

MATHEMATICS PAPER 2

11.15 am – 12.45 pm (1½ hours)

Subject Code 180

1. Read carefully the instructions on the Answer Sheet. Stick a barcode label and insert the information required in the spaces provided.
2. When told to open this book, you should check that all the questions are there. Look for the words '**END OF PAPER**' after the last question.
3. All questions carry equal marks.
4. **ANSWER ALL QUESTIONS.** You should use an HB pencil to mark all your answers on the Answer Sheet. Wrong marks must be completely erased with a clean rubber.
5. You should mark only **ONE** answer for each question. If you mark more than one answer, you will receive **NO MARKS** for that question.
6. No marks will be deducted for wrong answers.

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	$= \pi rl$
	Volume	$= \frac{1}{3}\pi r^2 h$
PRISM	Volume	$= \text{base area} \times \text{height}$
PYRAMID	Volume	$= \frac{1}{3} \times \text{base area} \times \text{height}$

There are 36 questions in Section A and 18 questions in Section B.
The diagrams in this paper are not necessarily drawn to scale.
Choose the best answer for each question.

Section A

1. $\left(\frac{1}{2}\right)^{888} (-2)^{887} =$

- A. -2 .
- B. -0.5 .
- C. 0 .
- D. 0.5 .

2. If $m = 7 - 3n$, then $n =$

- A. $\frac{7-m}{3}$.
- B. $\frac{7+m}{3}$.
- C. $\frac{3}{7-m}$.
- D. $\frac{3}{7+m}$.

3. $\frac{-k}{1-k} - \frac{1}{k-1} =$

- A. 1 .
- B. $\frac{k+1}{k-1}$.
- C. $\frac{k+1}{1-k}$.
- D. $\frac{k^2+1}{k^2-1}$.

4. $(2x^2 - 3x + 1) - 2(x^2 + 2x - 1) =$

- A. $x - 1$.
- B. $-7x + 3$.
- C. $4x^2 + x - 1$.
- D. $4x^2 - 7x + 3$.

5. Which of the following must have $x + y$ as a factor?

- I. $x^2 - y^2$
- II. $x^2 + y^2$
- III. $x(x + y) - x - y$

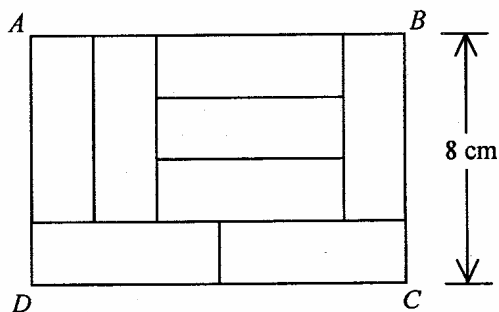
- A. I only
- B. II only
- C. I and III only
- D. II and III only

6. Let $f(x) = x^2 + kx + 7$, where k is a constant. If $f(4) - f(3) = 21$, then $k =$

- A. 0 .
- B. 4 .
- C. 14 .
- D. 28 .

7. In the figure, the rectangle $ABCD$ is divided into eight identical rectangles. Find the area of the rectangle $ABCD$.

- A. 40 cm^2
- B. 80 cm^2
- C. 96 cm^2
- D. 112 cm^2

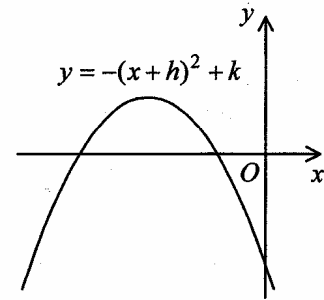


8. If $m+2 = n-1 = 3m+n-46$, then $n =$

- A. 15.
- B. 16.
- C. 17.
- D. 18.

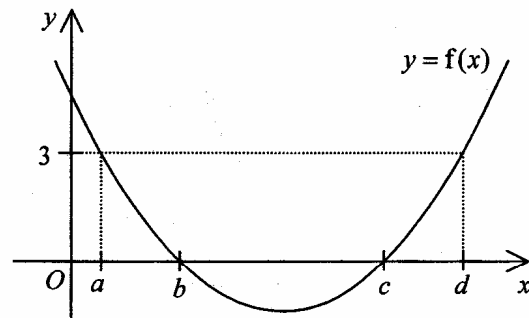
9. The figure shows the graph of $y = -(x+h)^2 + k$. Which of the following must be true?

- A. $h > 0$ and $k > 0$
- B. $h > 0$ and $k < 0$
- C. $h < 0$ and $k > 0$
- D. $h < 0$ and $k < 0$

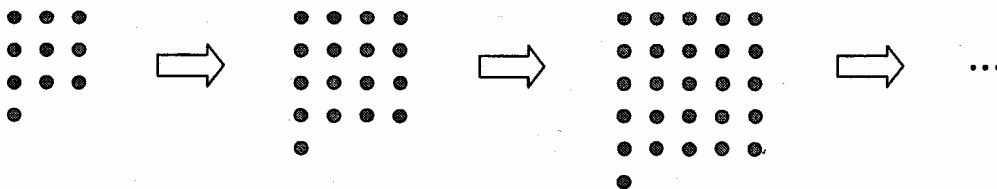


10. The figure shows the graph of $y = f(x)$, where $f(x)$ is a quadratic function. The solution of $f(x) < 3$ is

- A. $a < x < d$.
- B. $b < x < c$.
- C. $x < a$ or $x > d$.
- D. $x < b$ or $x > c$.



11. In the figure, the 1st pattern consists of 10 dots. For any positive integer n , the $(n+1)$ th pattern is formed by adding $(2n+5)$ dots to the n th pattern. Find the number of dots in the 7th pattern.



- A. 50
- B. 65
- C. 82
- D. 101

12. The marked price of a bag is \$ 900 . If the bag is sold at the marked price, then the percentage profit is 50% . If the bag is sold at a 20% discount on the marked price, then the profit is
- A. \$ 120 .
 - B. \$ 180 .
 - C. \$ 210 .
 - D. \$ 270 .
13. The costs of rice of brand *A* and rice of brand *B* are \$8/kg and \$4/kg respectively. If x kg of rice of brand *A* and y kg of rice of brand *B* are mixed so that the cost of the mixture is \$5/kg , find $x : y$.
- A. 1:2
 - B. 2:1
 - C. 1:3
 - D. 3:1
14. Suppose that y varies directly as x and inversely as z^2 . If x and z are both decreased by 20% , then y
- A. is decreased by 17% .
 - B. is decreased by 20% .
 - C. is increased by 20% .
 - D. is increased by 25% .
15. It is known that $f(x)$ varies partly as x and partly as x^2 . If $f(1) = 5$ and $f(2) = 16$, then $f(3) =$
- A. 21 .
 - B. 27 .
 - C. 33 .
 - D. 57 .

16. If the radius of a sphere is measured as 8 cm correct to the nearest cm, then the least possible surface area of the sphere is

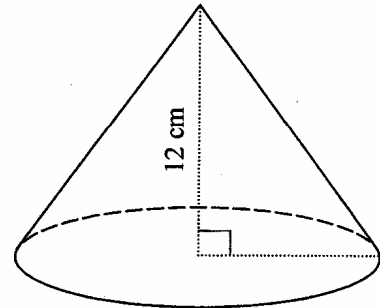
- A. $64\pi \text{ cm}^2$.
- B. $225\pi \text{ cm}^2$.
- C. $256\pi \text{ cm}^2$.
- D. $\frac{1125\pi}{2} \text{ cm}^2$.

17. $0.0498765 =$

- A. 0.050 (correct to 2 decimal places).
- B. 0.050 (correct to 3 significant figures).
- C. 0.0499 (correct to 4 decimal places).
- D. 0.0499 (correct to 5 significant figures).

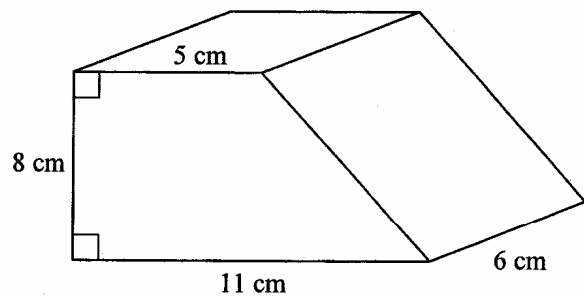
18. The figure shows a solid right circular cone of height 12 cm . The circumference of the base is 18π cm . Find the total surface area of the circular cone.

- A. $81\pi \text{ cm}^2$
- B. $135\pi \text{ cm}^2$
- C. $216\pi \text{ cm}^2$
- D. $324\pi \text{ cm}^2$



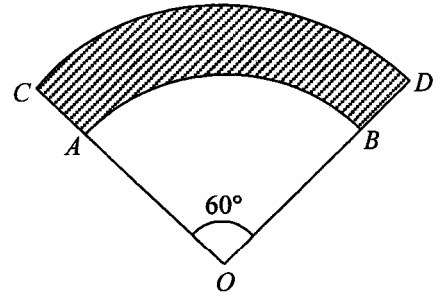
19. In the figure, the volume of the right prism is

- A. 128 cm^3 .
- B. 332 cm^3 .
- C. 384 cm^3 .
- D. 768 cm^3 .



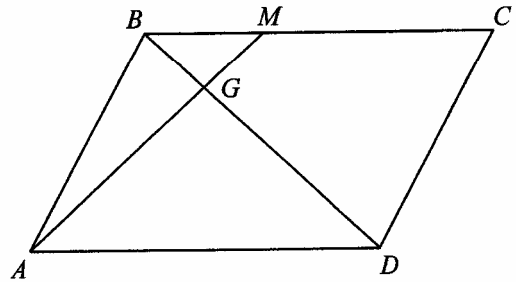
20. In the figure, OAB and OCD are sectors with centre O . It is given that the area of the shaded regio $ABDC$ is $54\pi \text{ cm}^2$. If $AC = 6 \text{ cm}$, then $OA =$

- A. 15 cm .
 B. 21 cm .
 C. 24 cm .
 D. 30 cm .



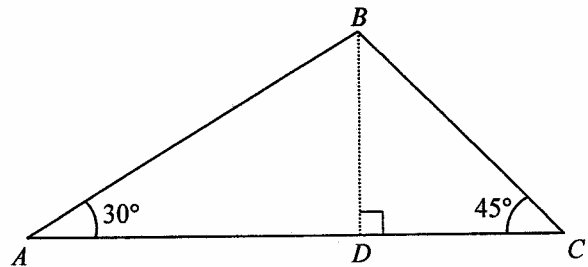
21. In the figure, $ABCD$ is a parallelogram. M is a point lying on BC such that $BM : MC = 1 : 2$. If BD and AM intersect at G and the area of $\triangle BGM$ is 1 cm^2 , then the area of the parallelogram $ABCD$ is

- A. 9 cm^2 .
 B. 11 cm^2 .
 C. 12 cm^2 .
 D. 24 cm^2 .



22. In the figure, D is a point lying on AC such that BD is perpendicular to AC . Find $AD : DC$.

- A. $1 : \sqrt{2}$
 B. $\sqrt{2} : 1$
 C. $\sqrt{3} : 1$
 D. $\sqrt{3} : \sqrt{2}$

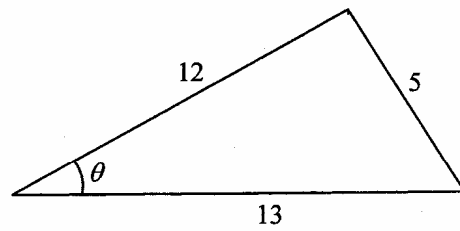


23. $\frac{\cos A}{\tan(90^\circ - A)} =$

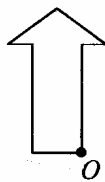
- A. $\sin A$.
 B. $\cos A$.
 C. $\frac{1}{\sin A}$.
 D. $\frac{1}{\cos A}$.

24. In the figure, $\tan \theta =$

- A. $\frac{5}{12}$
- B. $\frac{5}{13}$
- C. $\frac{12}{13}$
- D. $\frac{13}{12}$

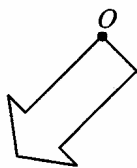


25.

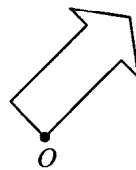


If the plane figure above is rotated anticlockwise about the point O through 135° , which of the following is its image?

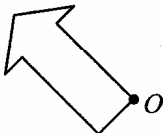
A.



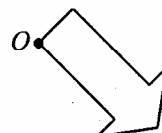
B.



C.

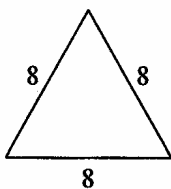


D.

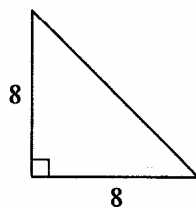


26. Which of following triangles have reflectional symmetry but do not have rotational symmetry?

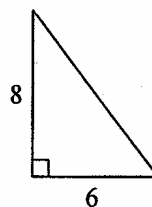
I.



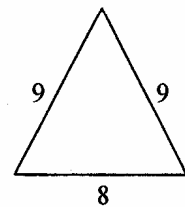
II.



III.



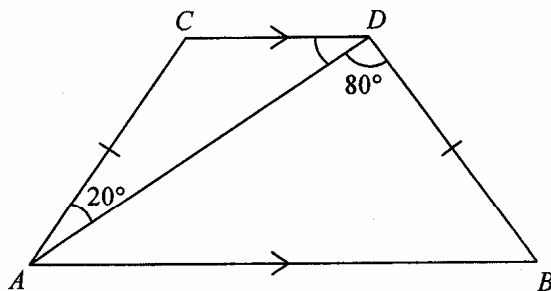
IV.



- A. I and III only
- B. I and IV only
- C. II and III only
- D. II and IV only

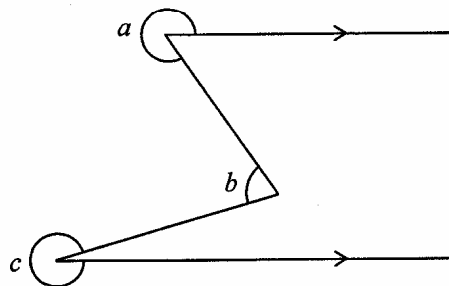
27. In the figure, $AB \parallel CD$ and $AC = BD$. If $\angle CAD = 20^\circ$ and $\angle ADB = 80^\circ$, then $\angle ADC =$

- A. 30° .
- B. 40° .
- C. 50° .
- D. 60° .



28. According to the figure, which of the following must be true?

- A. $a + b = c$
- B. $a + b = c + 90^\circ$
- C. $a + c = b + 540^\circ$
- D. $a + b + c = 720^\circ$



29. The coordinates of the points A and B are $(-2, a)$ and $(b, 7)$ respectively. If the coordinates of the mid-point of AB are $(1, 5)$, then $a =$

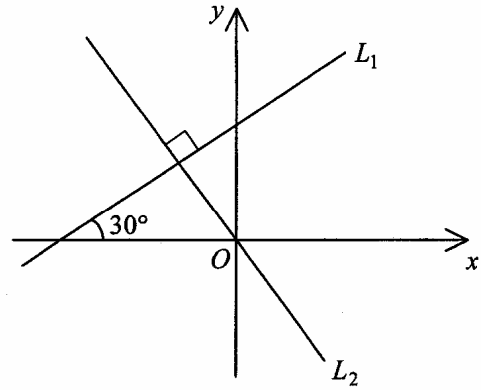
- A. 0.
- B. 3.
- C. 4.
- D. 17.

30. If the polar coordinates of the point P are $(2, 300^\circ)$, then the rectangular coordinates of P are

- A. $(-\sqrt{3}, 1)$.
- B. $(-1, \sqrt{3})$.
- C. $(1, -\sqrt{3})$.
- D. $(\sqrt{3}, -1)$.

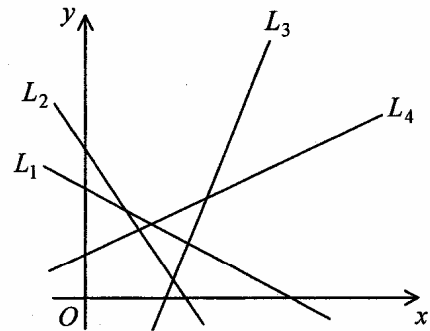
31. In the figure, the straight lines L_1 and L_2 are perpendicular to each other. Find the equation of L_2 .

- A. $x - \sqrt{3}y = 0$
- B. $x + \sqrt{3}y = 0$
- C. $\sqrt{3}x - y = 0$
- D. $\sqrt{3}x + y = 0$



32. In the figure, L_1 , L_2 , L_3 and L_4 are straight lines. If m_1 , m_2 , m_3 and m_4 are the slopes of L_1 , L_2 , L_3 and L_4 respectively, which of the following must be true?

- A. $m_1 < m_2 < m_3 < m_4$
- B. $m_1 < m_2 < m_4 < m_3$
- C. $m_2 < m_1 < m_3 < m_4$
- D. $m_2 < m_1 < m_4 < m_3$



33. $4\star$ is a 2-digit number, where \star is an integer from 0 to 9 inclusive. Find the probability that the 2-digit number is a prime number.

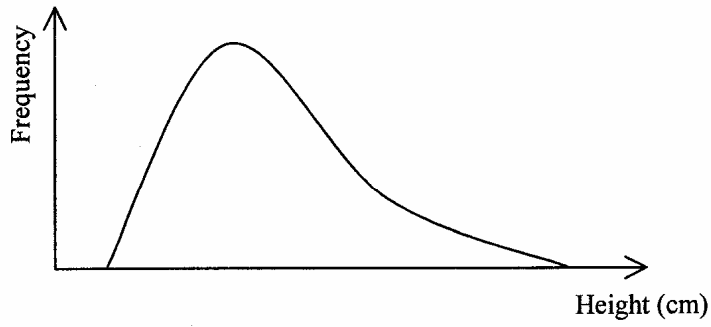
- A. 0.2
- B. 0.3
- C. 0.4
- D. 0.5

34. Let A be a group of numbers $\{\alpha, \beta, \gamma, \delta\}$ and B be another group of numbers $\{\alpha, \beta, \gamma, \delta, \mu\}$, where $\alpha < \beta < \gamma < \delta < \mu$. Which of the following must be true?

- I. The range of A is smaller than that of B .
- II. The mean of A is smaller than that of B .
- III. The median of A is smaller than that of B .

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

35. The frequency curve below shows the distribution of the heights (in cm) of the students in a school.



Which of the following box-and-whisker diagrams may represent the distribution of their heights?

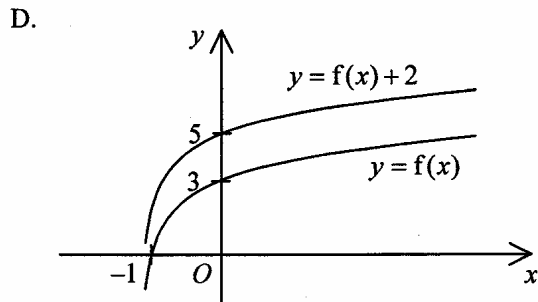
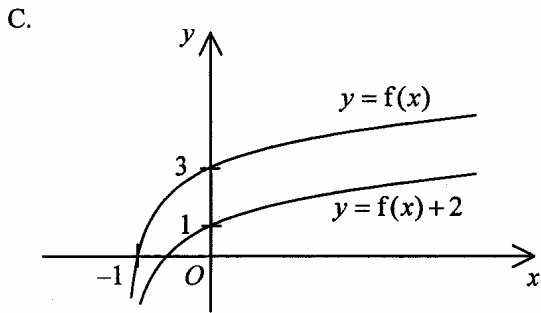
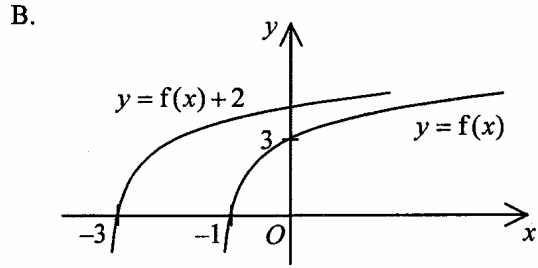
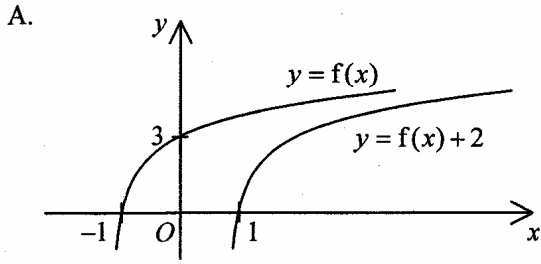
- A.
- B.
- C.
- D.

36. If y increases when x increases, which of the following scatter diagrams may represent the relation between x and y ?

- A.
- B.
- C.
- D.

Section B

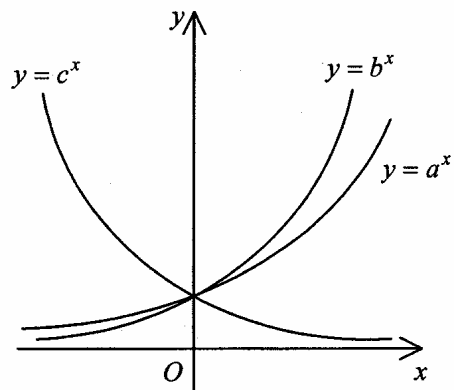
37. Which of the following may represent the graph of $y = f(x)$ and the graph of $y = f(x) + 2$ on the same rectangular coordinate system?



38. The figure shows the graph of $y = a^x$, the graph of $y = b^x$ and the graph of $y = c^x$ on the same rectangular coordinate system, where a , b and c are positive constants. Which of the following must be true?

- I. $a > b$
- II. $b > c$
- III. $a > 1$
- IV. $c > 1$

- A. I and III only
- B. I and IV only
- C. II and III only
- D. II and IV only



39. If $a > 0$, then $\sqrt{49a} - \sqrt{25a} =$

- A. $2\sqrt{a}$.
- B. $12\sqrt{a}$.
- C. $\sqrt{24a}$.
- D. $\sqrt{74a}$.

40. $11000011000111_2 =$

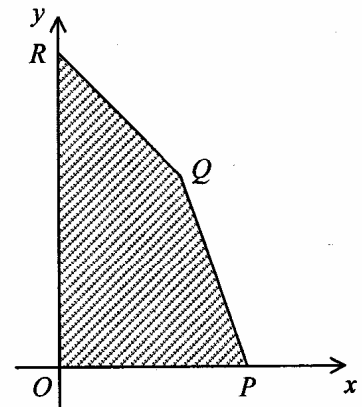
- A. $2^{13} + 2^{12} + 2^7 + 2^6 + 7$.
- B. $2^{13} + 2^{12} + 2^7 + 2^6 + 14$.
- C. $2^{14} + 2^{13} + 2^8 + 2^7 + 7$.
- D. $2^{14} + 2^{13} + 2^8 + 2^7 + 14$.

41. If the sum and the product of two numbers are 34 and 120 respectively, then the difference between the two numbers is

- A. 24.
- B. 26.
- C. 28.
- D. 30.

42. In the figure, the equations of PQ and QR are $3x + y = 36$ and $x + y = 20$ respectively. If (x, y) is a point lying in the shaded region $OPQR$ (including the boundary), then the least value of $2x - 3y + 180$ is

- A. 72.
- B. 120.
- C. 160.
- D. 204.



43. Let a , b and c be positive integers. Which of the following must be arithmetic sequences?

- I. $a+10, 2a+7, 3a+4, 4a+1$
- II. $8^b - 1, 8^{2b} - 2, 8^{3b} - 3, 8^{4b} - 4$
- III. $\log c^3, \log c^8, \log c^{13}, \log c^{18}$

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

44. If $a-6, a, a+5$ is a geometric sequence, then the common ratio of the sequence is

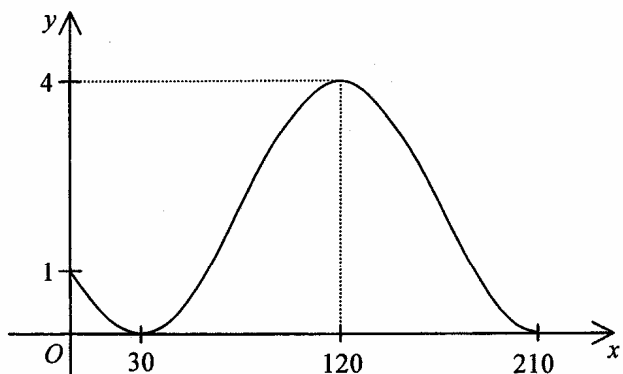
- A. -30 .
- B. $\frac{5}{6}$.
- C. $\frac{6}{5}$.
- D. 6 .

45. For $0^\circ \leq \theta < 360^\circ$, how many roots does the equation $3\sin^2 \theta + 2\sin \theta - 1 = 0$ have?

- A. 2
- B. 3
- C. 4
- D. 5

46. Let a and b be constants. If the figure shows the graph of $y = a \cos(2x^\circ + 120^\circ) + b$, then

- A. $a=1$ and $b=3$.
- B. $a=2$ and $b=2$.
- C. $a=3$ and $b=1$.
- D. $a=4$ and $b=0$.

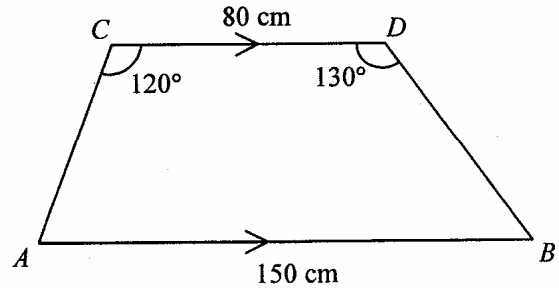


47. For $0^\circ \leq \theta \leq 360^\circ$, the least value of $\frac{2 + \sin \theta}{2 - \sin \theta}$ is

- A. -1 .
- B. $\frac{1}{3}$.
- C. 1 .
- D. 3 .

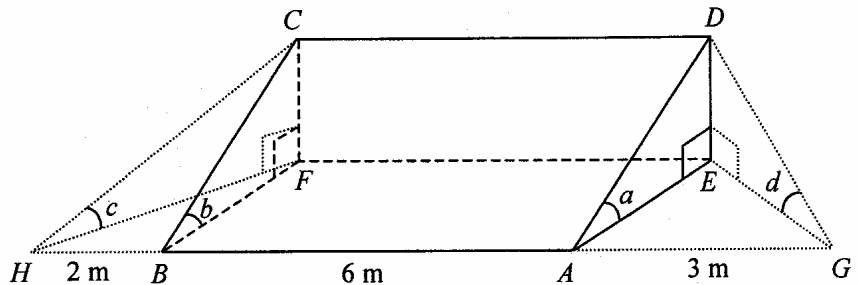
48. In the figure, $AB \parallel CD$, $AB = 150$ cm and $CD = 80$ cm. Find BD correct to the nearest cm.

- A. 60 cm
- B. 62 cm
- C. 64 cm
- D. 65 cm



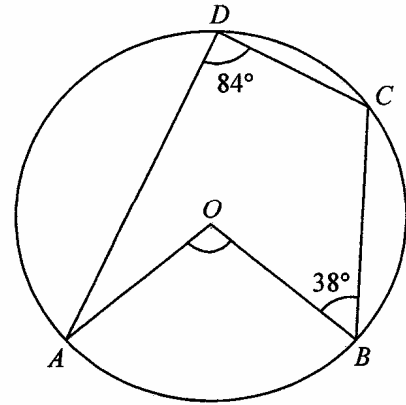
49. The figure shows a right prism $ABCDEF$ with a right-angled triangle as the cross-section. A , B , E and F lie on the horizontal ground. G and H are two points on the horizontal ground so that G , A , B and H are collinear. It is given that $AB = 6$ m, $AG = 3$ m and $BH = 2$ m. If $\angle DAE = a$, $\angle CBF = b$, $\angle CHF = c$ and $\angle DGE = d$, which of the following must be true?

- A. $a < d < c$
- B. $c < a < d$
- C. $c < d < b$
- D. $d < c < b$



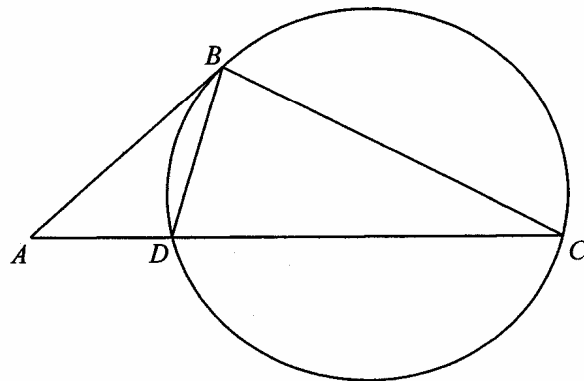
50. In the figure, O is the centre of the circle $ABCD$. If $\angle ADC = 84^\circ$ and $\angle CBO = 38^\circ$, then $\angle AOB =$

- A. 64° .
- B. 88° .
- C. 104° .
- D. 168° .



51. In the figure, AB is the tangent to the circle at B and ADC is a straight line. If $AB : AD = 2 : 1$, then the area of $\triangle ABD$: the area of $\triangle BCD =$

- A. $1 : 2$.
- B. $1 : 3$.
- C. $1 : 4$.
- D. $2 : 3$.



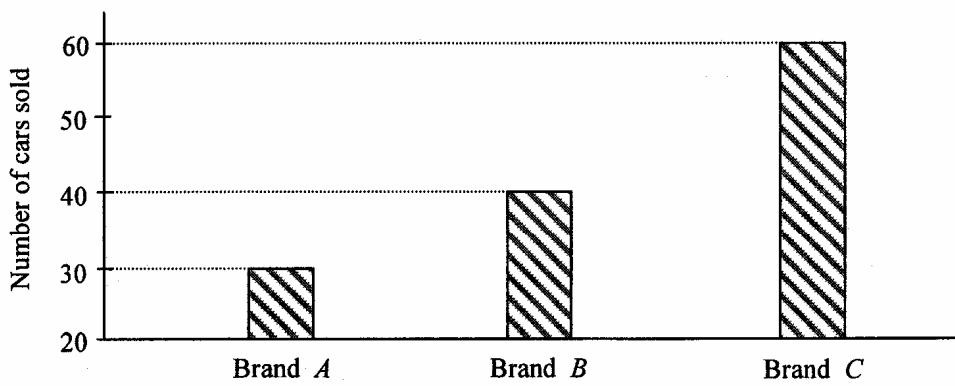
52. Let O be the origin. If the coordinates of the points A and B are $(48, 0)$ and $(24, 18)$ respectively, then the y -coordinate of the orthocentre of $\triangle ABO$ is

- A. -7 .
- B. 6 .
- C. 8 .
- D. 32 .

53. The equation of a circle is $x^2 + y^2 - 4x - 8y + 11 = 0$. Which of the following are true?

- I. The coordinates of the centre of the circle are $(2, 4)$.
 - II. The radius of the circle is 3.
 - III. The origin lies outside the circle.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

54. The bar chart below shows the numbers of cars sold for brand A , brand B and brand C in a certain month.



A sales representative makes the following claims:

- I. In that month, the number of cars sold for brand C is two times that for brand B .
- II. In that month, the total number of cars sold for brand A and brand B is less than the number of cars sold for brand C .
- III. In that month, the number of cars sold for brand A is 50% less than that for brand C .

Which of the above claims are *false*?

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

END OF PAPER