FORM TP 2021093

TEST CODE **01234020**

MAY/JUNE 2021

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 $ax^2 + bx + c = 0$,

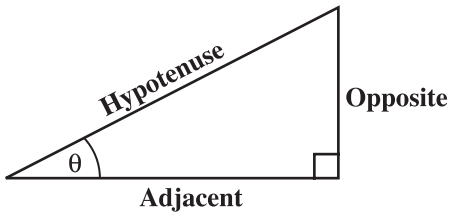
$$\text{then } x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometric ratios

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

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

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

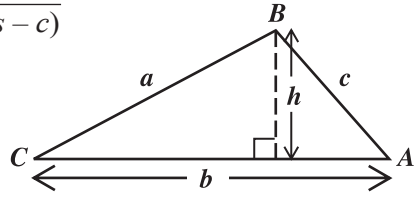


Area of a triangle — Area of $\Delta = \frac{1}{2} bh$ where b is the length of the base and h is the perpendicular height.

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

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

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



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

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

GO ON TO THE NEXT PAGE

SECTION I

Answer ALL questions.

All working must be clearly shown.

1. (a) Using a calculator, or otherwise, calculate the EXACT value of

$$1\frac{4}{7} \div \frac{2}{3} - 1\frac{5}{7}.$$

.....

(2 marks)

(b) When Meghan started working, she was paid $85 each week. After a six-month probationary period, her pay was increased by 20%. How much was she paid each week **after** the increase?

.....

(1 mark)

(c) In 1965, the population of Country *A* was 2 714 000. In 2015, the population was 3 663 900.

(i) a) Write the population in 2015 correct to 3 significant figures.

.....

(1 mark)

b) Write the population in 1965 in standard form.

.....

(1 mark)

(ii) Determine the percentage increase in the population from 1965 to 2015.

.....

(2 marks)

(d) The ratio of teachers to male students to female students in a school is 3:17:18. If the TOTAL **number of students** in the school is 630, determine the **number of teachers** in the school.

.....

(2 marks)

Total 9 marks

GO ON TO THE NEXT PAGE

2. (a) Two quantities, n and T, are related as follows:

$$n = \sqrt{T}.$$

(i) Find the value of n when $T = 49$.

.....

(1 mark)

(ii) Make T the subject of the formula.

.....

(1 mark)

(b) Ally is x years. Jim is 5 years older than Ally and Chris is twice as old as Ally.

(i) Write expressions in terms of x for Jim's age and Chris' age.

Jim's age .....

Chris' age .....

(2 marks)

(ii) In **two years' time**, the product of Ally's age and Chris' age will be the same as the square of Jim's **present** age.

Show that the equation $x^2 - 4x - 21 = 0$ represents the information given above.

.....

(3 marks)

(iii) Calculate Ally's present age.

.....

(2 marks)

Total 9 marks

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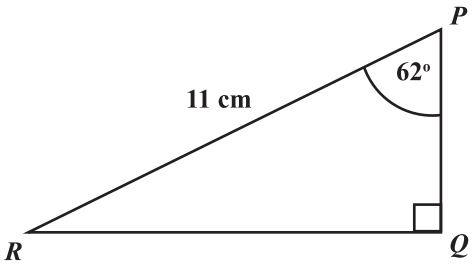
3. (a) The diagram below shows the triangle *PQR* in which angle *QPR* = 62°, angle *PQR* = 90° and *PR* = 11 cm.



Calculate

(i) the size of angle *PRQ*

.....

(1 mark)

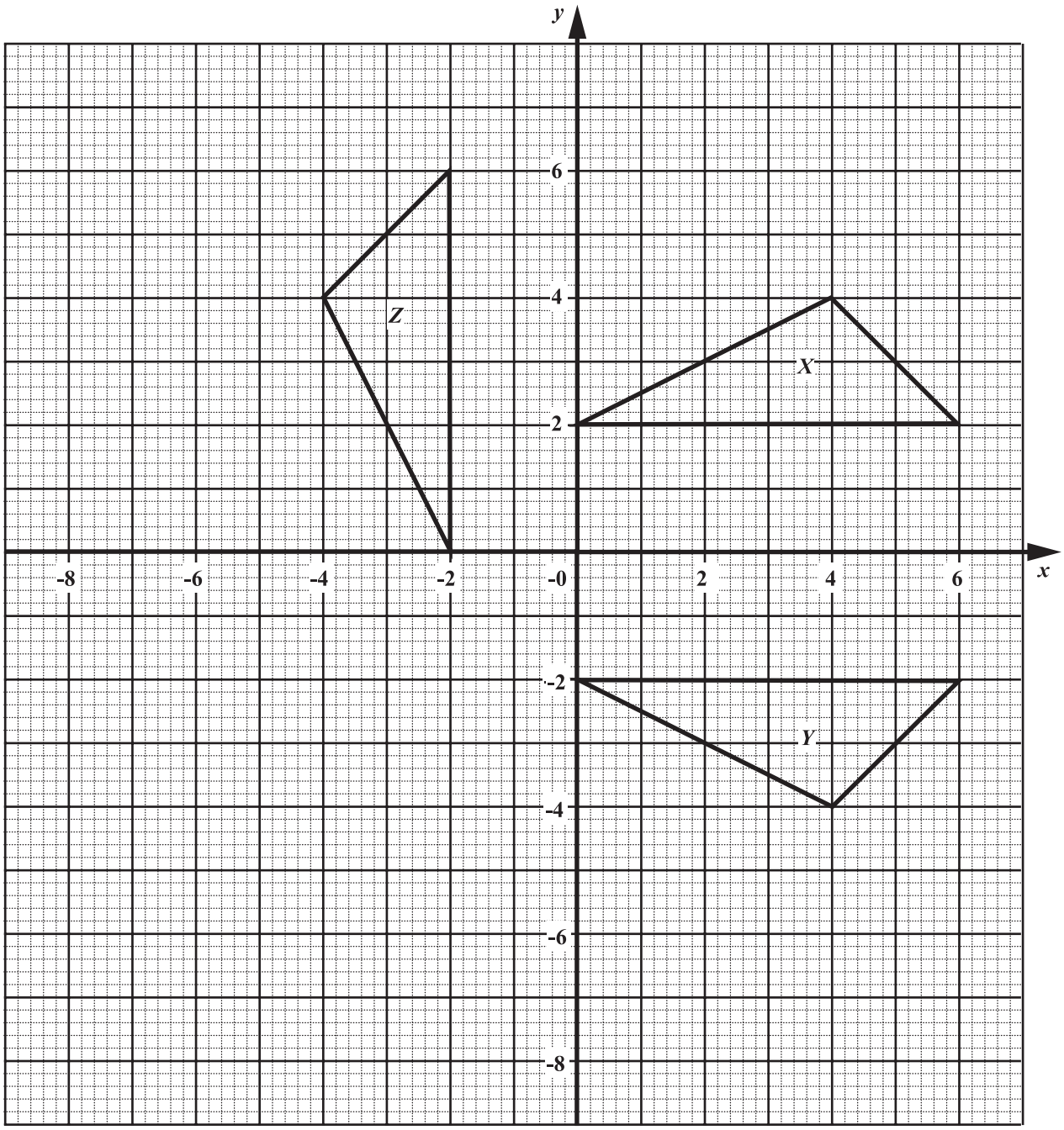
(ii) the length of the side *RQ*.

.....

(2 marks)

GO ON TO THE NEXT PAGE

(b) The diagram below shows three triangles, *X*, *Y* and *Z*, on a square grid.



(i) Triangle X is mapped onto Triangle Y by a reflection. State the equation of the mirror line.

.....

(1 mark)

(ii) Describe fully the transformation which maps Triangle X onto Triangle Z.

.....

.....

.....

.....

(2 marks)

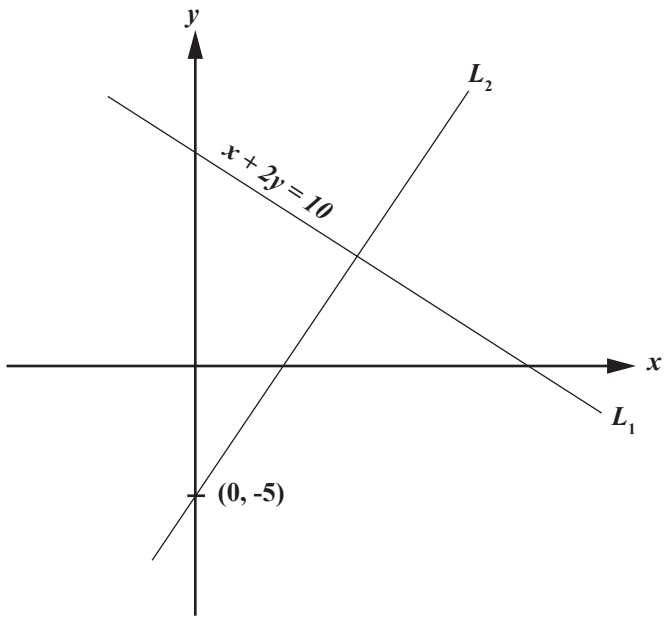
(iii) On the diagram **on page 10**, translate Triangle Y using the vector $\begin{pmatrix} -7 \\ 1 \end{pmatrix}$.

Label this image V. **(1 mark)**

(iv) On the diagram **on page 10**, enlarge Triangle X about the centre, $C(0, 0)$, and scale factor $\frac{1}{2}$. Label this image W. **(2 marks)**

Total 9 marks

4. (a) The diagram below shows two lines, L_1 and L_2. The equation of the line L_1 is $x + 2y = 10$. The line L_2 passes through the point $(0, -5)$ and is **perpendicular** to L_1.



(i) Express the equation of the line L_1 in the form $y = mx + c$.

.....

(1 mark)

(ii) State the gradient of the line L_1.

.....

(1 mark)

(iii) Hence, determine the equation of the line L_2.

.....

(2 marks)

(b) Given that $f(x) = \frac{1}{3}x + 4$ and $g(x) = \frac{3x}{x+1}$,

(i) determine the value of $f(9)$

.....

(1 mark)

(ii) calculate the value of $fg(-3)$

.....

(2 marks)

(iii) determine the value of x, for which $g(x) = \frac{5}{2}$.

.....

(2 marks)

Total 9 marks

GO ON TO THE NEXT PAGE

NOTHING HAS BEEN OMITTED.

5. (a) One hundred students were surveyed on the amount of money they spent on data for their cellphones during a week. The table below shows the results as well as the midpoint for each class interval.

Amount Spent ($)	**Number of Students (*f*)**	**Midpoint ($) (*x*)**
$50 < x \leq 60$	7	55
$60 < x \leq 70$	11	65
$70 < x \leq 80$	31	75
$80 < x \leq 90$	29	85
$90 < x \leq 100$	22	95

Using the table,

(i) a) determine the modal class of the amount of money spent

.....

(1 mark)

b) calculate an estimate of the mean amount of money spent, giving your answer correct to 2 decimal places.

.....

(2 marks)

GO ON TO THE NEXT PAGE

(ii) Damion reports that the median amount spent is $84. Briefly explain why Damion's report could be correct.

.....

.....

.....

(1 mark)

(b) The two-way/contingency table below gives information on the mode of transportation to school for 100 students.

	Walk	**Cycle**	**Drive**	**Total**
Boy	15		14	48
Girl		18	26	
Total	23		40	100

(i) Complete the table by inserting the missing values. **(2 marks)**

(ii) A student is selected at random. What is the probability that he/she was being driven to school on that day?

.....

(1 mark)

(iii) One of the girls is selected at random. What is the probability that she did NOT cycle to school?

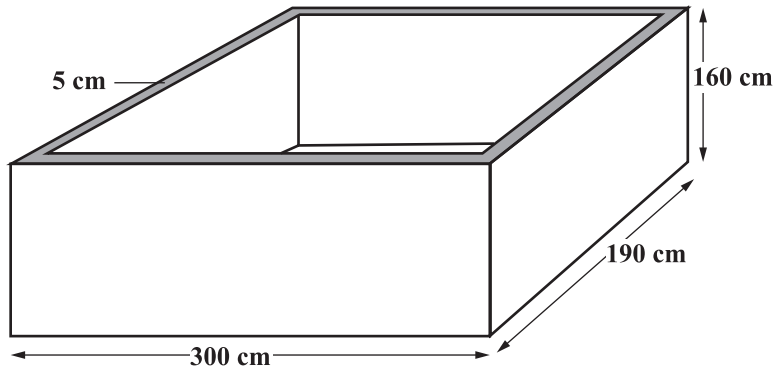
.....

(2 marks)

Total 9 marks

GO ON TO THE NEXT PAGE

6. Farmer Brown makes troughs to feed his farm animals, using wood that is 5 cm thick. As shown in the diagram below, the troughs are rectangular-based, open at the top and have external dimensions of 300 cm by 190 cm by 160 cm.



(a) Show, by calculation, that the internal capacity (volume) of the trough is 8 091 000 cm^3.

.....

(3 marks)

GO ON TO THE NEXT PAGE

(b) Calculate the volume of wood needed to make a trough.

.....

(3 marks)

(c) Farmer Brown must paint the INTERNAL surface of the trough. Given that 1 gallon of paint covers approximately 280 000 cm^2 of surface, determine the TOTAL amount of paint, **in litres**, that is needed to paint the internal surface of the trough.

(1 gallon ≈ 3.79 litres)

.....

(3 marks)

Total 9 marks

7. The first 3 figures in a sequence of shapes, formed by connecting lines of unit length, are shown below.

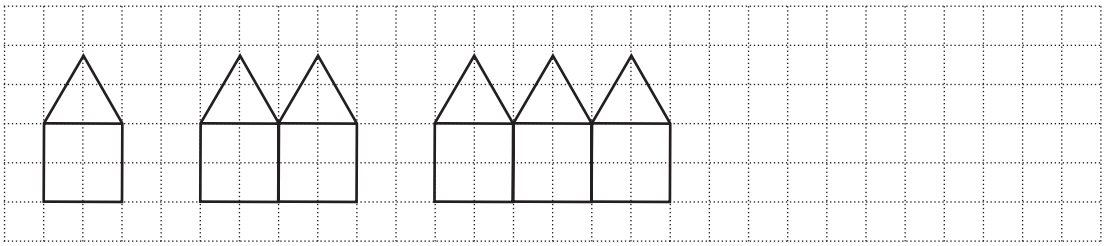


Figure 1 **Figure 2** **Figure 3** **Figure 4**

(a) Draw Figure 4 of the pattern in the space provided above. **(2 marks)**

(b) The number of lines, L, in each shape and the perimeter, P, of the shape follow a pattern. Study the pattern of numbers in each row of the table below and answer the questions that follow.

Complete the table below showing the number of lines and the perimeter of each figure.

	Figure	**Number of Lines (L)**	**Perimeter (P)**	
	1	6	5	
	2	11	8	
	3	16	11	
	⋮	⋮	⋮	
(i)	5	_____	_____	**(2 marks)**
	⋮	⋮	⋮	
(ii)	_____	66	_____	**(2 marks)**
	⋮	⋮	⋮	
(iii)	n	_____	_____	**(2 marks)**

GO ON TO THE NEXT PAGE

(c) Write a simplified expression, in terms of n, for the **difference**, d, between the number of lines and the perimeter of any figure, n.

.....

(2 marks)

Total 10 marks

SECTION II

Answer ALL questions.

ALL working MUST be clearly shown.

ALGEBRA, RELATIONS, FUNCTIONS AND GRAPHS

8. Marla buys 2 types of mobile phones, B-Flo and C-Flex, from a company to retail. One B-Flo mobile phone costs \$60 while one C-Flex costs \$80. She buys x number of B-Flo phones and y number of C-Flex phones.

(a) (i) Marla must **not** spend more than \$1 200. Write an inequality to represent this information.

.....

(1 mark)

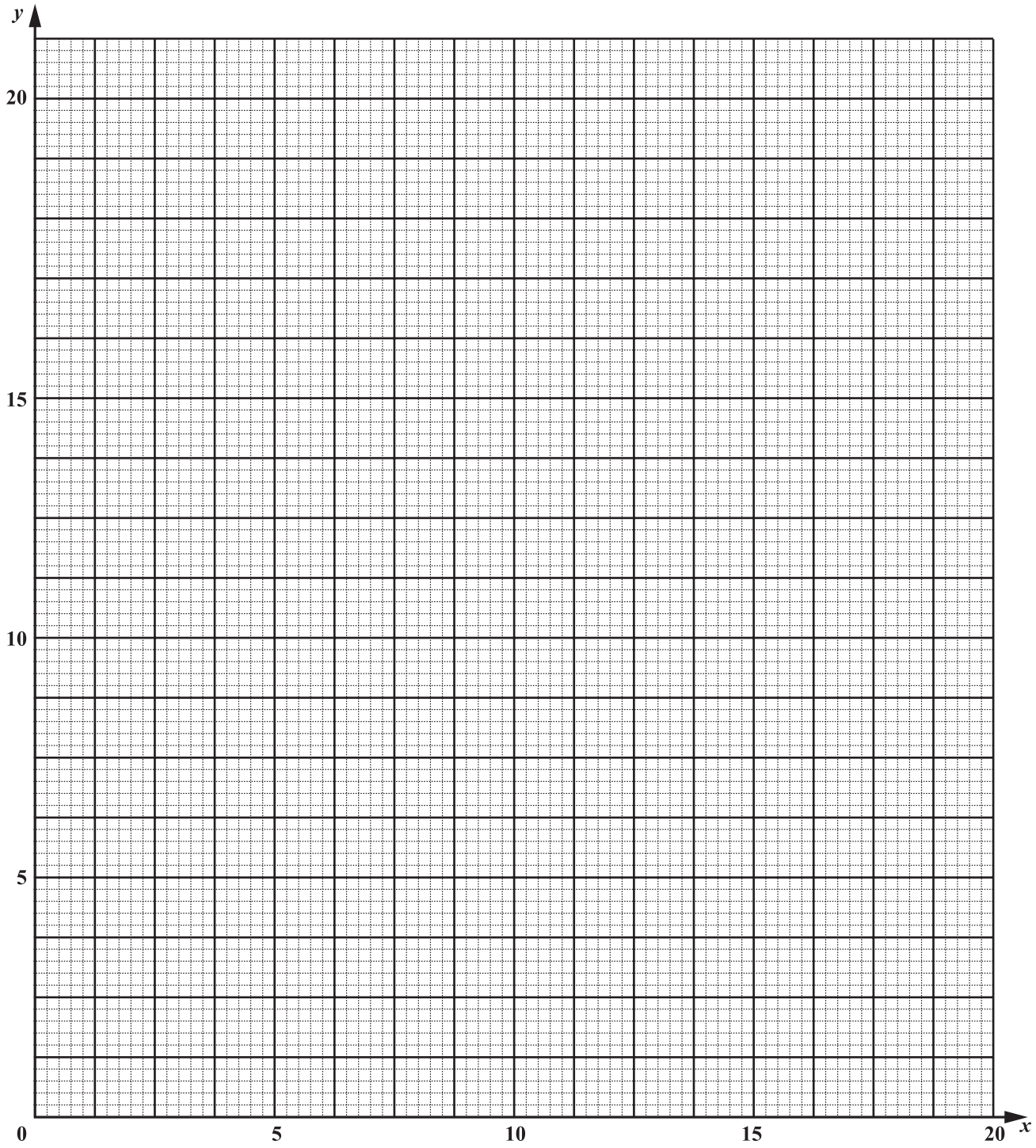
(ii) The number of B-Flo phones must be greater than or equal to the number of C-Flex phones. Write down an inequality in x and y to show this information.

.....

(1 mark)

GO ON TO THE NEXT PAGE

(iii) Represent the two inequalities **on page 22** on the grid shown below. Label as *R* the region which satisfies both inequalities.



(4 marks)

(iv) The total number of mobile phones is represented by $x + y$. According to the graph **on page 23**, what is the largest possible value of $x + y$?

.....

(1 mark)

(b) The table below shows pairs of values for the function $y = x^2 + x - 4$.

x	–4	–3	–2	–1	0	1	2	3
y	8	2	–2	–4	–4	–2	2	8

(i) On the grid provided **on page 25**, plot the remaining 4 points and draw the graph of the function $y = x^2 + x - 4$ for $-4 \leq x \leq 3$. **(3 marks)**

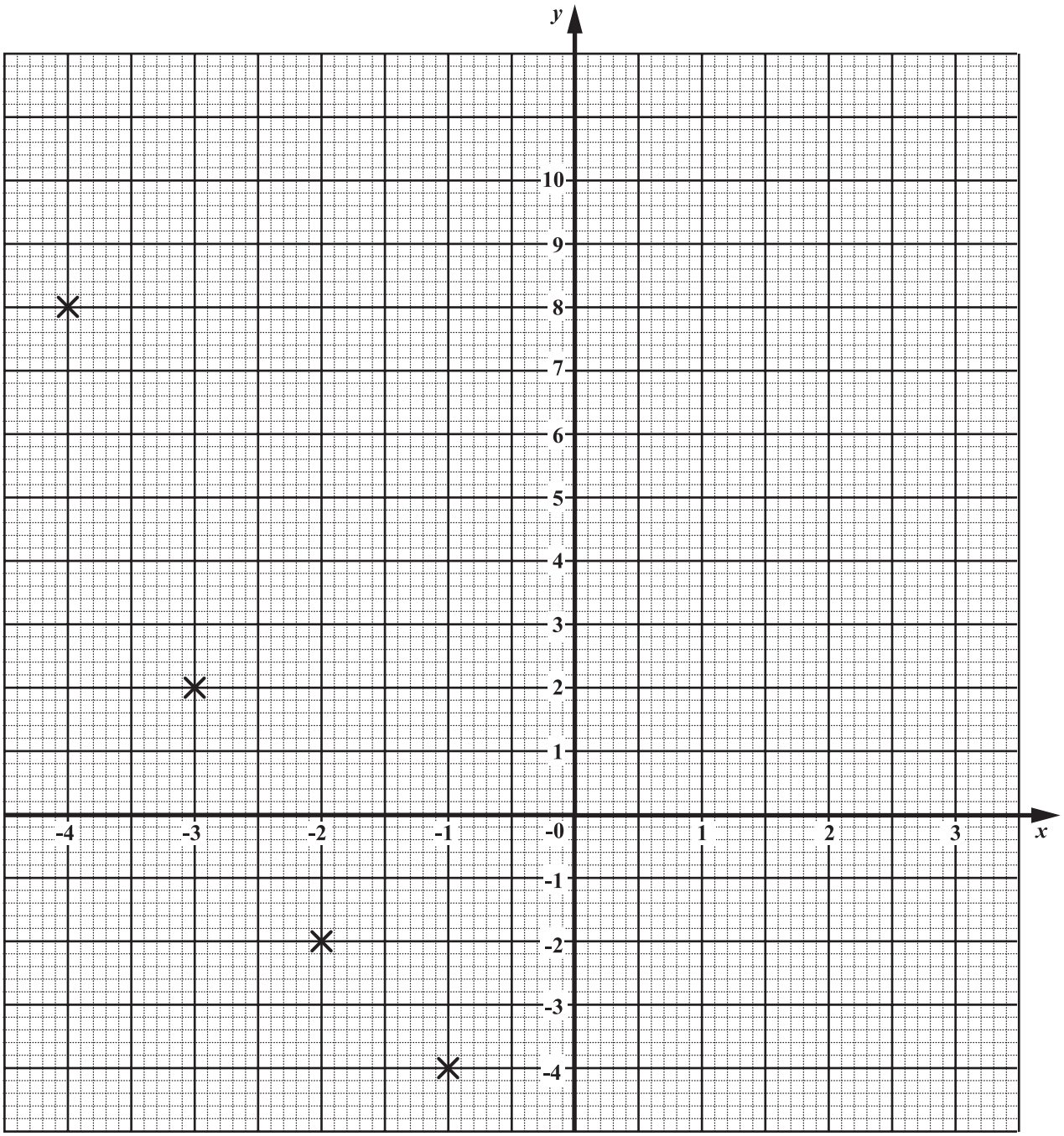
(ii) Write down the maximum or minimum value of the function.

.....

(1 mark)

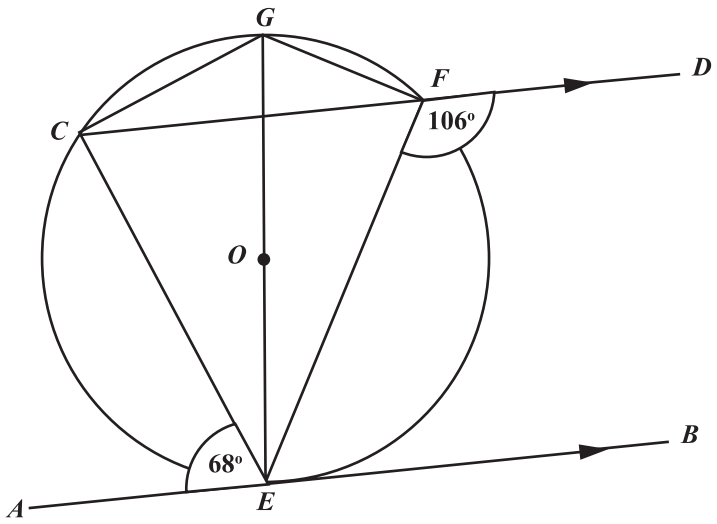
(iii) Using a ruler, draw the axis of symmetry on the graph **on page 25**. **(1 mark)**

Total 12 marks



GEOMETRY AND TRIGONOMETRY

9. (a) In the diagram below, *E*, *C*, *G* and *F* are points on the circumference of a circle. *EG* is a diameter of the circle. The tangent *AEB* is parallel to *CD*. Angle *AEC* = 68° and angle *EFD* = 106°.



Determine the value of EACH of the following angles. Show detailed working where necessary and give a reason to support your answer.

(i) *ECD*

Reason .....

.....

.....

.....

(2 marks)

GO ON TO THE NEXT PAGE

(ii) *CEG*

Reason .....

.....

.....

.....

(2 marks)

(iii) *CGF*

Reason .....

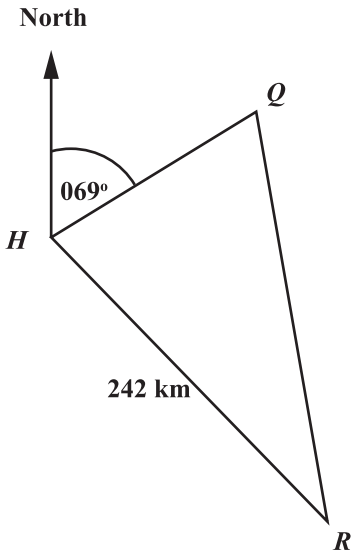
.....

.....

.....

(2 marks)

(b) From a harbour, H, the bearing of two ships, Q and R, are 069° and 151° respectively. Q is 175 km from H while R is 242 km from H.



(i) Complete the diagram above to show the information given. **(1 mark)**

(ii) Calculate QR, the distance between the two ships, to the nearest km.

.....

(3 marks)

GO ON TO THE NEXT PAGE

(iii) Calculate how far due south is Ship *R* of the harbour, *H*.

.....

(2 marks)

Total 12 marks

VECTORS AND MATRICES

10. (a) (i) Calculate the matrix product $\begin{pmatrix} 5 & 4 \\ -3 & -2 \end{pmatrix}\begin{pmatrix} 2 & 1 & -4 \\ 0 & 3 & 6 \end{pmatrix}$.

.....

(2 marks)

(ii) State why the two matrices in (a) (i) are conformable for multiplication.

.....

(1 mark)

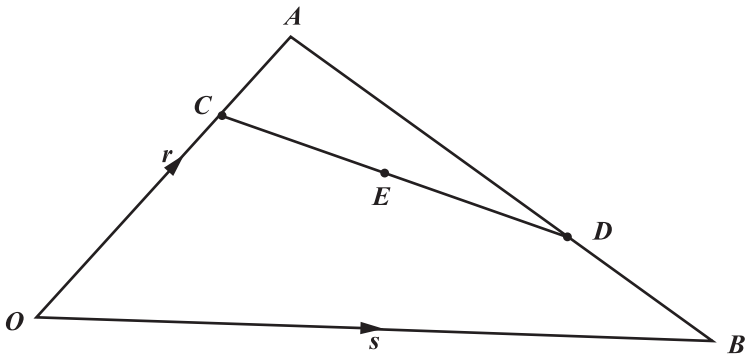
(b) Determine the inverse of $\begin{pmatrix} 5 & 4 \\ -3 & -2 \end{pmatrix}$.

.....

(2 marks)

GO ON TO THE NEXT PAGE

(c) The diagram below shows triangle OAB in which $\overrightarrow{OA} = r$ and $\overrightarrow{OB} = s$. In addition, E is the midpoint of CD, $OC = \frac{3}{4}OA$ and $AD = \frac{2}{3}AB$.



Write in terms of r and s, in the simplest form, an expression for

(i) $\overrightarrow{CD}$

.....

(2 marks)

(ii) $\overrightarrow{OE}$.

.....

(2 marks)

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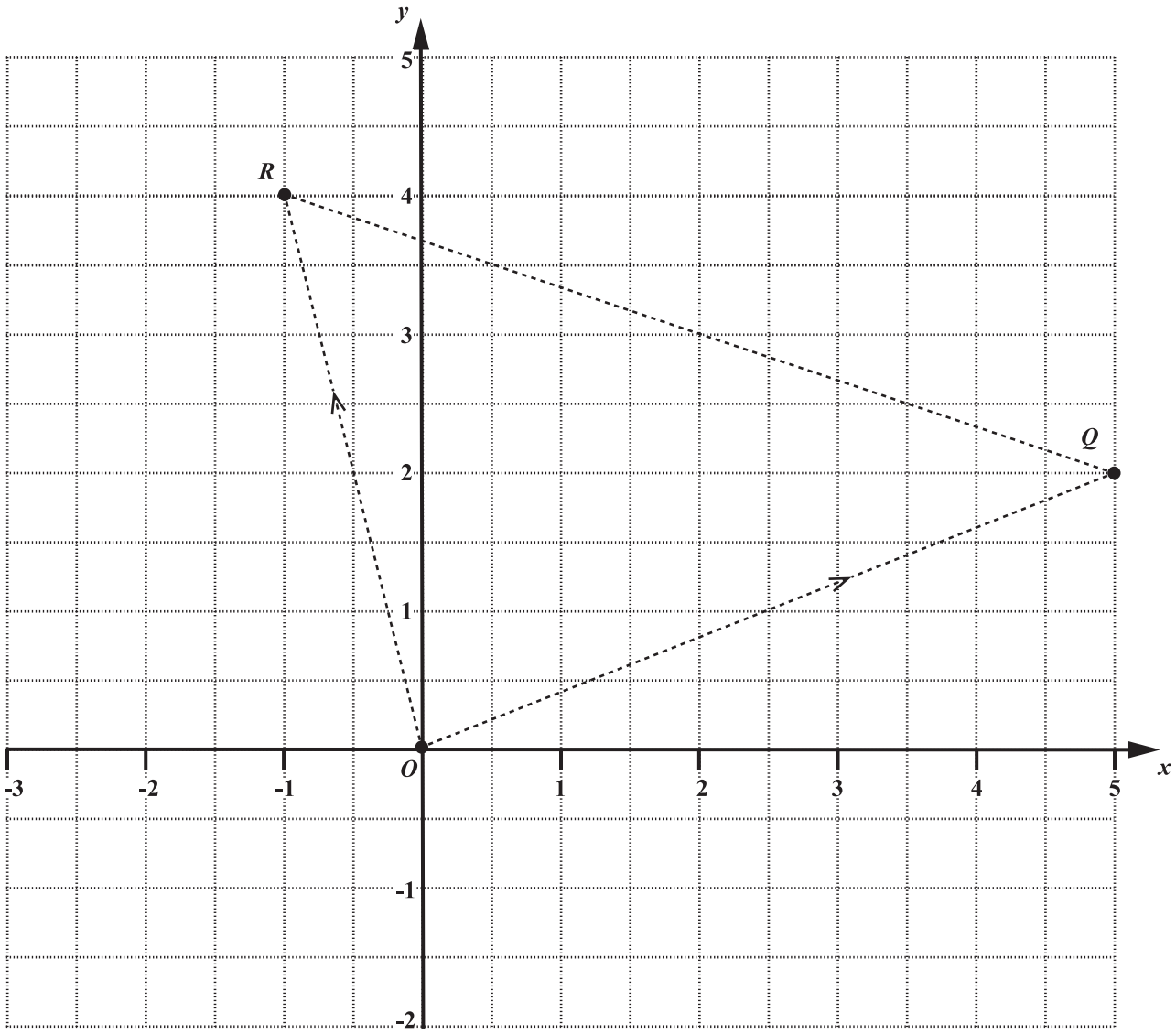
(d) The points O, Q and R have coordinates (0, 0), (5, 2) and (–1, 4) respectively.



(i) Write $\overrightarrow{OR}$ as a column vector.

.....

(1 mark)

GO ON TO THE NEXT PAGE

(ii) Determine $\left|\overrightarrow{QR}\right|$.

.....

(2 marks)

Total 12 marks

END OF TEST

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