ZHONGHUA SECONDARY SCHOOL

PRELIMINARY EXAMINATION 2024

SECONDARY 4 EXPRESS / 4 NORMAL (ACADEMIC) SBB
SECONDARY 5 NORMAL (ACADEMIC)

Candidate's Name	Class	Register Number

MATHEMATICS

4052/02

PAPER 2

27 August 2024
2 hours and 15 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number in the spaces at the top of this page.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

Answer **all** questions.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degree, unless a different level of accuracy is specified in the question.
The use of an approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

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**.

90

Setter: Ms Lee Jie Li
Vetted by: Mr Francis Tan

This document consists of **24** printed pages.

[Turn over

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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

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

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

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1 Write down the following numbers in ascending order.

$$-\frac{25}{37},\ (-0.51)^{\frac{2}{3}},\ \sqrt{0.36},\ 0.\dot{6},\ -\frac{\pi}{6}$$

Answer ....., ..., ..., ..., ... [1]

2



The diagram shows two geometrically similar pails.
The area of the base of the smaller pail is 54 cm^2.
The area of the base of the larger pail is 150 cm^2.

The height of the larger pail is 26 cm. .
Calculate the height of the smaller pail.

Answer ..... cm [2]

[Turn over

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3 **(a)** Solve $\frac{2x}{5} = 2 + \frac{3x-11}{15}$.

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

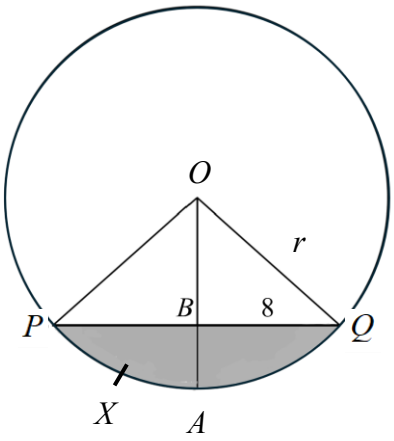
(b) Simplify $\frac{12p^2q^2}{7r^3} \div \frac{3p^5r}{14q^3}$, giving your answer in positive index notation.

Answer ..... [2]

[Turn over

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4 **(a)** The diagram shows the cross-section of a pipe filled with water.
The cross-section is a circle with centre O and radius r cm.
P, X, A and Q are points on the circle.
PBQ is a straight line such that $PB = BQ$ and $BQ = 8$ cm.
The ratio of $AB : BO$ is $1 : 2$.



Show that $r = 10.733$ cm. [3]

Answer

(b) Find arc length AXP.

Answer ..... cm [3]

[Turn over

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5 Tom requires a 7 year loan of $120 000 to purchase a new car.
Bank *M* charges an interest of 4% per annum compounded monthly.
Bank *N* charges a simple interest of 4.3% per annum.

Determine which bank loan Tom should take. Justify your answer clearly.
Answer

He should take loan from Bank ..... because .....
..... [4]

6 **(a)** The cash price of a furniture set is $10 850.
Kate buys the sofa on hire purchase.
She pays a deposit of one fifth of the cash price.
She then makes 24 monthly payments of $$x$.
Given that the total amount that Kate pays for the furniture set is $11 578,
find the value of x.

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

[Turn over

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(b) The exchange rate between Singapore dollars ($) and US dollars (USD) is $1 = USD 0.74.
The exchange rate between British pounds (£) and Singapore dollars ($) is £1= $1.72.

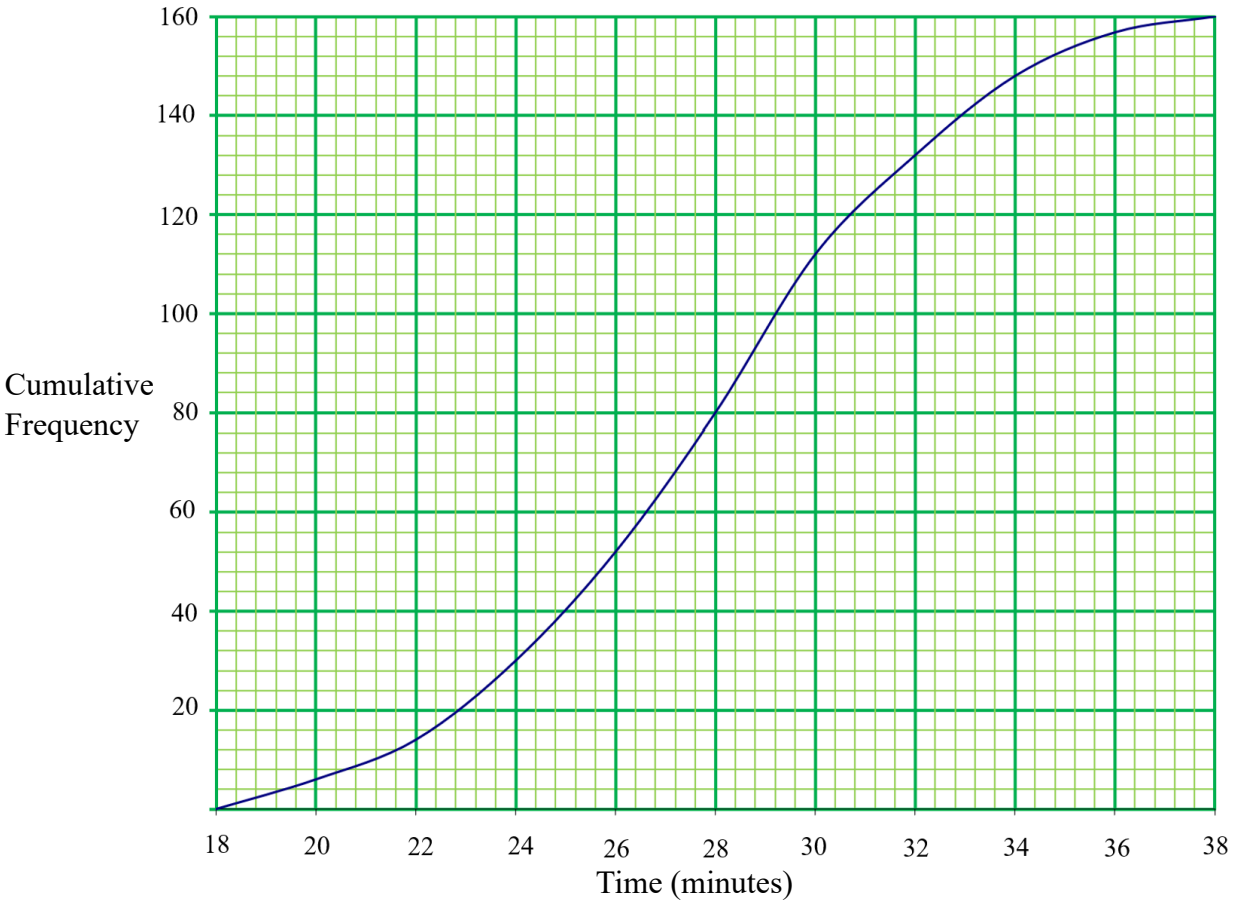
Kate wants to buy a handbag.
The same handbag costs USD 234 on online shopping platform *A* and £234 on online shopping platform *B*.

By comparing the exchange rates, explain how you can tell that the handbag costs more on online shopping platform *B*. [2]

Answer

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7 **(a)** The cumulative frequency graph shows the distribution of the times of the first 160 students from school A to finish the cross-country run in 2024.



Use the curve to estimate

(i) the median time,

Answer ..... mins [1]

(ii) the interquartile range of the times,

Answer ..... mins [2]

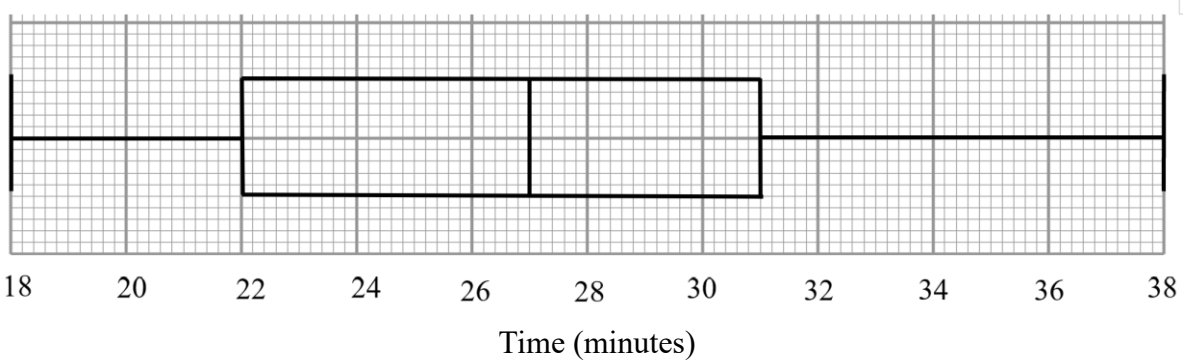
(iii) the value of p, given that $p\%$ of the students take more than 26 minutes.

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

[Turn over

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(b) The box-and-whisker plot represents the distribution of the times of the first 160 students from school B to finish the cross-country run in 2024.



Below are three statements comparing these times from the two schools.
For each one, write whether you agree or disagree, giving a reason for each answer. [3]

Statement	Agree/disagree	Reason
The students in school B are slower on average.		
The times of the first 40 students from school A were closer together compared to that of school B.		
The times of students in school A are more consistent compared to that of school B.		

[Turn over

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8 **(a)** Complete the table of values for $y = \frac{1}{2}\left(x^3 + x^2\right) - 4x + 3$.

x	–4	–3	–2	–1	0	1	2	3
y		6	9	7	3	0	1	9

[1]

(b) On the grid given on page 11, draw the graph of $y = \frac{1}{2}\left(x^3 + x^2\right) - 4x + 3$ for $-4 \leq x \leq 3$. [3]

(c) Use your graph to write an inequality in k where $\frac{1}{2}\left(x^3 + x^2\right) - 4x + 3 = k$ has three solutions.

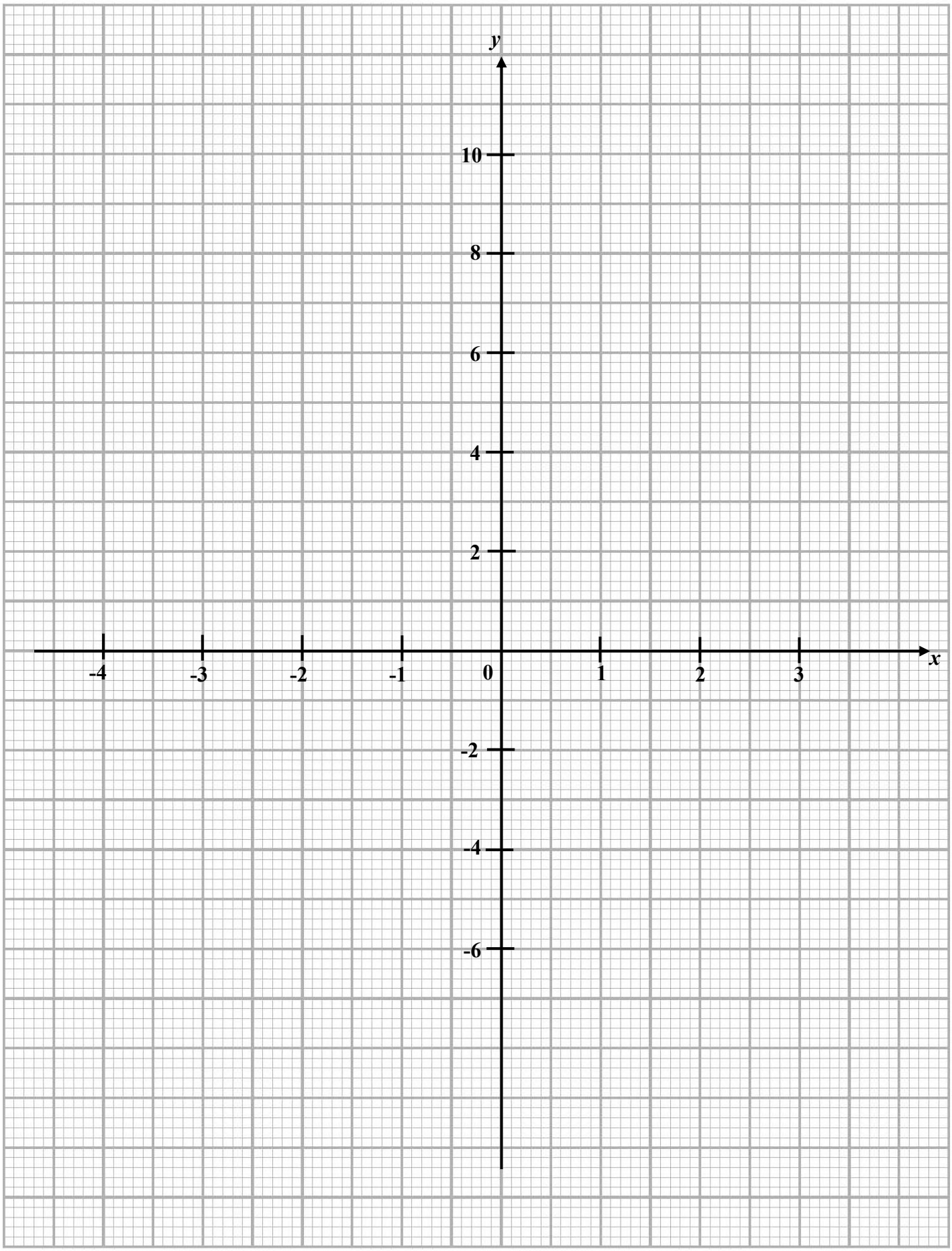
Answer ..... [2]

(d) Using the graph, find the gradient of the curve at $x = -2.7$.

Answer ..... [2]

[Turn over

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(e) By drawing a suitable straight line on the grid, solve the equation $x^3 + x^2 - 6x - 2$.

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

[Turn over

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9 **(a)** $\xi = \{x: x \text{ is an integer and } 1 \leq x \leq 12\}$

$A = \{x: x \text{ is a prime number}\}$

$B = \{x: x \text{ is a factor of } 10\}$

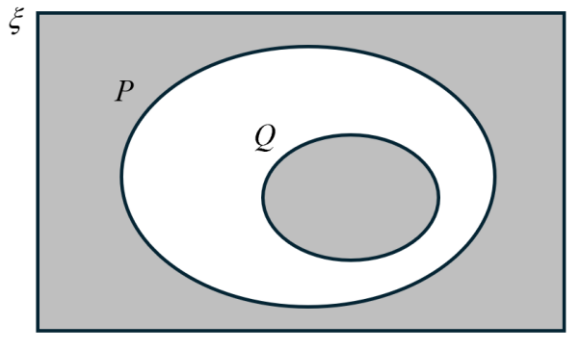
(i) List the elements of $A \cap B'$.

Answer ..... [1]

(ii) List the elements of $(A \cup B)'$.

Answer ..... [1]

(b) Write down the set represented by the following shaded region.



Answer ..... [1]

(c) The sets ξ, A and B satisfy the conditions $n(\xi) = 41,\ n(A) = 25,\ n(B) = 7$.

Find

(i) the largest possible value of $n(A \cup B)'$,

Answer ..... [1]

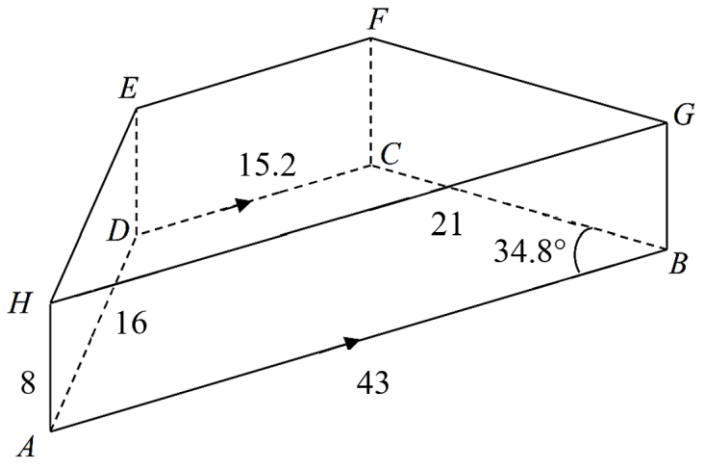
(ii) the smallest possible value of $n(A \cup B)'$.

Answer ..... [1]

[Turn over

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10 The diagram shows a trapezoidal prism.
The base $ABCD$ is on flat ground.
$ABGH$, $BCFG$, $ADEH$ and $DCFE$ are vertical rectangular planes.
$AB = 43$ m, $BC = 21$ m, $CD = 15.2$ m, $AD = 16$ m, $AH = 8$ m and $\angle ABC = 34.8°$.
AB is parallel to DC.



(a) Calculate the length of AC.

Answer ..... m [2]

(b) Calculate angle FAC.

Answer ..... ° [2]

[Turn over

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(c) Calculate the area of triangle *AFB*.

Answer ..... m^2 [4]

(d) Calculate the perpendicular distance from point *D* to the line *AB*.

Answer ..... m [2]

[Turn over

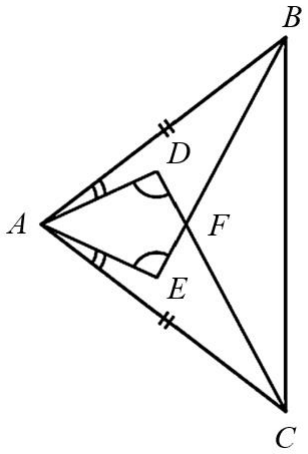
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(e) A point P moves along AB.
Find the largest angle of depression of P from E.

Answer ..... ° [2]

11 In the diagram, $AB = AC$, $\angle AEB = \angle ADC$ and $\angle BAD = \angle CAE$.

Prove that the triangles ABE and ACD are congruent. [3]



Answer

[Turn over

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12 *ABCD* is a parallelogram and its diagonals intersect at point *M*.

$\overrightarrow{AB} = \begin{pmatrix} 8 \\ 2 \end{pmatrix}$ and $\overrightarrow{AM} = \begin{pmatrix} 2.5 \\ -2 \end{pmatrix}$.

The coordinates of *A* are $(0, 4)$.

(i) Show that the position vector of *C* is $\begin{pmatrix} 5 \\ 0 \end{pmatrix}$. [1]

Answer

(ii) Find the coordinates of vertex *D*.

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

[Turn over

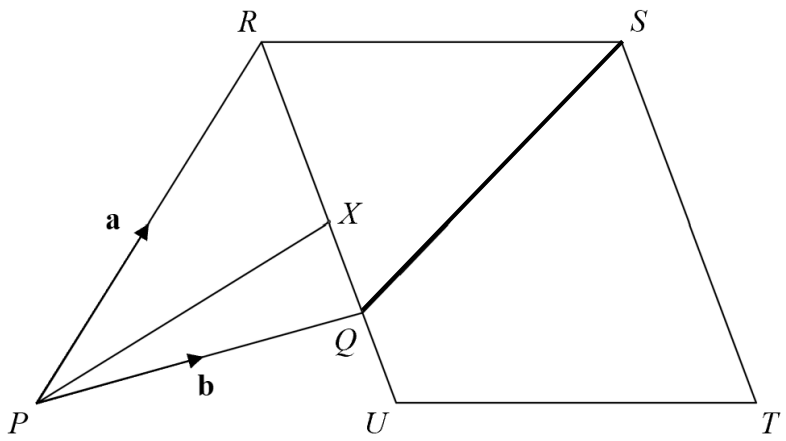
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(iii) Find the length of diagonal *BD*.

Answer ..... [4]

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13



In the diagram, PQR is a triangle and $RSTU$ is a parallelogram.

Q is a point on RU such that $RQ:QU = 3:1$ and X is the midpoint of RU.

$\overrightarrow{PR} = \mathbf{a}$, $\overrightarrow{PQ} = \mathbf{b}$ and $\overrightarrow{UT} = -\frac{1}{3}\mathbf{a} + \frac{4}{3}\mathbf{b}$.

(a) Express, as simply as possible, in terms of **a** and/or **b,**

(i) $\overrightarrow{QR}$

Answer $\overrightarrow{QR}$ = ... [1]

(ii) $\overrightarrow{XR}$

Answer $\overrightarrow{XR}$ = ... [1]

(b) Show that P, X and S lie on a straight line. [3]

Answer

[Turn over

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(c) Calculate the ratio of area of triangle PRS to the area of parallelogram $RSTU$.

Answer ..... : ..... [2]

14 **Most Popular Vegetables among Students**

Vegetables	Number of students who chose it
Broccoli	
Carrot	
Tomato	

Key: Each picture represents 20 students

Explain how the above pictogram may be misleading.

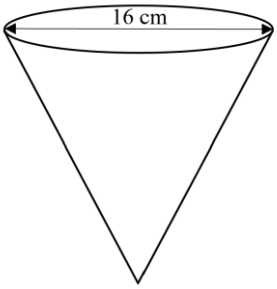
.....

..... [1]

[Turn over

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15 (a) The diagram shows an inverted right circular cone with a base diameter of 16 cm.



The curved surface area of the cone is 136π cm^2.
Find the height of the cone.

Answer ..... cm [3]

(b) Water is poured into the empty cone. .
Given volume of water is 163.84π cm^3, find the height of the water in the cone.

Answer ..... cm [3]

[Turn over

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16 Mrs Tan runs a shop selling pancakes, waffles and coffee.
She hires three workers in the shop, namely Amy, Betty and Clara.
Amy makes the pancakes, Betty makes the waffles and Clara makes the coffee.

Information on the shop and items are as shown:

[1]Opening hours	[1]Rental Cost	[1]Wage per worker	[1]Other operating cost*
10am to 9pm daily	$7000	$1920	$340

1. These are calculated per month, each month is taken to be 30 days.
* Other operating cost comprises other costs such as utilities, excluding ingredient cost.

Item	Selling price per item	Ingredient cost price per item
Pancakes	$5.50	$2.85
Waffles	$6.50	$2.90
Coffee	$3.00	$1.70

(a) Calculate the total expenses per month, excluding ingredient cost.

Answer $.....[1]

[Turn over

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(b) In one day, a total of 124 pancakes and waffles are made.
The time taken to make a waffle is 30 seconds more than the time taken to make a pancake.
On average, Amy and Betty each spend 8 hours a day making pancakes and waffles.
They work every day when the shop is open.
On average, the shop sells 70 cups of coffee a day.

If Mrs Tan wants to raise the current price of the coffee by $\$p$ so that she can make a profit of at least \$3000 a month from her business, suggest a minimum value of p.
Justify your answers clearly with calculations.

[Turn over for additional working space and (c)]

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Additional working space for 16(b)

Answer p = ... [8]

(c) State an assumption you have made in your calculations in **(b)**.

.....

..... [1]

End of Paper

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2024 4Exp/5NA/4NA SBB Preliminary Examinations
4052/1 Mathematics Paper 2
Answer Key

1a	$-\frac{25}{37}$ $-\frac{\pi}{6}$ $\sqrt{0.36}$ $(-0.51)^{\frac{2}{3}}$ $0.\dot{6}$	11	In triangle ABE and ACD, $\angle AEB = \angle ADC$ (Given) $\angle BAE = \angle BAD + \angle DAE$ $= \angle CAE + \angle DAE$ (since given $= \angle CAD$ $\angle BAD = \angle CAE$) $AB = AC$ (Given) Hence, ABE and ACD are congruent. (AAS congruence test) (since two pairs of corresponding angles and the non-included sides are equal).
2	15.6		
3a	$\frac{19}{3}$		
3b	$\frac{8q^5}{p^3r^4}$		
4b	9.03		
5	Interest from Bank M = \$38701.66 Interest from Bank N = \$36120 Bank *N* is a better option because the interest earned under Bank *N* (\$36120) is lower than that under Bank *M* (\$38701.66)./ He would pay \$2581.66 less interest under Bank *N* compared to Bank *M*.	12a(i)	$\overrightarrow{OC} = \overrightarrow{OA} + \overrightarrow{AC}$ $= \begin{pmatrix} 0 \\ 4 \end{pmatrix} + 2\overrightarrow{AM}$ $= \begin{pmatrix} 0 \\ 4 \end{pmatrix} + \begin{pmatrix} 5 \\ -4 \end{pmatrix}$ $= \begin{pmatrix} 5 \\ 0 \end{pmatrix}$
6a	392		
6b	USD 1 = $\$\frac{1}{0.74}$ = \$ 1.35 (2d.p.) Since £1 = \$1.72 which is more than \$1.35(cost of USD1), £234 will cost more than USD 234, hence the handbag costs more on the online shopping portal *B*.	12a(i)	$(-3,-2)$
7a(i)	28	12a(iii)	13.6
7a(ii)	5.8		
7a(iii)	67.5	13a(i)	$\mathbf{a}-\mathbf{b}$
7b	Disagree. The median time for students in school B is 27 minutes which is shorter than median time for school A (28 minutes), hence students in school B are faster on average. Disagree. The lower quartile of times from school B is 22 mins which is shorter than that of school A(25mins), hence times of the	13a(ii) 13b	$\frac{2}{3}(\mathbf{a}-\mathbf{b})$ Since $\overrightarrow{PX} = \overrightarrow{XS}$, $\overrightarrow{PX}$ is parallel to $\overrightarrow{XS}$ and they have a common point X,

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<table>
<tr><td></td><td>first 40 students from school B were closer together compared to that of school A.
Agree.
The interquartile range of times from school A is 5.8 mins which is smaller than that of school B(9 mins), hence the times in school A were more consistent compared to that of school B.</td><td>13c

14</td><td>Thus P, X and S are collinear points/lie on the same straight line.

1:2

The sizes of the pictures in the pictogram are different, hence readers might be misled that carrots is the most popular fruit but the most popular fruit is broccoli.</td></tr>
<tr><td>8b</td><td>$-0.25 < k < 9$</td><td></td><td></td></tr>
<tr><td>8d</td><td>Accurate answer: 4.24</td><td>15(a)</td><td>15</td></tr>
<tr><td>8e</td><td>$x = -2.85$ or -0.35 or 2.2.</td><td>15(b)</td><td>12</td></tr>
<tr><td>9a(i)</td><td>$\{3,7,11\}$</td><td>16(a)</td><td>13100</td></tr>
<tr><td>9a(ii)</td><td>$\{4,6,8,9,12\}$</td><td rowspan="5">16(b)</td><td rowspan="8">Let t be the time taken to make a pancake in seconds.
Do working and obtained
$t = -\frac{480}{31}$ or $t = 450$
(rejected since $t > 0$)
$\therefore t = 450$
Continue to work out, we get
$p = \frac{3000-1198}{70\times 30}$
$= \$0.8580$
$\approx \$0.90$
$\therefore$ Minimum p = 0.90

The respective <u>rate</u>s at which the pancakes, waffles and coffee are made are <u>constant</u>. OR
The respective numbers of pancakes and waffles sold <u>each day</u> are <u>constant.</u></td></tr>
<tr><td>9b</td><td>$P' \cup Q$</td></tr>
<tr><td>9c(i)</td><td>16</td></tr>
<tr><td>9c(ii)</td><td>9</td></tr>
<tr><td>10(a)</td><td>28.4</td></tr>
<tr><td>10(b)</td><td>15.7</td><td rowspan="3">16(c)</td></tr>
<tr><td>10(c)</td><td>310</td></tr>
<tr><td>10(d)</td><td>12.0</td><td rowspan="2"></td></tr>
<tr><td>10(e)</td><td>33.7°</td></tr>
</table>

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