Q19**	**a)**  Pattern 5
	b) -3		**b)** 2n+1
	c) $y = -3x + 21$		**c)** Not odd

Q20	**A:** 5**, B:** 2	**Q22**	**a)** $(0,-15)$
Q21	**a)** $\frac{4}{9}$		**b)** $x=1$
	b) $\frac{1}{18}$		

Q11)



68. Prelims Paper 1 (MS)

Thursday, August 8, 2024 1:21 PM

Answer **all** the questions.

1 $-4.4 \quad -(2.1)^2 \quad \pi \quad \frac{22}{7} \quad \sqrt[3]{27}$

-4.41 3.1415 3.1429 3

Write these numbers in order of size, starting with the smallest.

B1 – Any 2 correct
B1 – All correct

Answer $-(2.1)^2$, -4.4, $\sqrt[3]{27}$, π, $\frac{22}{7}$ [2]

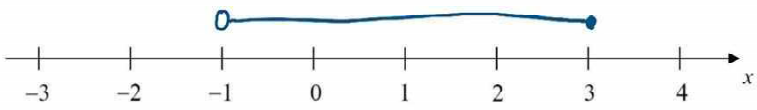
smallest

---

2 **(a)** Represent $-1 < x \leq 3$ on the number line below.

Answer

B1



[1]

(b) Solve the inequality $-3x \leq 7$

$-3x \leq 7$

$x \geq -\frac{7}{3}$

$x \geq -2\frac{1}{3}$

Answer $x \geq -2\frac{1}{3}$ [1] B1

(c) State the smallest integer that satisfy $-3x \leq 7$

Answer -2 [1] B1 FCF

---

3 2940 expressed as a product of its prime factors is $2^2 \times 3 \times 5 \times 7^2$.

(a) Express 504 as a product of its prime factors.

2 | 504
2 | 252
2 | 126
3 | 63
3 | 21
7

$504 = 2^3 \times 3^2 \times 7$

Answer $2^3 \times 3^2 \times 7$ B1 [1]

(b) Find the lowest common factor of 2940 and 504.

$2940 = 2^2 \times 3 \times 5 \times 7^2$
$504 = 2^3 \times 3^2 \times 7$

LCM $= 2^3 \times 3^2 \times 5 \times 7^2$
$= 17640$ //

Answer 17640 B1 [1]

(c) Find the smallest integer k such that 2940k is a perfect square.

$3 \times 5 = 15$ //

15 B1 [1]

---

4 Which of these ratio(s) are equivalent to the ratio $a : b$?

$a^b : b^a$ $\quad a^2 : b^2$ $\quad 4a : 4b$ $\quad \frac{1}{b} : \frac{1}{a}$ $\quad a+2 : b+2$

Answer $4a : 4b$ B1 $\quad \frac{1}{b} : \frac{1}{a}$ B1 [2]

---

5 Gracia has a map drawn to a scale 1 : 25 000.

(a) Rewrite the scale in the form 1 cm to x km.

1 cm : 25 000 cm

1 cm : 250 m

1 cm : 0.25 km

B1

Answer 1 : 0.25 [1]

(b) A road on the map is 13 cm long.
Find the actual length of the road in kilometres.

map : Actual

1 : 0.25

13 : 3.25

B1

Answer 3.25 km [1]

(c) A plot of land has an area of 120 km^2.
Find the area of the plot of land on the map in square centimetres.

map : Actual

1 cm : 0.25 km

4 cm : 1 km

16 cm^2 : 1 km^2 −M1

1920 cm^2 : 120 km^2

Alt

map : Actual

1 cm : 0.25 km

1 cm^2 : 0.0625 km^2 −M1

1920 cm^2 : 120 km^2

Answer 1920 A1 cm^2 [2]

6 $x^2+6x-2=(x+a)^2+b$

(a) Find the value of a and b.

$x^2+6x-2 = (x+3)^2-3^2-2$

$= (x+3)^2-11$

B1 B1

Answer $a =$ 3, $b =$ −11 [2]

(b) Hence, solve $x^2+6x-2=0$.
Give your answers correct to 2 decimal places.

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

$(x+3)^2-11=0$

$(x+3)^2=11$

$x+3=\sqrt{11}$ or $x+3=-\sqrt{11}$ −m1

$x=\sqrt{11}-3$ or $x=-3-\sqrt{11}$

$x=0.32$ or $x=-6.32$

* do not accept other methods

A1

Answer $x =$ 0.32, −6.32 [2]

7 $v = 3w + 8u^2$.

(a) Find v when $w = 4$ and $u = -2$.

$v = 3(4) + 8(-2)^2$

$= 44$

B1

Answer $v =$ 44 [1]

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

$v = 3w + 8u^2$

$v - 3w = 8u^2$

$u^2 = \frac{v-3w}{8}$ -M1

$u = \pm\sqrt{\frac{v-3w}{8}}$ A1

reject if missing "$u =$"

Answer $u = \pm\sqrt{\frac{v-3w}{8}}$ [2]

---

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

(M1)

$3x - 2(3+x) = 6$ -M1

$3x - 6 - 2x = 6$

$x = 12$ // A1

(M2)

$\frac{3x}{6} - \frac{2(3+x)}{6} = 1$ – M1 (same base)

$\frac{3x - 2(3+x)}{6} = 1$

$3x - 2(3+x) = 6$

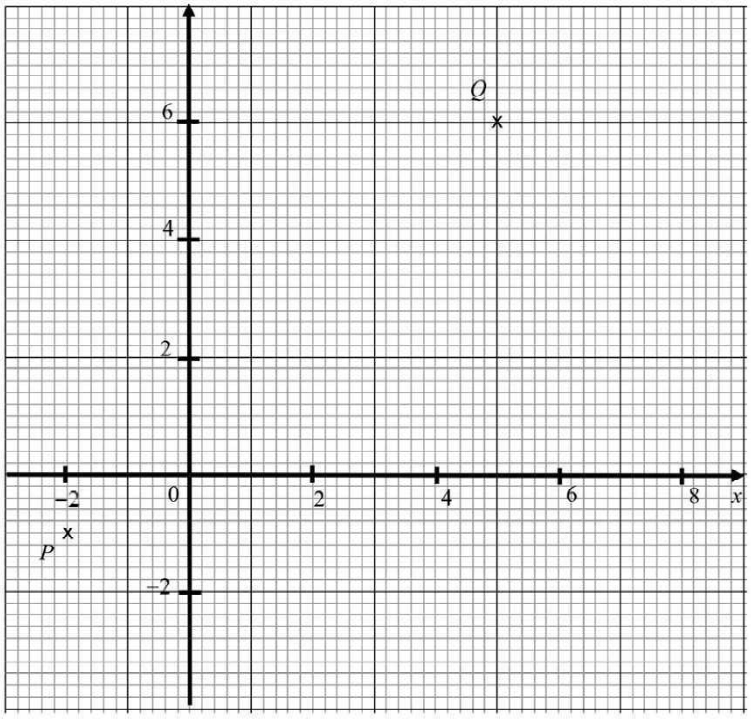
$3x - 6 - 2x = 6$

$x = 12$ // - A1

Answer $x = 12$ [2]

---

9 P is the point $(-2, -1)$ and Q is the point $(5, 6)$.



(a) Find the length of PQ.

$PQ = \sqrt{(-2-5)^2 + (-1-6)^2}$

$= 9.90$ (3sf)

B1

Answer 9.90 [1]

(b) R is the point $(8, k)$.
Given that the gradient of QR is -3, find the value of k.

$\text{grad}_{QR} = \frac{6-k}{5-8}$ -m1

$\frac{6-k}{5-8} = -3$

$\frac{6-k}{-3} = -3$

$6-k = 9$

$k = -3$ A1

Answer −3 [2]

Alt
using Q: (5,6), grad QR = −3,
$6 = -3(5) + c$
$c = 21$ -m1
Eqn line QR: $y = -3x + 21$
when $x = 8$,
$y = -3(8) + 21$
$y = -3$
$\therefore k = -3$ -A1

(c) Find the equation of line QR.

$y = mx + c$

$y = -3x + c$

when $x = 5$, $y = 6$

$6 = -3(5) + c$

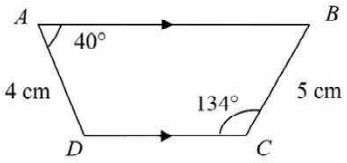
$c = 21$ M1 → Allow FCF from (b)

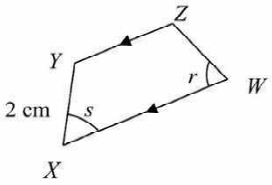
A1

Answer $y = -3x + 21$ [2]

---

10 In the diagram below, $ABCD$ is similar to $WXYZ$.
AB is parallel to CD.





(a) Find the value of r.

Answer $r =$ 40 B1 [1]

(b) Find the value of s.

$\angle s = \angle B$.

$\angle B = 180° - 134°$

$= 46°$

Answer $s =$ 46 B1 [1]

(c) Find the length of ZW.

M1

Scale factor : $\frac{YX}{BC} = \frac{2}{5}$ – M1

$ZW = 4 \times \frac{2}{5}$

$= 1.6$ – A1

M2 $\frac{YX}{BC} = \frac{ZW}{DA}$

$\frac{2}{5} = \frac{ZW}{4}$ – M1

$ZW = \frac{2}{5} \times 4$

$= 1.6$ – A1

Answer 1.6 or $1\frac{3}{5}$ cm [2]

M3

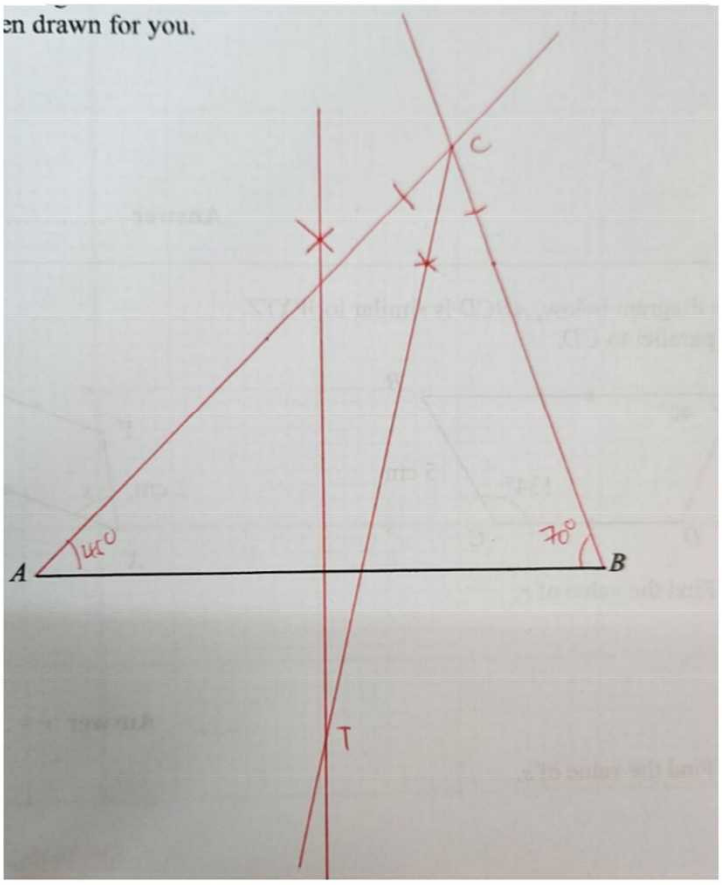
Scale factor (enlargement) $= \frac{5}{2}$ – M1

$ZW = 4 \div \frac{5}{2}$

$= 1.6$ – A1

11 ABC is a triangle with $AB = 9$ cm, angle $BAC = 45°$ and angle $ABC = 70°$.

(a) Construct triangle ABC
AB has been drawn for you



B2

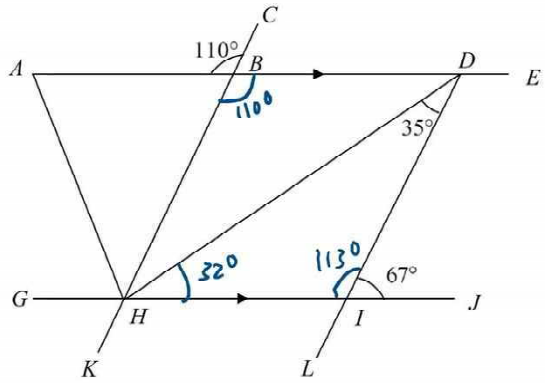
[2]

(b) The perpendicular bisector of AB and the angle bisector of ACB meet at point T.
Label point T. [2]

B1 - ⊥ bisect
B1 - ∠ bisect

17 H

AE, *GJ*, *CK* and *DL* are straight lines.
AE and *GJ* are parallel to each other.
Angle $DIJ = 67°$, angle $HDI = 35°$, angle $ABC = 110°$.



* -1m for entire question if no reason.

By stating your reason clearly, find

(a) **(i)** angle *HBD*,

$\angle HBD = 110°$ (vert. opp $\angle$s) B1

110

Answer ..... ° [1]

(ii) angle *DHI*.

$\angle DIH = 180° - 67°$ (adj. $\angle$s on a str. line) -M1
$= 113°$

$\angle DHI = 180° - 113° - 35°$ ($\angle$ sum of $\triangle$)
$= 32°$

(AH)
$\angle DHI = 67° - 35°$
$= 32°$ (ext $\angle$ of $\triangle$)

Answer 32 A1 ° [2]

(b) Is *BDIH* a parallelogram?
Explain and show your working clearly.

Answer

(M1) NO, $\angle DIH = 113°$, not $110°$. $\therefore$ $\angle DIH$ & $\angle HBE$ not opp $\angle$ of llgram, $\therefore$ BDIH not a llgram

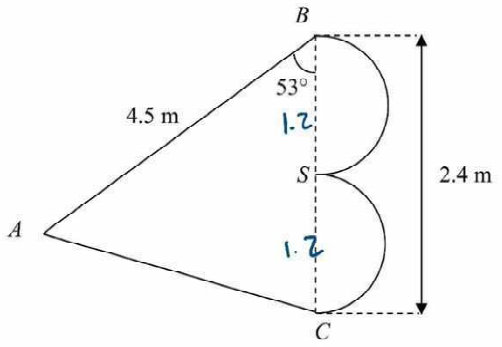
(M2) NO. $\angle BDH = 32°$ (alt $\angle$s) B1

[1]

But $\angle HBD + \angle BDI$
$= 110° + 32° + 35°$
$= 177°$
$\neq 180°$

13

12 A playground is made up of triangle ABC and two congruent semicircles with diameter BS and SC respectively.
Angle $ABC = 53°$, $AB = 4.5$ m and $BC = 2.4$ m.



(a) Calculate the perimeter of the playground.

$AC^2 = 4.5^2 + 2.4^2 - 2(4.5)(2.4)\cos 53°$ – M1

$AC = 3.6070$

$BS + SC = 1.2\pi$ – M1

$= 3.76991$

Perimeter $= 3.6070 + 1.2\pi + 4.5$

$= 11.9$ m // A1

Answer 11.9 m [3]

(b) (i) Calculate the area of the playground.

Area $ABC = \frac{1}{2}(4.5)(2.4)\sin 53°$ – M1

$= 4.3126\ m^2$

Area circle $= \pi(0.6)^2$ – M1

$= 1.1310\ m^2$

Total area $= 4.3126 + 1.1310$

$= 5.44\ m^2$ // A1

Answer 5.44 m² [3]

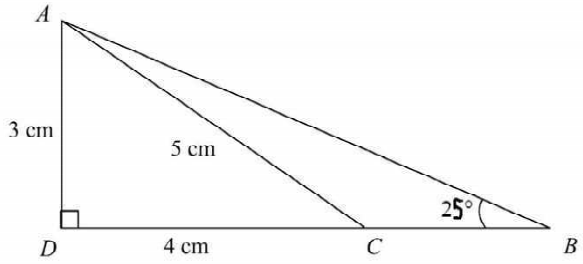
(ii) Convert your answer in **(bi)** to cm^2.

B1

Answer 54 400 cm^2 [1]

14

13 In the diagram below, Angle $ADB = 90°$, $AC = 5$ cm, $AD = 3$ cm, $DC = 4$ cm.



(a) Find the exact value of $\cos ACB$.

$\cos ACD = \frac{4}{5}$

$\cos ACB = -\cos(180° - \angle ACB)$

$= -\cos ACD$

$= -\frac{4}{5}$ //

B1

Answer $-\frac{4}{5}$ cm [1]

(b) Calculate CB

$\tan 25° = \frac{3}{DB}$

$DB = \frac{3}{\tan 25°}$ -M1

$CB = \frac{3}{\tan 25°} - 4$

$= 2.43$ cm // -A1

Answer 2.43 cm [2]

AH

$\angle ACB = \cos^{-1}\left(-\frac{4}{5}\right)$

$= 143.13°$

$\angle CAB = 180° - 143.13° - 25°$

$= 11.87°$

$\frac{BC}{\sin 11.87°} = \frac{5}{\sin 25°}$ -M1

$\frac{5}{\sin 25°} \times \sin 11.87°$

$\frac{1}{\sin 11.87^\circ} = \frac{}{\sin 25^\circ}$

$BC = \frac{5}{\sin 25^\circ} \times \sin 11.87^\circ$

$= 2.43$,, – A1

15

14 Mrs Leow wish to invest $5000 in the bank for **6** years.
He has researched and found two options.

Bank ABC	Bank XYZ
Simple interest at 2.5% per annum.	Compound interest at 2.4% per annum, compounded yearly.

Which bank should Mrs Leow invest in to earn the greatest profit? Show workings to support your answer.

Answer

Bank ABC

$I = \frac{PRT}{100}$

$= \frac{5000(2.5)(6)}{100}$

$= 750$ – M1

Bank XYZ

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

$= 5000\left(1+\frac{2.4}{100}\right)^6$ – M1

$= 5764.61$

$I = 5764.61 - 5000$

$= 764.61$ – M1

Alt M1 : Bank ABC
$(750 + 5000 = \$5750)$

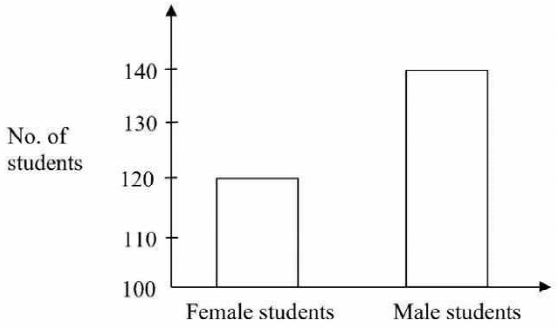
(m1) Mrs Leow should invest in bank B ~~XYZ~~ because it offers a higher interest ($764.61) than bank ~~ABC~~ ($750) A1 √ A [4]

(m2) Bank B ~~XYZ~~ as it offers more money at the end of 6 years ($5764.61) than bank ~~ABC~~ A ($5750)

(m3) Bank B as she can earn $14.61 more.

16

~~15~~ The following bar graph shows the number of male and female students who spends more than five hours on their phones per day.

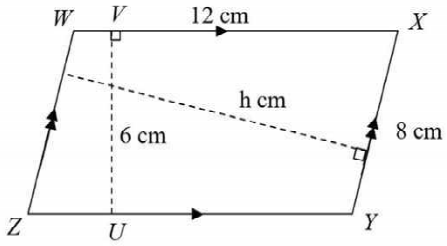


Ayden claims that there are twice as many male students than female students who spends more than five hours on their phones per day.
State one feature of the bar graph that is misleading and explain why.

Answer The vertical axis does not start from 0.
Hence, while male bar appears to be twice as tall, the number of male students (140) is not twice of female (120) [1] B1

---

17 The diagram shows parallelogram $WXYZ$.
$WX = 12$ cm, $XY = 8$ cm and $VU = 6$ cm.
Find the length of h.



Area = 12 x 6 - M1
= 72 cm²

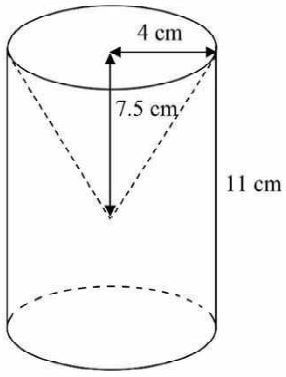
72 = 8h

h = 9 cm A1

Answer 9 cm [2]

18

~~17~~ The diagram shows a solid formed by removing a cone from a cylinder.



The cylinder and the cone have a common radius of 4 cm.
The height of the cone is 7.5 cm, and the height of the cylinder is 11cm.
Calculate the volume of the solid.

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

$= \frac{1}{3}\pi (4)^2 (7.5)$ – m1

$= 125.66\ cm^2$

Volume cylinder $= \pi r^2 h$

$= \pi (4)^2 (11)$ – m1

$= 552.92\ cm^2$

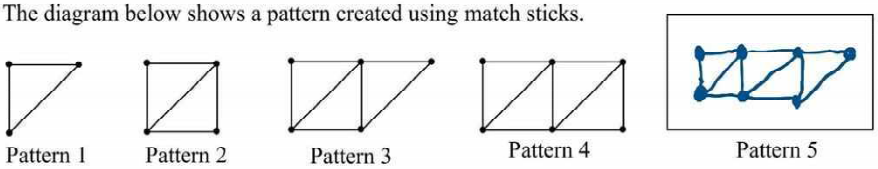
Volume solid $= 552.92 - 125.66$

$= 427\ cm^2$ A1

Answer 427 cm [~~4~~] 3

19

~~18~~ The diagram below shows a pattern created using match sticks.



Pattern 1 Pattern 2 Pattern 3 Pattern 4 Pattern 5

B1

(a) Draw pattern 5 in the space above. [1]

(b) Write down an expression, in terms of n, for the number of sticks in Pattern n.

$T_1 = 3$

$T_2 = 5$

$T_3 = 7$

$T_4 = 9$

$T_n = 3 + 2(n-1)$

$= 3 + 2n - 2$

$= 2n + 1$

B1

Answer $2n+1$ ..... m^2 [1]

(c) Will there be a Pattern number with 100 match sticks?
If yes, find the pattern number.
Otherwise, explain why no such pattern number exists.

Answer

$100 = 2n + 1$

$99 = 2n$

$n = 49.5$

M1 No. To have 100 matchsticks $n = 49.5$. But n must be an integer/whole number.

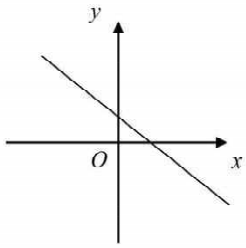
B1

M2 No, every pattern has an odd number of matchsticks [1]

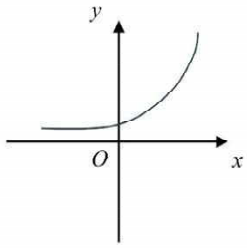
20
~~19~~ Match the following functions to their graphs.

Graph A: $y = -\frac{3}{x}$

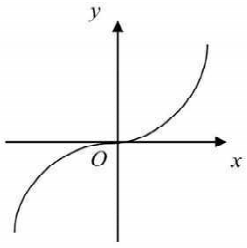
Graph B: $y = 2^x$



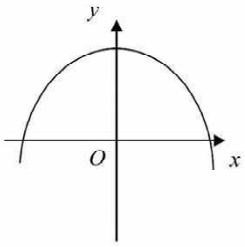
Graph 1



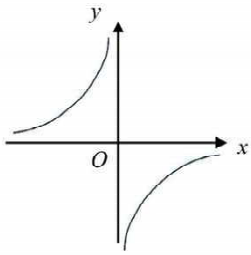
Graph 2



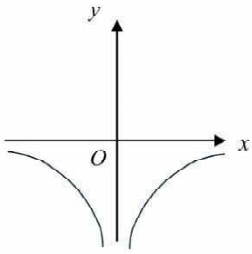
Graph 3



Graph 4



Graph 5



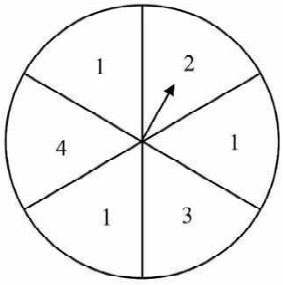
Graph 6

Answer **Graph A** 5 ..... [1] B1

Graph B 2 ..... [1] B1

21

~~20~~ A stall runs a spinner game at a fair.



Each player will spin the wheel twice.
Find the probability that

(a) The spinner will land on odd numbers on both spins.

$P(\text{odd, odd}) = \frac{4}{6} \times \frac{4}{6}$

$= \frac{4}{9}$

B1

Answer $\frac{4}{9}$ [1]

(b) The total score of both spins is greater than 6.

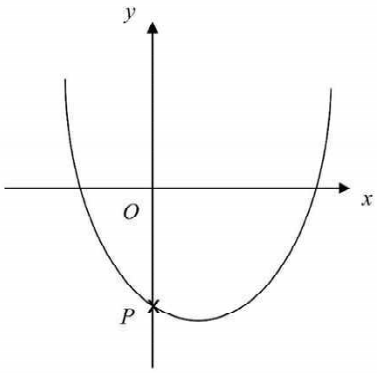
$P(4,3) + P(3,4) + P(4,4)$

$= \left(\frac{1}{6} \times \frac{1}{6}\right) + \left(\frac{1}{6} \times \frac{1}{6}\right) + \left(\frac{1}{6} \times \frac{1}{6}\right)$ -M1 (Any one bracket)

$= \frac{1}{18}$ -A1

Answer $\frac{1}{18}$ [2]

22 The diagram shows a sketch of the graph $y = (x+3)(x-5)$.



(a) Find the coordinates of point P.

when $x = 0$,

$y = (0+3)(0-5)$

$= -15$

Answer P (0 , −15) B1 [1]

(b) State the equation of the line of symmetry of the graph.

$\frac{5+(-3)}{2} = 1$

Answer $x = 1$ B1 [1]

----- END OF PAPER -----

Efforts Today, Rewards Tomorrow

YUAN CHING SECONDARY SCHOOL
Secondary Four Normal (Academic) Course
Preliminary Examination 2024

CANDIDATE NAME			
CLASS		INDEX NUMBER	

MATHEMATICS

4045/02

Paper 2

1 August 2024

Candidates answer on the question paper.

2 hours

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staple, paper clips, highlighters, 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.
The total number of marks for this paper is 70.

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.

	MARKS
Total	/ 70

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

[Turn Over]

Mathematical Formulae

Compound Interest

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

Mensuration

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

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

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

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

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

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

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

Trigonometry

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

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

Statistics

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

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

Section A (62 marks)
Answer **all** the questions in this section.

1 **(a)** Evaluate $\dfrac{45.3}{0.0568 \times 16.5}$.

Answer ……. [1]

(b) y is directly proportional to the square of x.
Given that $y = 10$ when $x = 2$, find y when $x = 6$.

Answer y = ……... [2]

---

2 **(a)** Write 0.006 013 74 in standard form, correct to 3 significant figures.

Answer ……. [1]

(b) Simplify $\left(\dfrac{x^6}{64}\right)^{-\frac{2}{3}}$.

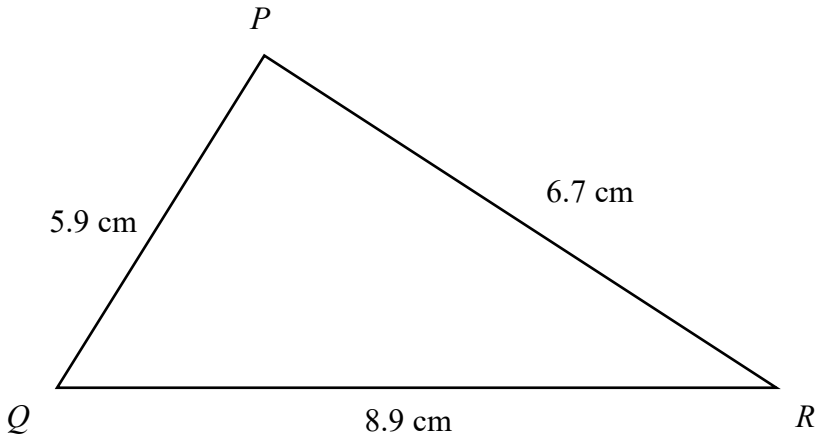
Answer ……. [2]

---

3 **(a)** The interior angle of a regular polygon is $165°$.
Find the number of sides of the polygon.

Answer …… sides [2]

(b) The diagram below shows triangle *PQR*.



Determine if triangle *PQR* is a right-angled triangle.
Show your working clearly.
Answer

……

……

…… [2]

4 Mr Wong travels from Singapore to Japan.
He exchanges Singapore dollars ($) $1500 into Japanese Yen (¥) when the exchange rate is $1 = ¥115.98.

(a) How much Japanese Yen (¥) does he have?

Answer ¥……. [1]

(b) In Japan, Mr Wong spends ¥23 370.
On his return, he exchanges the remaining Japanese Yen (¥) into Singapore dollars ($) when the exchange rate is $1 = ¥116.25.
How many Singapore dollars does he receive?

Answer $ …… [2]

5 **(a)** Solve the simultaneous equations.

$$6x + 2y = -2$$
$$4x - 3y = 29$$

Answer x = ……...

y = ……... [3]

(b) Two car rental companies charge the following values of y for x km driven.

Company A: $y = 3x + 150$
Company B: $y = 4x + 100$

(i) Which rental company has a higher initial fee?

Answer Company …… [1]

(ii) Calculate the driven distance for the cost of the two companies to be the same.

Answer ……... km [2]

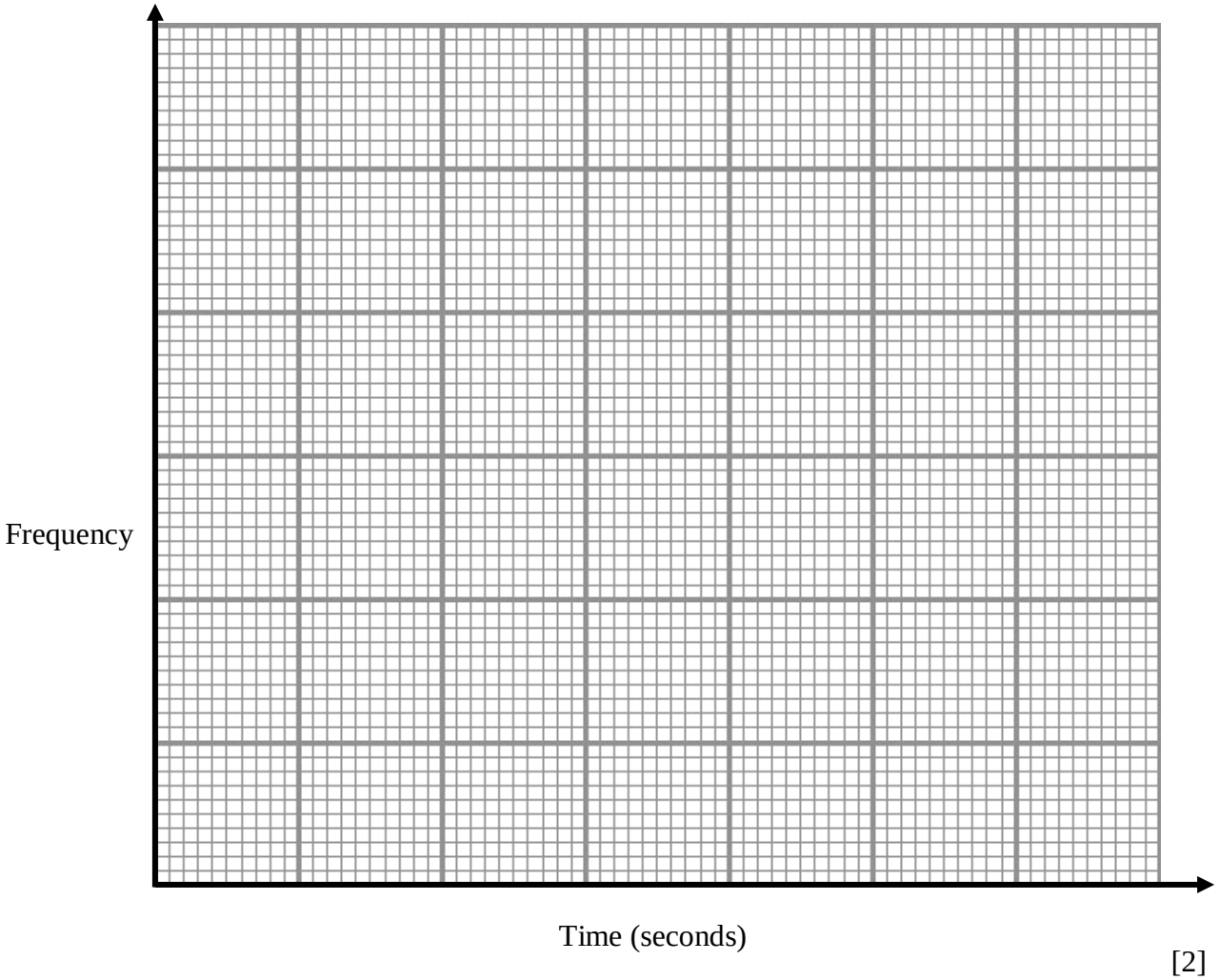
(c) A water balloon is launched into the air so that the height, h metres, after t seconds is $h = -4t^2 + 27t + 2$.
Calculate the time taken for the water balloon to burst as it hits the ground.

Answer …….. s [3]

6 The table gives information about the time spent, in minutes, by 50 students revising Mathematics on Sunday.

Time spent (x minutes)	**Frequency**
$0 < x \leq 15$	12
$15 < x \leq 30$	25
$30 < x \leq 45$	8
$45 < x \leq 60$	5

(a) On the grid, draw a histogram to represent this information.



[2]

(b) State the modal time interval.

Answer ..... [1]

Calculate an estimate of the

(c) **(i)** mean time,

Answer …….. min [2]

(ii) standard deviation time.

Answer …….. min [1]

(d) Find the percentage of students who spent more than 30 minutes revising Mathematics on Sunday.

Answer …….. [1]

---

7 This table of values is for $y = x^3 - 6x + 1$.

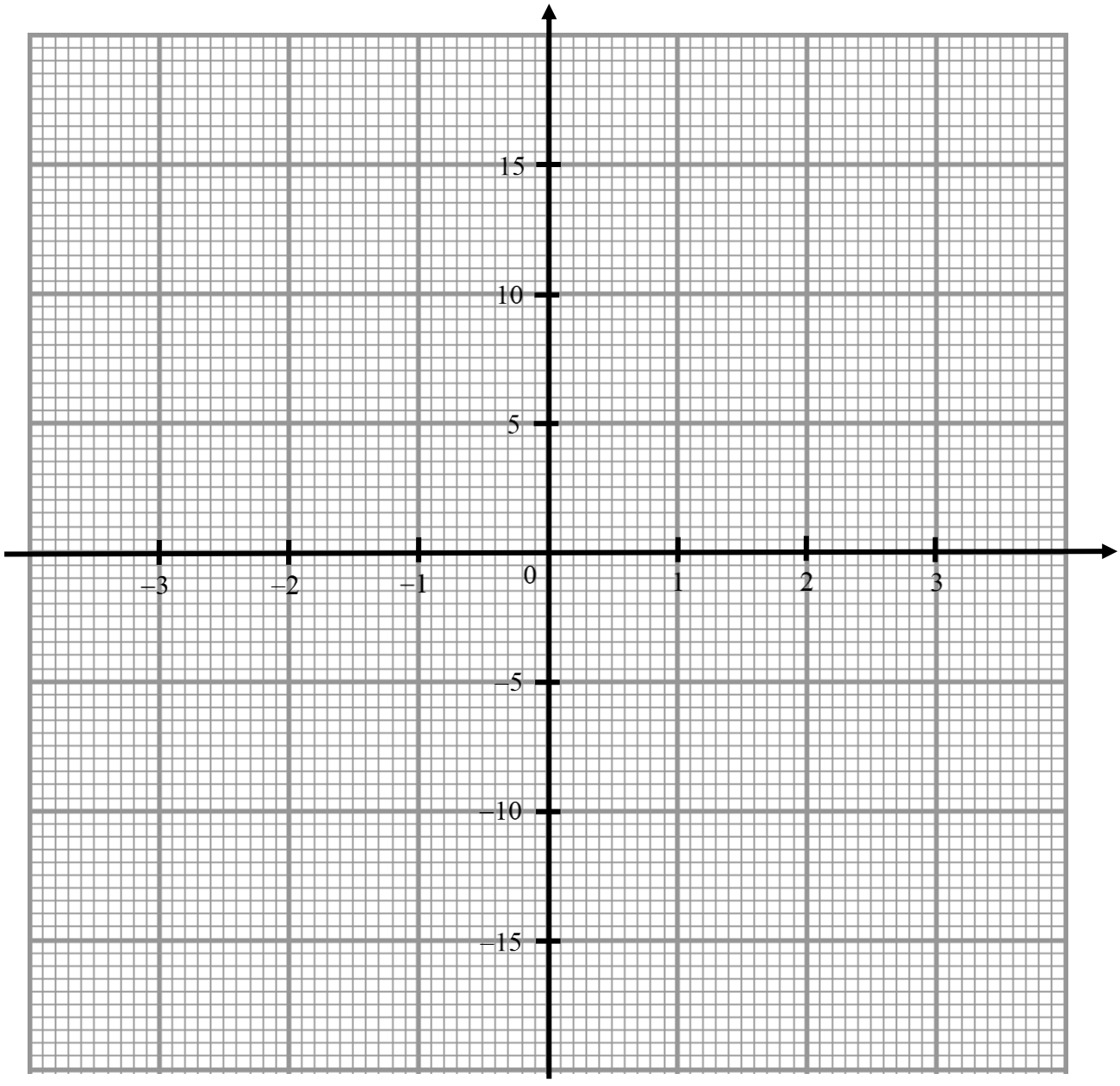
x	–3	–2	–1	0	1	2	3
y	–8	a	6	1	–4	b	10

(a) Calculate the value of a and the value of b.

Answer a = ……...

b = ……... [2]

(b) Draw the graph of $y = x^3 - 6x + 1$ for $-3 \leq x \leq 3$.



[3]

(c) Use your graph to find the largest value of x when $y = 2.5$.

Answer x = ……... [1]

(d) By drawing a tangent, estimate the gradient of the graph of $y = x^3 - 6x + 1$ when $x = 2$.

Answer ……. [2]

---

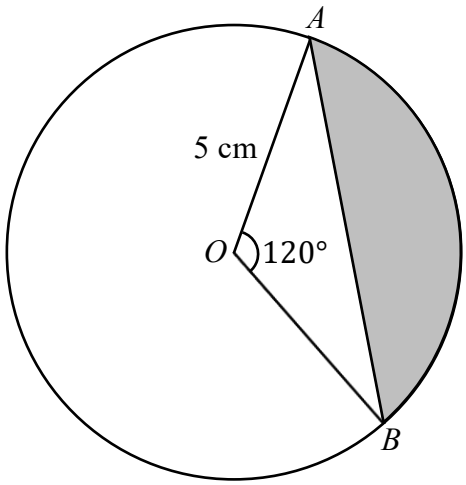
8 **(a)** Expand and simplify $(3x - 2)^2$.

Answer ……. [2]

(b) Factorise completely $8x^2 - 18y^2$.

Answer ……. [2]

9



A circle has centre O and radius 5 cm.
Minor sector AOB has an angle of $120°$.

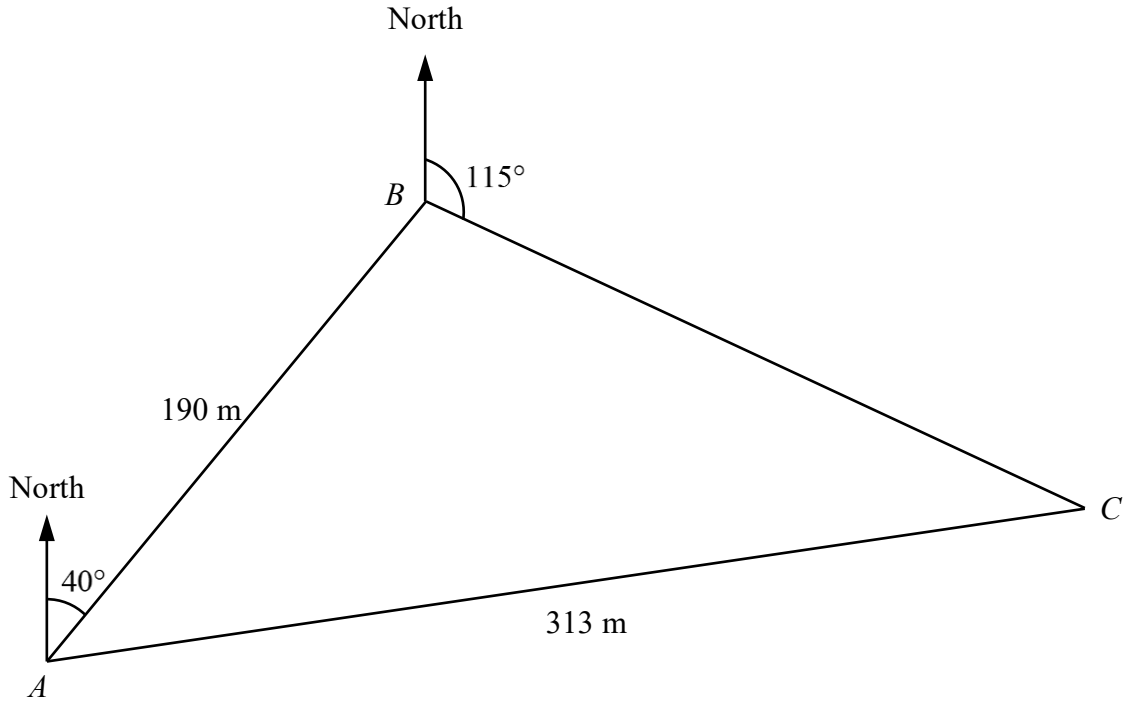
(a) Find the perimeter of major sector AOB.
Give your answer in the form $p\pi + q$.

Answer ……... cm [3]

(b) Find the area of the shaded segment.

Answer …….. cm^2 [3]

10



Mr Tan walks 190 m on a bearing of $040°$ from his office building at point *A* to the hawker centre at point *B* for lunch.
He then walks on a bearing of $115°$ from the hawker centre to a café at point *C* for a cup of coffee.

(a) Mr Tan looks up to his office from the café, which is 313 m away, at an angle of elevation of $23°$.
Calculate the vertical height of his office building.

Answer ……..... m [2]

(b) Calculate the bearing of *A* from *C*.

Answer ……..... ° [5]

11 James and Susan are preparing for a triathlon.
The triathlon comprises three activities, swimming, cycling and running.
The tables below provide information about the triathlon.

Activities	Distance
Swim	1500 m
Cycle	40 km
Run	10 km

	Cumulative Timings (x)	
Award / Gender	**Male**	**Female**
Gold	x < 2 h 10 min	x < 2 h 40 min
Silver	2 h 10 min ≤ x < 2 h 30 min	2 h 40 min ≤ x < 3 h 00 min
Bronze	2 h 30 min ≤ x < 2 h 50 min	3 h 00 min ≤ x < 3 h 20 min
Consolation	x ≥ 2 h 50 min	x ≥ 3 h 20 min

(a) Calculate the total distance covered, in kilometres, during the triathlon.

Answer ....…...…..…….... km [1]

(b) James's cumulative time for completing the three activities is 135 minutes.
State the award that he can obtain.

Answer ....…...…..……..... [1]

	Average speed (km / h) (y)		
Intensity / Activities	**Swimming**	**Cycling**	**Running**
With intense training	$3 < y \leq 5$	$22 < y \leq 30$	$8 < y \leq 11.9$
Without intense training	$0 < y \leq 3$	$0 < y \leq 22$	$0 < y \leq 8$

From past triathlons, the range of Susan's average speed for each of the activities is recorded in the table above.
Due to time constraints, Susan only has time to train intensely for one of the sports, which will allow her to improve her speed.

(c) Calculate the shortest amount of time, in hours, Susan requires to complete the cycling activity without intense training. Leave your answer in fraction.

Answer ……..……..…….. h [2]

(d) Susan plans to train intensively for either swimming or running.
Which should she decide on? Justify your decision with calculations.

Answer

……...

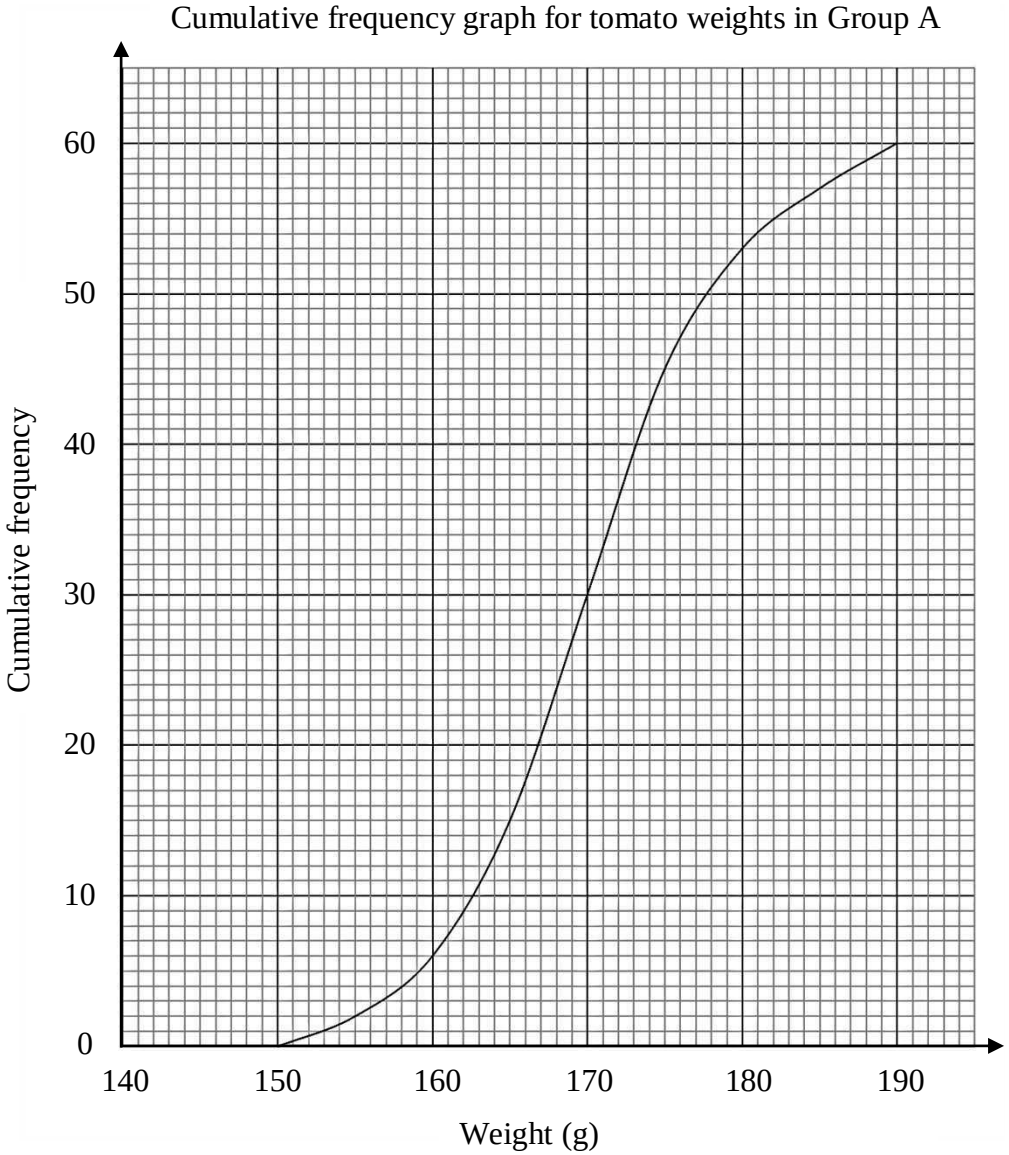
……... [4]

Section B (8 marks)

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

12 Ah Seng owns a farm that grows tomatoes.
This year, he separates his tomato plants into two groups, Group A and Group B.

Ah Seng gave fertiliser to the tomato plants in Group A and weighed the 60 tomatoes from Group A.
The cumulative frequency graph shows some information about the weights of the tomatoes.



Use the graph to estimate

(a) (i) the median weight,

Answer …….. g [1]

(ii) the interquartile range,

Answer …….. g [2]

(iii) the number of tomatoes that are more than 182g.

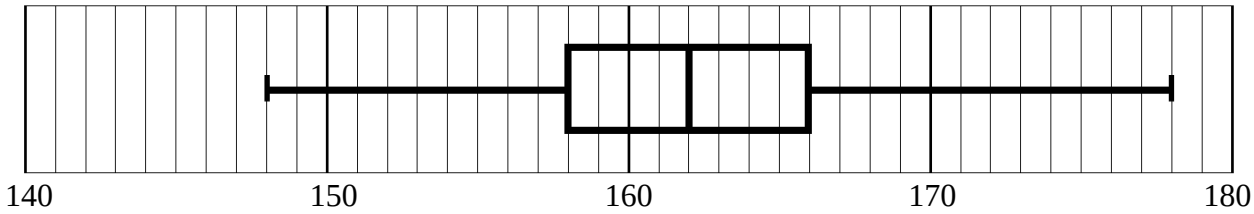
Answer …….. tomatoes [1]

(b) Calculate the percentile of a tomato weighing 177g.

Answer ……. % [2]

(c) Ah Seng did not give fertiliser to the tomato plants in Group B.
He weighed the 60 tomatoes from Group B.
The box-and-whiskers plot below shows the results collected.

Box-and-Whiskers plot for tomato weights in Group B



Compare the distribution of the weights of the tomatoes from Group A with the distribution of the weights of the tomatoes from Group B.

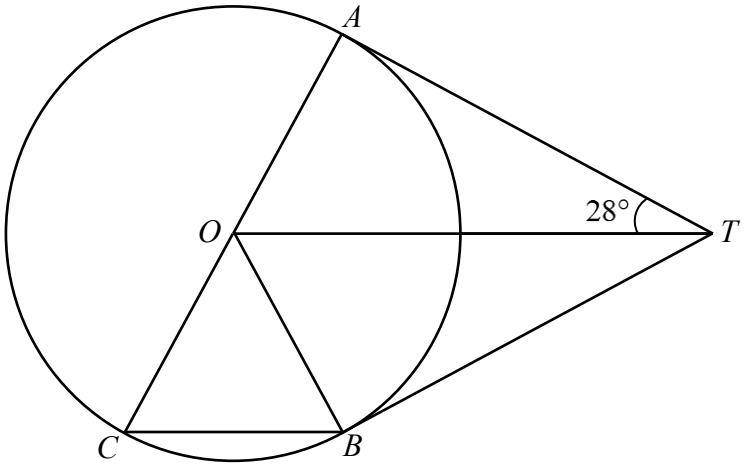
Answer ……...

…….

…….

……. [2]

13 (a)



A, *B* and *C* are points on the circumference of a circle with centre *O*.
TA and *TB* are tangents to the circle.
AC is the diameter of the circle and angle $OTA = 28°$.

Find, stating your reasons clearly,

(i) angle *AOB*,

Answer ……..... ° [2]

(ii) angle *OBC*.

Answer ……..... ° [2]

(b) A bag contains 5 red marbles, 3 blue marbles and 2 green marbles.
Jasmine takes one marble at random from the bag and puts it on the table.
She then takes a second marble at random from the same bag.

Calculate the probability that the two marbles are

(i) the same colour,

Answer ……. [3]

(ii) of different colours.

Answer ……. [1]

----- END OF PAPER -----

Efforts Today, Rewards Tomorrow

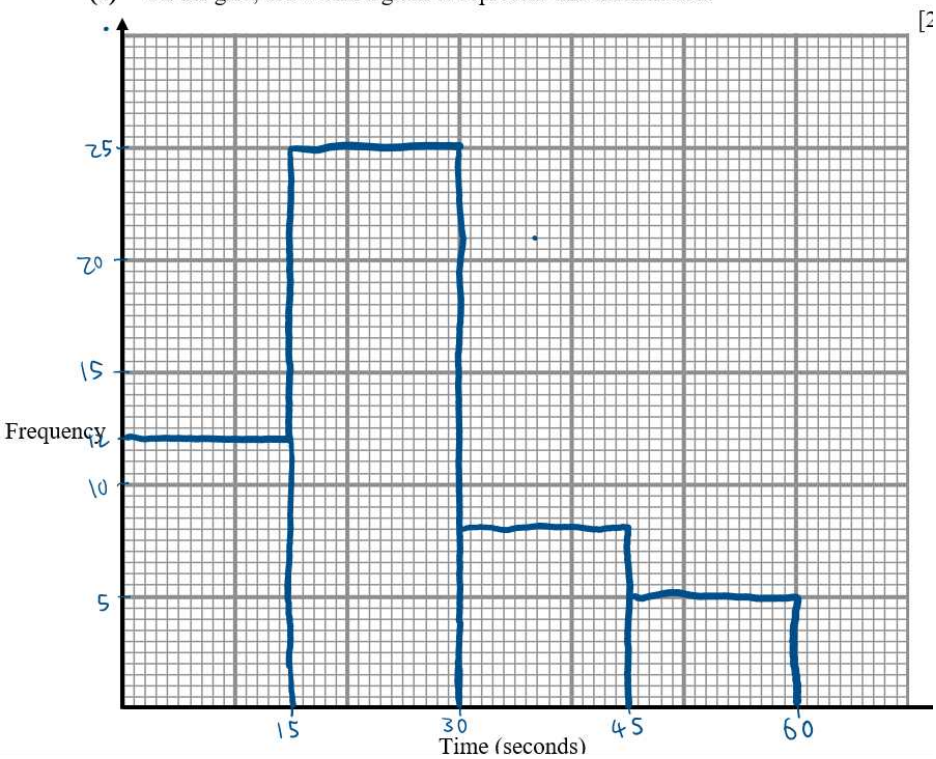
Answer Key

Q1	a) 48.3	**Q11**	a) 51.5
	b) 90		b) Silver Award
Q2	a) 6.01×10^{-3}		c) $1\frac{9}{11}$
	b) $\frac{16}{x^4}$		d) Running
Q3	a) 24	**Q12**	ai) 170
	b) No		aii) 10
Q4	a) 173 970		aiii) 5
	b) 1295.48		b) 81.7
Q5	a) $x=2, y=-7$		c) Group A heavier Group B more consistent
	bi) Company A	**Q13**	ai) 124
	bii) 50		aii) 62
	c) 5.60		bi) $\frac{14}{45}$
Q6	a) See below		bii) $\frac{31}{45}$
	b) $15<x\leq30$		
	ci) 24.3		
	cii) 13.3		
	d) 26		
Q7	a) $a=5, b=-3$		
	b) See below		
	c) 2.7		
	d) 6		
Q8	a) $9x^2-12x+4$		
	b) $2(2x+3y)(2x-3y)$		
Q9	a) $6\frac{2}{3}\pi+10$		
	b) 15.4		
Q10	a) 133		
	b) 259.1		

Q6a:

(a) On the grid, draw a histogram to represent this information.

[2



Q7b: