

CRESCENT GIRLS' SCHOOL SECONDARY FOUR PRELIMINARY EXAMINATION

MATHEMATICS Paper 1

4052/01 21 August 2023 2 hours 15 mins

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

Write your name and index number on all the work you hand in. Write in dark blue or black pen on both sides of the paper. 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 question, it must be shown with the answer.

Omission of essential working will result in loss of marks.

The use of an approved scientific calculator is expected, where appropriate.

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 of the marks for this paper is **90**.

For Examiner's Use

Question	1	2	3	4	5	6	7	8	9	10	11	12
Marks												
Question	13	14	15	16	17	18	19	20	21	22	23	24
Marks												

Table of Penalties		Qn. No.		
Presentation	-1			
Accuracy/ Units	-1		Parent's/ Guardian's Signature	90

This question paper consists of 25 printed pages.

Mathematical Formulae

Compound Interest

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

Mensuration

Curved surface area of a cone = πrl

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

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

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

Area of 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

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^{2} = b^{2} + c^{2} - 2bc \cos A$$

1

Statistics

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

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

Answer **all** the questions.

1 (a) It is given that
$$m = 2\pi \sqrt{\frac{k+2h^2}{h^2}}$$
.
Find *m* when $k = 1.2$ and $h = 0.3$.

Answer $m = \dots$ [1]

(b) Two numbers p and q, written as the products of their prime factors, are $p = 2^2 \times 3^5 \times 5^6$ and $q = 2^2 \times 3^3$.

(i) Find the HCF of p and q.

Answer [1]

(ii) Find the smallest positive integer k such that $(p \times q \times k)$ is a perfect cube.

Answer k = [1]

(c) Estimate the percentage of the rectangle that is shaded.



Answer% [1]

[Turn over

2	(a)	Is 673 a prime number?	
		Answer	[1]
	(b)	Explain your reasoning.	
		Answer	
			[1]

3 In a library, the ratio of the number of books to magazines is 3 : 2. In a donation drive to help an overseas primary school, many books and magazines were given away. If the number of books is reduced by 40% and the number of magazines is reduced by 20%, find the new ratio of the number of books to the number of magazines.

Answer [2]

4 (a) Simplify
$$\frac{7x}{2y^2} \div \frac{21x^3}{8y}$$
.

2023 Prelim S4 Mathematics P1

(b) Factorise $p^3 + 7p^2 - 4p - 28$ completely.

Answer [2]

5 The stem and leaf diagram below shows the scores of 16 students in a Science class test.

Stem	Le	af						
2	5	5	7					
3	0	0	1	2	x	8		
4	2	3	5	7	7	У	9	Key: 2 5 represents 25 marks

Given that the median score is 36 marks, and the mean score is 37 marks, find the value of x and of y.

6 Solve the inequality $\frac{3x-1}{2} \le x+3 < 3x+5$. Illustrate your solution on the number line. [3]

Answer

7 Study the number pattern, then find the values of the unknowns in lines (a), (b) and (c).

$$\frac{2}{1 \times 2 \times 3} = \frac{1}{1} - \frac{2}{2} + \frac{1}{3}$$
$$\frac{2}{2 \times 3 \times 4} = \frac{1}{2} - \frac{2}{3} + \frac{1}{4}$$
$$\frac{2}{3 \times 4 \times 5} = \frac{1}{3} - \frac{2}{4} + \frac{1}{5}$$

(a)
$$\frac{2}{10 \times 11 \times 12} = \frac{1}{s} - \frac{2}{u} + \frac{1}{v}$$

(b)
$$\frac{2}{w} = \frac{1}{15} - \frac{2}{16} + \frac{1}{17}$$

(c)
$$\frac{2}{10626} = \frac{1}{x} - \frac{2}{y} + \frac{1}{z}$$

Answer (a) $s = \dots, u = \dots, v = \dots$ [1]

Answer (**b**) $w = \dots$ [1]

Answer (c) $x = \dots, y = \dots, z = \dots$ [1]

2023 Prelim S4 Mathematics P1

- 8 Given that y is inversely proportional to $x^2 + 1$ and the difference in the values of y when x = 1 and when x = 3 is 4.
 - (a) Express y in terms of x.

Answer $y = \dots$ [2]

(b) Find the value of y when x = -2.

Answer $y = \dots$ [1]

A piece of metal is heated to 375°C and then left to cool for 15 minutes.
 The temperature of the metal decreases at a rate of 18 °C/min for the first 5 minutes and then decreases at a rate of 7 °C /min for the next 10 minutes.
 Find the time taken for the metal to cool to a temperature of 250 °C.

[Turn over

10 Keith walks a distance of 1.2 km at an average speed of 6 km/h and takes a break for 15 minutes. He then continues to run a further distance of 800 m in 4 minutes. Calculate, in km/h, his average speed for the whole journey.

Answerkm/h [2]

- 11 216 cubes, each having edges of 2.6 cm, measured to the nearest 0.1 cm, fit exactly into a larger cubic box. Find the
 - (a) greatest possible length of the cubic box.

(b) least possible volume of the cubic box.

Answercm³ [2]

12 *ABCDEF* is a regular hexagon. (not drawn to scale)



(a) State the name of the triangle *EOD*.

Answer

- (b) Find(i) reflex angle *EOC*.

Answer Reflex angle EOC =° [2]

(ii) angle ANB.

Answer angle $ANB = \dots ^{\circ}$ [2]

- In a park XYZ, XY = 100 km and YZ = 45 km. X is due west of Y and the bearing of Z from Y is 300°.
 The point Y is marked in the space below. Construct the park XYZ using the scale 1 cm : [2] 10 km.
 Construct on the diagram drawn below,
 (i) the perpendicular bisector of XY, [1]
 - (ii) the bisector of angle ZXY.
 - (iii) A bench *B* is in the park, equidistant from *X* and *Y* and nearer to *XZ* than *XY*. Mark [1] a possible position of *B* on the diagram drawn.

Answer



[1]

14 In the diagram, *O* is the centre of a wheel of circumference 150 cm. The points *X* and *Y* lie on the circumference of the wheel and $\angle XOY = 0.8726$ radians.



(a) Calculate the number of complete revolutions the wheel would make in travelling a distance of 1 km.

Answer revolutions [1]

(b) Find the length of the minor arc XY.

Answer cm [2]

(c) Calculate the area of the minor sector *XOY*.

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[Turn over

11

15 The figure shows a triangle *ABC* with A(1, -3), B(-1, -1) and C(7, p). The gradient of *AB* is -2k and the length of *AC* is $\sqrt{72}$ units.



(a) Find the values of(i) k,

Answer k = [1]

(ii) *p*.

Answer $p = \dots$ [2]

(b) Find the equation of the line AB.

Answer [1]

16 (a) Given that $x^2 + y^2 = a$ and xy = b, find $(2x - 2y)^2$ in terms of a and b.

(b) Given that $\frac{y}{x} = 2048$ and $\frac{z}{y} = 2048$, where $x \neq 0$ and $y \neq 0$. Find the value of $\frac{y+z}{x+y}$.

17 In the diagram, *ABC* is a straight line. *BCDE* is a rectangle and *F* is the midpoint of *BE*. Given that AB = BE and angle $BFC = 45^{\circ}$, show that triangle *ABF* is congruent to triangle *EBC*.

[3]



Answer

18 (a) An area of 144 km² is represented by 25 cm² on a map A.
(i) Find the scale of the map A in the form 1 : n.

(ii) New Town and Sea City are 2.4 cm apart on the map *A*. How far apart will the two locations be on map *B*, if map *B* has a scale of 1:40 000?

(b) Jim drove from Kuala Lumpur to Johor Bahru. According to his car's odometer (distance measuring device), he travelled 334.2 km. However, the map he had stated that the two cities are 325.2 km apart. Why is there a difference?

Answer

[1] 2023 Prelim S4 Mathematics P1 [Turn over

- 19 (a) $\varepsilon = \{x : x \text{ is an integer and } 0 \le x < 12\}$
 - $A = \{x : x \text{ is divisible by 4}\}$
 - $B = \{x : x \text{ is an integer and } -2x+1 \le -6\}$
 - (i) List the set of $A \cup B'$.

(ii) Find $n(A \cup B)$.

Answer [1]

(b) Given that the set X is a proper subset of set Y as shown in the Venn diagram below. [1] Shade $(Y \cap X')$ on the diagram.





The figure shows the triangle *ABC* where angle $ACB = 20^{\circ}$. Given that AB = x units, BC = y units and the area of the triangle is 400 units², find the length of *AC*, giving your answer to 3 decimal places.

Answer $AC = \dots$ units [4]

2023 Prelim S4 Mathematics P1

[Turn over

20

21 The number of concert tickets sold on one weekend is given in the table below.

	Children	Adults	Senior Citizens
Saturday	50	90	75
Sunday	28	120	45

(a) Represent the above information with a matrix N.

Answer
$$\mathbf{N} = \dots$$
 [1]

The price of a ticket is \$3 for a child, \$8 for an adult and \$6 for a senior citizen.

This information can be represented by the matrix
$$\mathbf{C} = \begin{pmatrix} 3 \\ 8 \\ 6 \end{pmatrix}$$
.

(b) Evaluate the matrix \mathbf{T} such that $\mathbf{T} = \mathbf{NC}$.

Answer $\mathbf{T} = \dots$ [1]

To increase the profits, two proposals are examined:

Double the ticket prices on Sunday. Proposal 1:

Increase the ticket prices by 25% for both days. Proposal 2:

The matrix **P** is such that **PT** gives the total amount collected from the sale of tickets for the weekend under Proposal 1.

The matrix **Q** is such that **QT** gives the total amount collected from the sale of tickets for the weekend under Proposal 2.

(c) (i) Write down the matrix **P** and matrix **Q**.

Answer $\mathbf{P} = \dots$

(ii) Evaluate PT and QT.

Answer $\mathbf{PT} = \dots$ [2]

(iii) Which proposal is better for improving sales. Explain your answer.

Answer

..... [1]

2023 Prelim S4 Mathematics P1

[Turn over

22 (a) On the axes given, sketch the following graphs, indicating the x and y intercepts where relevant. The coordinates (1,1) are denoted as black dots in each diagram.

(i)
$$y = -x^2$$
 (ii) $y = 2^x$ [2]

Answer



(b) Hence explain why the equation $2^x + x^2 = 0$ has no solution. Answer

.....[1]



(a) Given that the car travels a distance of 250 m for the first 10 seconds, find the value of v.

Answer $v = \dots$ [2]

(b) Find the acceleration of the car when t = 15 s.

Answerm/s² [1]

(c) Given that the deceleration of the car between t = 30 s and t = p s is 1.52 m/s², find the value of p.

Answer $p = \dots$ [2]

[Turn over

24 The currency exchange table at a bank shows the rates in local currency. The currency exchange board is read from the bank's point of view.

The following is the currency exchange table shown at a foreign bank in Singapore in the beginning of 2019.

Currency	Bank Buy	Bank Sell		
euros (€)	1.5159	1.5584		

At the beginning of 2019, Angie invested Singapore Dollars (\$) 480 000 in this foreign bank account.

(a) Calculate the amount invested by Angie in euros (\in) .

Answer € [1]

(b) The foreign bank account offers an interest rate of 2.5% per annum compounded half yearly. Calculate the amount in euros (€) that Angie can withdraw at the end of 2022.

(c) At the end of 2022, Angie decided to close the account and withdraw the money. The currency exchange table shown at the foreign bank in Singapore is as follow.

Currency	Bank Buy	Bank Sell
euros (€)	1.4211	1.4583

Calculate the amount he withdrew in Singapore Dollars (\$), correct to the nearest dollar.

Answer \$..... [1]

END OF PAPER



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

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

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Trigonometry

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^{2} = b^{2} + c^{2} - 2bc \cos A$$

Statistics

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

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

Answer **all** the questions.

1 (a) It is given that
$$m = 2\pi \sqrt{\frac{k+2h^2}{h^2}}$$
.
Find *m* when $k = 1.2$ and $h = 0.3$.

24.6 (3sf)

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

(b) Two numbers p and q, written as the products of their prime factors, are $p = 2^2 \times 3^5 \times 5^6$ and $q = 2^2 \times 3^3$.

(i) Find the HCF of p and q.

$$HCF = 2^2 \times 3^3 = 108$$

Answer [1]

(ii) Find the smallest positive integer k such that $(p \times q \times k)$ is a perfect cube.

$$(p \times q \times k) = 2^4 \times 3^5 \times 5^6 \times k$$

 $k = 2^2 \times 3$
 $= 12$

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

(c) Estimate the percentage of the rectangle that is shaded.



35% (accept 30% to 40%)

Answer% [1]

[Turn over

2 (a) Is 673 a prime number? True

Answer [1]

(b) Explain your reasoning.

Answer Check if 673 is divisible by any prime numbers less than the square root of 673.

-[1]
- 3 In a library, the ratio of the number of books to magazines is 3 : 2. In a donation drive to help an overseas primary school, many books and magazines were given away. If the number of books is reduced by 40% and the number of magazines is reduced by 20%, find the new ratio of the number of books to the number of magazines.

Let original no. of books be x. Original no. of magazine be y.

$$\frac{x}{y} = \frac{3}{2}$$
New ratio
$$\frac{0.6x}{0.8y} = \frac{6}{8} \times \frac{x}{y}$$

$$= \frac{6}{8} \times \frac{3}{2}$$

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

$$= 9:8$$

Answer [2]

4 (a) Simplify
$$\frac{7x}{2y^2} \div \frac{21x^3}{8y}$$
.
 $\frac{7x}{2y^2} \div \frac{21x^3}{8y} = \frac{7x}{2y^2} \times \frac{8y}{21x^3}$
 $= \frac{x}{y^2} \times \frac{4y}{3x^3}$
 $= \frac{4}{3x^2y}$

4

(b) Factorise $p^3 + 7p^2 - 4p - 28$ completely.

$$p^{3} + 7p^{2} - 4p - 28 = p^{2}(p+7) - 4(p+7)$$
$$= (p^{2} - 4)(p+7)$$
$$= (p+2)(p-2)(p+7)$$

5 The stem and leaf diagram below shows the scores of 16 students in a Science class test.

Stem	Le	af						
2	5	5	7					
3	0	0	1	2	x	8		
4	2	3	5	7	7	У	9	Key: 2 5 represents 25 marks

Given that the median score is 36 marks, and the mean score is 37 marks, find the value of x and of y.

$$\frac{30 + x + 38}{2} = 36$$

x = 4
Since the mean is 37,
$$\frac{2(25) + 27 + 2(30) + 31 + 32 + 34 + 38 + 42 + 43 + 45 + 2(47) + (40 + y) + 49}{16} = 37$$

y = 7

6 Solve the inequality $\frac{3x-1}{2} \le x+3 < 3x+5$. Illustrate your solution on the number line. [3]

Answer

$$\frac{3x-1}{2} \le x+3$$

$$3x-1 \le 2x+6$$

$$x \le 7$$

$$-1 < x \le 7$$

$$-1 < x \le 7$$

$$-1$$

[Turn over

7 Study the number pattern, then find the values of the unknowns in lines (a), (b) and (c).

$$\frac{2}{1 \times 2 \times 3} = \frac{1}{1} - \frac{2}{2} + \frac{1}{3}$$
$$\frac{2}{2 \times 3 \times 4} = \frac{1}{2} - \frac{2}{3} + \frac{1}{4}$$
$$\frac{2}{3 \times 4 \times 5} = \frac{1}{3} - \frac{2}{4} + \frac{1}{5}$$
(a)
$$\frac{2}{10 \times 11 \times 12} = \frac{1}{s} - \frac{2}{u} + \frac{1}{v}$$
(b)
$$\frac{2}{w} = \frac{1}{15} - \frac{2}{16} + \frac{1}{17}$$
(c)
$$\frac{2}{10626} = \frac{1}{x} - \frac{2}{y} + \frac{1}{z}$$

- (a) 10, 11, 12
- (b) 4080 or 15×16×17
- (c) 21, 22, 23

Answer (a) $s = \dots, u = \dots, v = \dots$ [1]

Answer (**b**) $w = \dots$ [1]

Answer (c) $x = \dots, y = \dots, z = \dots$ [1]

- 8 Given that y is inversely proportional to $x^2 + 1$ and the difference in the values of y when x = 1 and when x = 3 is 4.
 - (a) Express y in terms of x.

Let
$$y = \frac{k}{x^2 + 12}$$

 $\frac{k}{1+1} - \frac{k}{9+1} = 4$
 $\frac{k}{2} - \frac{k}{10} = 4$
 $\frac{2k}{5} = 4 \Longrightarrow k = 10$
 $\therefore y = \frac{10}{x^2 + 1}$
Let $y = \frac{k}{x^2 + 12}$
 $\frac{k}{9+1} - \frac{k}{1+1} = 4$
OR $\frac{k}{10} - \frac{k}{2} = 4$
 $-\frac{2k}{5} = 4 \Longrightarrow k = -10$
 $\therefore y = \frac{-10}{x^2 + 1}$

$$Answer y = \dots \qquad [2]$$

(b) Find the value of y when x = -2.

When
$$x = -2$$
,
 $y = \frac{10}{(-2)^2 + 1}$ OR $y = \frac{-10}{(-2)^2 + 1}$
 $= 2$ $= -2$

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

 9 A piece of metal is heated to 375°C and then left to cool for 15 minutes. The temperature of the metal decreases at a rate of 18°C/min for the first 5 minutes and then decreases at a rate of 7°C /min for the next 10 minutes. Find the time taken for the metal to cool to a temperature of 250°C.

In the 1st 5 mins, temperature change =
$$375 - 18 \times 5$$

= 285° C
For temperature to drop to 250° C, time required = $\frac{285 - 250}{7}$
= 5 min
Total time taken = $5 + 5$
= 10 min

10 Keith walks a distance of 1.2 km at an average speed of 6 km/h and takes a break for 15 minutes. He then continues to run a further distance of 800 m in 4 minutes. Calculate, in km/h, his average speed for the whole journey.

Time taken for the 1.2 km walk = $1.2 \div 6$ = 0.2 hours / 12 mins Total time taken = 12 + 15 + 4= 31 mins Average speed = $2 \div \frac{31}{60}$ = 3.87 km/h

Answerkm/h [2]

- 11 216 cubes, each having edges of 2.6 cm, measured to the nearest 0.1 cm, fit exactly into a larger cubic box. Find the
 - (a) greatest possible length of the cubic box.

Greatest possible length of cubic box = 2.65×6 = 15.9 cm

Answercm [1]

(b) least possible volume of the cubic box.

Least possible volume of cubic box = 216×2.55^3 = 3581.577 cm³

Answercm³ [2]

12 *ABCDEF* is a regular hexagon. (not drawn to scale)



(a) State the name of the triangle *EOD*.

Answer

Equilateral triangle

- (b) Find

(i) reflex angle *EOC*.

reflex angle $EOC = 360^\circ - 60^\circ - 60^\circ$ (\angle s at a point) or $4 \times 60^\circ$ = 240°

Answer Reflex angle EOC =° [2]

(ii) angle ANB.

AB = BO = OF = FA∴ ABOF is a rhombus. $\angle ANB = 90^{\circ}$ (diagonals of a rhombus bisect at \perp)

Answer angle $ANB = \dots$ [2]

13 In a park XYZ, XY = 100 km and YZ = 45 km. X is due west of Y and the bearing of Z from Y is 300°.

The point *Y* is marked in the space below. Construct the park *XYZ* using the scale 1 cm: [2] 10 km.

Construct on the diagram drawn below,

- (i) the perpendicular bisector of XY,
- (ii) the bisector of angle *ZXY*. [1]

[1]

(iii) A bench *B* is in the park, equidistant from *X* and *Y* and nearer to *XZ* than *XY*. [1] Mark a possible position of *B* on the diagram drawn.

Answer



14 In the diagram, *O* is the centre of a wheel of circumference 150 cm. The points *X* and *Y* lie on the circumference of the wheel and $\angle XOY = 0.8726$ radians.



(a) Calculate the number of complete revolutions the wheel would make in travelling a distance of 1 km.

Number of revolutions = $100000 \div 150$ = 666

Answer revolutions [1]

(b) Find the length of the minor arc XY.

Radius =
$$\frac{150}{2\pi}$$

=23.87 cm (4sf)
Minor arc $XY = \frac{150}{2\pi} \times 0.8726$
= 20.8 cm (3sf)

Answer cm [2]

(c) Calculate the area of the minor sector *XOY*.

Area of minor sector XOY

$$= \frac{1}{2} \left(\frac{150}{2\pi} \right)^2 (0.8726)$$

= 249 cm² (3sf)

[Turn over

11

15 The figure shows a triangle *ABC* with A(1, -3), B(-1, -1) and C(7, p). The gradient of *AB* is -2k and the length of *AC* is $\sqrt{72}$ units.



(a) Find the values of(i) k,

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

Answer k = [1]

(ii) *p*.

$$(\sqrt{72})^2 = 6^2 + (p+3)^2$$

 $(p+3)^2 = 36$
 $p+3 = 6$ or $p+3 = -6$
 $p=3$ or $p=-3(rej)$

Answer $p = \dots$ [2]

(b) Find the equation of the line *AB*.

$$y+3 = -1(x-1)$$
$$y = -x-2$$

13

16 (a) Given that $x^2 + y^2 = a$ and xy = b, find $(2x - 2y)^2$ in terms of a and b.

$$(2x-2y)^{2} = 4(x-y)^{2}$$

= 4(x² + y² - 2xy)
= 4(a-2b) (or 4a-8b)

(b) Given that
$$\frac{y}{x} = 2048$$
 and $\frac{z}{y} = 2048$, where $x \neq 0$ and $y \neq 0$.

Find the value of
$$\frac{y+z}{x+y}$$
.

$$\frac{y}{x} = 2048 \Rightarrow y = 2048x$$

$$\frac{z}{y} = 2048 \Rightarrow z = 2048y$$

$$\frac{y}{x} = 2048 \Rightarrow y = 2048x$$

$$\frac{z}{y} = 2048 \Rightarrow z = 2048y = (2048^{2})x$$

$$\frac{y+z}{y+z} = 2048(x+y)$$

$$\frac{y+z}{x+y} = \frac{2048x + (2048^{2})x}{x+2048x}$$

$$\frac{y+z}{x+y} = 2048$$

$$= \frac{4196352x}{2049x} = 2048$$

17 In the diagram, *ABC* is a straight line. *BCDE* is a rectangle and *F* is the midpoint of *BE*. Given that AB = BE and angle $BFC = 45^\circ$, show that triangle *ABF* is congruent to triangle *EBC*.



[3]

$\angle FCB = 180 - 90 - 45 (sum of \angle s in a \Delta)$	
= 45°	
$\therefore BF = BC \ (isoseles \ \Delta)$	
$\angle ABF = \angle EBC = 90^{\circ}$	
AB = BE (given)	
$\therefore \ \Delta ABF \equiv \Delta EBC \ (SAS)$	
	_

18

	Map	Actual
Area Scale	25 cm^2	144 km ²
	1 cm ²	5.76 km ²
Linear Scale	1 cm	2.4 km
	1 cm	240 000 cm
	1	240 000

Scale of map *A* is 1 : 240 000

Answer [2]

(ii) New Town and Sea City are 2.4 cm apart on the map *A*. How far apart will the two locations be on map *B*, if map *B* has a scale of 1:40 000?

Actual distance apart = 2.4×2.4 = 5.76 km For map *B*, scale is 1cm : 0.4 km distance on map $B = \frac{5.76}{0.4}$ = 14.4 cm

(b) Jim drove from Kuala Lumpur to Johor Bahru. According to his car's odometer (distance measuring device), he travelled 334.2 km. However, the map he had stated that the two cities are 325.2 km apart. Why is there a difference?

It could have been a hilly terrain or

The starting and ending points could be different compared with the map. *or* The vehicle does not travel in a straight route from KL to Johore Bahru. *or* Any acceptable reason.

(a) $\varepsilon = \{x : x \text{ is an integer and } 0 \le x < 12\}$ $A = \{x : x \text{ is divisible by 4}\}$ $B = \{x : x \text{ is an integer and } -2x+1 \le -6\}$

(i) List the set of $A \cup B'$.

19

$$\varepsilon = \{ 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 \}$$

$$A = \{ 0, 4, 8 \}$$

$$-2x + 1 \le -6$$

$$-2x \le -7$$

$$x \ge 3.5$$

$$B = \{ 4, 5, 6, 7, 8, 9, 10, 11 \}$$

$$B' = \{ 0, 1, 2, 3 \}$$

$$A \cup B' = \{ 0, 1, 2, 3, 4, 8 \}$$

(ii) Find $n(A \cup B)$. $A \cup B = \{ 0, 4, 5, 6, 7, 8, 9, 10, 11 \}$ $n(A \cup B) = 9$

(b) Given that the set X is a proper subset of set Y as shown in the Venn diagram below. [1] Shade $(Y \cap X')$ on the diagram.



16



The figure shows the triangle *ABC* where angle $ACB = 20^{\circ}$. Given that AB = x units, BC = y units and the area of the triangle is 400 units², find the length of *AC*, giving your answer to 3 decimal places.

$$\frac{1}{2}xy = 400$$

$$xy = 800$$
 (1)

$$\tan 20^\circ = \frac{x}{y}$$

$$x = y \tan 20^\circ$$
 (2)
Sub (2) into (1)

$$(y \tan 20^\circ) y = 800$$

$$y^2 = \frac{800}{\tan 20^\circ}$$

$$y = \sqrt{\frac{800}{\tan 20^\circ}}$$
 (*rej* -ve value)

$$y = 46.882$$

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 $x = (46.882) \tan 20^{\circ}$ = 17.064 By Pythagoras Theorem $AC^{2} = AB^{2} + AC^{2}$ = (46.882)² + (17.064)² = 2489.1 $AC = 49.891 \text{ units (3dp)} \quad (\text{accept } 49.892)$

Answer $AC = \dots$ units [4]

21 The number of concert tickets sold on one weekend is given in the table below.

	Children	Adults	Senior Citizens
Saturday	50	90	75
Sunday	28	120	45

Represent the above information with a matrix N. **(a)**

 $\begin{pmatrix} 50 & 90 & 75 \\ 28 & 120 & 45 \end{pmatrix}$

Answer
$$\mathbf{N} = \dots$$
 [1]

The price of a ticket is \$3 for a child, \$8 for an adult and \$6 for a senior citizen.

This information can be represented by the matrix $\mathbf{C} = \begin{pmatrix} 3 \\ 8 \\ 6 \end{pmatrix}$.

(b) Evaluate the matrix \mathbf{T} such that $\mathbf{T} = \mathbf{NC}$.

$$\mathbf{T} = \begin{pmatrix} 50 & 90 & 75 \\ 28 & 120 & 45 \end{pmatrix} \begin{pmatrix} 3 \\ 8 \\ 6 \end{pmatrix}$$
$$= \begin{pmatrix} 1320 \\ 1314 \end{pmatrix}$$

Answer $\mathbf{T} = \dots$ [1]

To increase the profits, two proposals are examined:

Proposal 1: Double the ticket prices on Sunday.

Proposal 2: Increase the ticket prices by 25% for both days.

The matrix \mathbf{P} is such that \mathbf{PT} gives the total amount collected from the sale of tickets for the weekend under Proposal 1.

The matrix \mathbf{Q} is such that \mathbf{QT} gives the total amount collected from the sale of tickets for the weekend under Proposal 2.

(c) (i) Write down the matrix **P** and matrix **Q**.

 $\mathbf{P} = \begin{pmatrix} 1 & 2 \end{pmatrix}, \\ \mathbf{Q} = \begin{pmatrix} 1.25 & 1.25 \end{pmatrix}$

Answer $\mathbf{P} = \dots$

(ii) Evaluate **PT** and **QT**.

 $\mathbf{PT} = (1 \ 2) \begin{pmatrix} 1320 \\ 1314 \end{pmatrix} = (3948)$ $\mathbf{QT} = (1.25 \ 1.25) \begin{pmatrix} 1320 \\ 1314 \end{pmatrix} = (3292.5)$

Answer $\mathbf{PT} = \dots, \mathbf{QT} = \dots$ [2]

(iii) Which proposal is better for improving sales. Explain your answer.

Proposal 1 is better at improving sales as the amount of money collected is more than that from Proposal 2. [1] 22 (a) On the axes given, sketch the following graphs, indicating the x and y intercepts where relevant. The coordinates (1,1) are denoted as black dots in each diagram.

(i)
$$y = -x^2$$
 (ii) $y = 2^x$ [2]

Answer



(b) Hence explain why $2^x + x^2 = 0$ has no solution. Answer

 $2^{x} + x^{2} = 0$ has no solution since the graphs of $y = 2^{x}$ and $y = -x^{2}$ do not intersect.

[1]

23 The diagram shows the speed time graph of a car during a period of p seconds.



(a) Given that the car travels a distance of 250 m for the first 10 seconds, find the value of v.

$$\frac{1}{2}(12+v) \times 10 = 250$$
$$v = 38 \text{ m/s}$$

Answer $v = \dots$ [2]

(b) Find the acceleration of the car when t = 15 s.

 0 m/s^2

Answerm/s² [1]

(c) Given that the deceleration of the car between t = 30 s and t = p s is 1.52 m/s², find the value of p.

$$\frac{38-0}{p-30} = 1.52$$
$$p-30 = 25$$
$$p = 55$$

Answer $p = \dots$ [2]

24 The currency exchange table at a bank shows the rates in local currency. The currency exchange board is read from the bank's point of view.

The following is the currency exchange table shown at a foreign bank in Singapore in the beginning of 2019.

Currency	Bank Buy	Bank Sell
euros (€)	1.5159	1.5584

At the beginning of 2019, Angie invested Singapore Dollars (\$) 480 000 in this foreign bank account.

(a) Calculate the amount invested by Angie in euros (ϵ) .

 $\frac{480000}{1.5584} = €308008.21$ (nearest cent)

Answer € [1]

(b) The foreign bank account offers an interest rate of 2.5% per annum compounded half yearly. Calculate the amount in euros (€) that Angie can withdraw at the end of 2022.

$$\left(\frac{480000}{1.5584}\right) \left(1 + \frac{2.5/2}{100}\right)^{4\times 2}$$

= € 340190.79 (nearest cent)

Answer € [2]

(c) At the end of 2022, Angie decided to close the account and withdraw the money. The currency exchange table shown at the foreign bank in Singapore is as follow.

Currency	Bank Buy	Bank Sell
euros (€)	1.4211	1.4583

Calculate the amount he withdrew in Singapore Dollars (\$), correct to the nearest dollar.

340190.79×1.4211 = SGD 483445 (nearest dollar)

Answer \$..... [1]

END OF PAPER