

NAME: _____ ()

CLASS: _____

**FAIRFIELD METHODIST SCHOOL (SECONDARY)**

PRELIMINARY EXAMINATION 2025
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

MATHEMATICS**4052/02****Paper 2****Date: 26 August 2025****Duration: 2 hours 15 minutes**

Candidates answer on the Question Paper.

READ THESE INSTRUCTIONS FIRST

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

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

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 of the marks for this paper is 90.

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.**For Examiner's Use**

Table of Penalties		Question Number	Parent's / Guardian's Signature	90
Presentation	☐ 1 ☐ 2			
Rounding off	☐ 1			

Setter: Ms Lee CP

This question paper consists of 24 printed pages.

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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

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

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

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Answer **all** the questions.

1 (a) Solve the equation $\sqrt[3]{64^{5x+6}} = \frac{1}{16^{-x}}$.

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

(b) Write as a single fraction in its simplest form $\frac{3}{2-3x} - \frac{13}{6x^2+5x-6}$.

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

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- 1 (c) Given that $a = \sqrt{bc^2 - 1}$, express c in terms of a and b .

Answer [2]

- (d) (i) Solve the inequality $\frac{x+22}{3} < x-2 < \frac{x+25}{2}$.

Answer [2]

- (ii) Hence, find the prime numbers that satisfy the inequality in (i).

Answer [1]

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2 (a) In a game, two six-sided dice are used.

Die P has 2 blue faces and 4 yellow faces.

Die Q has 4 blue faces and 2 yellow faces.

Two dice are thrown together.

(i) Find the probability that both dice show a blue face on top, leaving your answer as a fraction in the simplest form.

Answer [1]

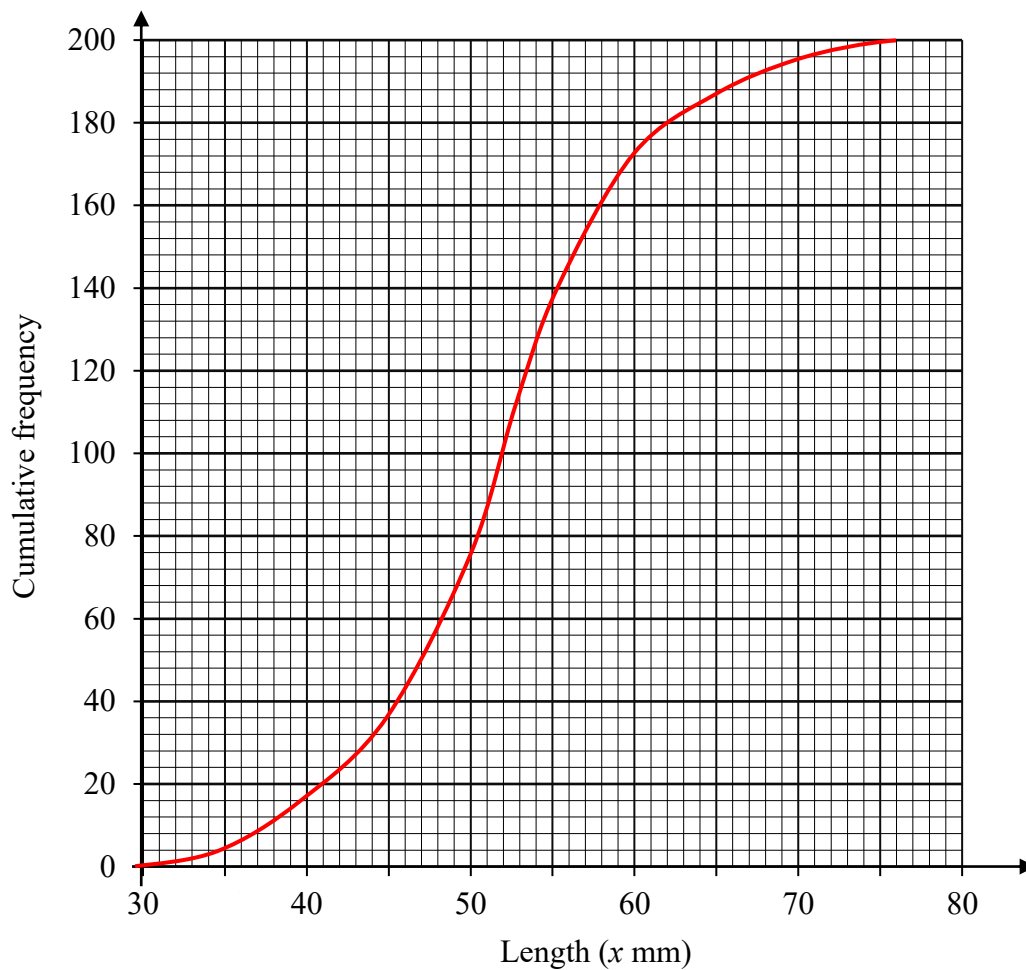
If both dice show blue, the player wins a prize.

If just one die shows blue, the player throws both dice again. The player wins a prize if both dice show blue this time.

(ii) Calculate the probability, that the player wins a prize on either the first throw or the second throw, leaving your answer as a fraction in the simplest form.

Answer [2]

- 2 (b) The cumulative frequency curve below shows the distribution of length of 200 leaves from tree A.



- (i) Use the curve to find the
(a) median length,

Answermm [1]

- (b) interquartile range.

Answermm [1]

- (ii) The above data is shown in a pie chart. What is the angle representing the sector for the range of length of leaves between 40 mm and 50 mm?

Answer° [1]

- 2 (b) (iii) It was found that the lengths were measured wrongly.

The correct length of each leaf is 4 mm more than recorded.

Explain how the median and interquartile range have been affected.

Answer

[2]

- (iv) With reference to the cumulative frequency curve, Alex said: “The range of length of the 200 leaves is $76 - 30 = 46$.” Explain why this statement is not true.

Answer
[1]

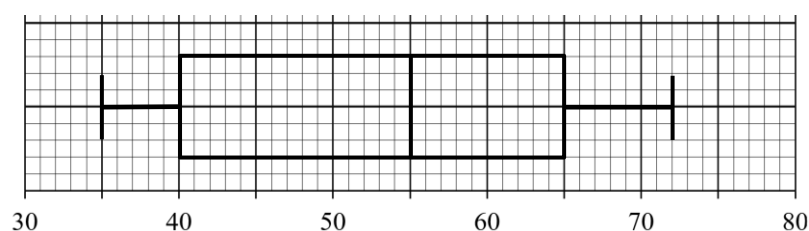
- (v) With reference to the cumulative frequency curve, Charlie said: “60% of the leaves has a length of at least 53.5 mm.”

Is Charlie correct? Justify your answer with clear calculations.

Answer

[2]

- (vi) The box-and-whisker plot below shows the lengths of leaves distribution from tree B.



Make two comparisons for the distribution of length of leaves between the two trees.

Answer
 1

 2
[2]

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- 3 (a) Anna currently takes 80 seconds to swim a 50 m lap.

In a year from now, she aims to increase her swimming speed by 20%.

Calculate the time Anna will take to complete 50 m in a year from now, leave your answer to the nearest second.

Answers [2]

- (b) Brad and Jude train by swimming a 50 m lap.

Brad swam at an average speed of x m/s and completed 28 laps.

Jude swam at an average speed of $\frac{1}{5}$ m/s slower than Brad and he completed 30 laps.

Brad started swimming $3\frac{1}{3}$ minutes later than Jude but they stopped at exactly the same time.

- (i) Write down an expression, in terms of x , for the time taken by Brad to complete 28 laps.

Answers [1]

- (ii) Write down an equation in x to represent the information given and show that it reduces to $10x^2 - 7x - 14 = 0$.

Answer

[3]

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- 3 (b) (iii) Solve the equation $10x^2 - 7x - 14 = 0$, giving your answer correct to 2 decimal places.

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

- (iv) Find the average of the times taken by Brad and Jude to swim one lap on Monday.

Answers [1]

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- 4 PA chemical manufacturing company produces two types of cleaning agents: **CClean** and **EFresh**. The company operates two production lines: Line X and Line Y for 5 days a week. The matrix **M** represents the average number of units produced per day on each line during Week 1.

$$\mathbf{M} = \begin{matrix} & \begin{matrix} \text{CClean} & \text{EFresh} \end{matrix} \\ \begin{pmatrix} 50 & 30 \\ 40 & 60 \end{pmatrix} & \begin{matrix} \text{Line X} \\ \text{Line Y} \end{matrix} \end{matrix}$$

- (a) Evaluate the matrix $\mathbf{N} = 5\mathbf{M}$.

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

- (b) The selling prices per unit for CClean and EFresh are \$15 and \$20, respectively. Represent the prices as a column matrix **P**.

Answer $\mathbf{P} =$ [1]

- (c) Evaluate the matrix $\mathbf{R} = \mathbf{NP}$.

Answer $\mathbf{R} =$ [1]

- (d) State what the elements of **R** represent.

Answer
[1]

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- 4 (e) In Week 2, the average production of all cleaning agents increased by 10% and the prices of all products increased by 5%.

Using matrices, calculate the earnings made by Line X and Line Y, respectively, in Week 2.

Answer [2]

- (f) (i) Write down a matrix **Q** such that the total earnings of both production lines in Week 2 can be calculated using matrix multiplication.

Answer **Q** = [1]

- (ii) Hence, find the total earnings of both production lines in Week 2.

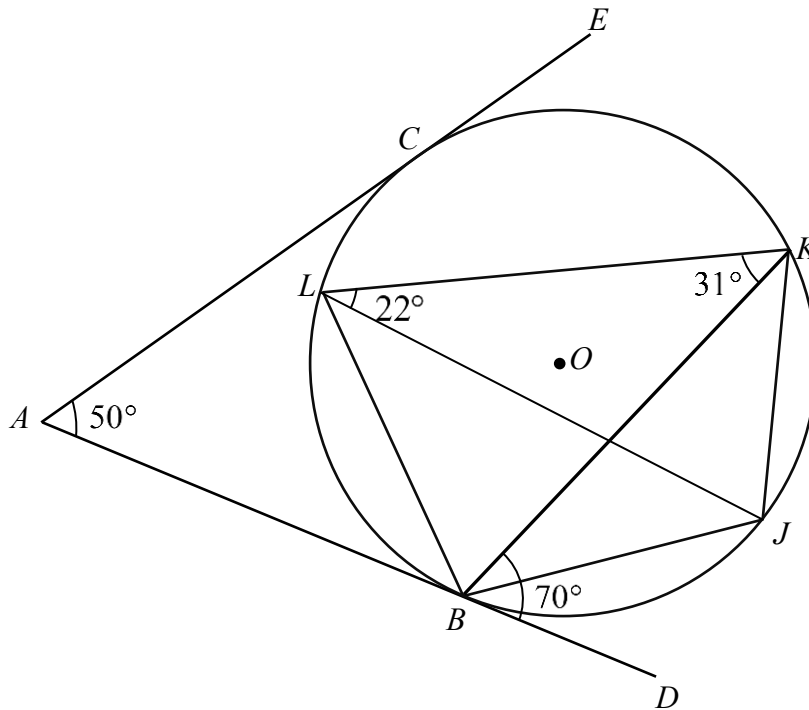
Answer \$..... [1]

5 The diagram shows a circle $BLCKJ$, centre O .

ACE and ABD are tangents to the circle at C and B respectively.

Angle JLB is equal to angle JBD .

Angle $BAC = 50^\circ$, angle $JLK = 22^\circ$, angle $KBD = 70^\circ$ and angle $BKL = 31^\circ$.



(a) Find, **giving reasons** for each answer,

(i) angle JBK ,

Answer Angle $JBK = \dots\dots\dots$ [1]

(ii) angle KBL ,

Answer Angle $KBL = \dots\dots\dots$ [2]

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5 (a) (iii) angle KOL ,

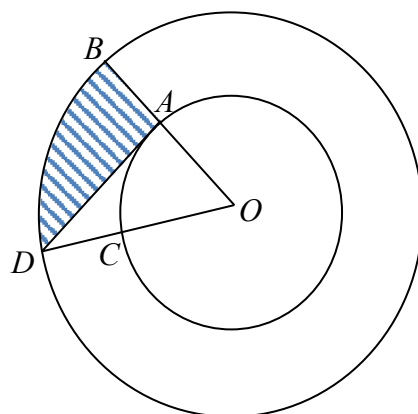
Answer Angle KOL = [1]

(iv) angle COB .

Answer Angle COB = [1]

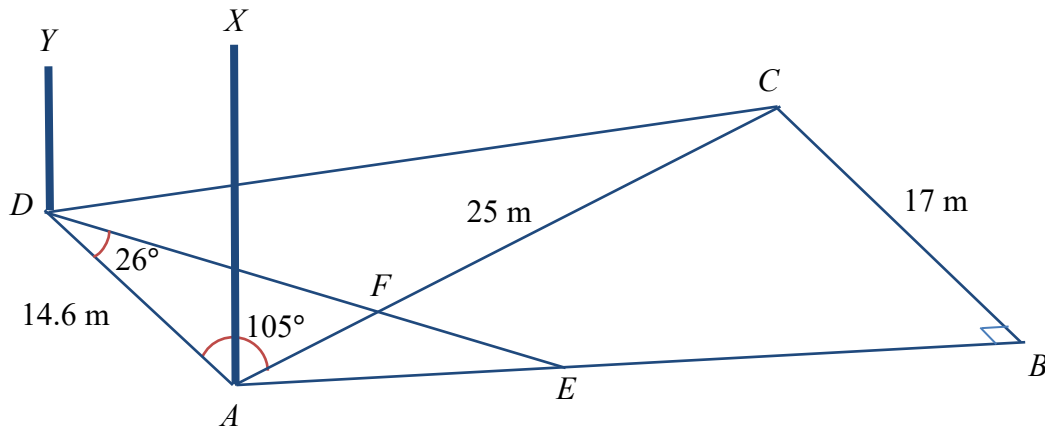
- (b) The diagram shows two concentric circles, centre O . The radius of the smaller circle is r cm. The radius the larger circle is 10 cm. The tangent to the smaller circle at A meets the larger circle at D . OAB and OCD are straight lines. Angle $BOD = 1.2$ radians. Show that the perimeter the shaded region is 27.7 cm, correct to 3 significant figures. Support your answer with reasons and show your working clearly.

Answer



[3]

6



$ABCD$ is a quadrilateral green space on a horizontal plane such that $BC = 17$ m, $AD = 14.6$ m, $AC = 25$ m, $\angle ABC = 90^\circ$ and $\angle CAD = 105^\circ$. E is a point on AB such that $\angle ADE = 26^\circ$.

AC intersects DE at F . Calculate

(a) DC ,

Answerm [3]

(b) FC ,

Answerm [2]

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6 (c) area of quadrilateral $ABCD$.

Answerm² [2]

(d) XA and YD are vertical poles at A and D respectively.

Given that $XA = 51\text{m}$ and the angle of elevation from A to Y is 59° , calculate

(i) the height of YD ,

Answerm [2]

(ii) the angle of depression from X to Y .

Answer[°] [2]

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- 7 The variables x and y are connected by the equation $y = \frac{9}{2x} + \frac{1}{2x^2} - \frac{3}{2}$.

(a) Complete the table of values, giving your answer correct to 2 decimal places.

x	1	1.5	2	2.5	3	4	5	6
y	3.5	1.72	0.88	0.38	0.06		-0.58	-0.74

[1]

- (b) On the grid, draw the graph of $y = \frac{9}{2x} + \frac{1}{2x^2} - \frac{3}{2}$ for $1 \leq x \leq 6$.

[3]

- (c) Using your graph, write down the solution of the equation $\frac{9}{2x} + \frac{1}{2x^2} - \frac{3}{2} = 0$ for $1 \leq x \leq 6$.

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

- (d) Use your graph to find the x -coordinate of a point on the curve $y = \frac{9}{2x} + \frac{1}{2x^2} - \frac{3}{2}$ at

which the gradient of the tangent is equal to $-\frac{1}{2}$.

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

- (e) By drawing an appropriate graph, find the range of values of x for which

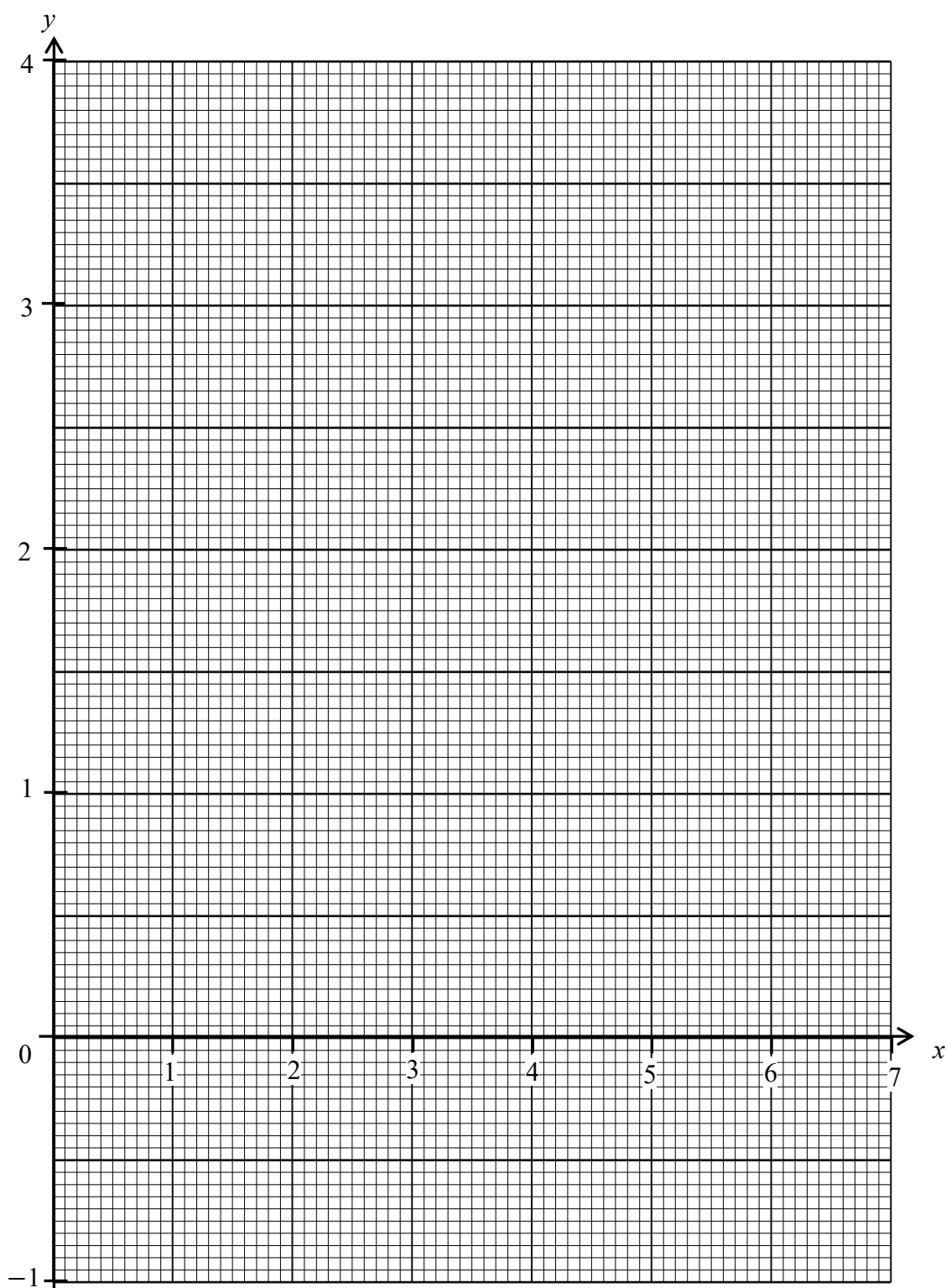
$$\frac{9}{x} + \frac{1}{x^2} < 9 - \frac{4x}{3}.$$

Answer $\dots\dots\dots$ [3]

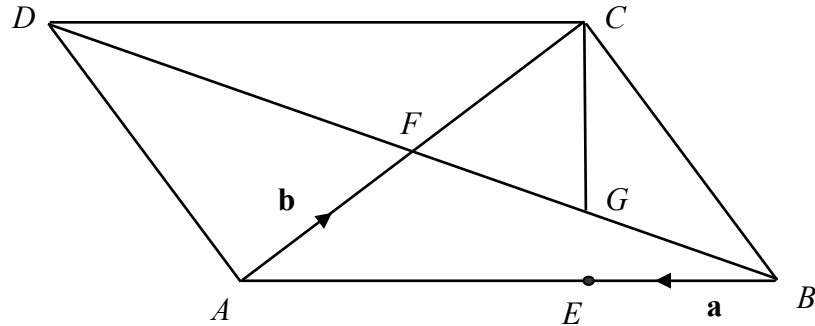
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Answer 7(b)



8 (a)



In the diagram, $ABCD$ is a parallelogram, where the diagonals AC and BD intersect at F . E is a point on AB such that $AB = 3BE$. G is the midpoint of BF .

$\vec{BE} = \mathbf{a}$ and $\vec{AF} = \mathbf{b}$.

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

(a) $\vec{BC}$,

Answer $\vec{BC} = \dots\dots\dots [1]$

(b) $\vec{BG}$,

Answer $\vec{BG} = \dots\dots\dots [1]$

(c) $\vec{CG}$.

Answer $\vec{CG} = \dots\dots\dots [1]$

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8 (a) (ii) Show that CG produced passes through E .

Answer

[2]

(iii) Calculate the value of

(a) $\frac{\text{Area of } \triangle CGF}{\text{Area of } \triangle CGD}$,

Answer [1]

(b) $\frac{\text{Area of } \triangle EGB}{\text{Area of } \triangle CGF}$.

Answer [2]

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8 (b) M is the point $(5, 7)$.

The point N is the result of the translation of the point M by $\begin{pmatrix} -8 \\ -10 \end{pmatrix}$.

(i) Find the coordinates of the point N .

Answer [1]

(ii) Find the equation of the line MN .

Answer [1]

(iii) Given $\overrightarrow{NP} = \frac{1}{2} \overrightarrow{NM}$. Using vectors, find the coordinates of the point P .

Answer [1]

- 9 The Airbus A350-900 is one of the latest aircraft owned by Singapore Airlines.
Singapore Airlines reconfigures its Airbus A350-900 in 3 different configurations, namely medium haul, long haul and ultra-long haul.

Table 1: Number of Seats

Aircraft	Business	Premium Economy	Economy
Medium haul (MH)	40	0	263
Long haul (LH)	42	24	187
Ultra-long haul (ULH)	67	94	0

Table 2: Maximum Weight for Airbus A350 - 900

Type of Maximum Weight	Weight
Take-Off	283 tonnes
Landing	207 tonnes
Fuel Capacity	166 488 litres
Payload [#]	51 976 kg
Ramp	284 tonnes

[#] Payload weight includes weight of passengers, and other items put on aircraft that generates revenue for the airlines, e.g., baggage, cargo, in-flight meals and drink, souvenirs, etc.

Conversion: 1 tonne = 1000 kg

Flights are considered safe when the total payload is at most 90% of the maximum allowable payload weight specified for the aircraft. Airlines will always maximise its allowable payload weight.

- (a) Find maximum allowable payload weight for Airbus A350 - 900.

Answerkg [2]

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- (b) Express the maximum payload weight as a percentage of maximum take-off weight.

Answer% [2]

The long haul (LH) and the ultra-long haul (UHL) aircraft configurations are used for routes from Singapore to the United States. Some information about the flight is provided below.

Description	Information
Crew Members	4 pilots and 13 cabin crews
Weight of person	Average human weight is 65 kg
Carry-on Baggage Allowance	Economy / Premium Economy: 1 piece per passenger Business Class: 2 pieces per passenger Pilot/Crew: 1 piece per passenger Maximum weight of carry-on baggage: 7 kg per piece
Checked-In Baggage Allowance	Economy/Premium Economy: 2 bags, up to 23 kg each Crew/Pilot: 2 bags, up to 23 kg each Business Class: 2 bags, up to 32 kg each
In-flight meals and drink	Economy/Premium Economy Class/Crew: • 2 main meals weighing approximately 1.2 kg/meal • 1 breakfast weighing approximately 900 g Business Class/Pilot: • 2 main meals weighing approximately 1.8 kg/meal • 1 breakfast weighing approximately 1.3 kg
Others	Miscellaneous Items: Comfort food / Duty free items for sale / Souvenirs etc Approximately 210 kg altogether

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- (c) Jamie claims that when all passenger seats are occupied, ultra long-haul aircraft (ULH) can transport twice the cargo weight compared to long haul (LH) aircraft.

Do you agree with Jamie's statement?

Justify your decision with calculations. State one assumption you made in the calculation.

Answer

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.....
.....[6]

End of paper

Sec 4EXP/5NA Prelim Exam Paper 2 Answer Key

1(a)	$x = -2$	1(b)	$\frac{6x+22}{(2-3x)(2x+3)}$ or $\frac{-6x-22}{(3x-2)(2x+3)}$
1(c)	$c = \pm \sqrt{\frac{a^2+1}{b}}$	1(d)(i) 1(d)(ii)	$14 < x < 29$ 17, 19, 23
2(a)(i)	$\frac{2}{9}$	2(a)(ii)	$\frac{28}{81}$
2(b)(i)(a)	52mm	2(b)(i)(b)	9.5 mm
2(b)(ii)	108°	2(b)(iii)	Median length will <u>increase by 4 mm</u> . Interquartile range will not be affected by the change of lengths.
2(b)(iv)	The statement is not true as the actual data of the cumulative frequency (CF) curve is unknown, therefore, the data shown in CF is an estimate Or. The length of the actual length of leaf is unknown.	2(b)(v)	60% of leaves = 120 leaves Minimum mark of 120 leaves = 50.5mm not 53.5 mm So Charlie's statement is false $P_{40} = 50.5\text{mm}$ not 53.5 mm. OR 60% of the leaves have length of at least 50.5 mm so Charlie's statement is false OR When $x = 53.5$ mm, % of leaves with length at least 53.5 mm $= \frac{200-120}{200} \times 100\%$ $= 40\%$ Therefore the statement is false as it has a percentage of 40% for leaves with at least 53.5 mm.
2(b)(vi)	Leaves from tree B is longer than leaves from tree A because the median length of leaves from tree B is larger (55 mm) than median length of leaves in tree A (52 mm). Leaves from tree A is shorter than leaves from tree A because the median length of leaves from tree A is smaller (52 mm) than median length of leaves in tree B (55 mm). Length of leaves in B is more spread out (varied) than the length of leaves in tree A because Interquartile range (IQR) of leaves in tree B (25 mm) is larger than IQR of length in tree A (9.5 mm). Length of leaves in A is less spread out than the length of leaves in tree B because Interquartile range (IQR) of leaves in tree A (9.5 mm) is smaller than IQR of length in tree B (25 mm).		
3(a)	67 s (nearest second)		
3(b)(i)	$\frac{1400}{x} \text{ s}$	3(b)(iii)	$x = 1.58$ or $x = -0.88$ (2 d.p.)
3(b)(iv)	33.9 s (3 s.f.)	4(a)	$\begin{pmatrix} 250 & 150 \\ 200 & 300 \end{pmatrix}$
4(b)	$\begin{pmatrix} 15 \\ 20 \end{pmatrix}$	4(c)	$\begin{pmatrix} 6750 \\ 9000 \end{pmatrix}$

4(d)	The total amount of money collected/received/earnings in Week 1/5 days for Line X (\$6,750) and Line Y (\$9000) respectively. Accept: Total revenue /total amount earned in 5 days/Week 1/a week for Line X and Line Y respectively.	4(e)	The total amount collected in Week 2 for Line X (\$7796.26) and Line Y (\$10395) respectively.
4(f)(i)	(1 1)	4(f)(ii)	\$18191.25
5(a)(i)	22°	5(a)(ii)	79°
5(a)(iii)	158°	5(a)(iv)	130°
6(a)	32.0 m (3 s.f.)	6(b)	16.5 m (3 s.f.)
6(c)	332 m^2 (3 s.f.)	6(d)(i)	24.3 m (3 s.f.)
6(d)(ii)	61.3° (1 d.p.)	7(a)	-0.34 (2 dp)
7(c)	3.1 ± 0.1	7(d)	$x\text{-coordinate} = 3 \pm 0.2$
7(e)	$1.4 < x < 5.5$ (± 0.15 accuracy)	8(a)(i)(a)	$\vec{BC} = 3\mathbf{a} + 2\mathbf{b}$
8(a)(i)(b)	$\vec{BG} = \frac{1}{2}(3\mathbf{a} + \mathbf{b})$	8(a)(i)(c)	$\vec{CG} = -\frac{3}{2}(\mathbf{a} + \mathbf{b})$
8(a)(ii)	Since $\vec{CG} = \frac{3}{4}\vec{CE}$ and C is a common point, therefore, C , G and E lies on the straight line. Since $\vec{CE} = 4\vec{GE}$ and E is a common point, therefore, C , G and E lies on the straight line.	OR	Since $\vec{CG} = 3\vec{GE}$ and G is a common point, therefore, C , G and E lies on the same straight line.
8(a)(iii)(a)	$\frac{1}{3}$	8(a)(iii)(b)	$\frac{1}{3}$
8(b)(i)	$N(-3, -3)$	8(b)(ii)	$y = \frac{5}{4}x + \frac{3}{4}$
8(b)(iii)	$P(1, 2)$	9(a)	46778.4 kg or 46800 kg (3 s.f.)
9(b)	18.4% (3 s.f.)	9(c)	I disagree with Jamie as it is less than 2 times.