FORM TP 2022094

TEST CODE **01234020**

MAY/JUNE 2022

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MATHEMATICS

Paper 02 – General Proficiency

2 hours 40 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of TWO sections: I and II.
2. Section I has SEVEN questions and Section II has THREE questions.
3. Answer ALL questions.
4. Write your answers in the spaces provided in this booklet.
5. Do NOT write in the margins.
6. All working MUST be clearly shown.
7. **A list of formulae is provided on page 4 of this booklet.**
8. If you need to rewrite any answer and there is not enough space to do so on the original page, you must use the extra page(s) provided at the back of this booklet. **Remember to draw a line through your original answer**.
9. **If you use the extra page(s) you MUST write the question number clearly in the box provided at the top of the extra page(s) and, where relevant, include the question part beside the answer.**
10. **ALL diagrams in this booklet are NOT drawn to scale, unless otherwise stated.**

Required Examination Materials

Electronic calculator
Geometry set

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

"*"Barcode Area"*"
Sequential Bar Code

LIST OF FORMULAE

Volume of a prism — $V = Ah$ where A is the area of a cross-section and h is the perpendicular length.

Volume of a cylinder — $V = \pi r^2 h$ where r is the radius of the base and h is the perpendicular height.

Volume of a right pyramid — $V = \frac{1}{3} Ah$ where A is the area of the base and h is the perpendicular height.

Circumference — $C = 2\pi r$ where r is the radius of the circle.

Arc length — $S = \frac{\theta}{360} \times 2\pi r$ where θ is the angle subtended by the arc, measured in degrees.

Area of a circle — $A = \pi r^2$ where r is the radius of the circle.

Area of a sector — $A = \frac{\theta}{360} \times \pi r^2$ where θ is the angle of the sector, measured in degrees.

Area of a trapezium — $A = \frac{1}{2}(a + b)\, h$ where a and b are the lengths of the parallel sides and h is the perpendicular distance between the parallel sides.

Roots of quadratic equations — If $ax^2 + bx + c = 0$,

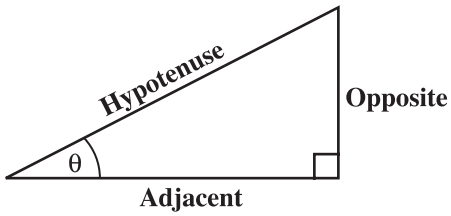
$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometric ratios

$$\sin\theta = \frac{\text{length of opposite side}}{\text{length of hypotenuse}}$$

$$\cos\theta = \frac{\text{length of adjacent side}}{\text{length of hypotenuse}}$$

$$\tan\theta = \frac{\text{length of opposite side}}{\text{length of adjacent side}}$$



Area of a triangle — Area of $\Delta = \frac{1}{2} bh$ where b is the length of the base and h is the perpendicular height.

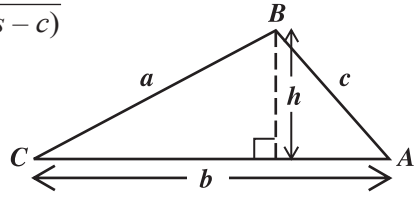
$$\text{Area of } \Delta ABC = \frac{1}{2} ab \sin C$$

$$\text{Area of } \Delta ABC = \sqrt{s(s-a)(s-b)(s-c)}$$

$$\text{where } s = \frac{a+b+c}{2}$$

Sine rule

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



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

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NOTHING HAS BEEN OMITTED.

SECTION I

Answer ALL questions.

All working MUST be clearly shown.

1. (a) Using a calculator, or otherwise, find the

(i) EXACT value of

a) $\frac{7}{8} + \frac{1}{6} \div \frac{2}{9}$

.....

(1 mark)

b) $\frac{8}{0.4^3}$

.....

(1 mark)

(ii) value of $\sqrt{26.8} - 2.5^{\frac{3}{2}}$, correct to 2 decimal places.

.....

(1 mark)

GO ON TO THE NEXT PAGE

(b) Children go to a Rodeo camp during the Easter holiday. Ms Rekha buys bananas and oranges for the children at the camp.

(i) Bananas cost $3.85 per kilogram. Ms Rekha buys 25 kg of bananas and receives a discount of 12%. How much money does she spend on bananas?

.....

(2 marks)

(ii) Ms Rekha spends $165.31, inclusive of a sales tax of 15%, on oranges. Calculate the original price of the oranges.

.....

(2 marks)

(iii) The ratio of the number of bananas to the number of oranges is 2:3. Furthermore, there are 24 more oranges than bananas.

Calculate the number of bananas Ms Rekha bought.

.....

(2 marks)

Total 9 marks

2. (a) (i) Factorize completely the following quadratic expression.

$5x^2 - 9x + 4$

.....

(2 marks)

(ii) Hence, solve the following equation.

$5x^2 - 9x + 4 = 0$

.....

(1 mark)

(b) Make v the subject of the formula.

$$w = \frac{5 + v}{v - 3}$$

.....

(3 marks)

GO ON TO THE NEXT PAGE

(c) The height, h, of an object is directly proportional to the square root of its perimeter, p.

(i) Write an equation showing the relationship between h and p.

.....

(1 mark)

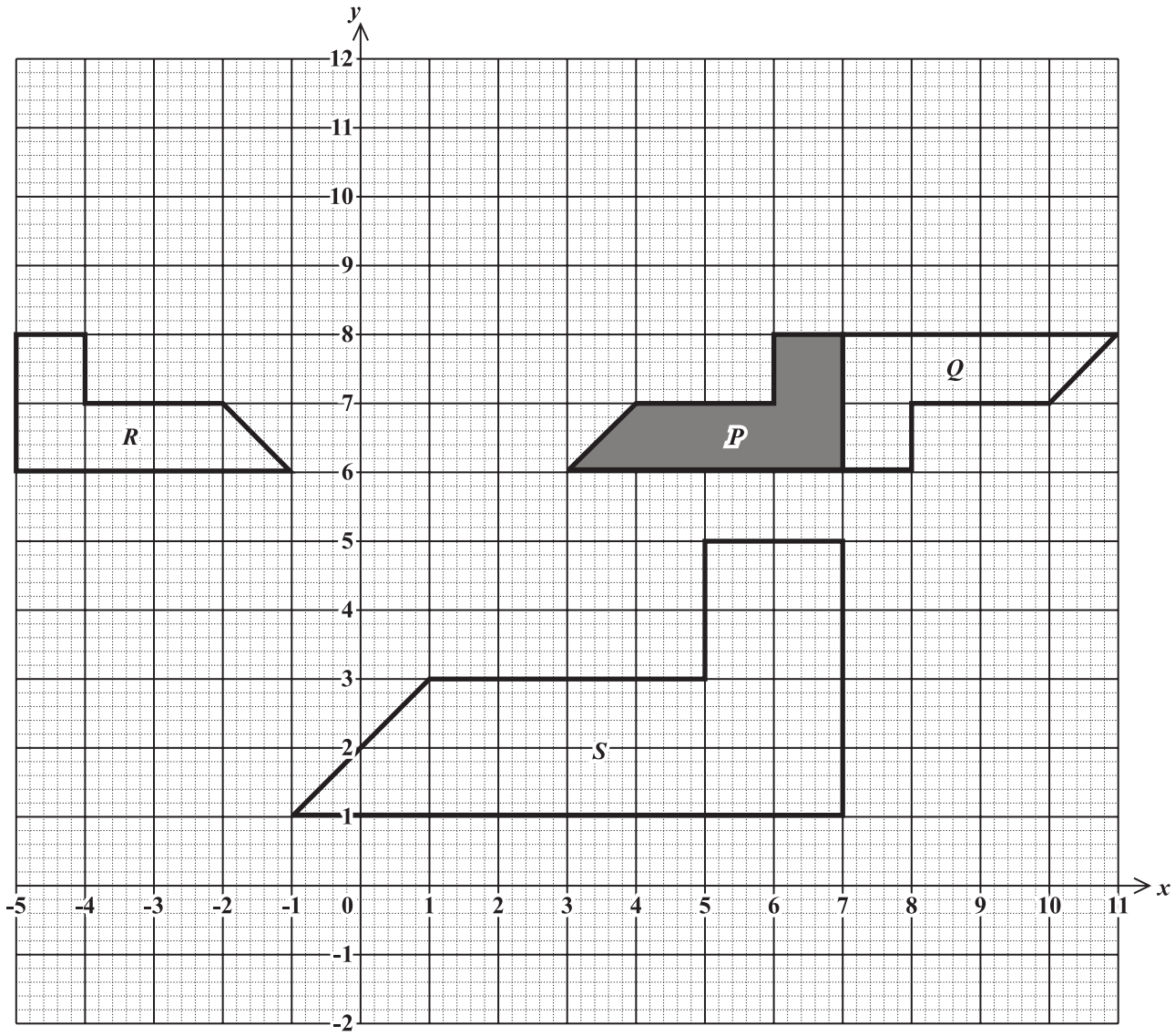
(ii) Given that $h = 5.4$ when $p = 1.44$, determine the value of h when $p = 2.89$.

.....

(2 marks)

Total 9 marks

3. The diagram below shows four shapes, *P*, *Q*, *R* and *S,* on a square grid.



(a) Describe fully the **single** transformation that maps shape *P* onto shape

(i) *Q*

.....

.....

.....

.....

(3 marks)

(ii) *R*

.....

.....

.....

.....

(2 marks)

(iii) *S.*

.....

.....

.....

.....

(3 marks)

(b) On the grid provided **on page 10**, draw the image of shape *P* after a translation by the vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$. Label this image *T*. **(1 mark)**

Total 9 marks

NOTHING HAS BEEN OMITTED.

4. (a) The functions f and g are defined as follows:

$f(x) = 5x + 7$ and $g(x) = 3x - 1$.

For the functions given above, determine

(i) $g\left[\frac{1}{3}\right]$

.....

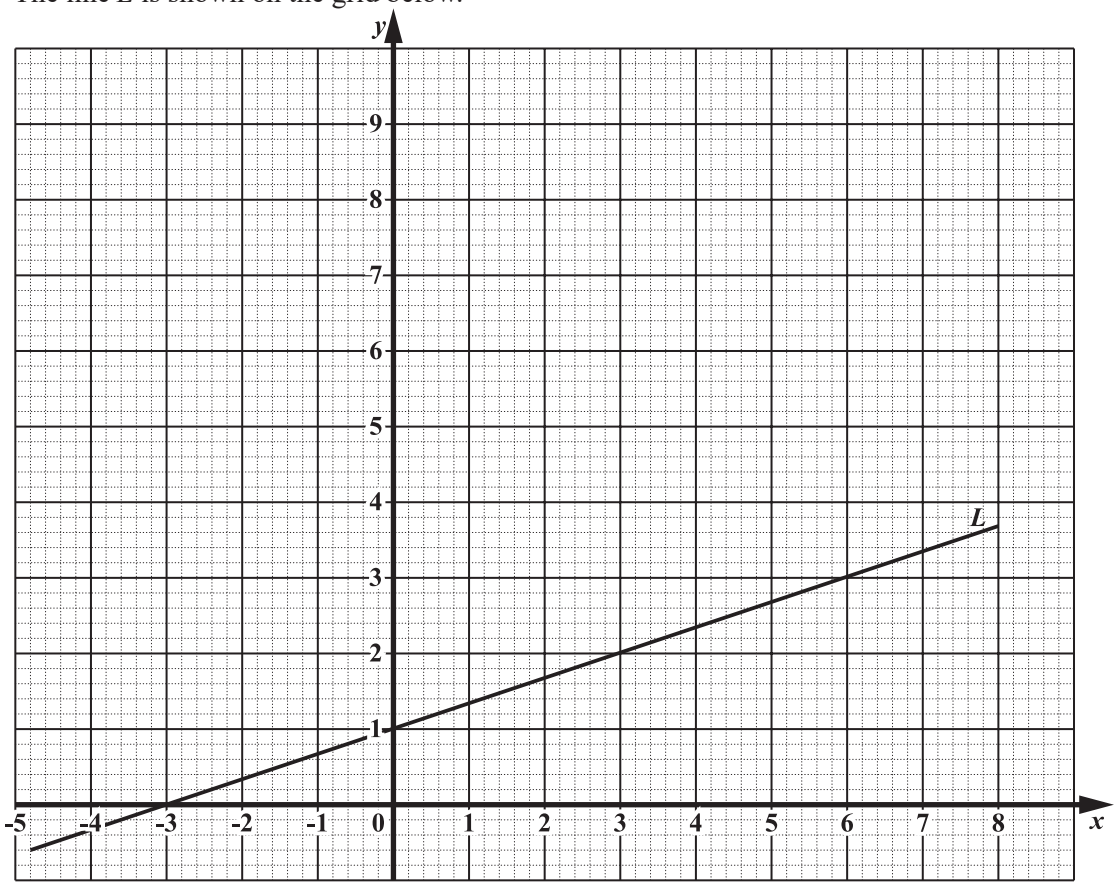
(1 mark)

(ii) $f^{-1}(-3)$.

.....

(2 marks)

(b) The line L is shown on the grid below.



(i) Write the equation of the line L in the form $y = mx + c$.

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(2 marks)

(ii) The equation of a different line, Q, is $y = -2x + 8$.

a) Write down the coordinates of the point where Q crosses the x-axis.

.....

(1 mark)

b) Write down the coordinates of the point where Q crosses the y-axis.

.....

(1 mark)

c) On the grid **on page 14**, draw the graph of the line Q. **(1 mark)**

(iii) Complete the statement below.

According to the graph, the solution of the system of equations consisting of L and Q is

.....

(1 mark)

Total 9 marks

5. A school nurse records the height, h cm, of each of the 150 students in Class A who was vaccinated. The table below shows the information.

Height, h (cm)	**Number of Students (f)**
$60 < h \leq 80$	4
$80 < h \leq 100$	20
$100 < h \leq 120$	35
$120 < h \leq 140$	67
$140 < h \leq 160$	20
$160 < h \leq 180$	4

(a) Complete the table below and use the information to calculate an estimate of the mean height of the students. Give your answer correct to 1 decimal place.

Height, h (cm)	**Number of Students (f)**	**Midpoint (x)**	**$f \times x$**
$60 < h \leq 80$	4	70	280
$80 < h \leq 100$	20	90	1 800
$100 < h \leq 120$	35	110	3 850
$120 < h \leq 140$	67	_____	_____
$140 < h \leq 160$	20	150	3 000
$160 < h \leq 180$	4	170	680

.....

(3 marks)

GO ON TO THE NEXT PAGE

(b) In Class B, the mean height of the students is 123.5 cm, and the standard deviation 29.87. For Class A, the standard deviation is 21.38.

Using the information provided, and your response in (a), comment on the distribution of the heights of the students in both Class A and Class B.

.....

.....

.....

.....

(1 mark)

(c) (i) Complete the cumulative frequency table below and use the information to construct the cumulative frequency curve on the grid provided **on page 19**.

Height, *h* (cm)	**Number of Students (*f*)**	**Cumulative Frequency**
$60 < h \leq 80$	4	4
$80 < h \leq 100$	20	24
$100 < h \leq 120$	35	_____
$120 < h \leq 140$	67	126
$140 < h \leq 160$	20	_____
$160 < h \leq 180$	4	150

(1 mark)

(ii) Use your cumulative frequency curve to find

a) an estimate of the median height of the group of students

.....

(1 mark)

b) the probability that a student chosen at random would be taller than 130 cm.

.....

(1 mark)

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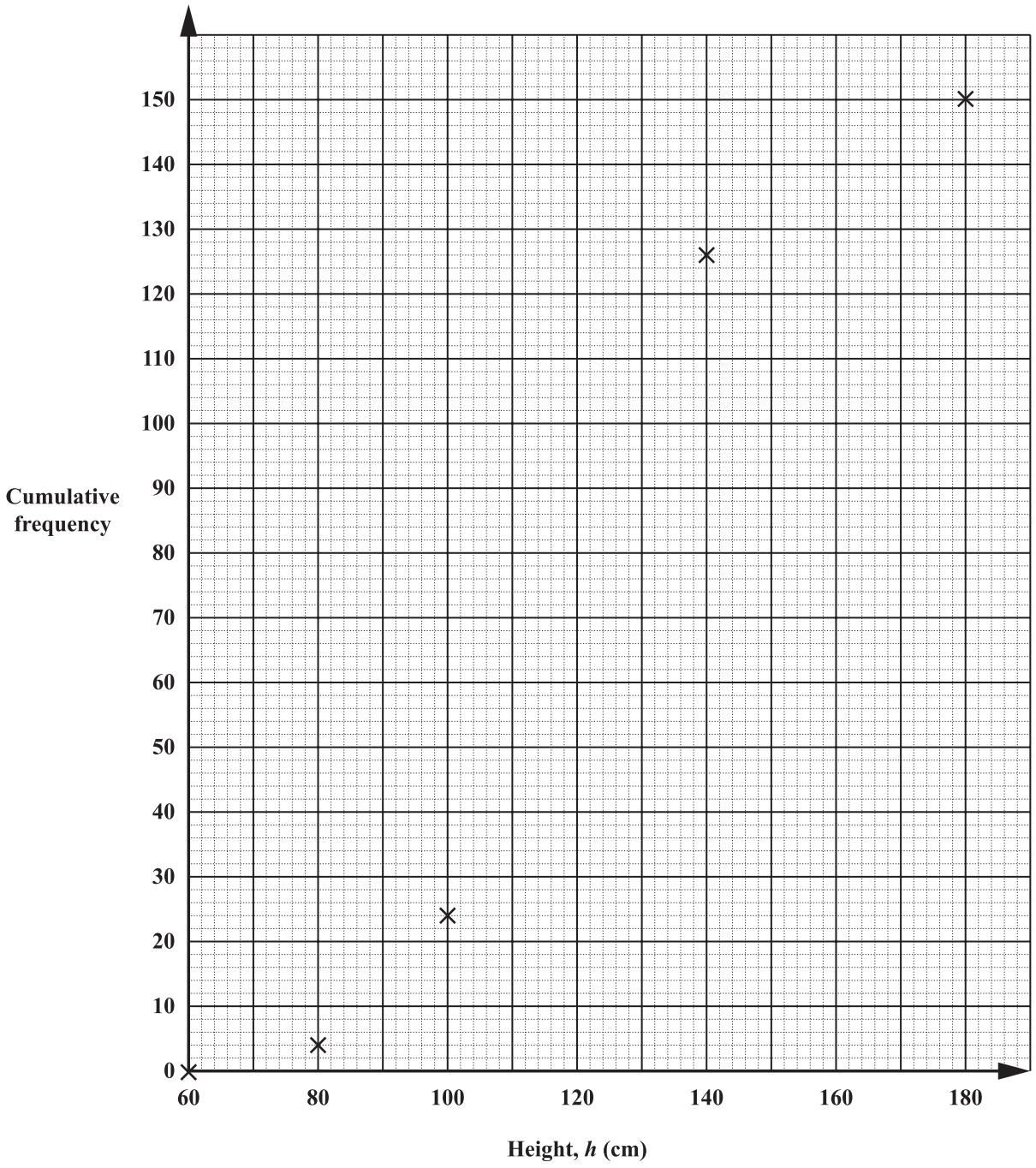
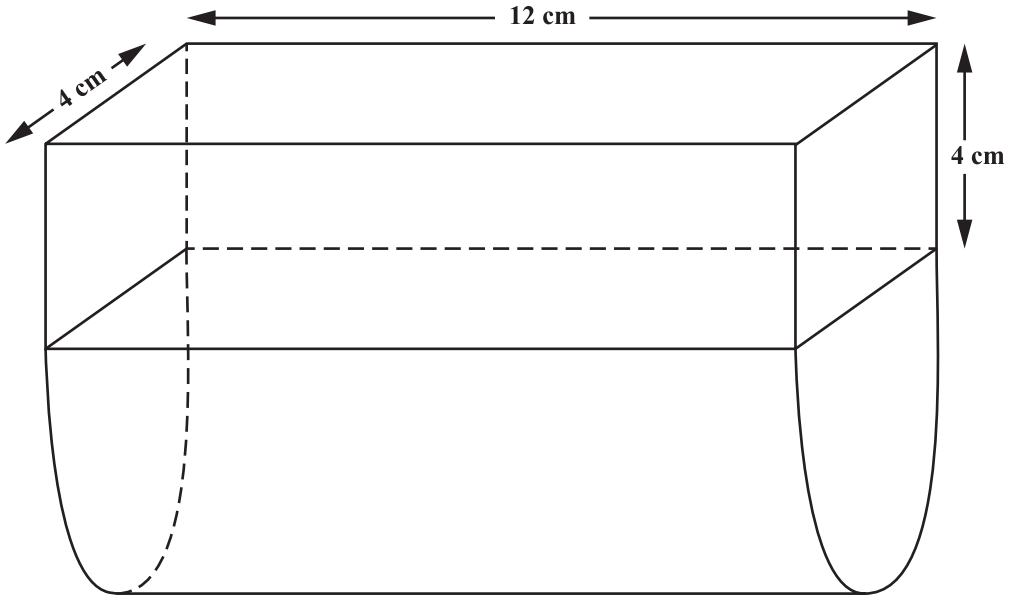


(2 marks)

Total 9 marks

6. The diagram below shows a solid made from a semi-circular cylindrical base, with a rectangular prism above it. The diameter of the cylindrical base and the width of the rectangular prism are 4 cm each.



(a) Calculate the TOTAL surface area of the solid.

[The surface area, A, of a cylinder with radius r is $A = 2\pi r^2 + 2\pi rh$].

.....

(4 marks)

GO ON TO THE NEXT PAGE

(b) Calculate the volume of the solid.

.....

(3 marks)

(c) The solid is made from gold. One **cubic centimetre** of gold has a mass of 19.3 grams. The cost of 1 gram of gold is $42.62.

Calculate the cost of the gold used to make the solid.

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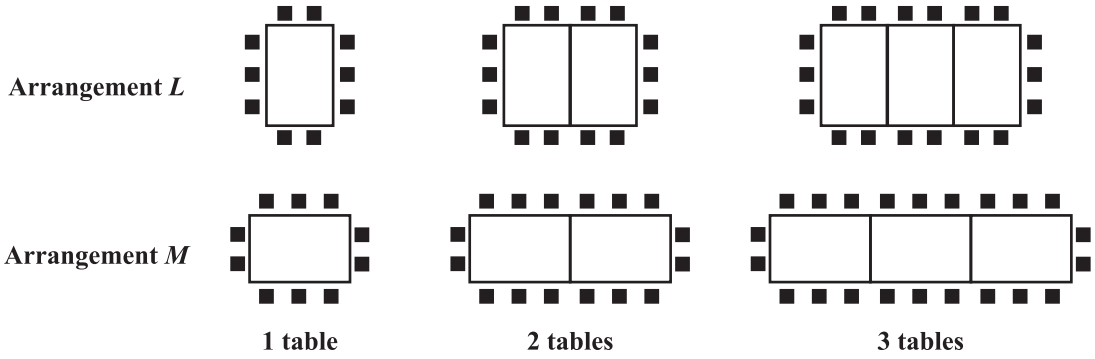
(2 marks)

Total 9 marks

7. At an entertainment hall, tables and chairs can be arranged in two different ways as shown in the diagram below.



(a) Draw the diagram for **4 tables** using **Arrangement *L***.

(2 marks)

(b) The number of chairs, C, that can be placed around a given number of tables, T, for either arrangement, L or M, forms a pattern. The values for C for the first 3 diagrams for both arrangements are shown in the table below. Study the pattern of numbers in each row of the table.

Complete the rows numbered (i), (ii) and (iii).

	Number of Tables (T)	**Arrangement L**	**Arrangement M**	
		Number of Chairs (C)	**Number of Chairs (C)**	
	1	10	10	
	2	14	16	
	3	18	22	
(i)	4	_____	_____	**(2 marks)**
	⋮	⋮	⋮	
(ii)	_____	_____	130	**(2 marks)**
	⋮	⋮	⋮	
(iii)	n	_____	_____	**(2 marks)**

(c) Leon needs to arrange tables to seat 70 people for a birthday party. Which of the arrangements, L or M, will allow him to rent the LEAST number of tables?

Use calculations to justify your answer.

.....

(2 marks)

Total 10 marks

GO ON TO THE NEXT PAGE

SECTION II

Answer ALL questions.

ALL working MUST be clearly shown.

ALGEBRA, RELATIONS, FUNCTIONS AND GRAPHS

8. A rental company has x cars and y minivans. The company has at least 8 vehicles altogether. The number of minivans is less than or equal to the number of cars. The number of cars is no more than 9.

(a) Write down THREE inequalities, in terms of x and/or y, other than $x \geq 0$ and $y \geq 0$, to represent this information.

.....

.....

.....

(3 marks)

(b) A car can carry 4 people and a minivan can carry 6 people. There are at most 60 persons to be taken on a tour.

Show that $2x + 3y \leq 30$.

.....

(1 mark)

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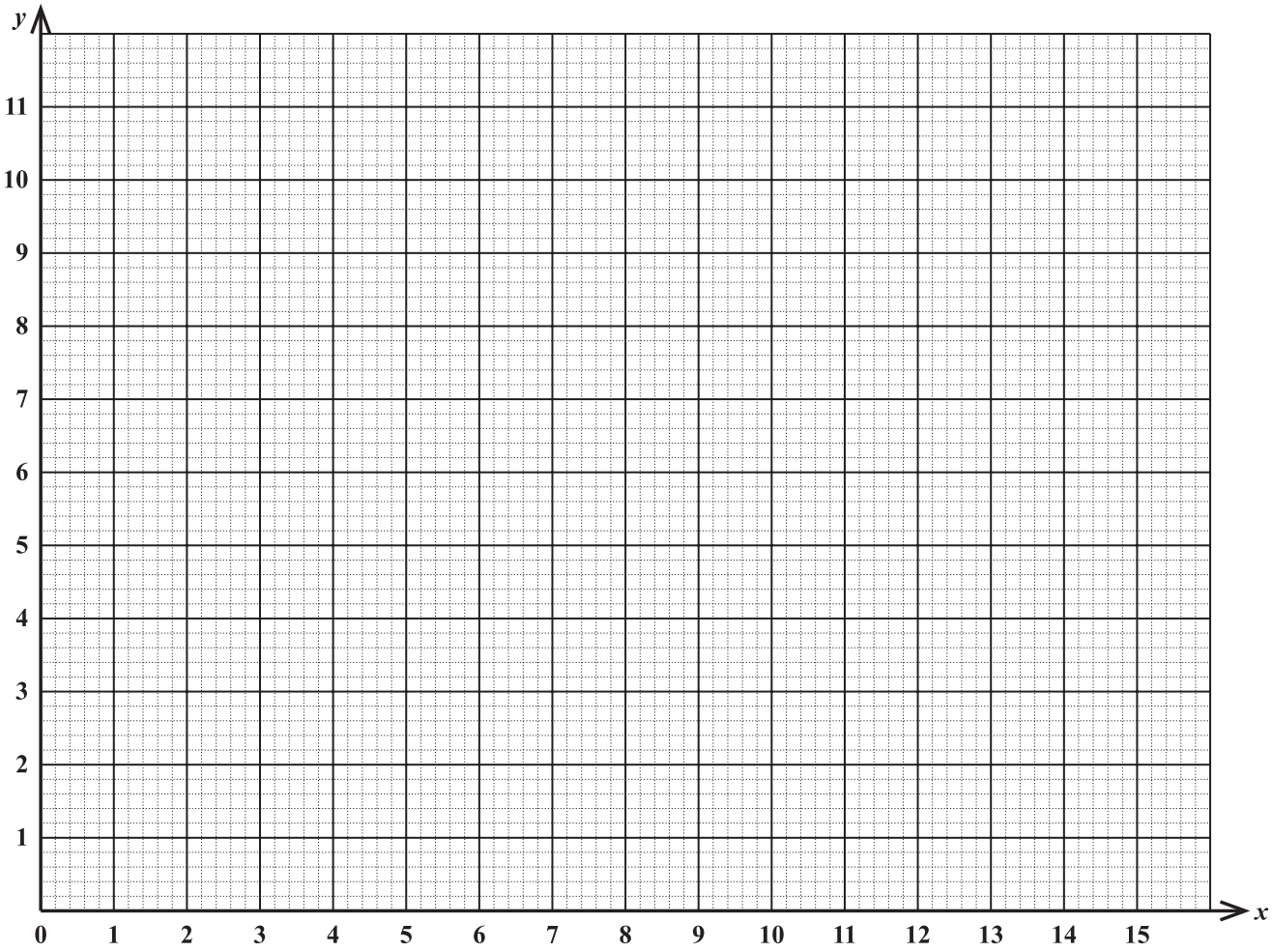
(c) On the grid below, plot the four lines associated with the inequalities in (a) and (b). Shade and label the region that satisfies ALL four inequalities *R*.



(5 marks)

(d) (i) Determine the **two combinations** for the MINIMUM number of cars and minivans that can be used to carry EXACTLY 60 people on the tour.

.....

(2 marks)

(ii) The company charges $75 to rent a car and $90 to rent a minivan. Show that the MINIMUM rental cost for this tour is $990.

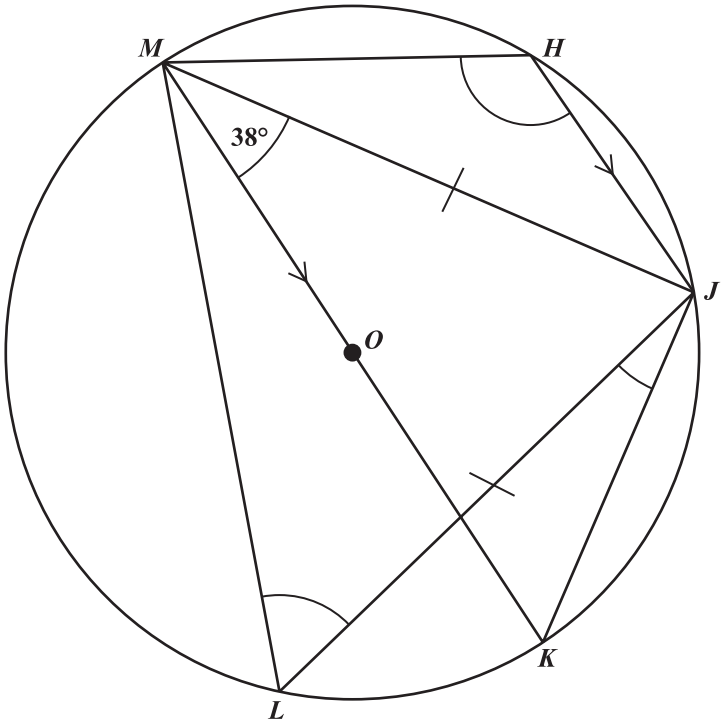
.....

(1 mark)

Total 12 marks

GEOMETRY AND TRIGONOMETRY

9. (a) H, J, K, L and M are points on the circumference of a circle with centre O. MK is a diameter of the circle and it is parallel to HJ. $MJ = JL$ and angle $JMK = 38°$.



(i) Explain, giving a reason, why angle

a) $HJM = 38°$

.....

.....

.....

(1 mark)

b) $MJK = 90°$.

.....

.....

.....

(1 mark)

(ii) Determine the value of EACH of the following angles. Show detailed working where appropriate.

a) Angle *MLJ*

.....

(2 marks)

b) Angle *LJK*

.....

(1 mark)

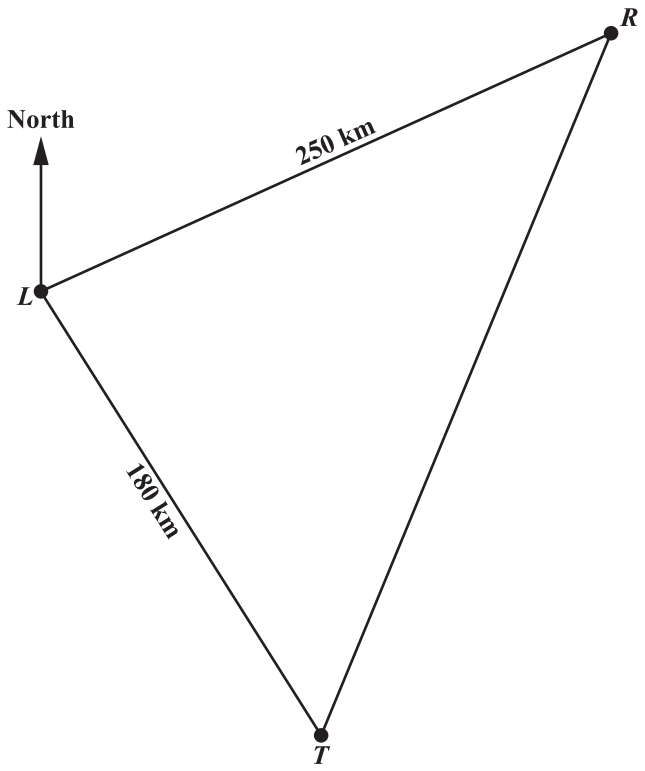
c) Angle *JHM*

.....

(1 mark)

GO ON TO THE NEXT PAGE

(b) From a port, *L*, ship *R* is 250 kilometres on a bearing of 065°. Ship *T* is 180 kilometres from *L* on a bearing of 148°. This information is illustrated in the diagram below.



(i) Complete the diagram above by inserting the value of angle *RLT*. **(1 mark)**

(ii) Calculate *RT*, the distance between the two ships.

.....

(2 marks)

(iii) Determine the bearing of T from R.

.....

(3 marks)

Total 12 marks

VECTORS AND MATRICES

10. (a) The transformation matrix $\boldsymbol{A} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ represents a rotation of 90° anticlockwise about the origin O.

The transformation matrix $\boldsymbol{B} = \begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ represents a reflection in the straight line with equation $y = -x$.

(i) Write the coordinates of P', the image of the point $P(7, 11)$ after it undergoes a rotation by 90° anticlockwise about the origin, O.

.....

(1 mark)

(ii) T is the combined transformation of A followed by B. Determine the elements of the matrix representing the transformation T.

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(2 marks)

(iii) Describe, geometrically, the transformation represented by T.

.....

.....

.....

(2 marks)

GO ON TO THE NEXT PAGE

(b) The 2×2 matrix C is defined, in terms of a scalar constant k, by

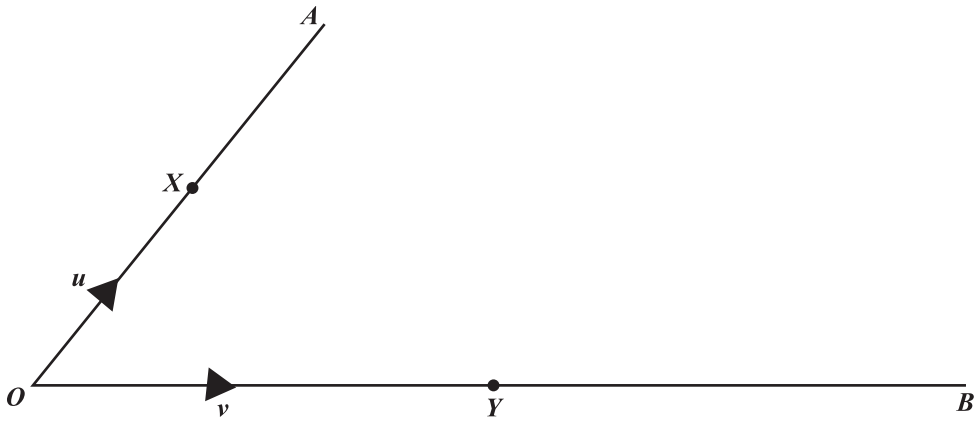
$$C = \begin{pmatrix} 3 & k \\ 6 & 4 \end{pmatrix}.$$

Determine the value of k, given that the matrix C is singular.

.....

(2 marks)

(c) In the diagram below, O is the origin, $\overrightarrow{OX} = u$ and $\overrightarrow{OY} = v$. OX and OY are extended so that X and Y are the midpoints of OA and OB respectively.



(i) Express $\overrightarrow{BX}$ in terms of u and v.

.....

(1 mark)

(ii) Given that YA and BX intersect at M and $BM = 2MX$,

a) express $\overrightarrow{BM}$ in terms of u and v.

.....

(1 mark)

b) using a vector method, show that the ratio YM:YA is 1:3. Show ALL working.

.....

(3 marks)

Total 12 marks

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.