

**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	$= \pi r l$
	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 54 questions in this paper.

The diagrams in this paper are not necessarily drawn to scale.

1. Evaluate  $1.15 \div 15$  correct to 3 significant figures.

A. 0.076

B. 0.077

C. 0.0766

D. 0.0767

E. 0.076

2.  $\frac{27^x}{3^y} =$

A.  $\frac{9x}{y}$

B.  $\frac{x}{9^y}$

C.  $9^{x-y}$

D.  $\frac{3x}{3^y}$

E.  $3^{3x-y}$

3. Find the L.C.M. of  $4x^2yz$  and  $6xy^3$ .

- A.  $2xy$
- B.  $12x^2y^3$
- C.  $12x^2y^3z$
- D.  $24x^2y^3z$
- E.  $24x^3y^4z$

4. If  $A = 2\pi r^2 + 2\pi r h$ , then  $h =$

- A.  $A - r$
- B.  $\frac{A}{r}$
- C.  $\frac{A}{2\pi r} - r$
- D.  $r - \frac{A}{2\pi r}$
- E.  $\frac{A}{2\pi r} - 2\pi r^2$

5. Find the remainder when  $x^3 - x^2 + 1$  is divided by  $2x + 1$ .

- A.  $-11$
- B.  $\frac{5}{8}$
- C.  $\frac{7}{8}$
- D.  $\frac{9}{8}$
- E.  $5$

6. Which of the following expressions has/have  $b - c$  as a factor?

- I.  $ab - ac$
- II.  $a(b - c) - b + c$
- III.  $a(b - c) - b - c$

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

7. Solve  $1 < -3x + 4 < 10$ .

- A.  $-2 < x < 1$
- B.  $-1 < x < 2$
- C.  $x < -2$  or  $x > 1$
- D.  $x < -1$  or  $x > 2$
- E. no solution

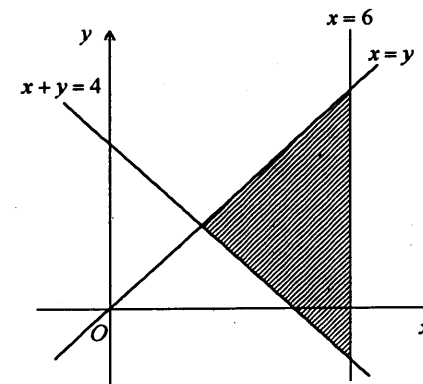
8. If  $\frac{2}{x^2 - 1} \equiv \frac{a}{x+1} + \frac{b}{x-1}$ , find  $a$  and  $b$ .

- A.  $a = 2, b = 1$
- B.  $a = 1, b = 2$
- C.  $a = 1, b = 1$
- D.  $a = 1, b = -1$
- E.  $a = -1, b = 1$

9. In the figure,  $(x, y)$  is any point in the shaded region (including the boundary). Which of the following is/are true?

- I.  $x \leq y$
- II.  $x + y \leq 4$
- III.  $x \leq 6$

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



10. Solve  $\begin{cases} x^2 + y^2 = 13 \\ x + y = 1 \end{cases}$

- A.  $\begin{cases} x = -2 \\ y = 3 \end{cases}$
- B.  $\begin{cases} x = -6 \\ y = 7 \end{cases}$
- C.  $\begin{cases} x = 2 \\ y = -1 \end{cases}$  or  $\begin{cases} x = -3 \\ y = 4 \end{cases}$
- D.  $\begin{cases} x = -2 \\ y = 3 \end{cases}$  or  $\begin{cases} x = 3 \\ y = -2 \end{cases}$
- E.  $\begin{cases} x = -6 \\ y = 7 \end{cases}$  or  $\begin{cases} x = 7 \\ y = -6 \end{cases}$

11. If  $\alpha$  and  $\beta$  are the roots of the equation  $2x^2 + 4x - 3 = 0$ , find  $\frac{\alpha}{\beta} + \frac{\beta}{\alpha}$ .

- A.  $-\frac{22}{3}$
- B.  $-\frac{16}{3}$
- C.  $-\frac{14}{3}$
- D.  $-\frac{8}{3}$
- E.  $\frac{2}{3}$

12. Find the  $n$ -th term of the A.P. 4, 2, 0, -2, ...

- A.  $2 + 2n$
- B.  $4 - 2n$
- C.  $4 + 2n$
- D.  $6 - 2n$
- E.  $(5 - n)n$

13. The sum to infinity of a G.P. is 2. If the first term is  $\frac{3}{2}$ , find the common ratio.

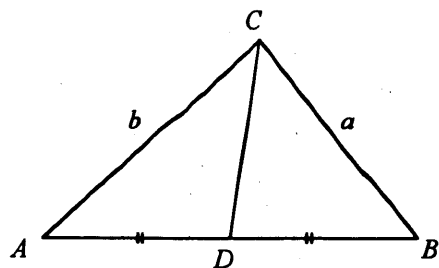
- A.  $-\frac{1}{2}$
- B.  $-\frac{1}{4}$
- C.  $\frac{1}{4}$
- D.  $\frac{1}{2}$
- E.  $\frac{3}{2}$

14. Shop A offers a 10% discount on a book marked at  $\$P$ . Shop B offers a 15% discount on the same book marked at  $\$Q$ . If the selling price of the book is the same in both shops, express  $Q$  in terms of  $P$ .

- A.  $Q = P + 5$
- B.  $Q = \frac{17}{18}P$
- C.  $Q = \frac{20}{21}P$
- D.  $Q = \frac{21}{20}P$
- E.  $Q = \frac{18}{17}P$

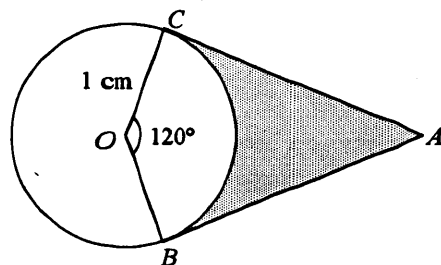
15. In the figure, area of  $\triangle ACD$  : area of  $\triangle BCD$  =

- A. 1 : 1 .
- B.  $a : b$  .
- C.  $b : a$  .
- D.  $a^2 : b^2$  .
- E.  $b^2 : a^2$  .



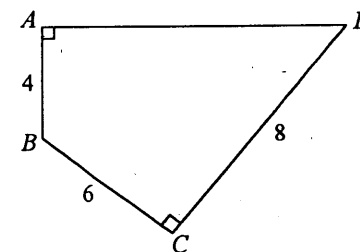
16. In the figure,  $O$  is the centre of the circle.  $AB$  and  $AC$  are tangents to the circle at  $B$  and  $C$  respectively. Area of the shaded region =

- A.  $(2 - \frac{\pi}{6}) \text{ cm}^2$  .
- B.  $(2 - \frac{\pi}{3}) \text{ cm}^2$  .
- C.  $(\sqrt{3} - \frac{\pi}{6}) \text{ cm}^2$  .
- D.  $(\sqrt{3} - \frac{\pi}{3}) \text{ cm}^2$  .
- E.  $(\frac{\sqrt{3}}{2} - \frac{\pi}{6}) \text{ cm}^2$  .



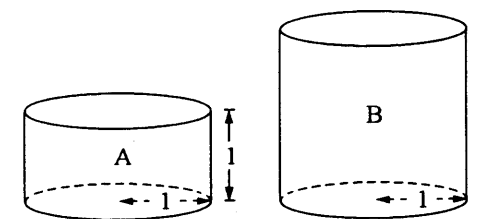
17. In the figure, the area of  $ABCD$  is

- A. 36 .
- B. 40 .
- C. 44 .
- D.  $4\sqrt{21} + 24$  .
- E.  $4\sqrt{29} + 24$  .



18. In the figure, A and B are two right solid cylinders with the same base radius 1 . If the heights of A and B are 1 and 2 respectively, find the total surface area of A / the total surface area of B

- A.  $\frac{1}{8}$
- B.  $\frac{1}{4}$
- C.  $\frac{1}{2}$
- D.  $\frac{3}{5}$
- E.  $\frac{2}{3}$



19. If  $0^\circ \leq \theta \leq 360^\circ$ , solve  $2 \sin \theta = -\sqrt{3}$ .

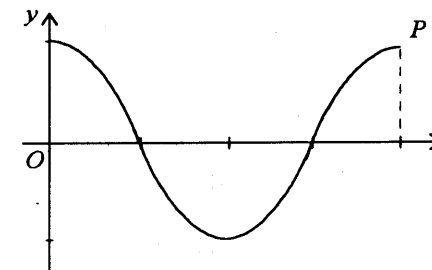
- A.  $120^\circ$  or  $240^\circ$
- B.  $120^\circ$  or  $300^\circ$
- C.  $150^\circ$  or  $330^\circ$
- D.  $210^\circ$  or  $330^\circ$
- E.  $240^\circ$  or  $300^\circ$

20. 
$$\frac{\frac{1}{\cos \theta} - \cos \theta}{\tan^2 \theta} =$$

- A.  $\sin \theta$
- B.  $\cos \theta$
- C.  $\cos^2 \theta$
- D.  $\frac{1}{\cos \theta}$
- E.  $\frac{1}{\tan \theta}$

21. The figure shows the graph of  $y = \frac{1}{2} \cos 2x$ . The point  $P$  is

- A.  $(\frac{\pi}{2}, 2)$
- B.  $(\pi, \frac{1}{2})$
- C.  $(\pi, 1)$
- D.  $(2\pi, \frac{1}{2})$
- E.  $(2\pi, 1)$



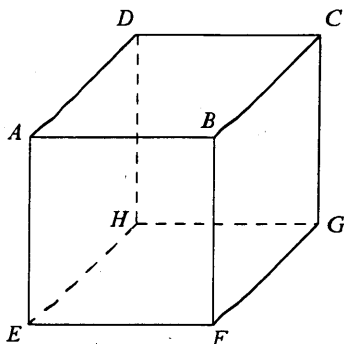
22. If  $0 \leq x \leq \pi$ , solve  $2 \sin x + 3 \cos x = 0$  correct to 3 significant figures.

- A. 0.588
- B. 0.983
- C. 2.16
- D. 2.55
- E. no solution

23. The figure shows a cube. Which of the following is/are equal to  $\angle AGE$ ?

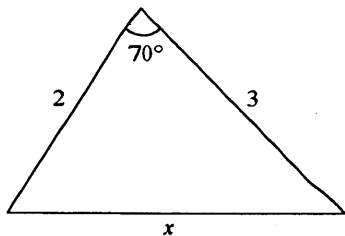
- I.  $\angle AGF$
- II.  $\angle BDF$
- III.  $\angle DEG$

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



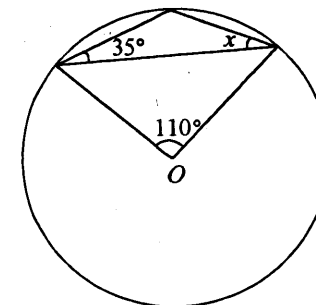
24. In the figure, find  $x$  correct to 3 significant figures.

- A. 2.71
- B. 2.98
- C. 3.31
- D. 3.88
- E. 4.14



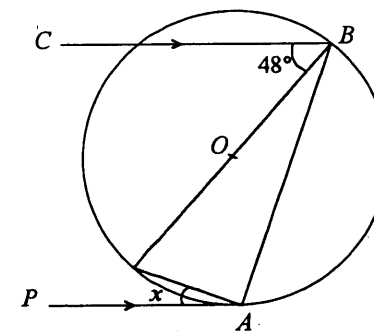
25. In the figure,  $O$  is the centre of the circle. Find  $x$ .

- A.  $20^\circ$
- B.  $27.5^\circ$
- C.  $35^\circ$
- D.  $37.5^\circ$
- E.  $40^\circ$



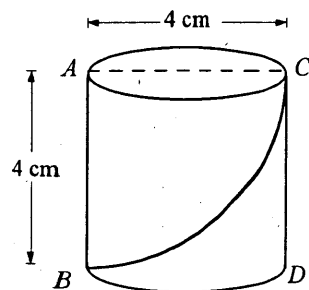
26. In the figure,  $O$  is the centre of the circle.  $PA$  is the tangent to the circle at  $A$  and  $CB \parallel PA$ . Find  $x$ .

- A.  $21^\circ$
- B.  $24^\circ$
- C.  $42^\circ$
- D.  $45^\circ$
- E.  $48^\circ$



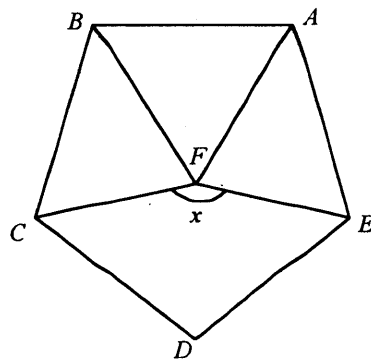
27. The figure shows a right circular cylinder with  $AC$  being a diameter of its upper face.  $AB$  and  $CD$  are two vertical lines on the curved surface. A curve is drawn on the surface of the cylinder from  $B$  to  $C$ . Find its shortest possible length.

- A.  $2\pi$  cm  
 B.  $2\sqrt{\pi^2 + 4}$  cm  
 C.  $4\sqrt{2}$  cm  
 D.  $4\sqrt{\pi^2 + 1}$  cm  
 E.  $4\sqrt{\pi^2 + 4}$  cm



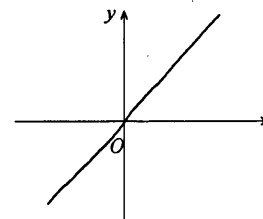
28. In the figure,  $ABCDE$  is a regular pentagon and  $ABF$  is an equilateral triangle. Find  $x$ .

- A.  $120^\circ$   
 B.  $126^\circ$   
 C.  $144^\circ$   
 D.  $156^\circ$   
 E.  $168^\circ$

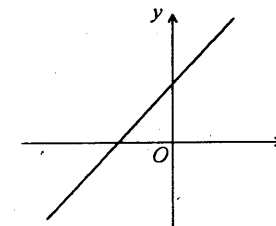


29. If  $a$ ,  $b$  and  $c$  are all positive, which of the following may represent the graph of  $ax + by + c = 0$ ?

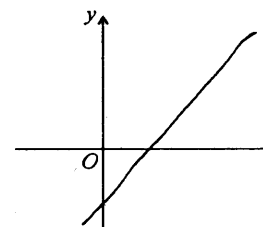
A.



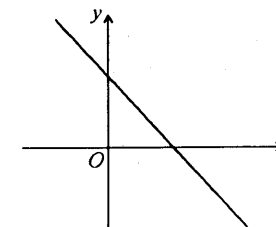
B.



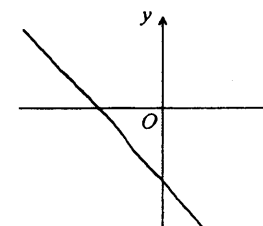
C.



D.



E.





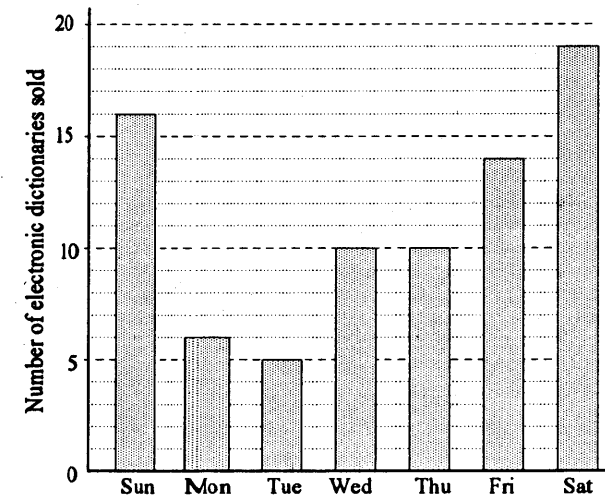
30. The equation of the circle centred at  $(a, b)$  and tangential to the  $x$ -axis is

- A.  $x^2 + y^2 - 2ax - 2by + a^2 = 0$  .
- B.  $x^2 + y^2 - 2ax - 2by + b^2 = 0$  .
- C.  $x^2 + y^2 - 2ax - 2by + a^2 + b^2 = 0$  .
- D.  $x^2 + y^2 + 2ax + 2by + a^2 = 0$  .
- E.  $x^2 + y^2 + 2ax + 2by + b^2 = 0$  .

31. Find the equation of the straight line which passes through  $(3, -1)$  and is perpendicular to  $2x - y + 1 = 0$  .

- A.  $x + 2y - 1 = 0$
- B.  $x + 2y + 1 = 0$
- C.  $x - 2y - 5 = 0$
- D.  $2x + y - 5 = 0$
- E.  $2x - y - 7 = 0$

32. The bar chart below shows the number of electronic dictionaries sold in a shop last week:



Of those electronic dictionaries sold last week, what percentage were sold on Sunday?

- A. 16%
- B. 18%
- C. 20%
- D. 22.5%
- E. 25%

33. Which of the following *cannot* be read directly from a cumulative frequency curve?

- I. Mean
- II. Median
- III. Mode

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

34. There are 10 parcels. Two of them contain one pen each. If a man opens the parcels at random, what is the probability that he can find the two pens by opening two parcels only?

- A.  $\frac{1}{25}$
- B.  $\frac{1}{45}$
- C.  $\frac{1}{50}$
- D.  $\frac{1}{90}$
- E.  $\frac{1}{100}$

35. In a certain game, the probability that John will win is 0.3. If he plays the game 3 times, find the probability that he will win at least once.

- A. 0.147
- B. 0.441
- C. 0.657
- D. 0.9
- E. 0.973

36. Simplify  $\frac{1}{x-1} + \frac{1}{x+1} + \frac{3x-1}{1-x^2}$ .

- A.  $\frac{1}{1-x}$
- B.  $\frac{1}{1+x}$
- C.  $-\frac{1}{1+x}$
- D.  $\frac{3x+1}{1-x^2}$
- E.  $\frac{1-5x}{1-x^2}$

37.  $m$  and  $n$  are multiples of 3 and 4 respectively. Which of the following must be true?

- I.  $mn$  is a multiple of 12.
- II. The H.C.F. of  $m$  and  $n$  is even.
- III. The L.C.M. of  $m$  and  $n$  is even.

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

38. Let  $x > y > 0$ . If  $\log(x+y) = a$  and  $\log(x-y) = b$ , then

$$\log \sqrt{x^2 - y^2} =$$

- A.  $\frac{a+b}{2}$
- B.  $\frac{ab}{2}$
- C.  $\sqrt{a+b}$
- D.  $\sqrt{ab}$
- E.  $\sqrt{a} + \sqrt{b}$

39. If  $\left(\frac{\sqrt{3}}{3} - \frac{1}{2}\right)x = 1$ , then  $x =$

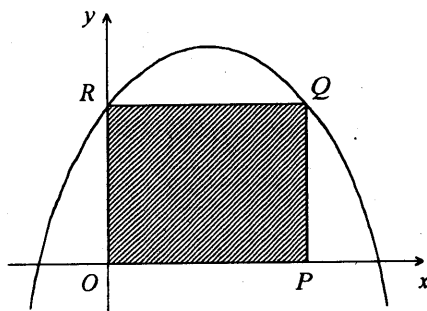
- A.  $-\frac{\sqrt{3}}{3} + \frac{1}{2}$
- B.  $\frac{\sqrt{3}}{3} + \frac{1}{2}$
- C.  $-4\sqrt{3} - 6$
- D.  $4\sqrt{3} - 6$
- E.  $4\sqrt{3} + 6$

40. If 3 is a root of the equation  $x^2 - x + c = 0$ , solve  $x^2 - x + c > 0$ .

- A.  $x < -2$  or  $x > 3$
- B.  $x < 2$  or  $x > 3$
- C.  $x > -6$
- D.  $-2 < x < 3$
- E.  $2 < x < 3$

41. The curve in the figure is the graph of  $y = -x^2 + bx + c$ . Find the area of the rectangle  $OPQR$ .

- A.  $bc$   
 B.  $b^2$   
 C.  $c^2$   
 D.  $b^2 - 4c$   
 E.  $b^2 + 4c$



42. If the common difference of the A.P.  $a_1, a_2, a_3, \dots$  is  $d$ , then the common difference of the A.P.  $2a_1 + 3, 2a_2 + 3, 2a_3 + 3, \dots$  is

- A.  $2$ .  
 B.  $3$ .  
 C.  $d$ .  
 D.  $2d$ .  
 E.  $2d + 3$ .

43. The length of a rectangle is decreased by 20%. If the area remains unchanged, find the percentage increase of its width.

- A.  $1\frac{1}{4}\%$   
 B.  $12\frac{1}{2}\%$   
 C.  $16\frac{2}{3}\%$   
 D. 20%  
 E. 25%

44. The following table shows the compositions of Tea A and Tea B which are mixtures of Chinese tea and Indian tea:

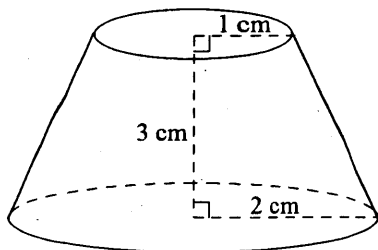
	Ratio of Chinese tea and Indian tea by weight
Tea A	3 : 1
Tea B	2 : 3

If 4 kg of tea A and 10 kg of tea B are mixed, find the ratio of Chinese tea and Indian tea in the mixture.

- A. 2 : 5  
 B. 16 : 17  
 C. 1 : 1  
 D. 5 : 4  
 E. 23 : 17

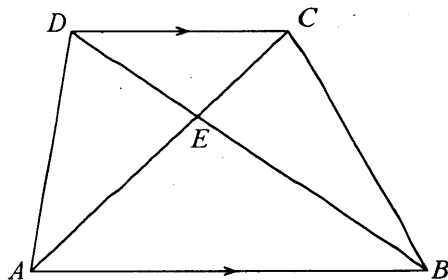
45. The figure shows a frustum of a right circular cone. The radii of the upper face and the base are 1 cm and 2 cm respectively. If the height is 3 cm, find the volume.

- A.  $3\pi \text{ cm}^3$   
 B.  $\frac{9}{2}\pi \text{ cm}^3$   
 C.  $\frac{11}{2}\pi \text{ cm}^3$   
 D.  $7\pi \text{ cm}^3$   
 E.  $\frac{15}{2}\pi \text{ cm}^3$



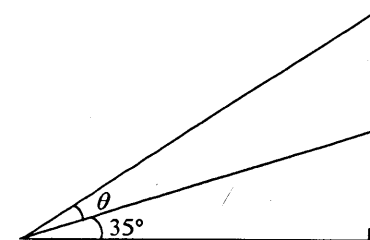
46. In the figure, if  $\frac{\text{Area of triangle } CDE}{\text{Area of triangle } BCE} = \frac{1}{2}$ ,  
 find  $\frac{\text{Area of triangle } CDE}{\text{Area of trapezium } ABCD}$ .

- A.  $\frac{1}{10}$   
 B.  $\frac{1}{9}$   
 C.  $\frac{1}{8}$   
 D.  $\frac{1}{7}$   
 E.  $\frac{1}{6}$



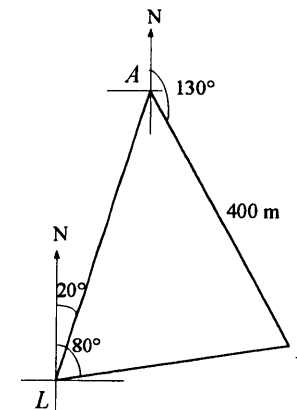
47. In the figure, find  $\theta$  correct to the nearest degree.

- A.  $16^\circ$   
 B.  $19^\circ$   
 C.  $26^\circ$   
 D.  $35^\circ$   
 E.  $36^\circ$



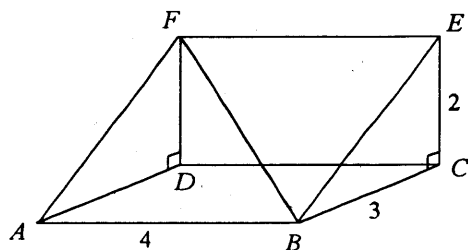
48. In the figure, the bearings of two ships  $A$  and  $B$  from a lighthouse  $L$  are  $020^\circ$  and  $080^\circ$  respectively.  $B$  is 400 m and at a bearing of  $130^\circ$  from  $A$ . Find the distance of  $B$  from  $L$ .

- A. 400 m  
 B.  $\frac{400}{\sin 60^\circ}$  m  
 C.  $\frac{400 \sin 50^\circ}{\sin 60^\circ}$  m  
 D.  $\frac{400 \sin 70^\circ}{\sin 60^\circ}$  m  
 E.  $\frac{400 \sin 70^\circ}{\sin 80^\circ}$  m



49. The figure shows a right prism with a right-angled triangle as the cross-section. Find the angle between the line  $BF$  and the plane  $ABCD$  correct to the nearest degree.

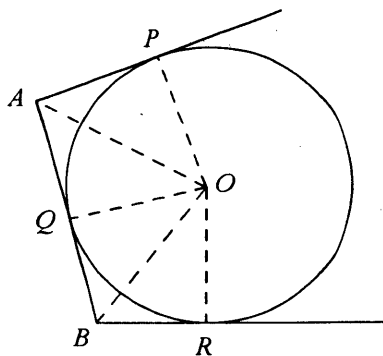
- A.  $22^\circ$   
 B.  $34^\circ$   
 C.  $37^\circ$   
 D.  $42^\circ$   
 E.  $56^\circ$



50. In the figure,  $O$  is the centre of the circle.  $AP$ ,  $AB$  and  $BR$  are tangents to the circle at  $P$ ,  $Q$  and  $R$  respectively. Which of the following must be true?

- I.  $AP + BR = AB$   
 II.  $OQ$  bisects  $\angle AOB$   
 III.  $\angle AOB = \frac{1}{2} \angle POR$

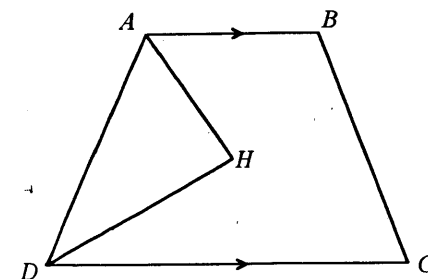
- A. I only  
 B. II only  
 C. I and II only  
 D. I and III only  
 E. I, II and III



51. In the figure,  $ABCD$  is a trapezium with  $AB \parallel DC$ .  $AH$  bisects  $\angle BAD$  and  $DH$  bisects  $\angle ADC$ . Which of the following must be true?

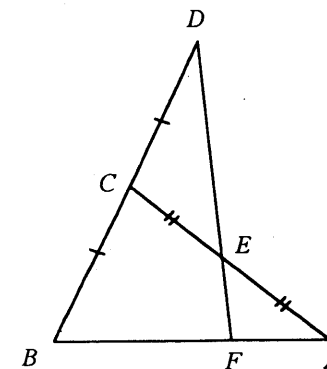
- I.  $\angle AHD = 90^\circ$   
 II.  $\angle ADC = \angle BCD$   
 III.  $\angle BAD + \angle BCD = 180^\circ$

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



52. In the figure,  $DE : EF =$

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



53.  $A(-3, 2)$  and  $B(1, 3)$  are two points.  $C$  is a point on the  $AB$  produced such that  $AB : BC = 1 : 2$ . Find the coordinates of  $C$ .

A.  $(-\frac{5}{3}, \frac{7}{3})$

B.  $(-\frac{1}{3}, \frac{8}{3})$

C.  $(3, \frac{7}{2})$

D.  $(5, 4)$

E.  $(9, 5)$

54.  $C_1: x^2 + y^2 = 4$  and  $C_2: x^2 + y^2 = 9$  are two circles. A chord  $AB$  of  $C_2$  touches  $C_1$ . Find the length of  $AB$ .

A.  $\sqrt{5}$

B.  $2\sqrt{5}$

C.  $\sqrt{65}$

D.  $2\sqrt{65}$

E. 10

**END OF PAPER**