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TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME	

CLASS				INDEX NUMBER		

MATHEMATICS 4052/01

Paper 1

16 August 2024

2 hours 15 minutes

Candidates answer on the Question Paper

READ THESE INSTRUCTIONS FIRST

Write your index number and name 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.
DO **NOT** WRITE ON ANY BARCODES.

Answer **all** the 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

This document consists of **23** printed pages and **1** blank page.

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Mathematical Formulae

Compound interest

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

Mensuration

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

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

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

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

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

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

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

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)** Calculate $\dfrac{165^2 + \sqrt[4]{75.125 - 11.2 \times (-3)}}{3.142}$.

Write your answer correct to 2 significant figures.

Answer …….……. [1]

(b) The number of people in a shopping mall is 1100, correct to the nearest hundred.

Write down the minimum number of people there are in the mall.

Answer …….……. [1]

2 Simplify

(a) $5 - 2(6x - 1)$,

Answer …….……. [1]

(b) $\left(\dfrac{27b^9}{a^6}\right)^{-\frac{1}{3}}$.

Answer …….……. [2]

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3 Albert and Chris have some savings in the ratio 5 : 3.
They spent $30 each from their savings and the new ratio of their savings is 2 : 1.
Find the amount of savings Chris has at the start.

Answer $ …….……. [2]

4 **(a)** Express 1400 as a product of its prime factors.

Answer …….……. [1]

(b) q is a number between 70 and 90.
The highest common factor of q and 1400 is 28.
Find the smallest possible value of q.

Answer $q =$ …….……. [2]

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5 Given that $\frac{1}{2^{a-1}} = 2^3 + 2^3 + 2^3 + 2^3$, find the value of a.

Answer $a =$ …….……. [2]

6 **(a)** Expand and simplify $2(5m+3n)^2$.

Answer …….…… [2]

(b) Factorise completely $24(mn)^2 - 21mn^3$.

Answer …….……. [1]

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7 The area of triangle XYZ is 12.6 cm^2.
$XY = 4.5$ cm and $YZ = 7.1$ cm.

Find two possible values for angle XYZ. Give your answers in radians.

Answer …...……rad or ……..… rad [3]

8 P is inversely proportional to Q^3 .
Find the percentage change in P when Q is reduced by 20%.

Answer ……..……% [2]

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9 It is given that $p = \dfrac{q + r^2}{q - 5}$.

(a) Find p when $q = \dfrac{1}{5}$ and $r = -6$.

Answer $p =$ …… [1]

(b) Express q in terms of p and r.

Answer …… [2]

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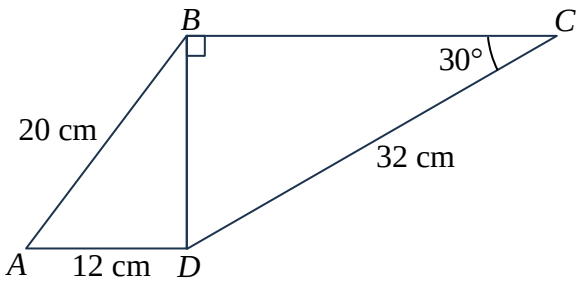
10 The diagram shows a quadrilateral *ABCD* made up of two triangles.
$AB = 20$ cm, $AD = 12$ cm, $CD = 32$ cm.
Angle $CBD = 90°$ and angle $BCD = 30°$.



(a) Find *BD*.

Answer …… cm [2]

(b) **Hence or otherwise**, show that it is possible to form a circle with diameter *AB* such that point *D* lies on the circumference of the circle.

Answer

[2]

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11 Write as a single fraction in its simplest form $\frac{3}{(1-2h)^2}+\frac{8}{2h-1}$.

Answer …….……. [3]

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12 k is a positive integer.
An odd number is formed when 5 is subtracted from twice of k.

(a) Write down an expression for the odd number in terms of k.

Answer …….……. [1]

(b) The sum between the odd number and the next consecutive odd number is greater than 16.

Form an inequality in terms of k and solve it to find the smallest possible value of the larger odd number.

Answer …….……. [3]

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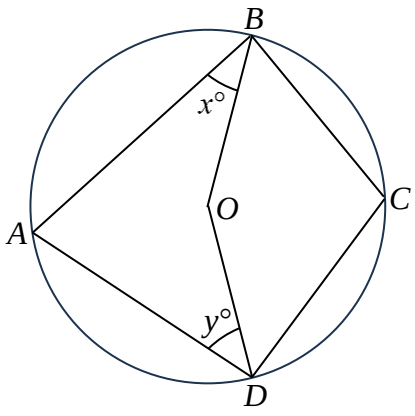
13 In the diagram, A, B, C and D are four points on a circle, centre O.
Angle $ABO = x°$ and angle $ADO = y°$.



Find angle BCD in terms of x and y.
Give reasons for each step of your working.

Answer ……...……...….° [3]

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14 **(a)** Factorise $3x^2 - 14x - 5$.

Answer …….……. [2]

(b) **Hence**, factorise completely $3(y+1)^2 - 14y - 19$.

Answer …….……. [2]

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15 The points $P(2, 3)$ and $Q(-1, -3)$ lie on the curve $y = ax^2 + bx + 2$.
Form and solve two simultaneous equations to find the values of a and b.

Answer $a =$ ……

$b =$ …… [4]

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16 A bag contains 15 red marbles, some blue marbles and some yellow marbles.
A marble is chosen at random from the bag.

The probability of choosing a blue marble is $\frac{1}{6}$ and the probability of choosing a yellow marble is $\frac{7}{12}$.

(a) Show that there are 60 marbles in total in the bag.

Answer

[2]

(b) Two marbles are chosen at random from the bag.
Find the probability that both marbles are blue.

Answer …….……. [2]

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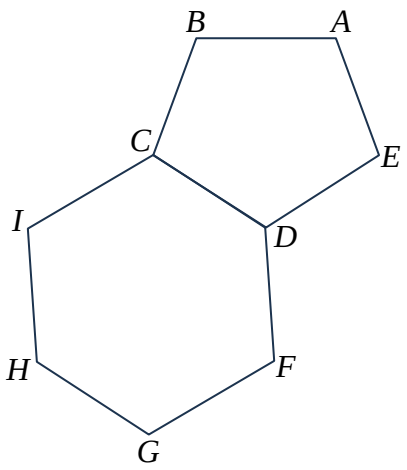
17 The figure is made up of a regular pentagon *ABCDE* and a regular hexagon *CDFGHI*.



(a) Find angle *BCI*.

Answer ……...……...….° [2]

(b) Determine whether *BC* and *CI* are two sides of another regular polygon.
Justify your answers with mathematical working.

Answer

…….

……. [2]

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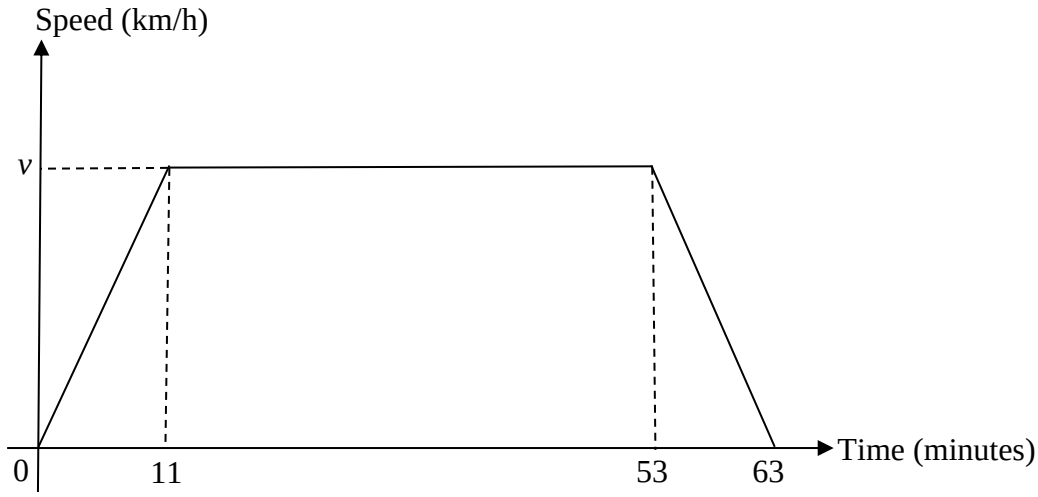
18 The diagram shows the speed-time graph of a cyclist from Town *A* to Town *B*.



(a) The total distance travelled by the cyclist is 14 km.
Show that $v = 16$.

Answer

[2]

(b) Find the speed of the cyclist 5 minutes from the start of the journey.

Answer …….……. km/h [1]

(c) Calculate the acceleration of the car in the last 10 minutes.

Answer …….……. km/h^2 [1]

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19 The times taken, in minutes, by 14 students to complete a Mathematics assignment are recorded.

The results are shown in the stem-and-leaf diagram.

1	1	5	9			
2	0	3	3	3	6	9
3	4	8	8	9		
4	0					

Key:
4 | 0 represents 40 minutes

(a) Find the modal time.

Answer …….……. mins [1]

(b) Find the percentage of students who took at most 20 minutes to complete the assignment.

Answer …….…… % [1]

(c) The time taken for the 15th student to complete the assignment is recorded.
The range increases to 31 minutes.
Find two possible times this student spent completing the assignment.

Answer ……. mins or ……. mins [2]

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20 The first four terms in a sequence of numbers are given below.

$$T_1 = \frac{2}{1} - \frac{3}{5} = \frac{7}{5}$$
$$T_2 = \frac{3}{5} - \frac{4}{5^2} = \frac{11}{25}$$
$$T_3 = \frac{4}{5^2} - \frac{5}{5^3} = \frac{3}{25}$$
$$T_4 = \frac{5}{5^3} - \frac{6}{5^4} = \frac{19}{625}$$

(a) Find T_5 .

Answer …….……. [1]

(b) Find an expression, in terms of *n*, for T_n .

Answer $T_n =$ …….……. [2]

(c) Evaluate the sum of the first ten terms, $T_1 + T_2 + T_3 + \ldots + T_{10}$.

Answer …….……. [2]

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21 Benedict left his house to go to the library.
He took the first bus, which travelled 5 km in t minutes.

He then alighted at a bus stop and waited for 12 minutes to switch to the next bus.

The second bus took 2 minutes less than the first bus to reach his destination after travelling a further 3.75 km.

(a) Find the time taken for the whole journey, in minutes, in terms of t.

Answer …….……. minutes [1]

(b) Given that the average speed for the whole journey is 10.5 km/h, form an equation in terms of t to calculate the total time taken for the journey.

Answer …….…… minutes [3]

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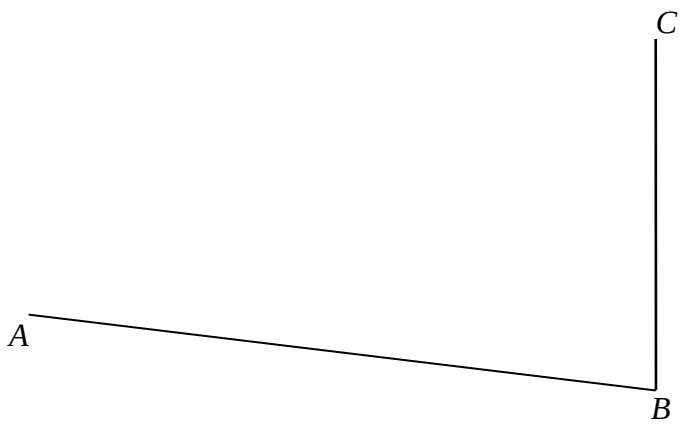
22 In this scale drawing, *A*, *B* and *C* are three corners of a park *ABCD* with *C* due north of *B*.



(a) Construct the perpendicular bisector of *BC*. [1]

(b) *D* is on a bearing of $065°$ from *A* and equidistant from *B* and *C*.
Mark and label point *D* on the drawing. [1]

(c) Construct the bisector of angle *ABC*. [1]

(d) Eleanor is standing inside the park *ABCD* such that she is closer to *BC* than *AB* and closer to *B* than *C*.
Shade the region where Eleanor could be standing.
[1]

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23 The table below shows the number of books read by 50 students in Class *A* in semester 1.

Number of books read, n	Frequency
$0 < n \leq 2$	8
$2 < n \leq 4$	21
$4 < n \leq 6$	11
$6 < n \leq 8$	3
$8 < n \leq 10$	7

(a) Calculate an estimate for

(i) the mean number of books read by the students,

Answer …….……. [1]

(ii) the standard deviation of the number of books read by the students.

Answer …….……. [1]

(b) After introducing a reading programme in semester 2, the number of books read by each student in Class *A* increased by 2.
State how the mean and standard deviation will change after the increase.

Answer

…….

……. [2]

(c) The standard deviation of the number of books read by the students from Class *B* was 3.15.

Use this information to comment on one difference between the two distributions.

Answer

…….

…….

…….. [1]

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24 An enrichment centre offers drama, writing and speech enrichment classes on weekdays during the school holiday.

The matrix **S** shows the number of students who attend the different classes for beginners and advanced levels in a day.

$$\begin{array}{cc} & \begin{array}{ccc} \text{drama} & \text{writing} & \text{speech} \end{array} \\ \mathbf{S} = & \begin{pmatrix} 25 & 32 & 40 \\ 21 & 19 & 32 \end{pmatrix} \begin{array}{l} \text{beginners} \\ \text{advanced} \end{array} \end{array}$$

(a) Evaluate the matrix **W** = 5**S**.

Answer **W =** [1]

The school fee for drama cost \$40 per session, \$25 per session for writing and \$30 per session for speech. The fees for beginner and advanced learners are the same for each type of class.

(b) Represent these amounts in a column matrix **C**.

Answer **C =** [1]

(c) Evaluate the matrix **T** = **WC**.

Answer **T =** [2]

(d) Explain what the elements in **T** represent.

Answer

…….

…….

……. [1]

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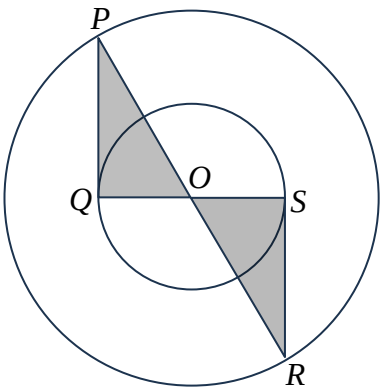
25 *PR* is a diameter of the large circle, centre *O*.
QS is a diameter of the small circle, centre *O*.

PQ and *RS* are tangents to the small circle.



(a) Show that triangle *OPQ* is congruent to triangle *ORS*.
Give a reason for each statement you make.

Answer

[3]

(b) The ratio of *OQ* to *PQ* to *OP* is 5 : 12 : 13.
Express the area of the shaded region as a percentage of the large circle.

Answer …….……. % [3]

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Answer Key

1(a)	8700
1(b)	1050
2(a)	$7-12x$
2(b)	$\frac{a^2}{3b^3}$
3	\$90
4(a)	$1400=2^3\times5^2\times7$
4(b)	$q=84$
5	$a=-4$
6(a)	$50m^2+60mn+18n^2$
6(b)	$3mn^2(8m-7n)$
7	$\angle XYZ=0.909$ radian or 2.23 radian
8	$95\frac{5}{16}\%$
9(a)	$-7\frac{13}{24}$
9(b)	$q=\frac{r^2+5p}{p-1}$
10(a)	16 cm
11	$\frac{16h-5}{(1-2h)^2}$
12(a)	$2k-5$
12(b)	11
13	$180°-x°-y°$
14(a)	$(3x+1)(x-5)$
14(b)	$(3y+4)(y-4)$
15	$a=-1.5$ and $b=3.5$
16(a)	60
16(b)	$\frac{3}{118}$
17(a)	132°
17(b)	Since the number of sides is not a positive integer greater than 3, *BC* and *CI* cannot be sides of a regular polygon.
18(b)	$7\frac{3}{11}$ km/h
18(c)	–96 km/h^2

19(a)	23
19(b)	$28\frac{4}{7}\%$
19(c)	42 and 9
20(a)	$T_5=\frac{6}{5^4}-\frac{7}{5^5}=\frac{23}{3125}$
20(c)	2.00
21(a)	$(2t+10)$ minutes
21(b)	50 minutes
23a(i)	4.2
23a(ii)	2.47
23(b)	The mean number of books will increase by 2 while the standard deviation value will remain the same.
23(c)	SD of class $A=2.47$ SD of class $B=3.15$ Since the standard deviation value of class *A* is lesser than class *B* by 0.68, class *A* has a smaller spread in distribution and the books read by class *A* is more homogeneous in general.
24(a)	$\begin{pmatrix}125 & 160 & 200\\105 & 95 & 160\end{pmatrix}$
24(b)	$\begin{pmatrix}40\\25\\30\end{pmatrix}$
24(c)	$\begin{pmatrix}15000\\11375\end{pmatrix}$
24(d)	The elements in **T** represent the total amount of school fees paid for weekdays in a week for beginner and advanced students respectively.
25(a)	ASA / RHS / AAS test
25(b)	11.3%

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TANJONG KATONG GIRLS' SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR EXPRESS

CANDIDATE NAME	

CLASS				INDEX NUMBER		

MATHEMATICS 4052/02

Paper 2

7 August 2024

2 hour 15 minutes

Candidates answer on the Question Paper

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TURN OVER FOR QUESTION 1

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1 **(a)** Solve the equation $\frac{3-2x}{7}=\frac{1}{3}(2x-1)$.

Answer $x=$ ……... [2]

(b) Simplify

(i) $\frac{25a^2-9b^2}{15a-10ab+6b^2-9b}$

Answer …… [3]

(ii) $\frac{3c}{4ab}\div\frac{c^3}{12a^2b}$.

Answer …… [2]

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(c) **(i)** Solve the equation $-x^2 + 9x - \frac{7}{2} = 0$ by **completing the square**. Give your solutions correct to two decimal places.

Answer $x =$ ……. or …… [3]

(ii) Explain why $-x^2 + 9x - \frac{7}{2} = 18$ has no real solution.

……..

……..

……..

…….. [2]

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2 **(a)** In a particular month, 21 people took a driving test.

One of the 21 people is selected at random.
The probability that it is a man who passed the test is $\frac{1}{7}$.

Two of the 21 people are selected at random.
The probability that they are both women who failed the test is $\frac{1}{10}$.

Complete the table of information about the 21 people who took the test on that particular month.

	Passed the test	**Failed the test**
Men		**9**
Women		

[4]

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(b) $\varepsilon = \{x : x \text{ is a student in a class}\}$
$A = \{x : x \text{ is a student who listens to pop music}\}$
$B = \{x : x \text{ is a student who listens to classical music}\}$

It is given that $\text{n}(\varepsilon) = 35$, $\text{n}(A) = 22$, $\text{n}(B) = 14$ and $\text{n}(A \cap B') = 12$.

(i) Describe in words the set $A \cap B'$.

……...

……... [1]

(ii) Find the number of students who listen to both pop and classical music.

Answer ……..... [1]

(iii) Find the number of students who listen to classical music only.

Answer ……... [1]

(iv) Find the number of students who listen to neither pop nor classical music.

Answer ……... [1]

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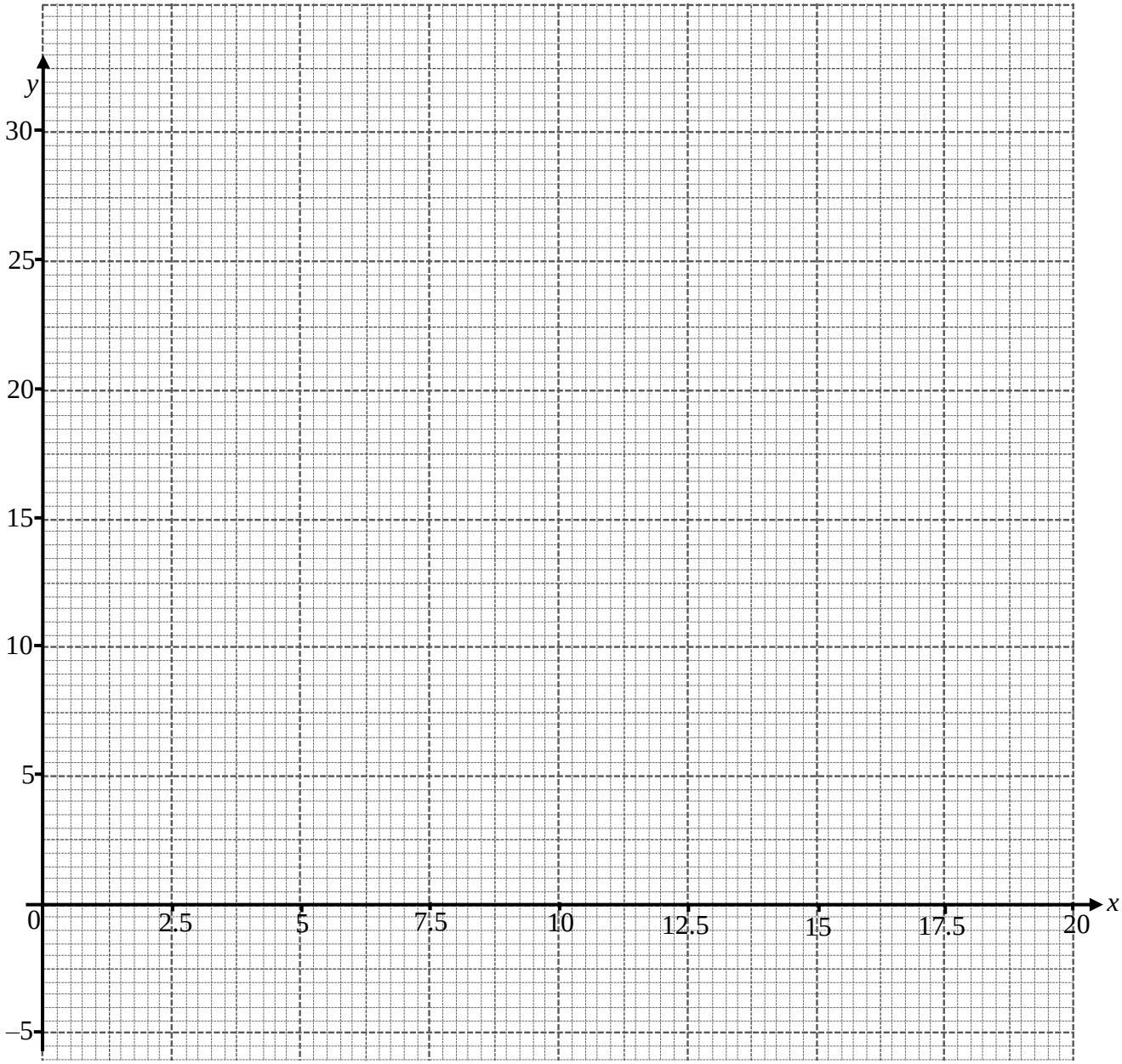
3 **(a)** Complete the table of values for $y = 2x + \frac{20}{x} - 15$.

x	1	2.5	5	10	12.5	15	20
y	7		–1	7	11.6	16.3	26

[1]

(b) On the grid, draw the graph of $y = 2x + \frac{20}{x} - 15$ for $0 < x \leq 20$.



[3]

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(c) Using the graph, state the range of values of x for which $2x + \frac{20}{x} < 22$.

Answer …… [2]

(d) By drawing a tangent, find the gradient of the curve at the point where $x = 4$.

Answer …… [2]

(e) By drawing a suitable straight line on the grid, find the solutions of the equation $x^2 - 13x + 20 = 0$.

Answer $x =$ …….. or ……. [2]

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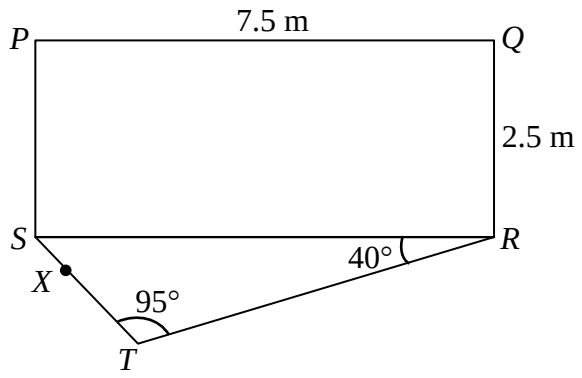
4 In the diagram, $PQRS$ is a vertical rectangular wall of height 2.5 m and length 7.5 m.
T is a point on level ground from the base of the wall RS.
$\angle STR = 95°$ and $\angle SRT = 40°$.
X is a point on ST such that $SX : XT$ is 1 : 3.



(a) Calculate the length of SX.

Answer ……..... m [3]

(b) Calculate the length of XR.

Answer …… m [3]

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(c) Calculate the length of PT.

Answer …….. m [1]

(d) A bird sat on the ledge of the wall along PQ such that its angle of elevation θ from X is the largest. Find θ.

Answer ……..……. ^{o} [4]

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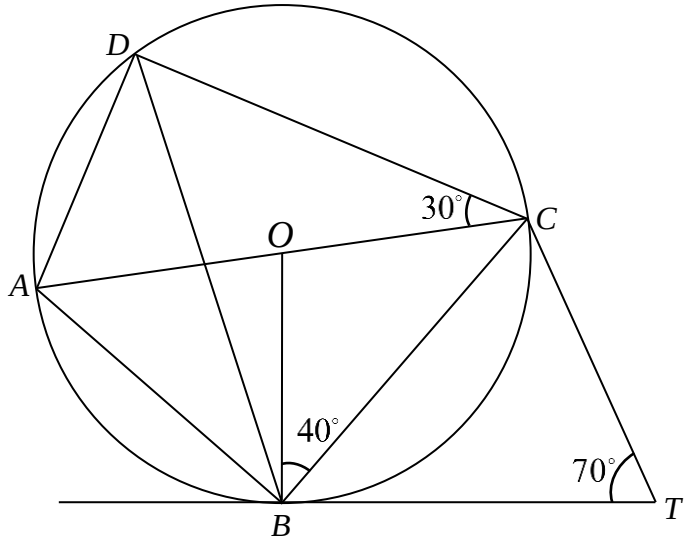
5 In the diagram, O is the centre of the circle through A, B, C, D and TB is the tangent at B. AC is the diameter of the circle, and the length of the minor arc BAD is 11 cm.
Given that $\angle OBC = 40^\circ$, $\angle ACD = 30^\circ$ and $\angle BTC = 70^\circ$.



(a) Find, giving a reason for each step of your working,

(i) $\angle ABD$,

Answer ……..…… ° [1]

(ii) $\angle BAD$.

Answer ……..…… ° [2]

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(iii) Taking $\pi = \frac{22}{7}$, calculate the radius of the circle.

Answer ……..…… cm [2]

(b) **(i)** Show that triangle *BCD* is similar to triangle *CTB*. Give a reason for each statement you make.

Answer

[4]

(ii) **Hence**, express CT in terms of x and y given that $BC = x$ cm and $BD = y$ cm.

Answer ……..…….. [2]

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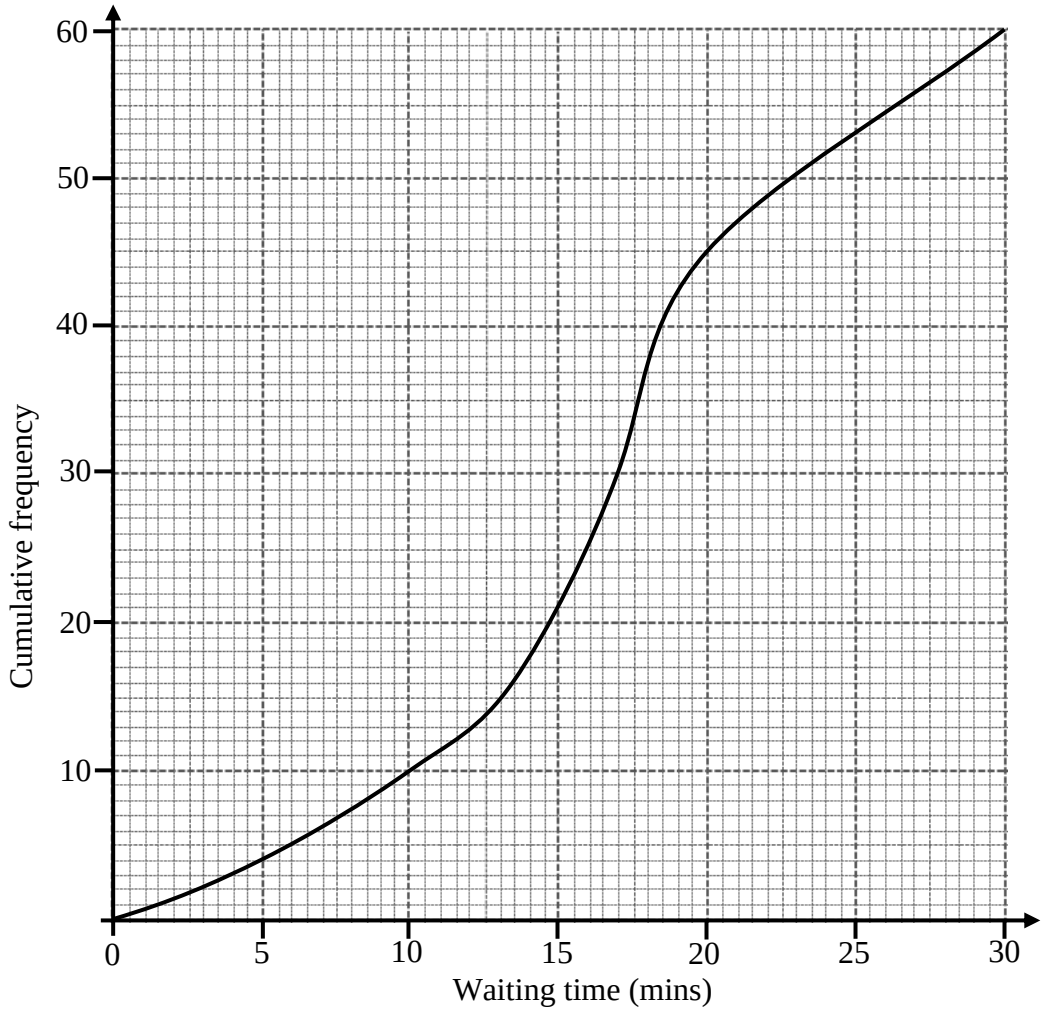
6 The cumulative frequency graph shows distribution of the waiting times before being served, in minutes, of 60 customers at restaurant *A* on a particular day.



(a) Use the curve to estimate

(i) the median waiting time,

Answer ……..…… min [1]

(ii) the interquartile range,

Answer ……..…… min [1]

(iii) the 35th percentile of the waiting time.

Answer ……..……. min [1]

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(b) Given that 20% of the customers waited more than x minutes to be served, find the value of x.

Answer x = ……..…… [1]

(c) The data below represents the waiting times of 10 customers from restaurant B on the same day.

10, 12, 14, 14, 15, 17, 17, 18, 22, 28

Calculate

(i) the median waiting time,

Answer ……..……. min [1]

(ii) the interquartile range.

Answer ……..……. min [1]

(d) The owner of restaurant B claims that his restaurant is more efficient and consistent in their service compared to restaurant A based on the data given. Give a reason why this is not a fair comparison.

……

…… [1]

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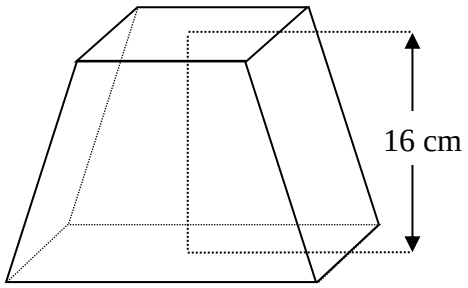
7 **(a)**



The figure shows a solid frustum of height 16 cm cut from right pyramid with square base. The horizontal top surface has an area of 5 cm^2 while the base area is 125 cm^2. The portion that is removed is h cm high.

(i) Show that $h = 4$.

Answer

[2]

(ii) Calculate the volume of the frustum.

Answer …… cm^3 [3]

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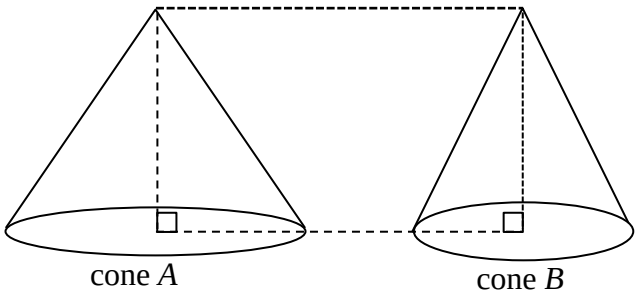
(iii) Find the percentage of the right pyramid that has been removed.

Answer …….. % [2]

(b) Two solid cones have the same height but the radius of cone *A* is 1.5 times of cone *B*. Given that the volume of cone *B* is 240 cm^3.



Find the volume of cone *A*.

Answer ……... cm^3 [3]

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8 **(a)** $\overrightarrow{AB} = \begin{pmatrix} -3 \\ 9 \end{pmatrix}$, $\overrightarrow{BC} = \begin{pmatrix} 2 \\ 5 \end{pmatrix}$, $\overrightarrow{CD} = \begin{pmatrix} d \\ 4 \end{pmatrix}$.

(i) Given that $\overrightarrow{CD}$ is parallel to $\overrightarrow{AB}$, find the value of d.

Answer d = ……... [2]

(ii) Find $\left|\overrightarrow{AC}\right|$.

Answer …….. units [2]

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TURN OVER FOR QUESTION 8(b)

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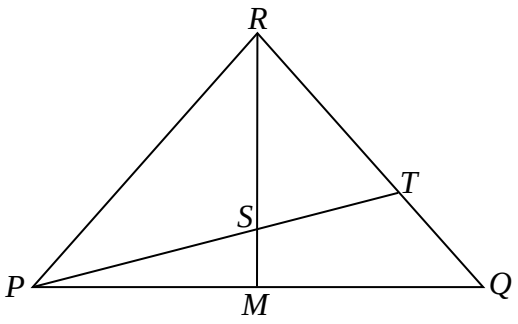
(b)



PQR is a triangle and *M* is the mid-point of *PQ*. It is given that $\overrightarrow{PQ} = \mathbf{a}$, $\overrightarrow{PR} = \mathbf{b}$, $\overrightarrow{QT} = h\overrightarrow{QR}$ and $\overrightarrow{RS} = k\overrightarrow{RM}$, where *k* and *h* are constants.

(i) Express $\overrightarrow{PS}$ in terms of *k*, **a** and **b**.

Answer ……..……... [2]

(ii) Express $\overrightarrow{PT}$ in terms of *h*, **a** and **b**.

Answer ……..……... [2]

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(iii) **Hence** show that $hk + 2 = 2(h + k)$ if P, S and T are collinear.

Answer

[1]

(iv) Given that $h = \frac{1}{3}$ and $k = \frac{4}{5}$, find the ratio of $PS : ST$.

Answer ……. : ……. [2]

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9 A factory prints posters for corporate events. The prices of printing posters of different sizes are listed below:

Type of banners	Size in inches	Prices (per copy)	Additional cost
Bulletin poster	11×17	\$2.00	5% of the total cost if printing a total area of more than 120 m^2
Mini poster	12×18	\$2.50	
Medium poster	18×24	\$3.50	
Large poster	24×36	\$5.00	

The factory has the following guidelines for operating the printers.

Guidelines
• A printer operates from 9.00 am to 4.00 pm every day. • A printer needs to be cooled for a period of 30 minutes after every 2 hours of printing. • A printer needs to be serviced if its rate of printing has slowed down to less than 60 m^2 a day.

(a) Given that 1 inch = 2.54 cm, find the area of a bulletin poster in m^2.

Answer ……. m^2 [1]

(b) Mr Tan wants to print 1200 bulletin posters for an event. Calculate how much does it cost.

Answer \$ ……. [2]

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(c) The factory uses 2 printers to print Mr Tan's order for an entire day. The older printer takes 15 seconds more to print one bulletin poster compared to the newer printer and the rates of printing of the 2 printers are constant throughout the day.

An operator of the printers claims that the older printer needs servicing. Do you agree? Justify your answers with clear working.

Answer

…….

……. [7]

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Answer Key

Question			Answer		Question			Answer
1	**(a)**		$x = 0.8 / \frac{4}{5}$		**6**	**(a)**	**(i)**	17 min
	(b)	**(i)**	$\frac{5a+3b}{3-2b}$				**(ii)**	7 min
		(ii)	$\frac{9a}{c^2}$				**(iii)**	15 min
	(c)	**(i)**	$x = 8.59$ or 0.41			**(b)**		21.5 min
		(ii)	Since the maximum value of $y = -x^2 + 9x - \frac{7}{2}$ is $16.75 / \frac{67}{4} <$ 18. There is no solution when $y = 18$.			**(c)**	**(i)**	16 min
2	**(a)**		**Passed** / **Failed** **Men**: 3 / **9** **Women**: 2 / 7				**(ii)**	4 min
	(b)	**(i)**	A set of students who only listen to pop music but not classical music.				**(iii)**	The sample sizes are not the same.
		(ii)	10		**7**	**(a)**	**(i)**	Use similar areas to show
		(iii)	4				**(ii)**	827 cm^3
		(iv)	9				**(iii)**	$\frac{4}{5}$ % / 0.8%
3	**(a)**		–2			**(b)**		540 cm^3
	(b)		See Graph		**8**	**(a)**	**(i)**	$d = -\frac{4}{3}$
	(c)		$1 < x < 10$				**(ii)**	14.0 unit
	(d)		0.753			**(b)**	**(i)**	$\frac{1}{2}k\mathbf{a} + (1-k)\mathbf{b}$
	(e)		$x = 1.783$ or 11.217				**(ii)**	$(1-h)\mathbf{a} + h\mathbf{b}$
4	**(a)**		1.21 m				**(iii)**	Use parallel vectors and equal scalar multiple to show.
	(b)		6.70 m				**(iv)**	$PS : ST = 3 : 2$
	(c)		5.45 m		**9**	**(a)**		0.121 m^2
	(d)		71.1° (1 d.p)			**(b)**		\$2520
5	**(a)**	**(i)**	30°			**(c)**		Since the older printer only printed 57.9 m^2 < 60 m^2. It will need to be serviced.
		(ii)	110°					
		(iii)	4.5					
	(b)	**(i)**	AA similarity test					
		(ii)	$\frac{x^2}{y}$					

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