

MATHEMATICS PAPER 1
Question-Answer Book

8.30 am – 10.30 am (2 hours)

This paper must be answered in English

INSTRUCTIONS

- Write your Candidate Number in the space provided on Page 1.
- Stick barcode labels in the spaces provided on Pages 1, 3, 5, 7, 9 and 11.
- This paper consists of THREE sections, A(1), A(2) and B. Each section carries 33 marks.
- Attempt ALL questions in Sections A(1) and A(2), and any THREE questions in Section B. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins. Answers written in the margins will not be marked.
- Graph paper and supplementary answer sheets will be supplied on request. Write your Candidate Number, fill in the question number and stick a barcode label on each sheet, and fasten them with string INSIDE this book.
- Write the question numbers of the questions you have attempted in Section B in the spaces provided on Page 1.
- Unless otherwise specified, all working must be clearly shown.
- Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.
- The diagrams in this paper are not necessarily drawn to scale.

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Candidate Number

Marker's
Use Only

Examiner's
Use Only

Marker No.

Examiner No.

Section A
Question No.

Marks

Marks

1-2

3-4

5-6

7-8

9

10

11

12

13

Section A
Total

Checker's
Use Only

Section A Total

Section B
Question No.*

Marks

Marks

Section B
Total

**To be filled in by the candidate*

Checker's
Use Only

Section B Total

Checker No.

FORMULAS FOR REFERENCE

SPHERE	Surface area	= $4\pi r^2$
	Volume	= $\frac{4}{3}\pi r^3$
CYLINDER	Area of curved surface	= $2\pi rh$
	Volume	= $\pi r^2 h$
CONE	Area of curved surface	= πrl
	Volume	= $\frac{1}{3}\pi r^2 h$
PRISM	Volume	= base area \times height
PYRAMID	Volume	= $\frac{1}{3} \times$ base area \times height

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SECTION A(1) (33 marks)

Answer ALL questions in this section and write your answers in the spaces provided.

1. Simplify $\frac{(ab)^3}{a^2}$ and express your answer with positive indices. (3 marks)

2. (a) Solve the inequality $\frac{14x}{5} \geq 2x + 7$.
(b) Write down the least integer satisfying the inequality $\frac{14x}{5} \geq 2x + 7$. (3 marks)

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3. (a) Write down all positive integers m such that $m + 2n = 5$, where n is a positive integer.
 (b) Write down all values of k such that $2x^2 + 5x + k \equiv (2x + m)(x + n)$, where m and n are positive integers.

(3 marks)

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4. In Figure 1, P , Q and R are three posting boxes on the horizontal ground. P is 9 km due east of R and Q is due south of R . The distance between P and Q is 14 km. Find the bearing of Q from P .

(3 marks)

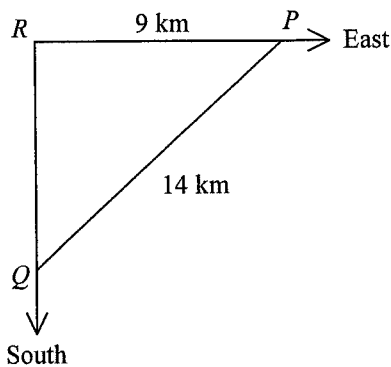


Figure 1

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5. A box contains three cards numbered 2, 3 and 4 respectively while a bag contains two balls numbered 6 and 7 respectively. If one card and one ball are randomly drawn from the box and the bag respectively, find the probability that the sum of the numbers drawn is 10. (3 marks)

6. It is given that $\frac{2s+t}{s+2t} = \frac{3}{4}$.

- (a) Express t in terms of s .
- (b) If $s+t=959$, find s and t .

(4 marks)

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7. John wants to buy the following items in a supermarket:

Item	Unit price	Quantity needed
Biscuit	\$8.2 per pack	4 packs
Chocolate	\$16.3 per box	3 boxes
Soft drink	\$4.8 per can	2 cans

- (a) By rounding up the unit price of each item to the nearest dollar, estimate the total amount that John should pay.
- (b) If John has only \$100, does he have enough money to buy all the items needed? Use the result of (a) to explain your answer.

(4 marks)

8. There are 625 boys in a school and the number of girls is 28% less than that of boys.

- (a) Find the number of girls in the school.
- (b) There are 860 local students in the school.
- (i) Find the percentage of local students in the school.
- (ii) It is given that 80% of the boys are local students. If $x\%$ of the girls are also local students, write down the value of x .

(5 marks)

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9. In Figure 2, $AB \parallel CD$. E is a point lying on AD such that $AE = AC$. Find x , y and z .

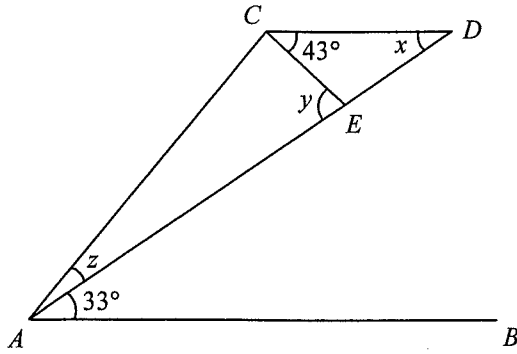


Figure 2

(5 marks)

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Section A(2) (33 marks)

Answer ALL questions in this section and write your answers in the spaces provided.

10. The frequency distribution table and the cumulative frequency distribution table below show the distribution of the weights of the 50 babies born in a hospital during the last week, where a , b , c , k , l and m are integers.

Weight (kg)	Frequency
2.6 – 2.8	a
2.9 – 3.1	12
3.2 – 3.4	b
3.5 – 3.7	10
3.8 – 4.0	c

Weight less than (kg)	Cumulative frequency
2.85	4
3.15	k
3.45	37
3.75	l
4.05	m

- (a) Find a , b and c . (4 marks)
- (b) Find estimates of the mean and the standard deviation of the weights of the 50 babies born in the hospital during the last week. (3 marks)

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11. Consider the function $f(x) = x^2 + bx - 15$, where b is a constant. It is given that the graph of $y = f(x)$ passes through the point $(4, 9)$.

(a) Find b . Hence, or otherwise, find the two x -intercepts of the graph of $y = f(x)$. (3 marks)

(b) Let k be a constant. If the equation $f(x) = k$ has two distinct real roots, find the range of values of k . (4 marks)

(c) Write down the equation of a straight line which intersects the graph of $y = f(x)$ at only one point. (1 mark)

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12. In Figure 3, the coordinates of the point A are $(4, 3)$. A is rotated anticlockwise about the origin O through 90° to B . C is the reflection image of A with respect to the x -axis.

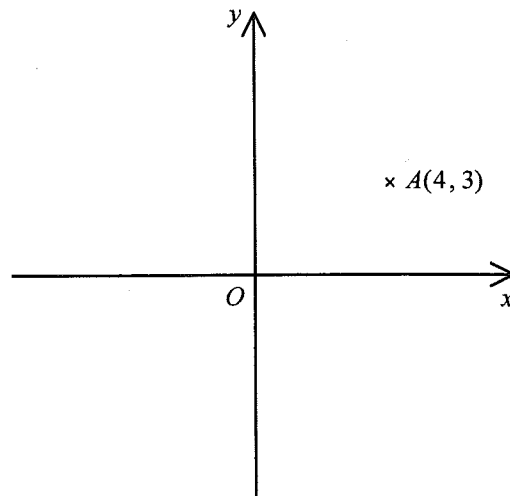


Figure 3

- (a) Write down the coordinates of B and C . (2 marks)
- (b) Are O , B and C collinear? Explain your answer. (3 marks)
- (c) A is translated horizontally to D such that $\angle BCD = 90^\circ$. Find the equation of the straight line passing through C and D . Hence, or otherwise, find the coordinates of D . (4 marks)

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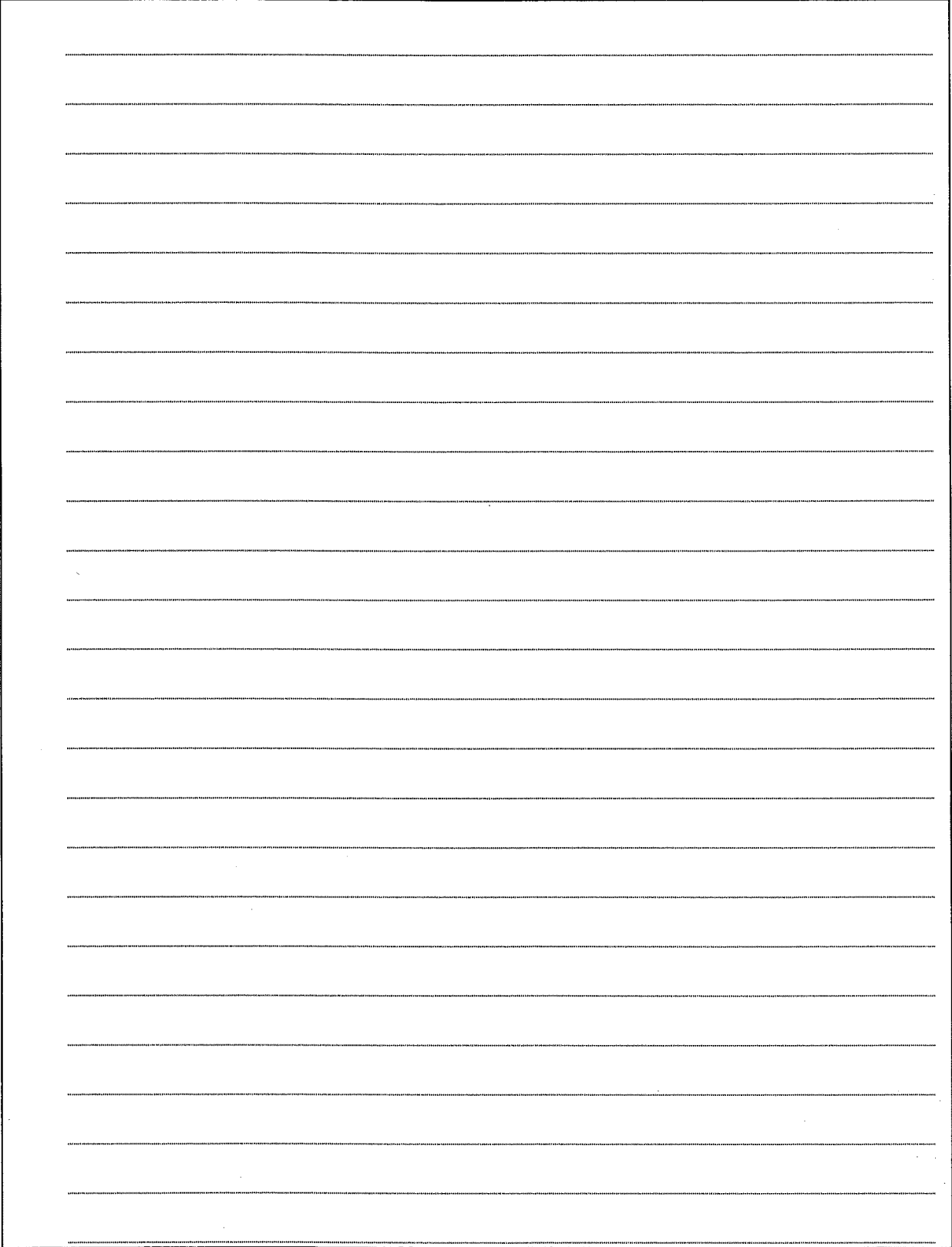
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13. In Figure 4(a), sector $OABC$ is a thin metal sheet. By joining OA and OC together, $OABC$ is folded to form a right circular cone X as shown in Figure 4(b). It is given that $OA = 20$ cm .

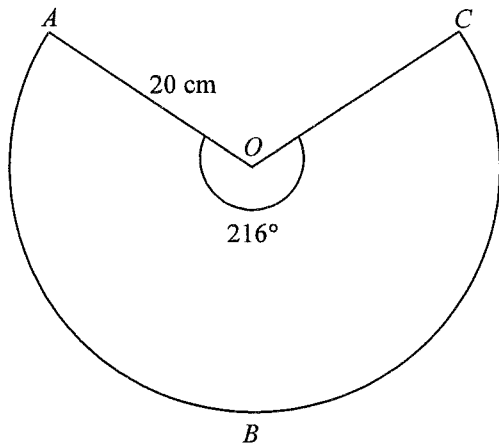


Figure 4(a)

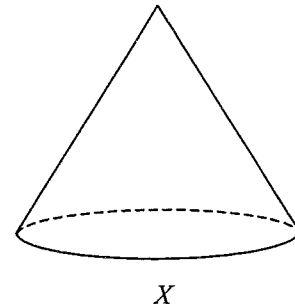
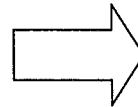


Figure 4(b)

- (a) Find the base radius and the height of X . (4 marks)
- (b) Find the volume of X in terms of π . (2 marks)
- (c) In Figure 4(c), sector $PDEF$ is another thin metal sheet. By joining PD and PF together, $PDEF$ is folded to form another right circular cone Y as shown in Figure 4(d). It is given that $PD = 10$ cm . Are X and Y similar? Explain your answer.

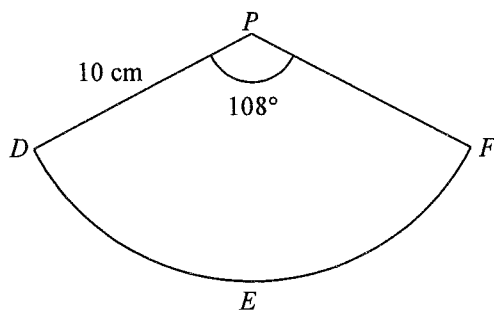


Figure 4(c)

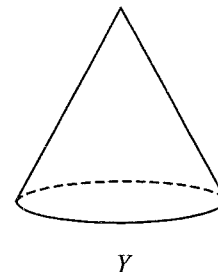
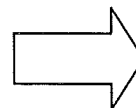


Figure 4(d)

(3 marks)

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SECTION B (33 marks)

Answer any **THREE** questions in this section and write your answers in the spaces provided. Each question carries 11 marks.

14. The stem-and-leaf diagram below shows the suggested bonuses (in dollars) of the 36 salesgirls of a boutique:

<u>Stem (thousands)</u>	<u>Leaf (hundreds)</u>
2	4 4 7
3	2 5 6 6 8
4	3 3 3 4 4 7 8 8 8
5	0 0 3 4 4 6
6	2 3 3 4 4 9 9
7	0 4 4 8
8	2 3

- (a) The suggested bonus of each salesgirl of the boutique is based on her performance. The following table shows the relation between level of performance and suggested bonus:

Level of performance	Suggested bonus (\$ x)
Excellent	$x > 6\,500$
Good	$4\,500 < x \leq 6\,500$
Fair	$x \leq 4\,500$

- (i) From the 36 salesgirls, one of them is randomly selected. Given that the level of performance of the selected salesgirl is good, find the probability that her suggested bonus is less than \$5 500 .
- (ii) From the 36 salesgirls, two of them are randomly selected.
- (1) Find the probability that the level of performance of one selected salesgirl is excellent and that of the other is good.
 - (2) Find the probability that the levels of performance of the two selected salesgirls are different.

(6 marks)

- (b) (i) Find the median and the inter-quartile range of the suggested bonuses of the 36 salesgirls.
- (ii) The boutique has made a considerable profit and so the manager wants to raise the suggested bonus of each of the 36 salesgirls such that the median of the suggested bonuses will be increased by 20% and the inter-quartile range will remain unchanged. Describe how the manager should raise the suggested bonus of each of the 36 salesgirls.

(5 marks)

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15. In Figure 5, H is the top of a tower and A is vertically below H . AB , BC and CA are straight paths on the horizontal ground and D is a point on AB . Christine walks from A to D along AD and finds that the angle of elevation of H from D is 50° . She then walks 50 m to B along DB and finds that the angle of elevation of H from B is 35° .

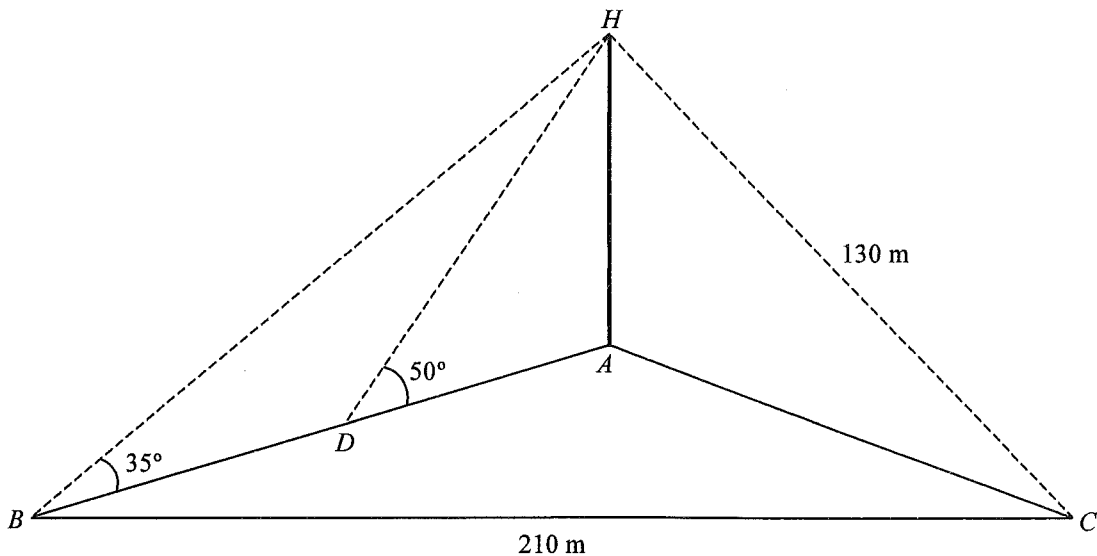


Figure 5

- (a) Find the distance between B and H . (2 marks)
- (b) Christine walks 210 m from B to C along BC . It is given that the distance between C and H is 130 m .
- (i) Find $\angle CBH$.
- (ii) Find the angle between the plane BCH and the horizontal ground.
- (iii) When Christine walks from B to C along BC , is it possible for her to find a point K on BC such that the angle of elevation of H from K is 75° ? Explain your answer. (9 marks)

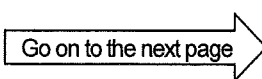
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16. In the current financial year of a city, the amount of salaries tax charged for a citizen is calculated according to the following rules:

Net chargeable income (\$)	Rate
On the first 30 000	$a\%$
On the next 30 000	10%
On the next 30 000	$b\%$
Remainder	24%

The net chargeable income is equal to the net total income minus the sum of allowances. The salaries tax charged shall not exceed the standard rate of salaries tax applied to the net total income. The standard rate of salaries tax for the current financial year is 20% .

It is given that $a, 10, b, 24$ is an arithmetic sequence.

- (a) Find a and b . (3 marks)
- (b) Suppose that in the current financial year of the city, the sum of allowances of a citizen is \$172 000 .
- (i) Let $\$P$ be the net total income of the citizen. If the citizen has to pay salaries tax at the standard rate, express the amount of salaries tax charged for the citizen in terms of P .
- (ii) Find the least net total income of the citizen so that the salaries tax is charged at the standard rate. (4 marks)
- (c) Peter is a citizen in the city. In the current financial year, the net total income and the sum of allowances of Peter are \$1400 000 and \$172 000 respectively. In order to pay his salaries tax, Peter begins to save money 12 months before the due day of paying salaries tax. A deposit of \$23 000 is saved in a bank on the same day of each month at an interest rate of 3% per annum, compounded monthly. There are totally 12 deposits. Will Peter have enough money to pay his salaries tax on the due day? Explain your answer. (4 marks)

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17. Figure 6(a) shows a circle passing through A , B and C . I is the in-centre of $\triangle ABC$ and AI produced meets the circle at P .

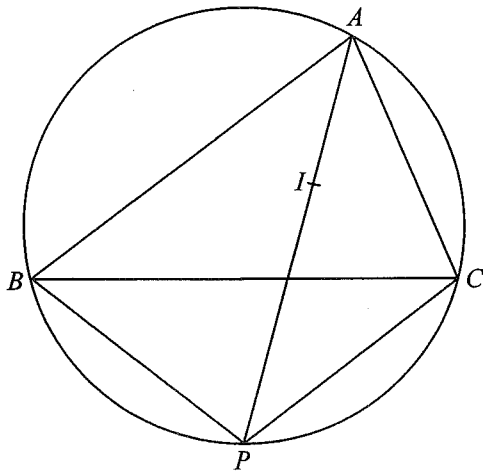


Figure 6(a)

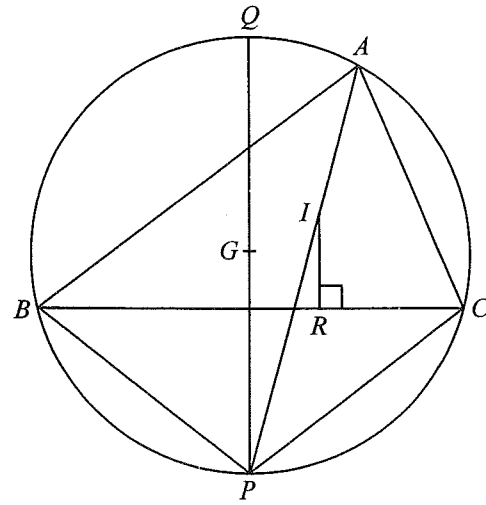


Figure 6(b)

- (a) Prove that $BP = CP = IP$. (3 marks)
- (b) Figure 6(b) is constructed by adding three points G , Q and R to Figure 6(a), where G is the circumcentre of $\triangle ABC$, PQ is a diameter of the circle and R is the foot of the perpendicular from I to BC . A rectangular coordinate system is then introduced in Figure 6(b) so that the coordinates of B , C and I are $(-80, 0)$, $(64, 0)$ and $(0, 32)$ respectively.
- (i) Find the equation of the circle with centre P and radius BP .
- (ii) Find the coordinates of Q .
- (iii) Are B , Q , I and R concyclic? Explain your answer.

(8 marks)

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