

Section - A

**Q.1** Find HCF of 867 and 255 using Euclid's division Algorithm. [2  $\frac{1}{2}$ ]

**Solution-** **Step I :**  $867 > 255$ , we apply the division lemma to 867 and 255, to get

$$867 = 255 \times 3 + 102$$

**Step II :** Since the remainder  $102 \neq 0$ , we apply the division lemma to 255 and 102, to get

$$255 = 102 \times 2 + 51$$

**Step III :** Since the remainder  $51 \neq 0$ , we apply division lemma to 102 and 51, to get

$$102 = 51 \times 2 + 0$$

Now the remainder is Zero. So our procedure stops. Since the divisor at this stage is 51. So the HCF of 867 and 255 is 51.

**Q.2** Find LCM and HCF of 26 and 91. [2  $\frac{1}{2}$ ]

**Solution-** 26 and 91

We have prime factor of 26

$$\begin{array}{r|l} 2 & 26 \\ \hline & 13 \end{array}$$

$$26 = 2 \times 13$$

We have prime factor of 91

$$\begin{array}{r|l} 7 & 91 \\ \hline & 13 \end{array}$$

$$91 = 7 \times 13$$

HCF (26,91) = Product of the smallest power of each common prime factor in the numbers.

$$\text{Hence, HCF (26,91) = } 13^1 = 13$$

LCM (26, 91) = Product of the greatest power of each prime factor involved in the numbers.

$$\text{Hence, LCM (26, 91) = } 2^1 \times 7^1 \times 13^1$$

$$= 2 \times 7 \times 13$$

$$= 182$$

**Verification**

LCM  $\times$  HCF = Product of two numbers

$$\Rightarrow 182 \times 13 = 26 \times 91$$

$$\Rightarrow 2366 = 2366.$$

**Q.3** Solve the following pair of linear equation :

$\left[2 \frac{1}{2}\right]$

$$x + y = 14$$

$$x - y = 4$$

**Solution :** Given pair of linear equations

$$x + y = 14 \quad \dots\dots(i)$$

$$x - y = 4 \quad \dots\dots(ii)$$

From equation (i), we get

$$y = 14 - x \quad \dots\dots(iii)$$

Substituting this value of y in equation (ii), we get

$$x - (14 - x) = 4$$

$$x - 14 + x = 4$$

$$\Rightarrow 2x = 4 + 14$$

$$\Rightarrow 2x = 18$$

$$\Rightarrow x = \frac{18}{2} = 9$$

Substituting the value of x in equation (iii), we get

$$y = 14 - 9 = 5$$

Hence  $x = 9, y = 5$ .

**Q.4** Find the roots of quadratic equation

$\left[2 \frac{1}{2}\right]$

$$100x^2 - 20x + 1 = 0$$

**Solution :** Let us first split the middle term  $-20x$  as  $-10x - 10x$  (because  $10x \times 10x = 100x^2$ )

$$\text{So, } 100x^2 - 10x - 10x + 1 = 0$$

$$\Rightarrow 10x(10x - 1) - 1(10x - 1) = 0$$

$$\Rightarrow (10x - 1)(10x - 1) = 0$$

Either  $(10x - 1) = 0$  or  $(10x - 1) = 1$

$$\Rightarrow 10x = 1 \text{ or } 10x - 1 = 0$$

$$\Rightarrow x = \frac{1}{10} \text{ or } x = \frac{1}{10}$$

Hence, given equation have two repeated roots, one for each repeated factor.

**Q.5** ABC is an isosceles triangle, right angled at C. Prove that  $AB^2 = 2AC^2$

$\left[2 \frac{1}{2}\right]$

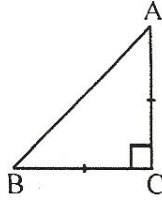
**Solution :** Given

An isosceles  $\triangle ABC$  which is right angled at C.

$$\Rightarrow AC = BC \text{ and } \angle ACB = 90^\circ$$

To prove

$$AB^2 = 2AC^2$$



Proof

In right  $\triangle ABC$

$$AB^2 = AC^2 + BC^2 \text{ (By pythagoras theorem)}$$

$$AB^2 = AC^2 + AC^2 \quad [\because BC = AC]$$

$$AB^2 = 2AC^2$$

$$\therefore AB^2 = 2AC^2$$

Hence, we proved the result.

**Q.6** If  $Q(0, 1)$  is equidistant from points  $P(5, -3)$  and  $R(x, 6)$ . Then find the value of  $x$  and also find the distance  $QR$  and  $PR$ .  $\left[2\frac{1}{2}\right]$

**Solution :** The point  $Q(0,1)$  is equidistant from the points  $P(5,3)$  and  $R(x,6)$

$$\therefore QP = QR$$

$$\Rightarrow \sqrt{(5-0)^2 + (-3-1)^2} = \sqrt{(x-0)^2 + (6-1)^2}$$

$$\Rightarrow \sqrt{25+16} = \sqrt{x^2+25}$$

$$\Rightarrow 25+16 = x^2+25$$

$$\Rightarrow x^2 = 16$$

$$\Rightarrow x = \pm 4$$

$$\text{Now, } QR = \sqrt{(x-0)^2 + (6-1)^2}$$

$$= \sqrt{x^2+25}$$

$$= \sqrt{16+25} \quad (\because x^2 = 16)$$

$$= \sqrt{41}$$

$$\text{and } PQ = \sqrt{(x-5)^2 + (6+3)^2}$$

When  $x = 4$

$$PR = \sqrt{(4-5)^2 + (6+3)^2}$$

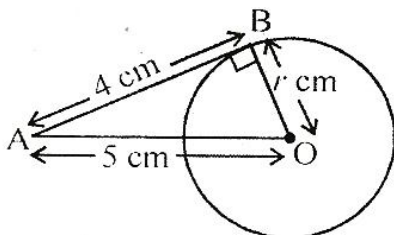
$$= \sqrt{1+81}$$

$$= \sqrt{82}$$

$$\begin{aligned} PR &= \sqrt{(-4 - 5)^2 + (6 + 3)^2} \\ &= \sqrt{81 + 81} = \sqrt{162} = 9\sqrt{2} \end{aligned}$$

**Q.7** The length of a tangent from a point A at a distance 5cm from the centre of the circle is 4 cm.  
Find the radius of the circle. [2  $\frac{1}{2}$ ]

**Solution :**



Let radius of the circle = r cm

The length of the tangent from point A = 4 cm

The length of point A from the centre of the circle = 5 cm

We know,  $\angle OBA = 90^\circ$

In right  $\triangle AOB$ ,

$$(AO)^2 = (AB)^2 + (OB)^2$$

$$\Rightarrow (5)^2 = (4)^2 + r^2$$

$$\Rightarrow r^2 = (5)^2 - (4)^2 = 25 - 16 = 9$$

$$\Rightarrow r = 3$$

Hence, radius of the circle = 3 cm

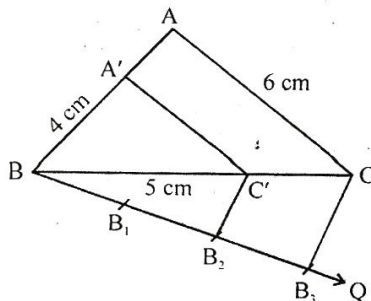
**Q.8** Construct a triangle with sides 4 cm, 5 cm & 6 cm and then another triangle similar to it whose

sides are  $\frac{2}{3}$  of the corresponding sides of first triangle. [2  $\frac{1}{2}$ ]

**Solution :** Given a triangle ABC, of sides 4 cm, 5 cm, and 6 cm, we are required to construct a triangle whose sides are  $\frac{2}{3}$  of the corresponding sides of  $\triangle ABC$ .

**Steps of constructions :**

(i) Draw a ray BQ making an acute angle with BC below the side of BC.



(ii) Mark 3 points  $B_1, B_2, B_3$  (the greater of 2 and 3 in  $\frac{2}{3}$ ) on BQ, so that  $BB_1 = B_1B_2 = B_2B_3$ .

(iii) Join C and  $B_3$

(iv) Draw a line through point  $B_2$  (the smaller of 2 and 3 in  $\frac{2}{3}$ ) which is parallel to the line  $B_3C$ , to intersect BC at  $C'$ .

(v) Through  $C'$  draw a line parallel to the line AC to intersect AB at  $A'$ .

Hence  $A'BC'$  is the triangle, whose sides are  $\frac{2}{3}$  of the sides of  $\Delta ABC$ .

**Q.9** A box contains 3 blue, 2 white, 4 red marbles. If a marble is taken out randomly, then calculate the probability that it will be a white marble.  $\left[2\frac{1}{2}\right]$

**Solution :** Total marbles = 3 + 2 + 4 = 9

Number of white marbles = 2

$\therefore$  Probability of getting white marbles =  $\frac{2}{9}$

**Q.10** One card is drawn from a well shuffled deck of 52 cards. Find the probability of getting a red face card.  $\left[2\frac{1}{2}\right]$

**Solution :** Total outcomes = 52

Number of red face card (2King, 2Queen and 2 Jack) = 6

$\therefore$  Probability of getting red face card =  $\frac{6}{52} = \frac{3}{26}$ .

### SECTION- B

**Q.11** Divide  $(x^4 - 3x^2 + 4x + 5)$  by  $(x^2 + 1 - x)$ .  $\left[3\frac{1}{2}\right]$

**Solution :**  $p(x) = (x^4 - 3x^2 + 4x + 5)$ ,

$g(x) = (x^2 + 1 - x)$

Here, divisor is not in standard form.

The standard form of  $g(x) = x^2 - x + 1$

Now, dividend and divisor are in standard form.

$$\begin{array}{r}
 \phantom{x^2 - x + 1} \overline{) x^4 + 0x^3 - 3x^2 + 4x + 5} \\
 \underline{x^4 - x^3 + x^2} \phantom{+ 5} \\
 \phantom{x^2 - x + 1} x^3 - 4x^2 + 4x + 5 \\
 \underline{\phantom{x^2 - x + 1} x^3 - x^2 + x} \phantom{+ 5} \\
 \phantom{x^2 - x + 1} \phantom{x^3} - 3x^2 + 3x + 5 \\
 \underline{\phantom{x^2 - x + 1} \phantom{x^3} - 3x^2 + 3x - 3} \\
 \phantom{x^2 - x + 1} \phantom{x^3} \phantom{- 3x^2} + 3x + 8
 \end{array}$$

Now, we stop the process because degree of dividend (remainder) becomes less than the degree of divisor.

Hence, remainder = 8

and quotient =  $x^2 + x - 3$ .

**Q.12 Solve the pair of equations graphically**

$\left[3\frac{1}{2}\right]$

$$x - y + 1 = 0$$

$$3x + 2y - 12 = 0$$

**Solution :** Given equations are

$$x - y + 1 = 0 \quad \dots\dots(i)$$

$$\text{and } 3x + 2y - 12 = 0 \quad \dots\dots(ii)$$

Let us draw the graphs of two equations :

We have,

$$x - y + 1 = 0$$

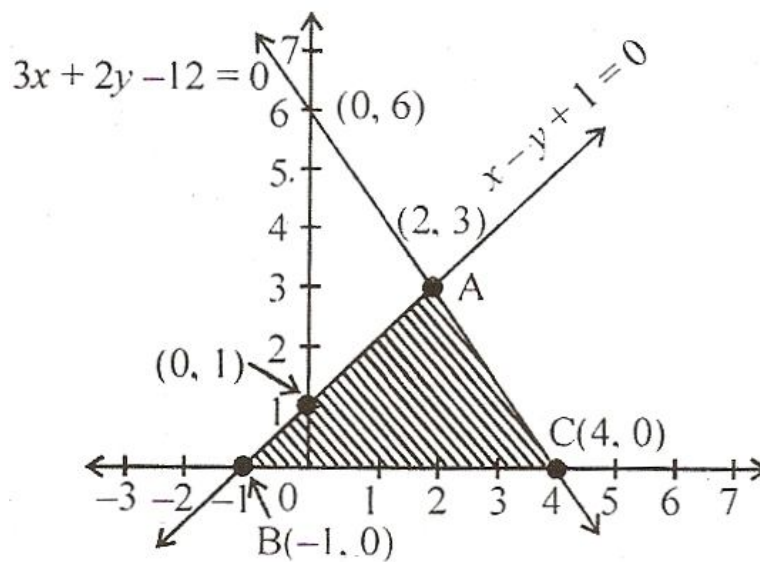
$$\Rightarrow y = x + 1$$

x	0	-1	2
y	1	0	3

$$\text{and } 3x + 2y = 12$$

$$\Rightarrow y = \frac{12-3x}{2}$$

x	0	4	2
y	6	0	3



From the graph, we find co-ordinates of the vertices of the triangle ABC formed by these lines and x-axis are : A (2,3) B (-1,0), and C (2,3).

**Q.13** How many three digit numbers are divisible by 7?

$\left[3\frac{1}{2}\right]$

**Solution :** The given AP which is divisible by 7 is 105, 112, 119, ..... 994

Let the three digit number, which is divisible by 7 are n.

Here  $a = 105$ ,  $d = 7$  and  $a_n = 994$

We know that

$$a_n = [a + (n - 1)d]$$

$$\Rightarrow 994 = [105 + (n - 1)7]$$

$$\Rightarrow 994 = 105 + 7n - 7$$

$$\Rightarrow 7n + 98 = 994$$

$$\Rightarrow 7n = 994 - 98$$

$$\Rightarrow 7n = 896$$

$$\Rightarrow n = \frac{896}{7} = 128$$

Hence, the three digit numbers which is divisible by 7 are 128.

**Q.14** Triangle ABC is an isosceles triangle with  $AC = BC$ .

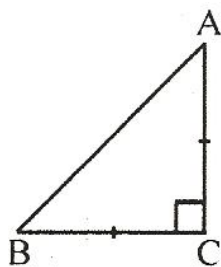
If  $AB^2 = 2AC^2$  then prove that triangle ABC is a right angled triangle.

$\left[3\frac{1}{2}\right]$

**Solution :** **Given**

An isosceles  $\Delta ABC$  which  $AC = BC$

$$AB^2 = 2AC^2$$



**To Prove**

$\Delta ABC$  is a right triangle.

**Proof**

In right  $\Delta ABC$ ,  $AC = BC$  Given .....(i)

$AB^2 = 2AC^2$  (Given) .....(ii)

Now,  $AC^2 + BC^2 = AC^2 + AC^2$  (using (i))

$$\Rightarrow AC^2 + BC^2 = 2AC^2$$

$$\Rightarrow AC^2 + BC^2 = AB^2 \quad \text{(using (ii))}$$

Hence, by the converse of the pythagoras theorem, we have  $\Delta ABC$  right angle at C.

**Q.15** Prove that :  $\frac{\sin \theta - \sin^3 \theta}{2\cos^3 \theta - \cos \theta} = \tan \theta$  [3  $\frac{1}{2}$ ]

**Solution :**

$$\begin{aligned} \text{L.H.S.} &= \frac{\sin \theta - \sin^3 \theta}{2\cos^3 \theta - \cos \theta} = \tan \theta \\ &= \frac{\sin \theta \times (1 - \sin^2 \theta)}{\cos \theta \times (2\cos^2 \theta - 1)} \\ &= \frac{\sin \theta \times (\cos^2 \theta + \sin^2 \theta - \sin^2 \theta)}{\cos \theta \times [2\cos^2 \theta - (\cos^2 \theta + \sin^2 \theta)]} \\ &\quad (\because \cos^2 \theta + \sin^2 \theta = 1) \\ &= \frac{\sin \theta \times (\cos^2 \theta - \sin^2 \theta)}{\cos \theta \times (\cos^2 \theta - \sin^2 \theta)} \\ &= \frac{\sin \theta}{\cos \theta} = \tan \theta = \text{R.H.S} \\ \therefore \text{L.H.S.} &= \text{R.H.S.} \end{aligned}$$

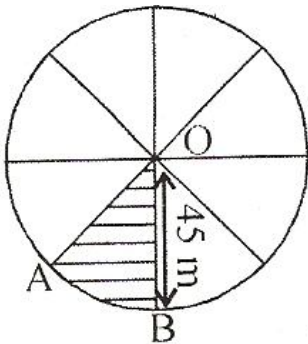
**Q.16** Evaluate :  $2 \tan^2 45^\circ + \cos^2 30^\circ - \sin^2 60^\circ$  [3  $\frac{1}{2}$ ]

**Solution :**

$$\begin{aligned} &2 \tan^2 45^\circ + \cos^2 30^\circ - \sin^2 60^\circ \\ &= 2 (1)^2 + \left(\frac{\sqrt{3}}{2}\right)^2 - \left(\frac{\sqrt{3}}{2}\right)^2 \\ &= 2 + \frac{3}{4} - \frac{3}{4} = 2. \end{aligned}$$

**Q.17** An umbrella has 8 ribs which are equally spaced. Assuming umbrella to be a flat circle of radius 45 cm. Find the area between the two consecutive ribs of the umbrella. [3  $\frac{1}{2}$ ]

**Solution :**



Radius of circle = 45 cm

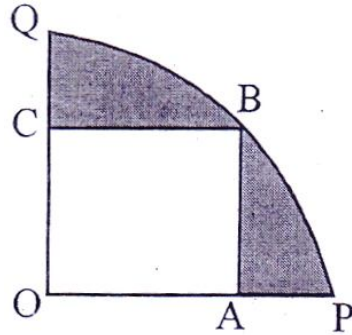
Angle subtended at the centre between two consecutive ribs =  $\frac{360^\circ}{8} = 45^\circ$

Therefore, area between two consecutive ribs of the umbrella = The area of the shaded sector

$$\begin{aligned} \text{OAB} &= \frac{\theta}{360} \times \pi r^2 \\ &= \frac{45^\circ}{360} \times 3.14 \times 45 \times 45 \\ &= \frac{22275}{28} \text{ cm}^2. \end{aligned}$$



- Q.18** In figure, a square OABC is inscribed in a quadrant OPBQ. If OA = 20 cm. Find Area of the shaded region. ( $\pi = 3.14$ ) [3  $\frac{1}{2}$ ]



**Solution :** Let draw a diagonal OB in square OABC  
 $AB = BC = OA = OC = 20$  cm  
 Because OABC is a square, so  $\angle QOP = 90^\circ$   
 Diagonal (OB) =  $\sqrt{OA^2 + OB^2}$   
 $OB = \sqrt{20^2 + 20^2}$   
 $= \sqrt{400 + 400}$   
 $= 20\sqrt{2}$  cm

But in figure, we have

Diagonal = radius of the circle =  $20\sqrt{2}$  cm.

Therefore, the area of shaded portion = Area of quadrant OPQ of circle - Area of square

$$= \left[ \frac{\theta}{360} \times \pi r^2 - (side)^2 \right]$$

$$= \left[ \frac{90}{360} \times \frac{22}{7} (20\sqrt{2})^2 - (20)^2 \right]$$

$$= \left[ \frac{1}{4} \times 3.14 \times 800 - 400 \right]$$

$$= 628 - 400 = 228 \text{ cm}^2.$$

- Q.19** Find the area of triangle whose vertices are (2, 3), (-1,0), (2,-4). [3  $\frac{1}{2}$ ]

**Solution :** Let vertices of a given triangle ABC are A (2,3), B (-1,0) and C (2,-4)

Hence,  $x_1 = 2$  and  $y_1 = 3$

$x_2 = -1$  and  $y_2 = 0$

$x_3 = 2$  and  $y_3 = -4$

We know that area of  $\Delta ABC$

$$= \frac{1}{2} [x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)]$$

$$= \frac{1}{2} [2(0 - 4) - 1(-4 - 3) + 2(3 - 0)]$$

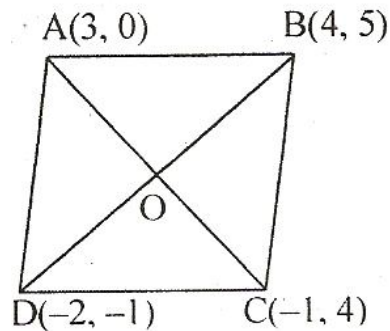
$$= \frac{1}{2}(8 + 7 + 6) = \frac{1}{2} \times 21$$

$$= 10.5 \text{ sq. units.}$$

**Q.20** Find the area of a rhombus if its vertices are (3, 0), (4, 5), (-1, 4) and (-2, -1) taken in order.

$\left[3\frac{1}{2}\right]$

**Solution :** Let A (3, 0), B (4, 5), C (-1, 4) and D (-2, -1) are the vertices of the rhombus.



Here, diagonal BD

$$= \sqrt{[4 - (-2)]^2 + (5 - (-1))^2}$$

$$= \sqrt{(4 + 2)^2 + (5 + 1)^2} = \sqrt{(6)^2 + (6)^2}$$

$$= \sqrt{36 + 36}$$

$$BD = \sqrt{72} = 6\sqrt{2}.$$

$$\text{and diagonal } AC = \sqrt{(-1 - 3)^2 + (4 - 0)^2}$$

$$= \sqrt{(-4)^2 + (4)^2}$$

$$= \sqrt{16 + 16}$$

$$AC = \sqrt{32} = 4\sqrt{2}$$

We know that area of rhombus

$$= \frac{1}{2}(BD \times AC) = \frac{1}{2}(6\sqrt{2} \times 4\sqrt{2})$$

$$= 24 \text{ square units.}$$

### SECTION- C

**Q.21** The difference of square of two numbers is 180. If square of smaller number is equal to 8 times the bigger number then find the two numbers. [5]

**Solution :** Let smaller number =  $x$

and larger number =  $y$

According to first condition,

$$x^2 = 8y \quad \dots\dots(i)$$

According to second condition,

$$y^2 - x^2 = 180 \quad \dots\dots(ii)$$

Putting the value of  $x^2$  from equation, (i) in equation (ii), we get

$$y^2 - 8y - 180 = 0 \quad \dots\dots(iii)$$

Which is a quadratic equation.

$$\Rightarrow y^2 - 18y + 10y - 180 = 0$$

$$\Rightarrow y(y - 18) + 10(y - 18) = 0$$

$$\Rightarrow (y - 18)(y + 10) = 0$$

Either  $y - 18 = 0$  or  $y + 10 = 0$

$$\Rightarrow y = 18 \text{ or } y = -10$$

when  $y = 18$  then  $x^2 = 8y$

$$\Rightarrow x^2 = 8 \times 18$$

$$\Rightarrow x^2 = 144$$

$$\Rightarrow x = \sqrt{144}$$

$$\Rightarrow x = \pm 12$$

when  $y = -10$  then  $x^2 = 8y$

$$\Rightarrow x^2 = 8 \times -10$$

$$\Rightarrow x^2 = -80$$

$$\Rightarrow x = \sqrt{-80}$$

$$\Rightarrow x \notin R$$

Hence,  $Y = 18$

and  $x = 12$  or  $-12$

### Case- 1

If smaller number = 12

$$\text{then larger number } (y) = \frac{x^2}{8} = \frac{(12)^2}{8} = \frac{144}{8} = 18$$

### Case -2

If smaller number = -12

then larger number (y)

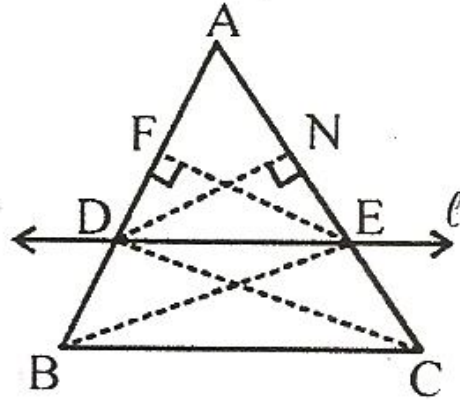
$$= \frac{x^2}{8} = \frac{(-12)^2}{8}$$

$$= \frac{144}{8} = 18.$$

**Q.22** If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct point, the other two sides are divided in the same ratio. [5]

**Solution :** Given

$\triangle ABC$  and a line parallel to BC intersects AB at D and AC at E



**To prove**

$$\frac{AD}{DB} = \frac{AE}{EC}$$

**Construction**

We join B and E, C and D then draw  $EF \perp AB$ , and  $DN \perp AC$

**Proof**

We have,  $ar(\triangle BDE) = ar(\triangle CDE)$

(The two areas are equal because the two triangles are on the same base DE and between same parallel line DE and BC)

We have

$$\frac{ar(\triangle ADE)}{ar(\triangle BDE)} = \frac{\frac{1}{2} \times AD \times EF}{\frac{1}{2} \times BD \times EF} = \frac{AD}{BD}$$

$$ar(\triangle ADE) = \frac{AD}{BD} \times ar(\triangle BDE) \dots (i)$$

$$\begin{aligned} \text{Similarly } \frac{ar(\triangle ADE)}{ar(\triangle CDE)} &= \frac{\frac{1}{2} \times AE \times DN}{\frac{1}{2} \times EC \times DN} \\ &= \frac{AE}{EC} \end{aligned}$$

$$ar(\triangle ADE) = \frac{AE}{EC} \times ar(\triangle CDE) \dots (ii)$$

From (i) and (ii), we get

$$\frac{AD}{BD} \times ar(\triangle BDE) = \frac{AE}{EC} \times ar(\triangle CDE) \quad [ \because ar(\triangle BDE) = ar(\triangle CDE) ]$$

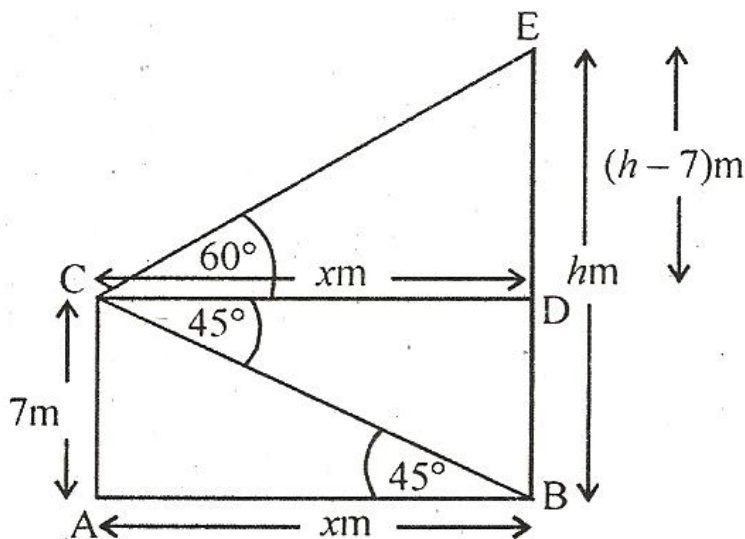
$$\Rightarrow \frac{AD}{BD} = \frac{AE}{EC}$$

Hence, we proved the result.

**Q.23** From the top of a 7m high Building the angle of elevation of the top of a cable tower is  $60^\circ$  and the angle of depression of its foot is  $45^\circ$ . Determine the height of the tower. [5]

**Solution** Let the height of the tower =  $hm$

and let the distance between foot of the tower and foot of the building =  $xm$



From the top of a building, the angle of elevation of the top of a cable tower =  $60^\circ$

$$\Rightarrow \angle ECD = 60^\circ$$

From the top of a building the angle of depression of =  $45^\circ$

$$\Rightarrow \angle CBA = 45^\circ$$

(Alternate, angles  $\angle DCB = \angle CBA$ )

In right  $\triangle CBA$ ,

$$\frac{CA}{AB} = \tan 45^\circ \Rightarrow \frac{7}{x} = 1 \Rightarrow x = 7m$$

Now, right  $\triangle CBA$ ,

$$\frac{ED}{CD} = \tan 60^\circ$$

$$\Rightarrow \frac{EB-DB}{x} = \sqrt{3}$$

$$\Rightarrow \frac{h-7}{7} = \sqrt{3} (\because x = 7m)$$

$$\Rightarrow h = 7\sqrt{3} + 7 \Rightarrow h = 7(\sqrt{3} + 1)$$

Hence, height of the cable tower =  $7(\sqrt{3} + 1)m$ .

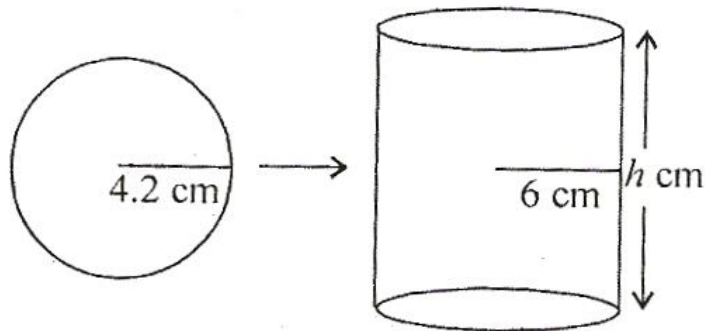
**Q.24** A metallic sphere of radius 4.2cm is melted and recast into the shape of cylinder of radius 6 cm. Find the height of the cylinder. [5]

Ans. Given

Radius of the sphere ( $r_1$ ) = 4.2 cm

Radius of the cylinder ( $r_2$ ) = 6 cm

Let the height of the cylinder =  $h$  cm



**We know that**

Volume of sphere = Volume of cylinder

$$\Rightarrow \frac{4}{3} \pi r_1^3 = \pi r_2^2 h$$

$$\Rightarrow h = \frac{4}{3} \pi r_1^3 \times \frac{1}{\pi r_2^2}$$

$$= \frac{4}{3} \cdot \frac{(4.2) \times (4.2) \times (4.2)}{6 \times 6} = 2.74 \text{ cm}$$

**Q.25** The following table gives the distribution of life time of 400 neon Lamps. Find the median life time of lamp. [5]

Life time (in hours)	No. of Lamps
1500-2000	14
2000-2500	56
2500-3000	60
3000-3500	86
3500-4000	74
4000-4500	62
4500-5000	48

ANS.

Life time (in hours)	Number of lamps ( $f_1$ )	Cumulative Frequency (c.f.)
1500-2000	14	14
2000-2500	56	70
2500-3000	60	130
3000-3500	86	216
3500-4000	74	290
4000-4500	62	352
4500-5000	48	400
	n=200	

Here, we have  $n = 200$ , so  $\frac{n}{2} = 100$

Hence, medium class is 3000 – 3500

Therefore,  $l = 3000$ ,  $f = 86$ ,  $c. f. = 130$  and  $h = 500$

Using the formula of median,

$$\text{Median} = l + \left[ \frac{\frac{n}{2} - c.f.}{f} \right] \times h$$

$$= 3000 \left[ \frac{200 - 130}{86} \right] \times 500$$

$$= 3000 + 406.98$$

$$= 3406.98 \text{ hours}$$

Hence, median life time of a lamp = 3406.98 hours