

MATHEMATICS Compulsory Part
PAPER 1
Question-Answer Book

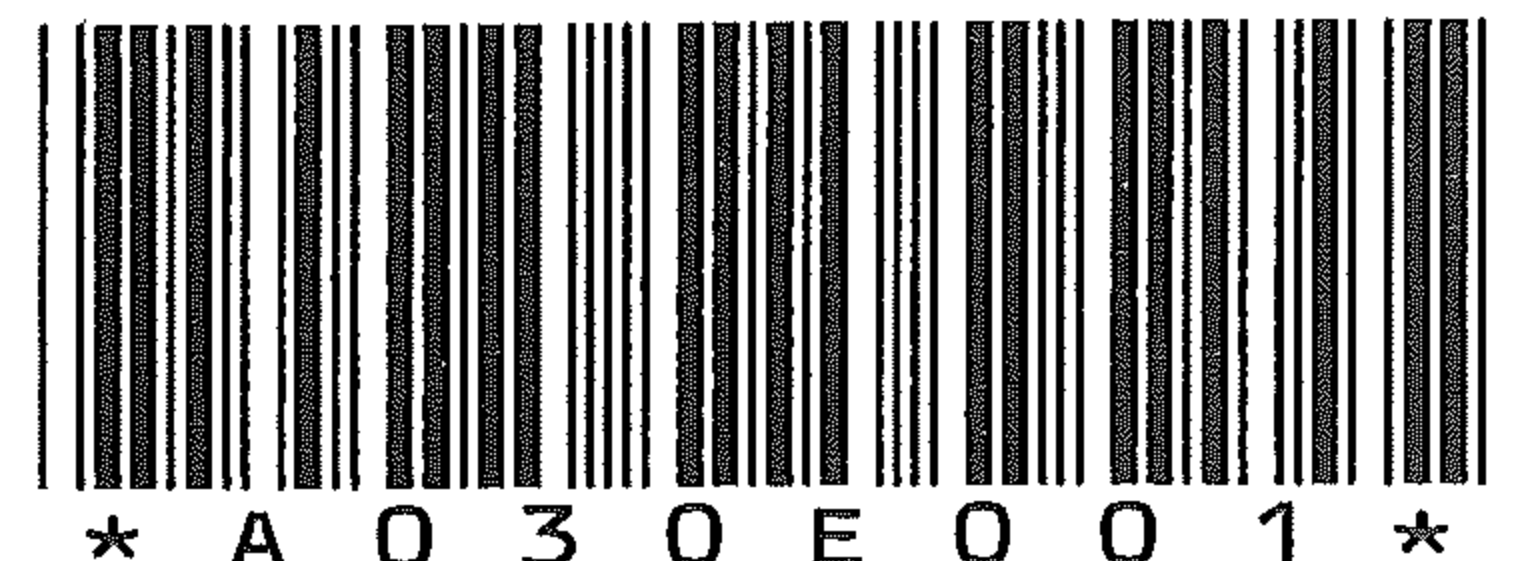
8.30 am – 10.45 am (2¼ hours)
This paper must be answered in English

INSTRUCTIONS

1. After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3, 5, 7, 9 and 11.
2. This paper consists of THREE sections, A(1), A(2) and B.
3. Attempt ALL questions in this paper. 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.
4. Graph paper and supplementary answer sheets will be supplied on request. Write your Candidate Number, mark the question number box and stick a barcode label on each sheet, and fasten them with string INSIDE this book.
5. Unless otherwise specified, all working must be clearly shown.
6. Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.
7. The diagrams in this paper are not necessarily drawn to scale.
8. No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

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Candidate Number



SECTION A(1) (35 marks)

1. Simplify $\frac{m^{-12}n^8}{n^3}$ and express your answer with positive indices. (3 marks)

2. Make a the subject of the formula $\frac{3a+b}{8} = b-1$. (3 marks)

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3. Factorize

(a) $x^2 - 6xy + 9y^2$,

(b) $x^2 - 6xy + 9y^2 + 7x - 21y$.

(3 marks)

4. The daily wage of Ada is 20% higher than that of Billy while the daily wage of Billy is 20% lower than that of Christine. It is given that the daily wage of Billy is \$480 .

(a) Find the daily wage of Ada.

(b) Who has the highest daily wage? Explain your answer.

(4 marks)

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5. There are 132 guards in an exhibition centre consisting of 6 zones. Each zone has the same number of guards. In each zone, there are 4 more female guards than male guards. Find the number of male guards in the exhibition centre. (4 marks)

6. (a) Find the range of values of x which satisfy both $\frac{4x+6}{7} > 2(x-3)$ and $2x-10 \leq 0$.
- (b) How many positive integers satisfy both the inequalities in (a)?

(4 marks)

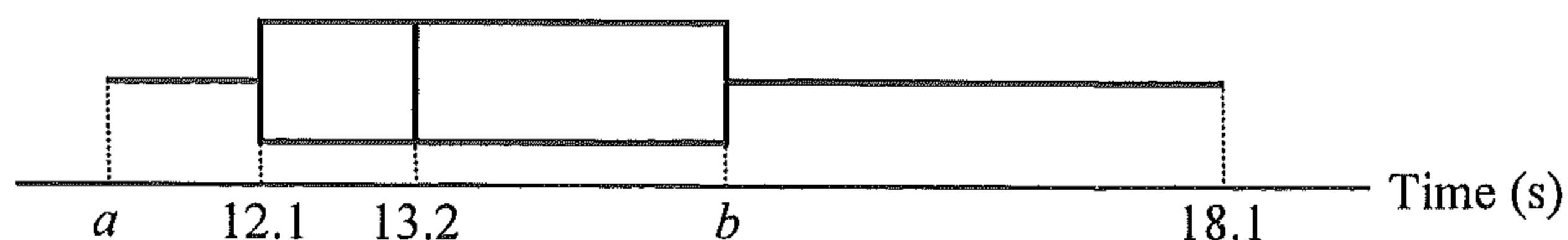
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7. The box-and-whisker diagram below shows the distribution of the times taken by a large group of students of an athletic club to finish a 100 m race:



The inter-quartile range and the range of the distribution are 3.2 s and 6.8 s respectively.

- (a) Find a and b .
- (b) The students join a training program. It is found that the longest time taken by the students to finish a 100 m race after the training is 2.9 s less than that before the training. The trainer claims that at least 25% of the students show improvement in the time taken to finish a 100 m race after the training. Do you agree? Explain your answer.

(4 marks)

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8. In Figure 1, AB , BC , CD and AD are chords of the circle. AC and BD intersect at E . It is given that $BE = 8$ cm, $CE = 20$ cm and $DE = 15$ cm.

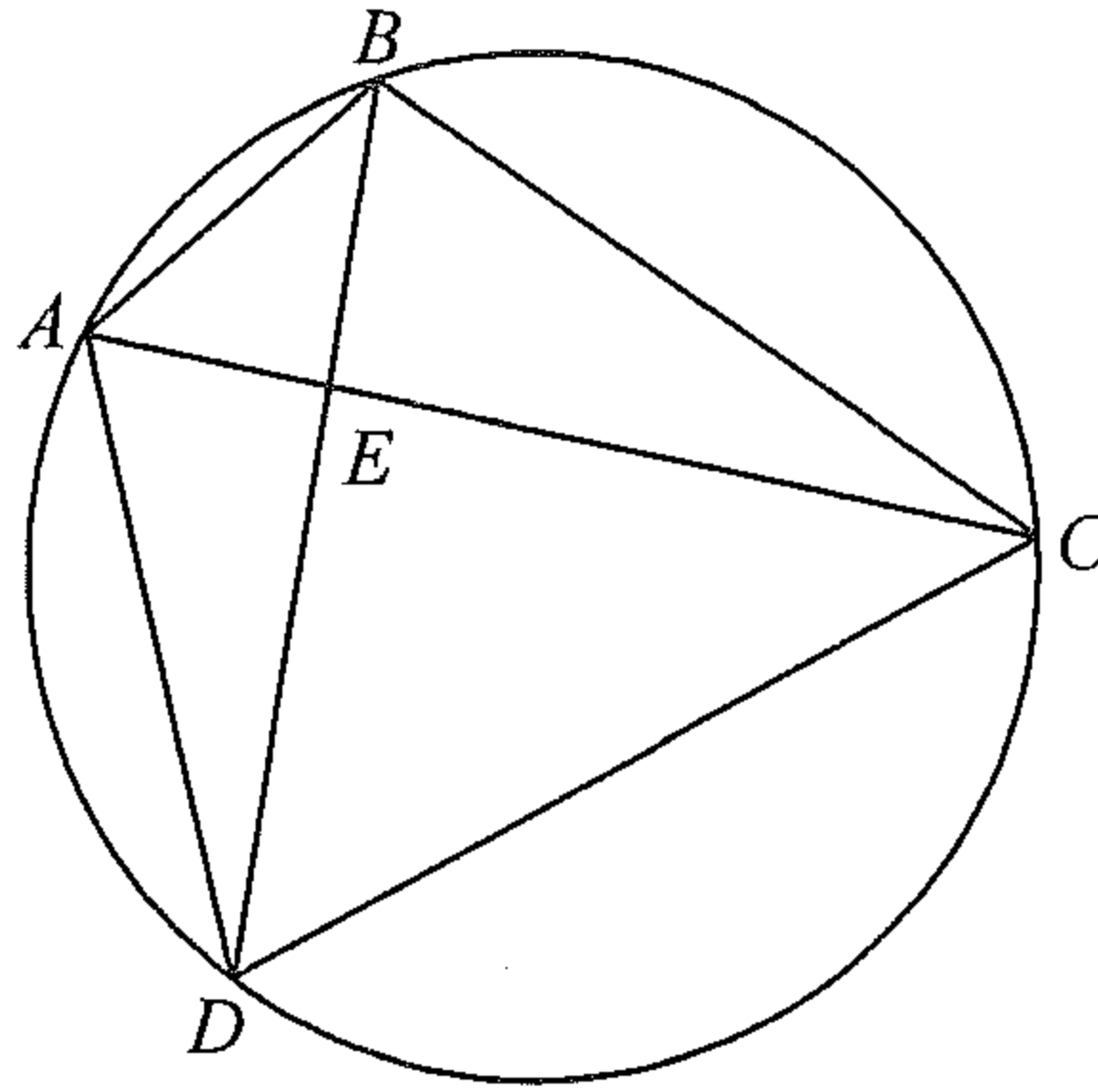


Figure 1

- (a) Write down a pair of similar triangles in Figure 1. Also find AE .
- (b) Suppose that $AB = 10$ cm. Are AC and BD perpendicular to each other? Explain your answer.

(5 marks)

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9. In Figure 2, the volume of the solid right prism $ABCDEFGH$ is 1020 cm^3 . The base $ABCD$ of the prism is a trapezium, where AD is parallel to BC . It is given that $\angle BAD = 90^\circ$, $AB = 12 \text{ cm}$, $BC = 6 \text{ cm}$ and $DE = 10 \text{ cm}$.

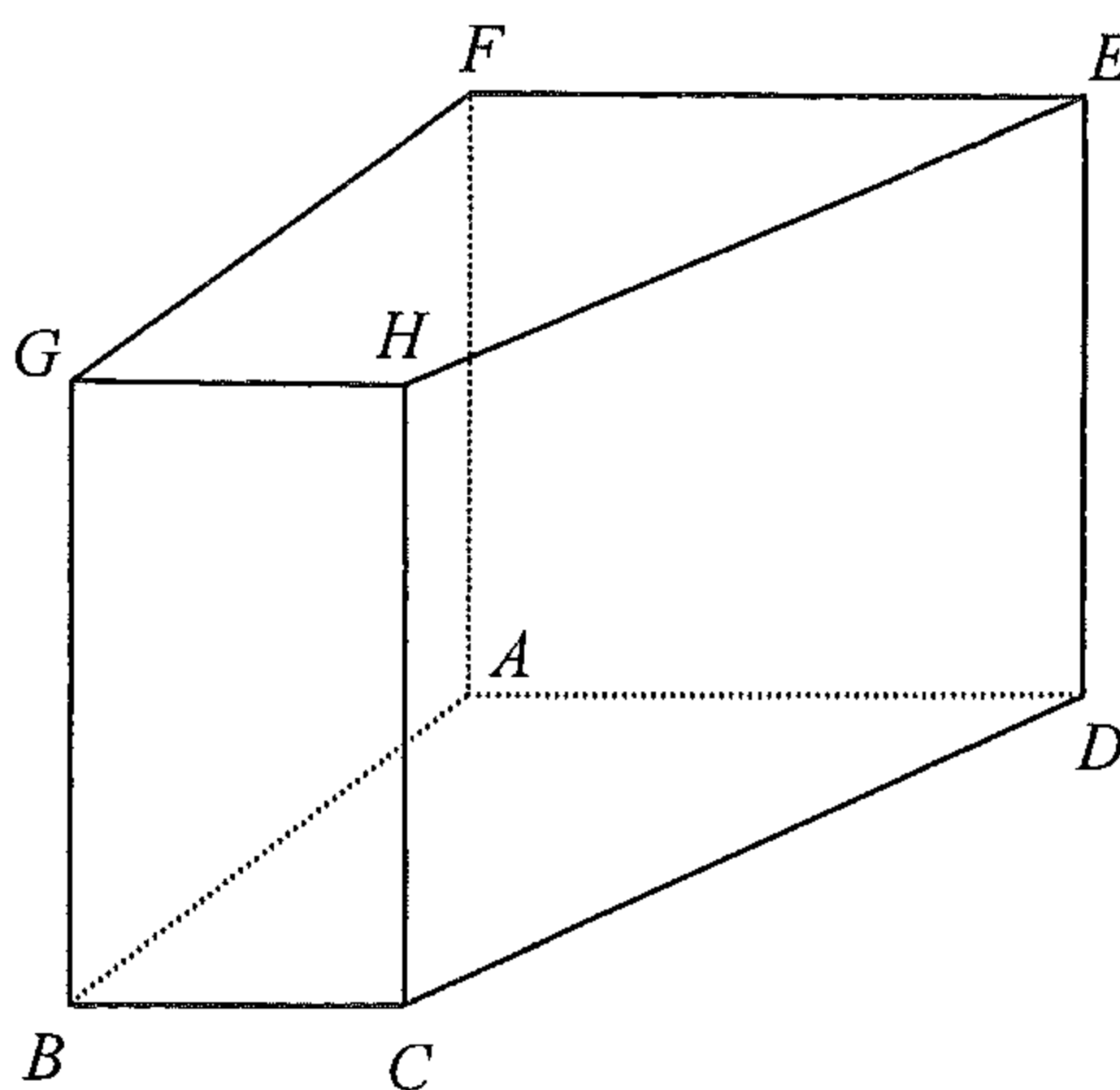


Figure 2

Find

- (a) the length of AD ,
- (b) the total surface area of the prism $ABCDEFGH$.

(5 marks)

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SECTION A(2) (35 marks)

10. Tom conducts a survey on the numbers of hours spent on doing homework in a week by secondary students. Questionnaires are sent out and twenty of them are returned. The stem-and-leaf diagram below shows the numbers of hours recorded in the twenty questionnaires:

| <u>Stem (tens)</u> | <u>Leaf (units)</u> | | | | | | | | | | | | | |
|--------------------|---------------------|---|---|---|---|---|---|---|---|---|---|---|---|--|
| 1 | 0 | 0 | 1 | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 6 | 7 | 7 | |
| 2 | 0 | 0 | 0 | 5 | 8 | | | | | | | | | |
| 3 | 4 | 6 | | | | | | | | | | | | |

- (a) Find the mean and the median of the numbers of hours recorded in the twenty questionnaires. (2 marks)
- (b) Tom receives four more questionnaires. He finds that the mean of the numbers of hours recorded in these four questionnaires is 18 . It is found that the numbers of hours recorded in two of these four questionnaires are 19 and 20 .
- (i) Write down the mean of the numbers of hours recorded in the twenty-four questionnaires.
- (ii) Is it possible that the median of the numbers of hours recorded in the twenty-four questionnaires is the same as the median found in (a)? Explain your answer. (4 marks)

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12. Figure 3(a) shows a solid metal right circular cone of base radius 48 cm and height 96 cm .

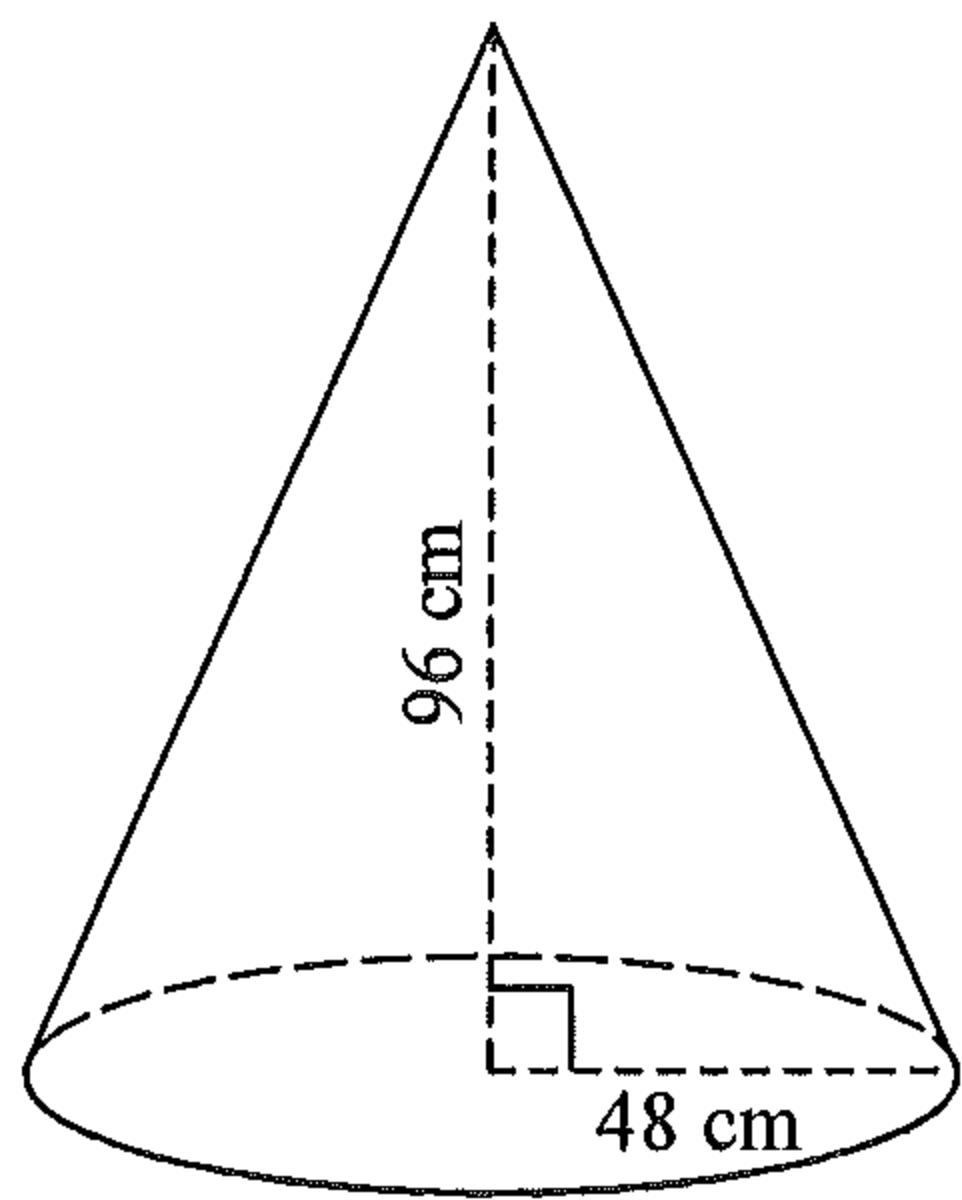


Figure 3(a)

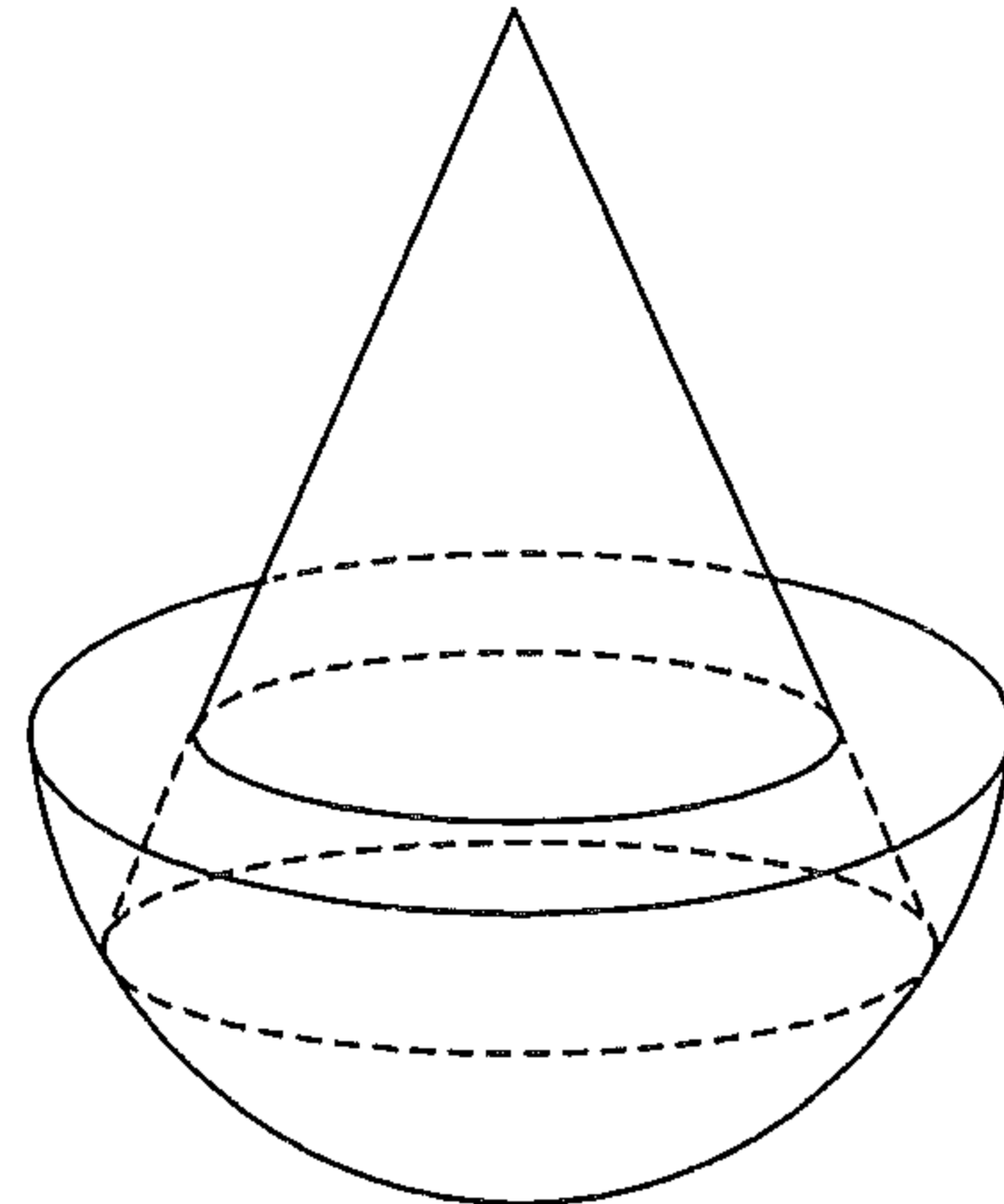


Figure 3(b)

- (a) Find the volume of the circular cone in terms of π . (2 marks)
- (b) A hemispherical vessel of radius 60 cm is held vertically on a horizontal surface. The vessel is fully filled with milk.
- (i) Find the volume of the milk in the vessel in terms of π .
- (ii) The circular cone is now held vertically in the vessel as shown in Figure 3(b). A craftsman claims that the volume of the milk remaining in the vessel is greater than 0.3 m^3 . Do you agree? Explain your answer.

(5 marks)

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13. (a) Find the value of k such that $x - 2$ is a factor of $kx^3 - 21x^2 + 24x - 4$. (2 marks)

(b) Figure 4 shows the graph of $y = 15x^2 - 63x + 72$. Q is a variable point on the graph in the first quadrant. P and R are the feet of the perpendiculars from Q to the x -axis and the y -axis respectively.

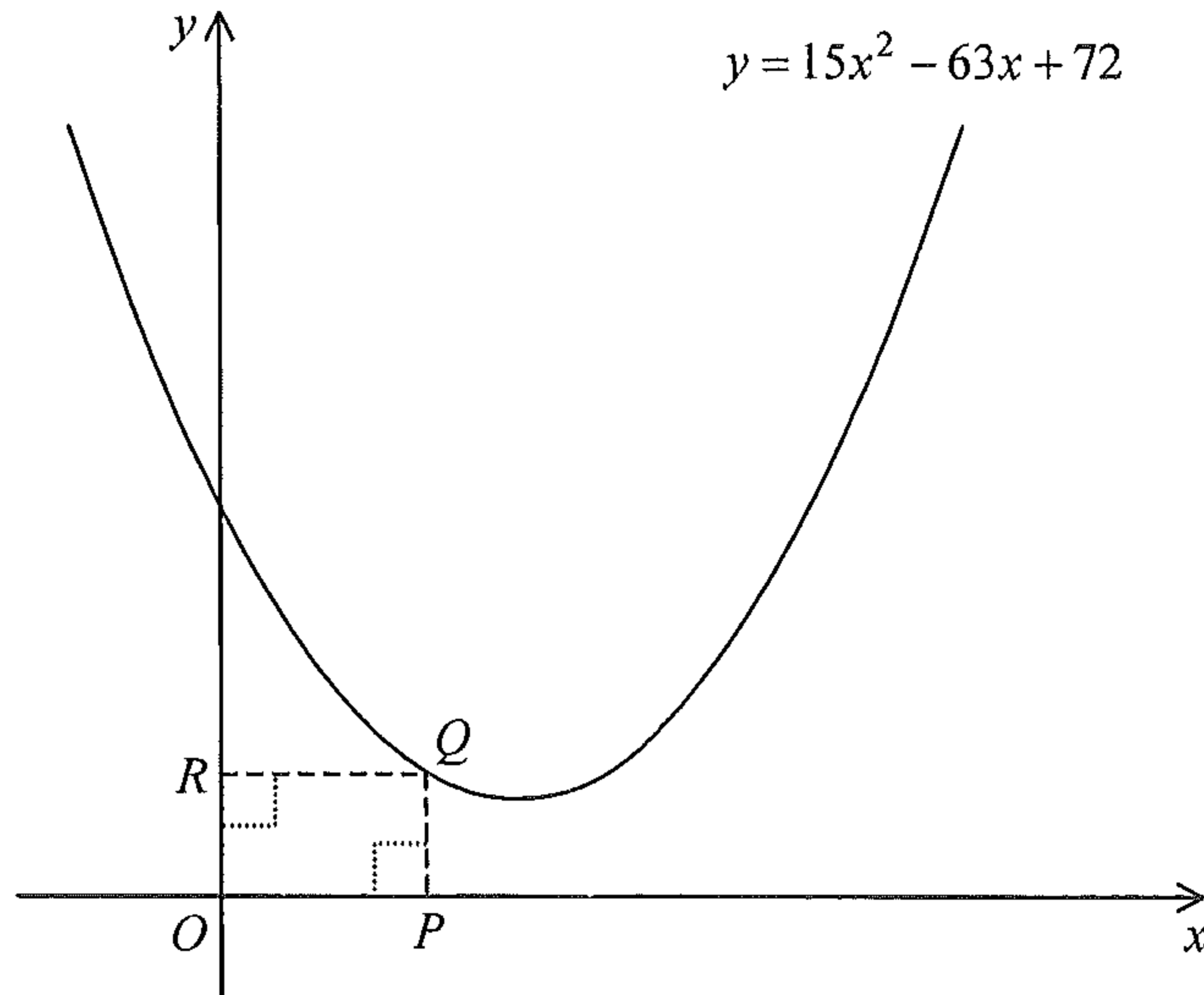


Figure 4

- (i) Let $(m, 0)$ be the coordinates of P . Express the area of the rectangle $OPQR$ in terms of m .
- (ii) Are there three different positions of Q such that the area of the rectangle $OPQR$ is 12? Explain your answer.

(5 marks)

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18. Figure 5(a) shows a right pyramid $VABCD$ with a square base, where $\angle VAB = 72^\circ$. The length of a side of the base is 20 cm. Let P and Q be the points lying on VA and VD respectively such that PQ is parallel to BC and $\angle PBA = 60^\circ$. A geometric model is made by cutting off the pyramid $VPBCQ$ from $VABCD$ as shown in Figure 5(b).

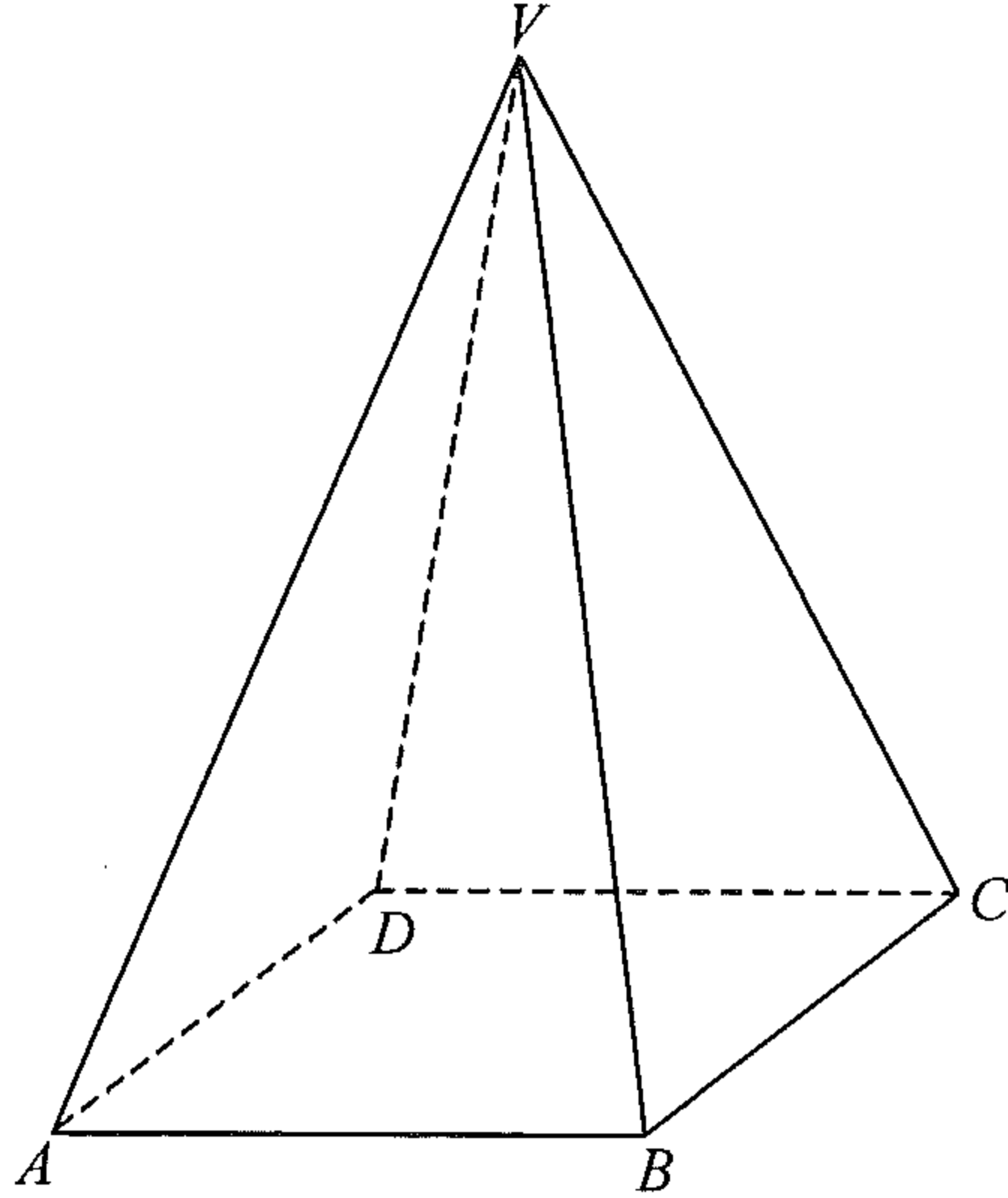


Figure 5(a)

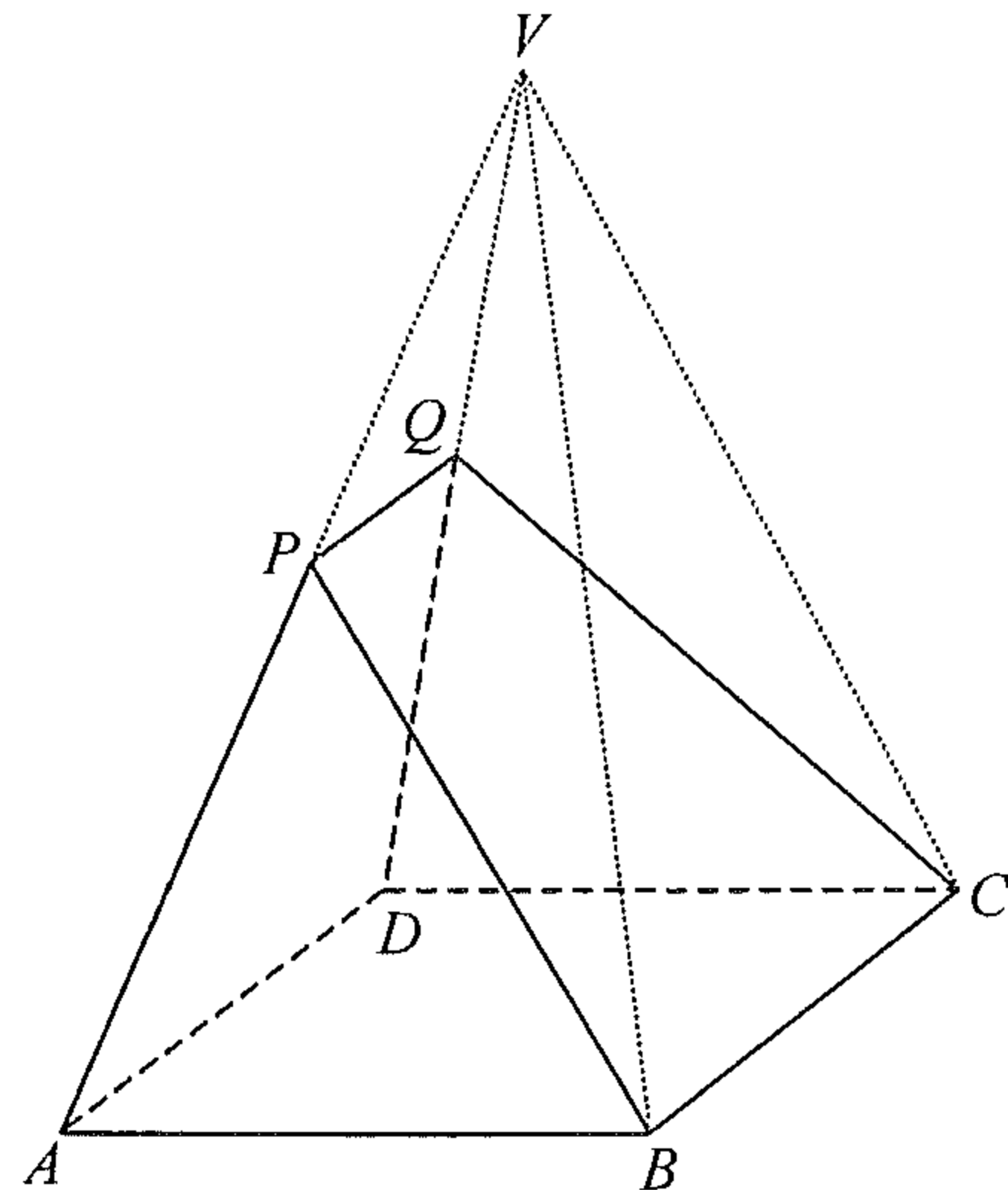


Figure 5(b)

- (a) Find the length of AP . (2 marks)
- (b) Let α be the angle between the plane $PBCQ$ and the base $ABCD$.
- (i) Find α .
- (ii) Let β be the angle between PB and the base $ABCD$. Which one of α and β is greater? Explain your answer. (6 marks)

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19. In a city, the air cargo terminal X of an airport handles goods of weight $A(n)$ tonnes in the n th year since the start of its operation, where n is a positive integer. It is given that $A(n) = ab^{2n}$, where a and b are positive constants. It is found that the weights of the goods handled by X in the 1st year and the 2nd year since the start of its operation are 254 100 tonnes and 307 461 tonnes respectively.

- (a) (i) Find a and b .
Hence find the weight of the goods handled by X in the 4th year since the start of its operation.
- (ii) Express, in terms of n , the total weight of the goods handled by X in the first n years since the start of its operation.

(6 marks)

(b) The air cargo terminal Y starts to operate since X has been operated for 4 years. Let $B(m)$ tonnes be the weight of the goods handled by Y in the m th year since the start of its operation, where m is a positive integer. It is given that $B(m) = 2ab^m$.

- (i) The manager of the airport claims that after Y has been operated, the weight of the goods handled by Y is less than that handled by X in each year. Do you agree? Explain your answer.
- (ii) The supervisor of the airport thinks that when the total weight of the goods handled by X and Y since the start of the operation of X exceeds 20 000 000 tonnes, new facilities should be installed to maintain the efficiency of the air cargo terminals. According to the supervisor, in which year since the start of the operation of X should the new facilities be installed?

(7 marks)

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END OF PAPER

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