CBSE

MATHEMATICS (Basic), Class-X
Sample Question Paper
(Issued by Board on 9th Oct, 2020)
For 2021 Examination

SOLUTIONS

PART-A

SECTION - I

1. $156 = 2^2 \times 3 \times 13$ **1**

2. Quadratic polynomial is given by

$= x^2 - (a + b)\,x + ab$

$= x^2 - 2x - 8$ **1**

3. HCF × LCM = product of two numbers

$$\text{LCM}\,(96,404) = \frac{96 \times 404}{\text{HCF}\,(96, 404)} = \frac{96 \times 404}{4}$$

LCM = 9696 **1**

OR

Every composite number can be expressed (factorized) as a product of primes, and this factorization is unique, apart from the order in which the factors occur. **1**

4. $x - 2y = 0$

$3x + 4y - 20 = 0$

$$\frac{1}{3} \neq -\frac{2}{4}$$

As, $\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$

is one condition for consistency.

Therefore, the pair of equations is consistent. **1**

5. 1 **1**

[CBSE Marking Scheme, 2021]

Detailed answer :

Since, 1 is the only common factor of co-prime, numbers.

Thus, HCF $(a, b) = 1$. **1**

6. $\theta = 60°$

$$\text{Area of sector} = \frac{\theta}{360°}\pi r^2$$

$$A = \frac{60°}{360°} \times \frac{22}{7} \times (6)^2 \text{ cm}^2 \quad ½$$

$$A = \frac{1}{6} \times \frac{22}{7} \times 36 \text{ cm}^2$$

$= 18.86 \text{ cm}^2$ ½

OR

Horse can graze in the field which is a circle of radius 28 cm.

So, required perimeter $= 2\pi r = 2.\pi(28)$ cm ½

$= 2 \times \dfrac{22}{7} \times (28)$ cm

$= 176$ cm ½

7. By converse of Thale's theorem $DE \parallel BC$

$\angle ADE = \angle ABC = 70°$

Given $\angle BAC = 50°$

$\angle ABC + \angle BAC + \angle BCA = 180°$

(Angle sum prop. of triangles)

$70° + 50° + \angle BCA = 180°$

$\angle BCA = 180° - 120° = 60°$ **1**

OR

$EC = AC - AE = (7 - 3.5)$ cm $= 3.5$ cm

$$\frac{AD}{BD} = \frac{2}{3} \text{ and } \frac{AE}{EC} = \frac{3.5}{3.5} = \frac{1}{1} \quad ½$$

So, $\dfrac{AD}{BD} \neq \dfrac{AE}{EC}$

Hence, By converse of Thale's Theorem, DE is not Parallel to BC. ½

8. $$\text{Length of the fence} = \frac{\text{Total cost}}{\text{Rate}}$$

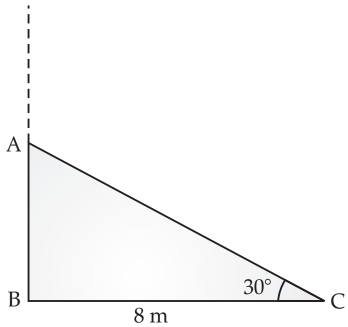
$$= \frac{\text{Rs. } 5280}{\text{Rs. } 24/\text{metre}} = 220 \text{ m} \quad ½$$

So, length of fence = Circumference of the field

$\therefore$ $220 \text{ m} = 2\pi r = 2 \times \dfrac{22}{7} \times r$

So, $r = \dfrac{220 \times 7}{2 \times 22} \text{ m} = 35 \text{ m}$ ½

9.



Sol : $\tan 30° = \frac{AB}{BC}$

$$\frac{1}{\sqrt{3}} = \frac{AB}{8}$$ ½

$$AB = \frac{8}{\sqrt{3}} \text{ metres}$$

Height from where it is broken is $\frac{8}{\sqrt{3}}$ metres. ½

10. Perimeter = Area

$$2\pi r = \pi r^2$$

$$r = 2 \text{ units}$$ 1

11. 3 median = mode + 2 mean 1

12. 8 1

13. $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ is the condition for the given pair of equations to have unique solution.

$$\frac{4}{2} \neq \frac{p}{2}$$

$$p \neq 4$$

Therefore, for all real values of p except 4, the given pair of equations will have a unique solution. 1

OR

Here, $\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}$

$$\frac{b_1}{b_2} = \frac{3}{6} = \frac{1}{2} \text{ and } \frac{c_1}{c_2} = \frac{5}{7}$$

$$\frac{1}{2} = \frac{1}{2} \neq \frac{5}{7}$$

$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ is the condition for which the given system of equations will represent parallel lines.

So, the given system of linear equations will represent a pair of parallel lines. 1

14. No. of red balls = 3, No. of black balls = 5

Total number of balls = 5 + 3 = 8

Probability of red balls = $\frac{3}{8}$ 1

OR

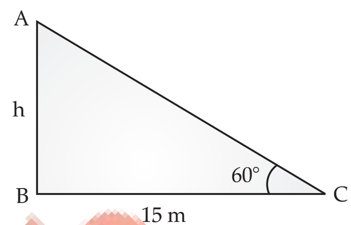
Total no of possible outcomes = 6

There are 3 Prime numbers, 2, 3, 5.

So, Probability of getting a prime number is $\frac{3}{6}$

$$= \frac{1}{2}$$ 1

15.



$$\tan 60° = \frac{h}{15}$$

$$\sqrt{3} = \frac{h}{15}$$

$$h = 15\sqrt{3} \text{ m}$$ 1

16. 1 1

SECTION - II

17. (i) (b) Cloth material required

$= 2 \times$ S.A.of hemispherical dome

$= 2 \times 2\pi r^2$

$= 2 \times 2 \times \frac{22}{7} \times (2.5)^2 \text{ m}^2$

$= 78.57 \text{ m}^2$ 1

(ii) (a) Volume of a cylindrical pillar

$= \pi r^2 h$ 1

(iii) (b) Lateral surface area = $2 \times 2\pi rh$

$= 4 \times \frac{22}{7} \times 1.4 \times 7 \text{ m}^2$

$= 123.2 \text{ m}^2$ 1

(iv) (d) Volume of hemisphere = $\frac{2}{3}\pi r^3$

$= \frac{2}{3} \times \frac{22}{7} \times (3.5)^3 \text{ m}^3$

$= 89.83 \text{ m}^3$ 1

(v) (b) Sum of the volumes of two hemispheres of radius 1 cm each

$= 2 \times \frac{2}{3}\pi 1^3$

Volume of sphere of radius 2 cm

$$= \frac{4}{3}\pi 2^3$$

So, required ratio is $= \dfrac{2 \times \dfrac{2}{3}\pi 1^3}{\dfrac{4}{3}\pi 2^3}$

$= 1 : 8$ **1**

18. (i) (c) (0, 0) **1**

(ii) (a) (4, 6) **1**

(iii) (a) (6, 5) **1**

(iv) (a) (16, 0) **1**

(v) (b) (– 12, 6) **1**

19. (i) (c) 90° **1**

(ii) (b) SAS **1**

(iii) (b) 4 : 9 **1**

(iv) (d) Converse of Pythagoras theorem **1**

(v) (c) 24 cm^2 **1**

20. (i) (d) Parabola **1**

(ii) (a) 2 **1**

(iii) (b) – 1, 3 **1**

(iv) (c) $x^2 - 2x - 3$ **1**

(v) (d) 0 **1**

PART-B

21. Let $P(x, y)$ be the required point. Using section formula

$$\left\{\frac{m_1x_2 + m_2x_1}{m_1 + m_2}, \frac{m_1y_2 + m_2y_1}{m_1 + m_2}\right\} = (x, y)$$

$x = \dfrac{3(8) + 1(4)}{3 + 1}$ $y = \dfrac{3(5) + 1(-3)}{3 + 1}$ **1**

$x = 7$ $y = 3$ **1**

(7, 3) is the required point

OR

Let $P(x, y)$ be equidistant from the points $A(7, 1)$ and $B(3, 5)$

Given $AP = BP$. So, $AP^2 = BP^2$

$(x - 7)^2 + (y - 1)^2 = (x - 3)^2 + (y - 5)^2$ **1**

$x^2 - 14x + 49 + y^2 - 2y + 1$

$= x^2 - 6x + 9 + y^2 - 10y + 25$

$x - y = 2$ **1**

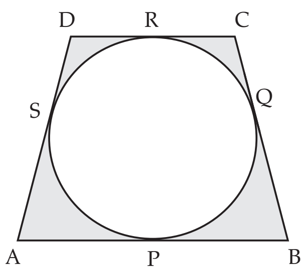
22. By BPT, In ΔABC

$$\frac{AM}{MB} = \frac{AL}{LC} \quad ...(1)\ ½$$

Also, In ΔADC $\dfrac{AN}{ND} = \dfrac{AL}{LC}$ ...(2) ½

By Equating (1) and (2) $\dfrac{AM}{MB} = \dfrac{AN}{ND}$ **1**

23. To prove : $AB + CD = AD + BC$.



Proof : $AS = AP$ **(i)**

(Length of tangents from an external point to a circle are equal)

$BQ = BP$ ...(ii)

$CQ = CR$ ...(iii)

$DS = DR$ ...(iv) **1**

Adding e.q., (i), (ii), (iii), and (iv)

$AS + BQ + CQ + DS = AP + BP + CR + DR$

$(AS + DS) + (BQ + CQ) = (AP + BP) + (CR + DR)$

$AD + BC = AB + CD$ **1**

24. For the correct constructions

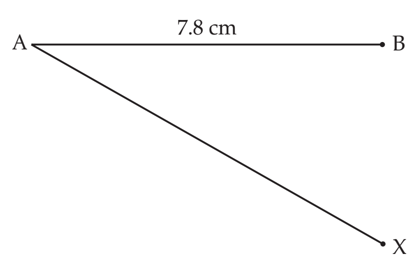
[CBSE Marking Scheme, 2021]

Detailed answer :

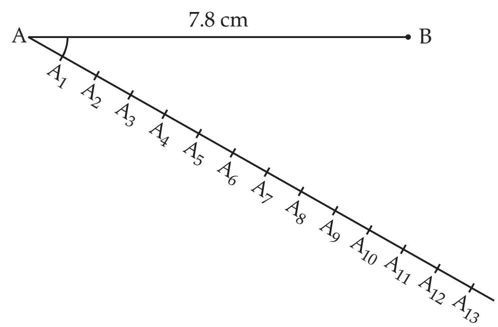
Steps of constructions :

(1) Draw line segment AB of length 7.8 cm.

(2) Draw any ray AX, making an acute angle with AB.



(3) Mark 13 (= 5 + 8) points A_1, A_2, A_3, A_4, ... A_{13}, on AX such that $AA_1 = A_1A_2 = A_2A_3$ .... by drawing equal arcs.



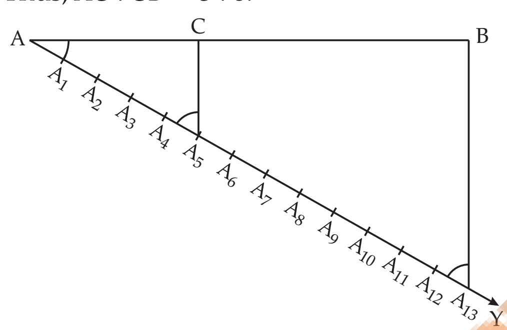
(4) Join BA_{13}.

(5) Since we want the ratio 5 : 8,

Through point A_5 ($m = 5$), we draw a line parallel to $A_{13}B$ by making $\angle AA_5C = \angle AA_{13}B$

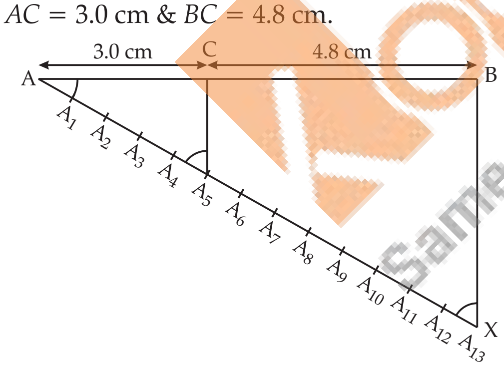
So, we copy $\angle AA_{13}B$ from point A_5.

Thus, $AC : CB = 5 : 8$.



On measuring AC and BC by scale,

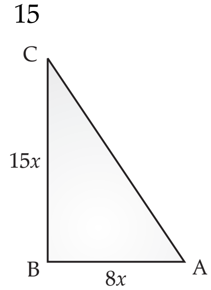
$AC = 3.0$ cm & $BC = 4.8$ cm.



1

25. 15 cot A = 8, find sin A and sec A.

$$\cot A = \frac{8}{15}$$



$$\frac{\text{Adj}}{\text{Oppo}} = \frac{8}{15}$$ ½

By Pythagoras Theorem

$$AC^2 = AB^2 + BC^2$$

$$AC = \sqrt{(8x)^2 + (15x)^2}$$

$$AC = 17x$$ ½

$$\sin A = \frac{15}{17}$$ ½

$$\sec A = \frac{17}{8}$$ ½

OR

By Pythagoras Theorem

$$QR = \sqrt{(13)^2 - (12)^2} \text{ cm}$$

$$QR = 5 \text{ cm}$$

$$\tan P = \frac{5}{12}$$ ½

$$\cot R = \frac{5}{12}$$ ½

$$\tan P - \cot R = \frac{5}{12} - \frac{5}{12}$$

$$= 0$$ **1**

26. 9, 17, 25, ...

$$S_n = 636$$

$$a = 9$$

$$d = a_2 - a_1$$

$$= 17 - 9 = 8$$

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

$$636 = \frac{n}{2}[2 \times 9 + (n-1)8]$$ ½

$$1272 = n[18 + 8n - 8]$$

$$1272 = n[10 + 8n]$$

$$8n^2 + 10n - 1272 = 0$$

$$4n^2 + 5n - 636 = 0$$ ½

$$n = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$n = \frac{-5 \pm \sqrt{5^2 - 4 \times 4 \times (-636)}}{2 \times 4}$$

$$n = \frac{-5 \pm 101}{8}$$ ½

$$n = \frac{96}{8} \qquad n = \frac{-106}{8}$$

$n = 12 \qquad n = \frac{-53}{4}$

$n = 12$ (since n cannot be negative) ½

PART - B

27. Let $\sqrt{3}$ be a rational number.

Then $\sqrt{3} = \frac{p}{q}$ HCF $(p, q) = 1$

Squaring both sides

$$(\sqrt{3})^2 = \left(\frac{p}{q}\right)^2$$

$$3 = \frac{p^2}{q^2} \qquad 1$$

$3q^2 = p^2$

3 divides p^2 » 3 divides p

3 is a factor of p

Take $p = 3C$

$3q^2 = (3C)^2$

$3q^2 = 9C^2$ **1**

3 divides q^2 » 3 divides q

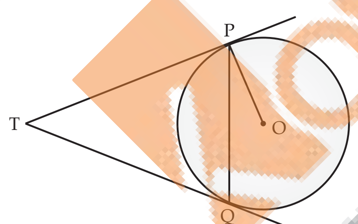
3 is a factor of q

Therefore 3 is a common factor of p and q

It is a contradiction to our assumption that p/q is rational.

Hence $\sqrt{3}$ is an irrational number. **1**

28.



Required to prove :-

$\angle PTQ = 2\angle OPQ$

Proof let $\angle PTQ = \theta$

Now by the theorem $TP = TQ$. So, TPQ is an isosceles triangle **1**

$\angle TPQ = \angle TQP = ½(180° - \theta)$

$= 90° - ½\theta$

$\angle OPT = 90°$ **1**

$\angle OPQ = \angle OPT - \angle TPQ = 90° - (90° - ½\theta)$

$= ½\theta$

$= ½\angle PTQ$

$\angle PTQ = 2\angle OPQ$ **1**

29. Let Meena has received x no. of ₹ 50 notes and y no. of ₹ 100 notes. So,

$50x + 100y = 2000$ ...(i)

$x + y = 25$ ...(ii)

multiply by 50

$50x + 100y = 2000$

$50x + 50y = 1250$ **1**

$- \quad - \quad -$

$50y = 750$

$y = 15$

Putting value of $y = 15$ in equation (ii) **1**

$x + 15 = 25$

$x = 10$

Meena has received 10 pieces ₹ 50 notes and 15 pieces of ₹ 100 notes. **1**

30. (i) 10, 11, 12… 90 are two digit numbers. There are 81 numbers. So, Probability of getting a two-digit number.

$= \frac{81}{90} = \frac{9}{10}$ **1**

(ii) 1, 4, 9, 16, 25, 36, 49, 64, 81 are perfect squares. So, Probability of getting a perfect square number.

$= \frac{9}{90} = \frac{1}{10}$ **1**

(iii) 5, 10, 15…. 90 are divisible by 5. There are 18 outcomes.. So, Probability of getting a number divisible by 5.

$= \frac{18}{90} = \frac{1}{5}$ **1**

OR

(i) Probability of getting *a* king of red colour.

P (King of red colour) $= \frac{2}{52} = \frac{1}{26}$ **1**

(ii) Probability of getting *a* spade

P (a spade) $= \frac{13}{52} = \frac{1}{4}$ **1**

(iii) Probability of getting a queen of diamonds

P (a queen of diamonds) $= \frac{1}{52}$ **1**

31. $r_1 = 6$ cm

$r_2 = 8$ cm

$r_3 = 10$ cm

Volume of sphere $= \frac{4}{3}\pi r^3$

Volume of the resulting sphere = Sum of the volumes of the smaller spheres. **1**

$$\frac{4}{3}\pi r^3 = \frac{4}{3}\pi r_1^3 + \frac{4}{3}\pi r_2^3 + \frac{4}{3}\pi r_3^3$$

$$\frac{4}{3}\pi r^3 = \frac{4}{3}\pi(r_1^3 + r_2^3 + r_2^3)$$

$$r^3 = 6^3 + 8^3 + 10^3 \qquad \textbf{1}$$

$$r^3 = 1728$$

$$r = \sqrt[3]{1728}$$

$$r = 12 \text{ cm} \qquad \textbf{1}$$

Therefore, the radius of the resulting sphere is 12 cm.

32. $\frac{(\sin A - \cos A + 1)}{(\sin A + \cos A - 1)} = \frac{1}{(\sec A - \tan A)}$

L.H.S. divide numerator and denominator by $\cos A$

$$= \frac{(\tan A - 1 + \sec A)}{(\tan A + 1 - \sec A)}$$

$$= \frac{(\tan A - 1 + \sec A)}{(1 - \sec A + \tan A)}$$

We know that $1 + \tan^2 A = \sec^2 A$

Or $1 = \sec^2 A - \tan^2 A$

$= (\sec A + \tan A)(\sec A - \tan A)$

$$= \frac{(\sec A + \tan A - 1)}{[(\sec A + \tan A)(\sec A - \tan A) - (\sec A - \tan A)]} \qquad \textbf{1}$$

$$= \frac{(\sec A + \tan A - 1)}{(\sec A - \tan A)(\sec A + \tan A - 1)}$$

$$= \frac{1}{(\sec A - \tan A)}$$ **Hence proved. 1**

33. Given :

Speed of boat = 18 km/hr

Distance = 24 km

Let x be the speed of stream.

Let t_1 and t_2 be the time for upstream and downstream.

As we know that,

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\Rightarrow \text{time} = \frac{\text{distance}}{\text{speed}} \qquad \textbf{½}$$

For upstream,

Speed = $(18 - x)$ km/hr

Distance = 24 km

Time = t_1

Therefore, $t_1 = \frac{24}{18 - x}$

For downstream,

Speed = $(18 + x)$ km/hr

Distance = 24 km

Time = t_2

Therefore,

$$t_2 = \frac{24}{18 - x} \qquad \textbf{½}$$

Now according to the question :

$$t_1 = t_2 + 1$$

$$\frac{24}{18 - x} = \frac{24}{18 + x} + 1 \qquad \textbf{½}$$

$$\Rightarrow \frac{24(18 + x) - 24(18 - x)}{(18 - x)(18 + x)} = 1$$

$\Rightarrow \quad 48x = (18 - x)(18 + x)$

$\Rightarrow \quad 48x = 324 + 18x - 18x - x^2$ **½**

$\Rightarrow \quad x^2 + 48x - 324 = 0$

$\Rightarrow \quad x^2 + 54x - 6x - 324 = 0$

$\Rightarrow \quad x(x + 54) - 6(x + 54) = 0$ **½**

$\Rightarrow \quad (x + 54)(x - 6) = 0$

$\Rightarrow \quad x = -54$ *or* $x = 6$

Since speed cannot be negative.

$\Rightarrow \quad x = -54$ will be rejected

$\therefore \quad x = 6$

Thus, the speed of stream is 6 km/hr. **½**

OR

Let one of the odd positive integer be x

then the other odd positive integer is $x + 2$

their sum of squares $= x^2 + (x + 2)^2$

$= x^2 + x^2 + 4x + 4$

$= 2x^2 + 4x + 4$

Given that their sum of squares = 290

$\Rightarrow \quad 2x^2 + 4x + 4 = 290$ **1**

$\Rightarrow \quad 2x^2 + 4x = 290 - 4 = 286$

$\Rightarrow \quad 2x^2 + 4x - 286 = 0$

$\Rightarrow \quad 2(x^2 + 2x - 143) = 0$

$\Rightarrow \quad x^2 + 2x - 143 = 0$

$\Rightarrow \quad x^2 + 13x - 11x - 143 = 0$ **1**

$\Rightarrow x(x + 13) - 11(x + 13) = 0$

$\Rightarrow \quad (x - 11)(x + 13) = 0$

$\Rightarrow \quad (x - 11) = 0, (x + 13) = 0$

Therefore, $x = 11$ *or* -13

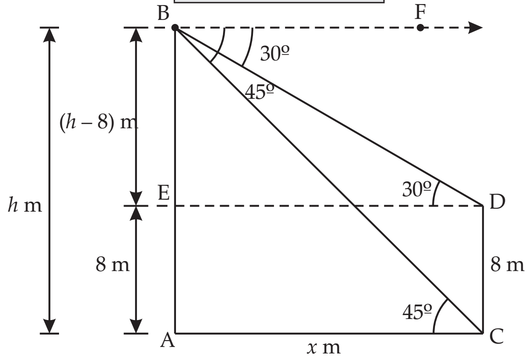
According to question, x is a positive odd integer. Hence, We take positive value of x

So, $\quad x = 11$ and $(x + 2) = 11 + 2 = 13$

Therefore, the odd positive integers are 11 and 13. **1**

PART - B

34.



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Let AB and CD be the multi-storied building and the building respectively.

Let the height of the multi-storied building = h m and the distance between the two buildings = x m.

$$AE = CD = 8 \text{ m [Given]}$$

$$BE = AB - AE = (h - 8) \text{ m}$$

and $\quad AC = DE = x$ m [Given]

Also,

$$\angle FBD = \angle BDE = 30° \text{ (Alternate angles)}$$

$$\angle FBC = \angle BCA = 45° \text{ (Alternate angles)} \quad \mathbf{1}$$

Now, In $\Delta\, ACB$,

$$\Rightarrow \tan 45° = \frac{AB}{AC} \left[\because \tan\theta = \frac{\text{Perpendicular}}{\text{Base}}\right]$$

$$\Rightarrow \quad 1 = \frac{h}{x}$$

$$\Rightarrow \quad x = h \qquad \text{...(i)}$$

In Δ BDE,

$$\Rightarrow \tan 30° = \frac{BE}{ED}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h-8}{x}$$

$$\Rightarrow \quad x = \sqrt{3}(h-8) \qquad \text{...(ii) } \mathbf{1}$$

From (i) and (ii), we get,

$$h = \sqrt{3}h - 8\sqrt{3}$$

$$\sqrt{3}h - h = 8\sqrt{3}$$

$$h(\sqrt{3} - 1) = 8\sqrt{3}$$

$$h = \frac{8\sqrt{3}}{\sqrt{3}-1} \qquad \mathbf{1}$$

$$h = \frac{8\sqrt{3}}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1}$$

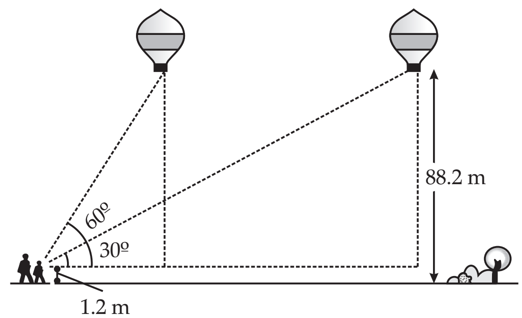
$$h = 4\sqrt{3}\,(\sqrt{3}+1)$$

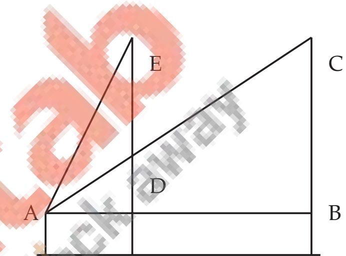
$$h = 12 + 4\sqrt{3} \text{ m}$$

Distance between the two building

$$x = \left(12 + 4\sqrt{3}\right) \text{m} \qquad \text{[From (i)] } \mathbf{1}$$

OR





From the figure, the angle of elevation for the first position of the balloon $\angle EAD$ = 60° and for second position $\angle BAC$ = 30°.The vertical distance

$$ED = CB = 88.2 - 1.2 = 87 \text{ m.}$$

Let $\quad AD = x$ m and $AB = y$ m. **1**

Then in right $\Delta\, ADE$,

$$\tan 60° = \frac{DE}{AD}$$

$$\sqrt{3} = \frac{87}{x}$$

$$x = \frac{87}{\sqrt{3}} \qquad \text{...(i) } \mathbf{1}$$

In right ΔABC,

$$\tan 30° = \frac{BC}{AB}$$

$$\frac{1}{\sqrt{3}} = \frac{87}{y}$$

$$y = 87\sqrt{3} \qquad \text{...(ii) } \mathbf{1}$$

Subtracting (i) and (ii)

$$y - x = 87\sqrt{3} - \frac{87}{\sqrt{3}}$$

$$y - x = \frac{87 \times 2}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$y - x = 58\sqrt{3} \text{ m}$$

Hence, the distance travelled by the balloon is equal to BD

$$y - x = 58\sqrt{3} \text{ m.}$$ **2**

35. Let A be the first term and D be the common difference of $A.P.$

$T_p = a = A + (p - 1) D = (A - D) + pD$ ...(1) ½

$T_q = b = A + (q - 1) D = (A - D) + qD$ ...(2) ½

$T_r = c = A + (r - 1) D = (A - D) + rD$ ...(3) ½

Here we have got two unknowns A and D which are to be eliminated. We multiply (1),(2) and (3) by $q - r$, $r - p$ and $p - q$ respectively and add :

$a (q - r) = (A - D) (q - r) + Dp (q - r)$ ½

$b (r - p) = (A - D) (r - p) + Dq (r - p)$ ½

$c (p - q) = (A - D) (p - q) + Dr (p - q)$ ½

$a (q - r) + b (r - p) + c (p - q)$ **1**

$= (A - D) [q - r + r - p + p - q] + D [p (q - r) + q (r - p) + r (p - q)]$

$= (A - D) (0) + D [pq - pr + qr - pq + rp - rq)$

$= 0.$ **1**

36.

Height (in cm)	f	C.F.
below 140	4	4
140-145	7	11
145-150	18	29
150-155	11	40
155-160	6	46
160-165	5	51

1

$$N = 51 \Rightarrow \frac{N}{2} = \frac{51}{2} = 25.5$$

As 29 is just greater than 25.5, therefore median class is 145 – 150.

$$\text{Median} = l + \frac{\left(\frac{N}{2} - C\right)}{f} \times h$$

Here, l = lower limit of median class =145

C = C.F. of the class preceding the median class = 11 ½

h = higher limit – lower limit = 150 − 145 = 5

f = frequency of median class =18

∴ median =

$$= 145 + \frac{(25.5 - 11)}{18} \times 5$$ ½

$= 149.03$

Mean by direct method **1**

Height (in cm)	f	xi	fxi
below 140	4	137.5	550
140 – 145	7	142.5	997.5
145 – 150	18	147.5	2655
150 – 155	11	152.5	1677.5
155 – 160	6	157.5	945
160 – 165	5	162.5	812.5

1

$$\text{Mean} = \frac{\sum fx}{N}$$

$$= \frac{7637.5}{51}$$

$= 149.75.$ **1**