Class-X

Mathematics Standard (041)

SEC-A

1. (b) infinite

2. (d) ab = 6

3. ~~(a) 7~~ (b) 3

4. (d) 10

5. (a) $x^2 - 4x + 1 = 0$

6. (a) $-\frac{17}{7}$

7. (d) 3 units

8. (c) 6.5 cm

9. (c.) 8000 m^3

10. (b) 21

11. (a) 3 cm

12. (a) $\sin 60^\circ$

13. (b) $\angle B = \angle D$

14. (c) −32

15. (c) $\frac{3}{4}$

16. (a) 30°

17. (b) $\frac{7}{0.04}$

18. (a) decreases by 2

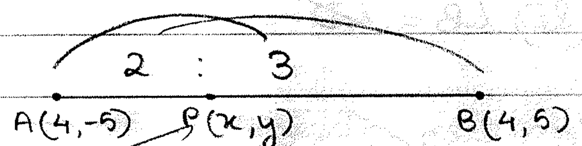
19. (C) Assertion (A) is true, but Reason (R) is false.

20. (C) Assertion (A) is true, but Reason (R) is false.
[only $\boxed{1 \text{ prime factor} = 5}$ ∵ prime factorisation of a prime number is the number itself]

SEC-B

21. A(4, −5) and B(4, 5)

(a) Let the coordinates of point P which divides AB such that AP : AB = 2 : 5 be P(x, y).



$$\frac{AP}{AB} = \frac{2}{5}$$

$$\Rightarrow \frac{AP + PB}{AP} = \frac{5}{2}$$

$$\Rightarrow 2PB = 3AP \quad \Rightarrow AP : PB = 2 : 3$$

P divides AB internally in the ratio of 2:3

By section formula,

$$P(x,y) = P\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}\right)$$

$$\Rightarrow P(x,y) = P\left(\frac{2\times 4+3\times 4}{2+3}, \frac{2\times 5+3\times(-5)}{2+3}\right)$$

$$\Rightarrow P(x,y) = P\left(\frac{20}{5}, \frac{-5}{5}\right) = P(4,-1)$$

$\therefore$ Coordinates of P are $\boxed{P(4,-1)}$

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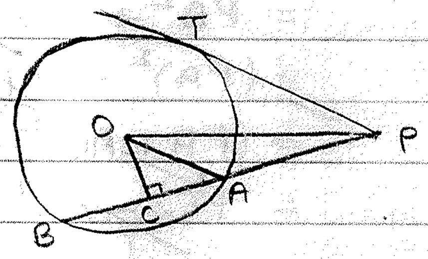
22. Given: Circle with centre O

PT is a tangent

$OC \perp AB$

To Prove: $PA \cdot PB = PC^2 - AC^2$



Proof: Perpendicular from centre to chord bisects it

$\Rightarrow$ C is midpoint of AB (∵ $\angle OCA = 90°$, given)

$\Rightarrow BC = CA = \frac{AB}{2}$

$\Rightarrow AB = 2AC$

By Pythagoras Theorem,

In right ΔOCA, $OA^2 = OC^2 + AC^2$

In right ΔOCP, $OP^2 = OC^2 + PC^2$

$$\begin{aligned} LHS &= PA \cdot PB \\ &= PA \times (PA + AB) \\ &= PA^2 + PA \cdot AB \\ &= PA^2 + PA \cdot 2AC \quad \text{(from ①)} \\ &= (PA)^2 + 2(PA)(AC) \\ &= (PA + AC)^2 - AC^2 \quad [(a+b)^2 = a^2 + 2ab + b^2] \\ &= PC^2 - AC^2 = RHS \end{aligned}$$

Hence, proved

23. First number = 96

Second number = 120

$$96 = 2^5 \times 3$$

$$120 = 2^3 \times 3 \times 5$$

$$\begin{array}{r|l} 2 & 96 \\ \hline 2 & 48 \\ \hline 2 & 24 \\ \hline 2 & 12 \\ \hline 2 & 6 \\ \hline & 3 \end{array} \qquad \begin{array}{r|l} 2 & 120 \\ \hline 2 & 60 \\ \hline 2 & 30 \\ \hline 3 & 15 \\ \hline & 5 \end{array}$$

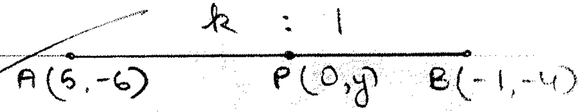
$$\text{HCF}(96, 120) = 2^3 \times 3$$
$$= 8 \times 3$$
$$= 24$$

$$\text{LCM}(96, 120) = 2^5 \times 3 \times 5$$
$$= 32 \times 3 \times 5$$
$$= 480$$

$\therefore$ $\text{HCF}(96, 120) = \boxed{24}$ and $\text{LCM}(96, 120) = \boxed{480}$

P.T.O.

24. Points are A(5, -6) and B(-1, -4)
Let the point where y-axis (x = 0) intersects AB be P(0, y)



Let the ratio in which P(0, y) divides AB be k : 1

By section formula,

$$P(x, y) = \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$$

$$\Rightarrow P(0, y) = \left(\frac{-k+5}{k+1}, \frac{-4k+(-6)}{k+1}\right)$$

$$\Rightarrow 0 = \frac{-k+5}{k+1} \quad \text{and} \quad y = \frac{-4k-6}{k+1}$$

$$\Rightarrow 0 = -k+5$$

$$\Rightarrow k = 5$$

$$\Rightarrow k : 1 = 5 : 1$$

$\therefore$ Ratio is $\boxed{5:1}$

25 (a) $a\cos\theta + b\sin\theta = m$

$a\sin\theta \cancel{+} - b\cos\theta = n$

<u>To prove:</u> $a^2 + b^2 = m^2 + n^2$

$a\cos\theta + b\sin\theta = m$

Squaring both sides,

$a^2\cos^2\theta + b^2\sin^2\theta + 2ab\sin\theta\cos\theta = m^2$ $\left[(a+b)^2 = a^2 + b^2 + 2ab\right]$

$a\sin\theta - b\cos\theta = n$

Squaring both sides,

$a^2\sin^2\theta + b^2\cos^2\theta - 2ab\sin\theta\cos\theta = n^2$ $\left[(a-b)^2 = a^2 + b^2 - 2ab\right]$

Adding ① and ②,

$(a^2\cos^2\theta + a^2\sin^2\theta) + (b^2\sin^2\theta + b^2\cos^2\theta) + \cancel{2ab\sin\theta\cos\theta}$
$\cancel{-2ab\sin\theta\cos\theta} = m^2 + n^2$

$\Rightarrow a^2(\sin^2\theta + \cos^2\theta) + b^2(\sin^2\theta + \cos^2\theta) = m^2 + n^2$

$\because \sin^2\theta + \cos^2\theta = 1$

$\Rightarrow a^2 + b^2 = m^2 + n^2$

LHS = RHS

Hence, proved

SEC-C

26. (a) Let us assume, to the contrary, that

$\sqrt{3}$ is rational.

$\Rightarrow \sqrt{3} = \frac{p}{q}$ where $q \neq 0$, p and q are coprime positive integers

Squaring both sides,

$\Rightarrow 3 = \frac{p^2}{q^2}$

$\Rightarrow p^2 = 3q^2$

$\Rightarrow$ 3 divides p^2

$\Rightarrow$ 3 divides p (∵ 3 is prime)

So, let $p = 3m$

Substituting in,

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

$\Rightarrow 9m^2 = 3q^2$

$\Rightarrow q^2 = 3m^2$

$\Rightarrow$ 3 divides q^2

$\Rightarrow$ 3 divides q

From ③ and ④,
3 divides both p and q
But p and q are coprime, i.e. $HCF(p, q) = 1$ (Using ①)
which is a contradiction
$\therefore$ our supposition is wrong
$\therefore$ $\sqrt{3}$ must be irrational.
Hence, proved

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27 Let the first term of AP be a
and common difference be d
AP: $a, a+d, a+2d, \ldots$
$a_n = a + (n-1)d$

$a_p = a + (p-1)d = q$
$\Rightarrow a + pd - d = q$
$a_q = a + (q-1)d = p$
$\Rightarrow a + qd - d = p$

Subtracting ① from ②,

$$a + qd - d = p$$
$$\ominus \quad a + pd - d = q$$
$$\overline{(q-p)d = p-q}$$
$$\Rightarrow d = -1$$

Substituting in ①,

$$a + p(-1) - (-1) = q$$
$$\Rightarrow a + 1 = p + q$$

$$a_n = a + (n-1)d$$
$$= a + (n-1)(-1)$$
$$= a - n + 1$$
$$= (a+1) - n$$
$$= p + q - n \qquad \text{(Substituting from ③)}$$

LHS = RHS

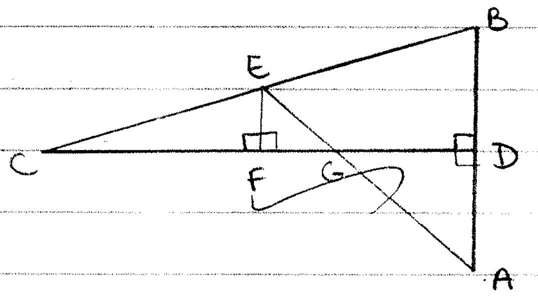
Hence, proved

28 (a) Given: CD is $\perp$ bisector of AB

EF $\perp$ CD

AE intersects CD at G

To Prove: $\dfrac{CF}{CD} = \dfrac{FG}{DG}$



Proof: In $\triangle EFG$ and and $\triangle ADG$,

$\angle EFG = \angle ADG = 90^\circ$ (given, linear pair with $\angle EFC$ and $\angle BDG$)

$\angle EGF = \angle AGD$ (vertically opposite angles)

$\therefore \triangle EFG \sim \triangle ADG$ (by AA similarity criterion)

$\Rightarrow \dfrac{EF}{AD} = \dfrac{FG}{DG}$ (~~cpst~~)

In $\triangle ECF$ and $\triangle BCD$,

$\angle EFC = \angle BDC = 90^\circ$ (given)

$\angle ECF = \angle BCD$ (common angle)

$\therefore \triangle ECF \sim \triangle BCD$ (by AA similarity criterion)

$\Rightarrow \dfrac{EF}{BD} = \dfrac{CF}{CD}$ (~~cpst~~)

But $AD = BD$ $\quad$ ($\because$ CD bisects AB)

$$\Rightarrow \frac{EF}{AD} = \frac{EF}{BD} = \frac{CF}{CD} \quad (2)$$

From (1) and (2),

$$\frac{EF}{AD} = \frac{CF}{CD} = \frac{\cancel{FD}\ FG}{DG}$$

$$\therefore \cancel{FG}\ \frac{CF}{CD} = \frac{FG}{DG}$$

Hence, proved

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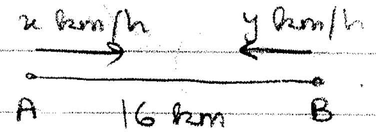
29. Let the speed of person 1 be x km/h
and speed of person 2 be y km/h $\quad (x > y)$

distance = speed $\times$ time

Given distance = 16 km

Case 1 : Towards each other



Time = 2 h

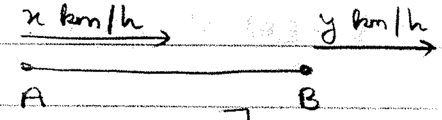
Speed = $(x+y)$ km/h

Distance = $2(x+y)$ km

$\Rightarrow \quad 16 = 2x + 2y$

$\Rightarrow \quad x + y = 8$

Case 2 Same direction



Time = 8 h

Speed = $(x-y)$ km/h

Distance (only AB) = $8(x-y)$ $\quad [16 + 8y = 8x]$

$\Rightarrow \quad 16 = 8x - 8y$

$\Rightarrow \quad x - y = 2$

Adding ① and ②,

$$\begin{array}{r} x + y = 8 \\ + \; x - y = 2 \\ \hline 2x = 10 \\ \hline \end{array}$$

$\Rightarrow x = 5$

Substituting in 1,

$$y = 3 \cancel{\text{km}}$$

$\therefore$ Speed of person 1 = $\boxed{5\ \text{km/h}}$

Speed of person 2 = $\boxed{3\ \text{km/h}}$

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30. $$\frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta} = 1 + \sec\theta\,\text{cosec}\,\theta$$

$$\text{LHS} = \frac{\tan\theta}{1-\cot\theta} + \frac{\cot\theta}{1-\tan\theta}$$

$$= \frac{\tan\theta}{1-\frac{1}{\tan\theta}} + \frac{\frac{1}{\tan\theta}}{1-\tan\theta}$$

$$= \frac{\tan^2\theta}{\tan\theta-1} + \frac{1}{\tan\theta(1-\tan\theta)}$$

$$= \frac{\tan^2\theta}{\tan\theta - 1} - \frac{1}{\tan\theta(\tan\theta - 1)}$$

$$= \frac{\tan^3\theta - 1}{(\tan\theta - 1)\tan\theta}$$

$$= \frac{\cancel{(\tan\theta - 1)}(\tan^2\theta + 1 + \tan\theta)}{\tan\theta\cancel{(\tan\theta - 1)}}$$

$\left[(a-b)(a^2+b^2+ab) = a^3 - b^3\right]$

$$= \frac{1 + \tan^2\theta + \tan\theta}{\tan\theta}$$

$$= \frac{\tan\theta + \sec^2\theta}{\tan\theta}$$

$(1 + \tan^2\theta = \sec^2\theta)$

$$= \frac{\tan\theta}{\tan\theta} + \frac{\sec^2\theta}{\tan\theta}$$

$$= 1 + \frac{1}{\cos^2\theta} \times \frac{\cos\theta}{\sin\theta}$$

$\left(\sec\theta = 1/\cos\theta \quad \tan\theta = \sin\theta/\cos\theta\right)$

$$= 1 + \frac{1}{\cos\theta\sin\theta}$$

$$= 1 + \sec\theta\,\mathrm{cosec}\,\theta$$

$= \text{RHS}$

Hence, proved

31.

Classes	Frequency (f_i)	Midpoints (x_i)	$u_i = \frac{x_i - A}{h}$	$f_i u_i$
25 - 30	14	27.5	-3	-42
30 - 35	22	32.5	-2	-44
35 - 40	16	37.5	-1	-16
40 - 45	6	A 42.5	0	0
45 - 50	5	47.5	1	5
50 - 55	3	52.5	2	6
55 - 60	4	57.5	3	12
	$\Sigma f_i = 70$			$\Sigma f_i u_i = -79$

$$\text{Mean} = \bar{x} = A + \frac{h \Sigma f_i u_i}{\Sigma f_i}$$

$$= 42.5 + \frac{5 \times (-79)}{70}$$

$$= 42.5 - \frac{395}{70}$$

$$= 42.5 - 5.642$$

$$= 36.858 \approx 36.86$$

$\therefore$ Mean = 36.86 (approx)

SEC-D

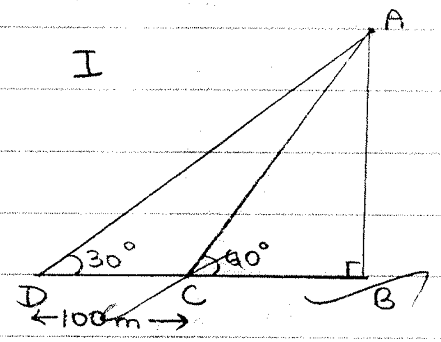
32. Introduction

2 cases are formed

A = hot-air balloon

C = first observer

D = second observer

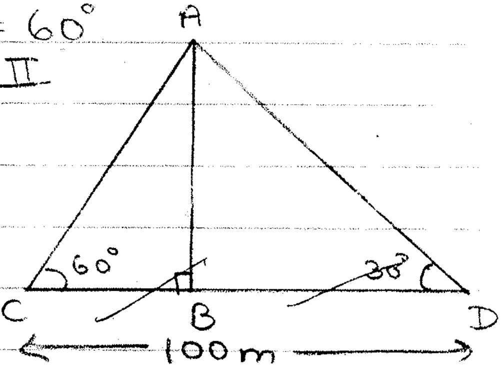


Angle of ~~elevation~~ of A from C = $\angle ACB = 60^\circ$

Angle of elevation of A from ~~B~~D

$= \angle ADB = 30^\circ$

CD = 100 m



(a). Let height of basket = AB = h m

Case I : In $\triangle ABC$, In $\triangle ABD$,

$\tan 60^\circ = \frac{AB}{BC}$, $\tan 30^\circ = \frac{AB}{BD}$

$\Rightarrow \sqrt{3} = \frac{h}{BC}$ $\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BC+100}$

$\Rightarrow BC = \frac{h}{\sqrt{3}}$ (1) $\Rightarrow BC + 100 = h\sqrt{3}$

$BC + 100 = h\sqrt{3}$

$\Rightarrow \frac{h}{\sqrt{3}} + 100 = h\sqrt{3}$

$\Rightarrow 100 = h\sqrt{3} - \frac{h\sqrt{3}}{3}$

$\Rightarrow \frac{2h\sqrt{3}}{3} = 100$

$\Rightarrow h = \frac{150}{\sqrt{3}} = 50\sqrt{3}$ m

$\therefore$ Height of basket $= \boxed{50\sqrt{3} \text{ m}}$

<u>Case 2</u>: In ΔABC,

$\tan 60^\circ = \frac{AB}{BC}$

$\Rightarrow \sqrt{3} = \frac{h}{BC}$

$\Rightarrow BC = \frac{h}{\sqrt{3}}$

In ΔABD,

$\tan 30^\circ = \frac{AB}{BD}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{BD}$

$\Rightarrow BD = h\sqrt{3}$

$BC + BD = 100\ m$

$\Rightarrow \dfrac{h}{\sqrt{3}} + h\sqrt{3} = 100$

$\Rightarrow \dfrac{4h\sqrt{3}}{3} = 100$

$\Rightarrow h = 25\sqrt{3}$

$\therefore$ Height of basket = $\boxed{25\sqrt{3}\ m}$

(b). Case 1 : Dist. of A from C = AC

In $\triangle ABC$,

$\sin 60^\circ = \dfrac{AB}{AC}$

$\Rightarrow \dfrac{\sqrt{3}}{2} = \dfrac{50\sqrt{3}}{AC}$

$\Rightarrow AC = 100\ m$

$\therefore$ Distance of basket from first observer = $\boxed{100\ m}$

Case 2: Dist. of A from C = AC

In $\triangle ABC$,

$$\sin 60^\circ = \frac{AB}{AC}$$

$$\Rightarrow \frac{\sqrt{3}}{2} = \frac{25\sqrt{3}}{AC}$$

$$\Rightarrow AC = 50\text{ m}$$

$\therefore$ Distance of basket from first observer = $\boxed{50\text{ m}}$

(c) Case 1: To find - BD

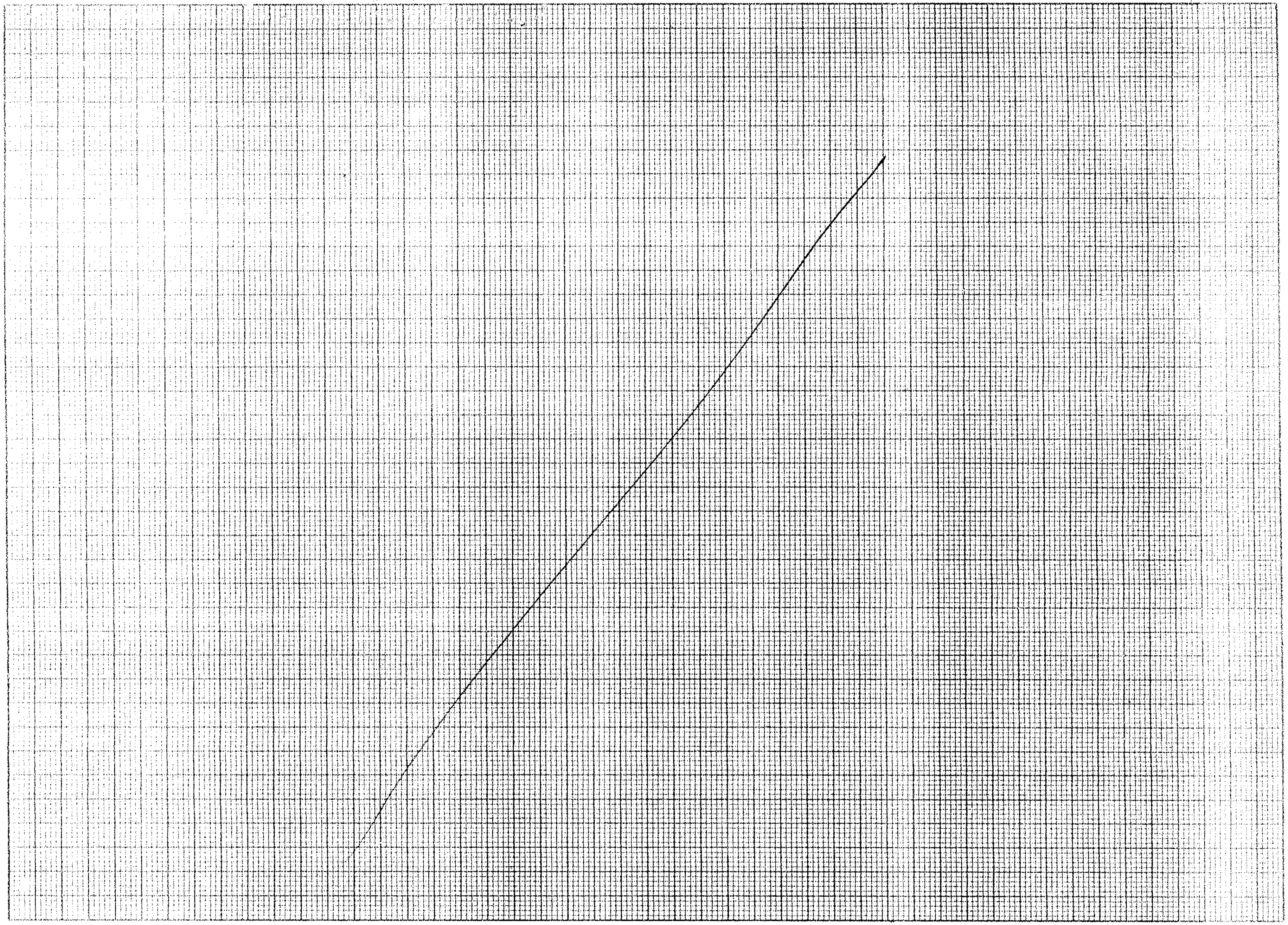
$$BD = BC + CD$$

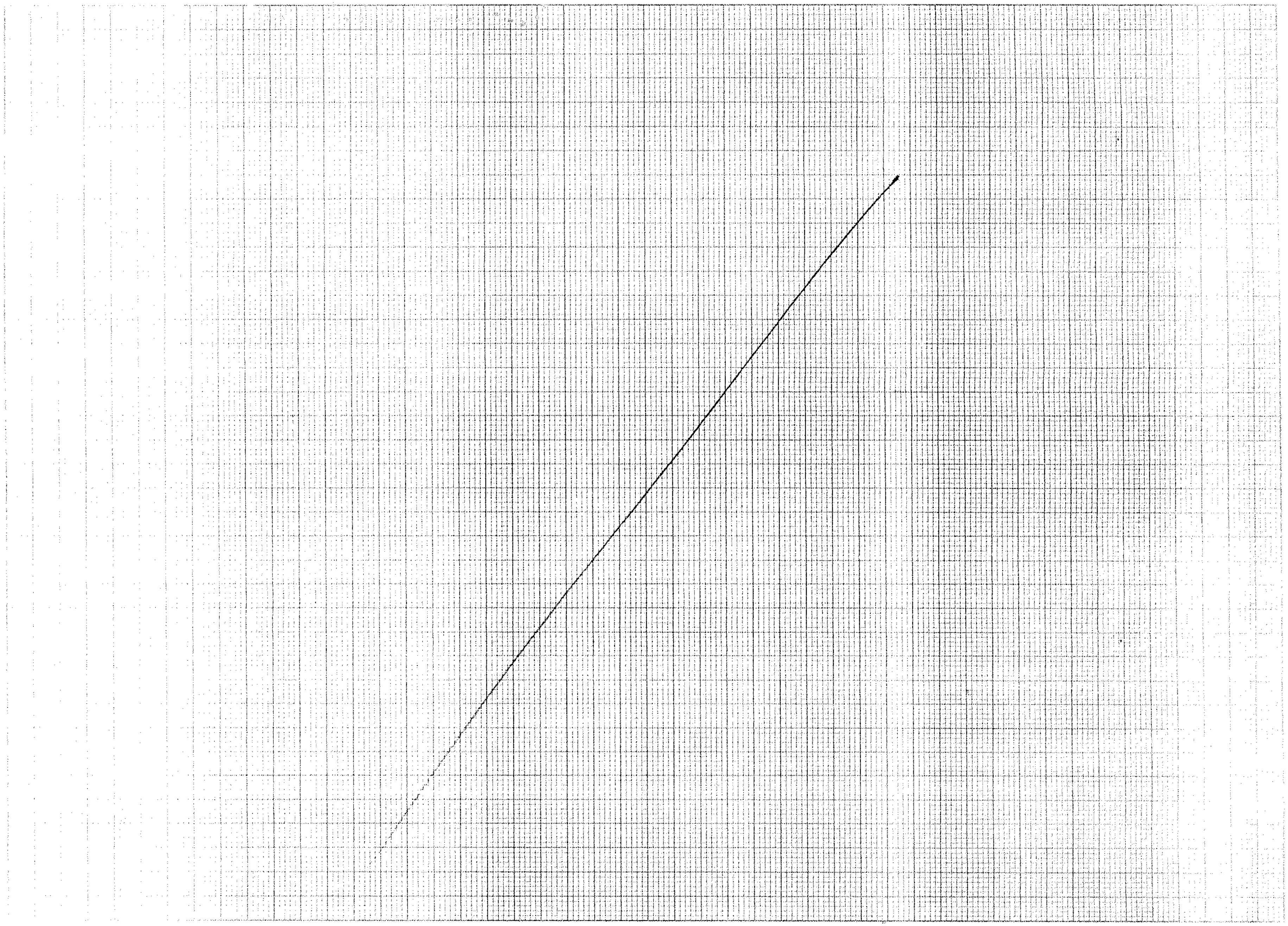
$$= \frac{h}{\sqrt{3}} + 100 \qquad \text{(from (1))}$$

$$= \frac{50\sqrt{3}}{\sqrt{3}} + 100$$

$$= 50 + 100 = 150$$

$\therefore$ Horizontal distance BD = $\boxed{150\text{ m}}$





Case 2 : To find - BD

$BD = h\sqrt{3}$ (from (2))

$= 25\sqrt{3} \times \sqrt{3}$

$= 75$

$\therefore$ Horizontal distance $BD = \boxed{75\text{ m}}$

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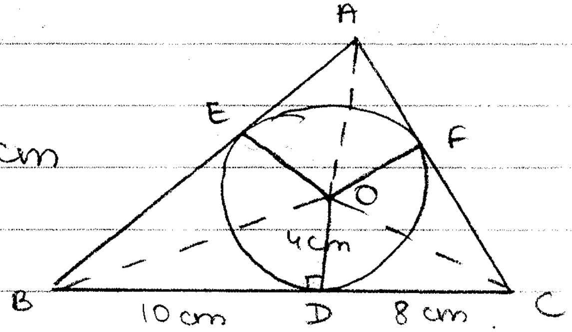
33. (a.) Given : $\triangle ABC$

Incircle with radius $r = 4$ cm

$BD = 10$ cm

$CD = 8$ cm

$ar(ABC) = 90\text{ cm}^2$



To find : Lengths of AB and AC.

Construction : Join OE, OF, OA, OB, OC

$OD = OE = OF = r = 4$cm (radii)

Tangents from same external point are equal in length.

From pt. A, $AE = AF = x$ (let it be)

From pt. B, $BE = BD = 10$ cm

From pt. C, $CD = CF = 8$ cm

Area of $\Delta = \frac{1}{2} \times b \times h$

Area of ΔABC = Area of ΔOAB + Area of ΔOBC + Area of ΔOCA

$$\Rightarrow 90 = \frac{1}{2} \times OE \times AB + \frac{1}{2} \times OD \times BC + \frac{1}{2} \times OF \times AC$$

$$\Rightarrow 90 = \frac{1}{2} \times r \times (AE + BE) + \frac{1}{2} \times r \times (BD + CD) + \frac{1}{2} \times r \times (CF + AF)$$

$$\Rightarrow 90 = \frac{1}{2} \times r \times (x + 10) + \frac{1}{2} \times r \times (10 + 8) + \frac{1}{2} \times r \times (8 + x)$$

$\Rightarrow 90 = \frac{1}{2} \times 4\ (x + 10 + 10 + 8 + 8 + x)$

$\Rightarrow 45 = 2x + 36$

$\Rightarrow 2x = 9$

$\Rightarrow x = 4.5$

$AB = AE + BE = 4.5 + 10 = 14.5\text{ cm}$

$AC = AF + CF = 4.5 + 8 = 12.5\text{ cm}$

$\therefore AB = \boxed{14.5\text{ cm}}$

$AC = \boxed{12.5\text{ cm}}$

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34. Let the original average speed be x km/h.

Original: distance $= 54$ km

speed $= x$ km/h

time $= \dfrac{\text{distance}}{\text{speed}} = \dfrac{54}{x}$ h

New : distance = 63 km

speed = $(x+6)$ km/h

time = $\frac{\text{distance}}{\text{speed}} = \frac{63}{x+6}$ h

$$\frac{54}{x} + \frac{63}{x+6} = 3$$

$$\Rightarrow 3\left(\frac{18}{x} + \frac{21}{x+6}\right) = 3$$

$$\Rightarrow \frac{18x + 108 + 21x}{x^2 + 6x} = 1$$

$$\Rightarrow 39x + 108 = x^2 + 6x$$

$$\Rightarrow x^2 - 33x - 108 = 0$$

$$\Rightarrow x^2 - 36x + 3x - 108 = 0$$

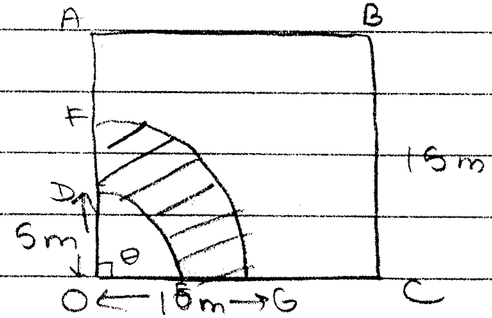
$$\Rightarrow x(x-36) + 3(x-36) = 0$$

$$\Rightarrow (x-36)(x+3) = 0$$

$$\Rightarrow x = 36 \text{ or } x = -3$$

$\because$ speed cannot be negative,
$x = -3$ will be neglected.
$\Rightarrow x = 36$

$\therefore$ Average speed of train (original) = $\boxed{36 \text{ km/h}}$



35 Square field OABC
Side = s = 15 m

Quadrant
$\angle DOE = \theta = 90^\circ$ (all angles of square $= 90^\circ$)
Radius = length of rope
$= r = 5$ m

Area grazed by horse = Area of sector DOE
$$= \frac{\theta}{360^\circ} \times \pi \times r^2$$

32

$$= \frac{\cancel{90}}{\cancel{360}_{4}} \times \frac{\cancel{3.14}^{157}}{\cancel{100}_{2}} \times 5 \times 5$$

$$= \frac{3925}{200}$$

$$= \boxed{1.9625 \text{ m}^2}$$

$$\begin{array}{r} 157 \\ 25 \\ \hline 785 \\ 314 \times \\ \hline 3925 \times 3 \\ 2 \quad 11775 \\ = 1962.5 \end{array}$$

Now, new radius = new length of rope = R = 10m

Increase in grazing area = Area of sector FOG − Area of sector DOE

$$= \frac{\theta}{360^\circ} \times \pi \times R^2 - \frac{\theta}{360^\circ} \times \pi \times r^2$$

$$= \frac{90}{360} \times \frac{314}{100} \times (10^2 - 5^2)$$

$$= \frac{\cancel{90}}{\cancel{360}_{4\,2}} \times \frac{\cancel{314}^{157}}{100} \times 15 \times 5 \qquad \boxed{a^2 - b^2 = (a+b)(a-b)}$$

$$= \frac{11775}{200}$$

$= \boxed{5.8875 \text{ m}^2}$

$\therefore$ Original area grazed $= \boxed{1.9625 \text{ m}^2}$

Increase in area $= \boxed{5.8875 \text{ m}^2}$

SEC-E

36. Golf ball = Sphere

Radius $= R = \frac{4.2}{2} = 2.1$ cm

Dimple = Hemisphere

Radius $= r = 2$ mm $= 0.2$ cm

(i) SA of 1 dimple = CSA of hemisphere

$= 2\pi r^2$

$= 2 \times \frac{22}{7} \times \frac{2}{10} \times \frac{2}{10}$

$$= \frac{176}{700} \text{ cm}^2$$

$$= \boxed{0.2514 \text{ cm}^2}$$

(ii) Vol to make 1 dimple $= $ Vol. of hemisphere

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

$$= \frac{2}{3} \times \frac{22}{7} \times \frac{2}{10} \times \frac{2}{10} \times \frac{2}{10}$$

$$= \frac{352}{21000}$$

$$= \boxed{0.01676 \text{ cm}^3}$$

21000) 3520 (0.01676
35200
21000
142000
126000
160000
147000
13000

(iii) (b) Vol of golf ball $=$ Vol. of sphere $-$ Vol of 315 hemispheres

$$= \frac{4}{3}\pi R^3 - \frac{2}{3}\pi r^3 \times 315$$

$$= \frac{4}{\cancel{3}} \times \frac{22}{\cancel{7}} \times \frac{\cancel{21}}{10} \times \frac{21}{10} \times \frac{21}{10} - \frac{2}{\cancel{3}} \times \frac{22}{\cancel{7}} \times \frac{2}{10} \times \frac{2}{10} \times \frac{\cancel{2}^{3}}{\cancel{10}} \times \cancel{315}^{15}$$

$= 38.808 - 5.28$

$= \cancel{33.688}\ \cancel{33.588}\ \boxed{33.528\ cm^3}$

37 (i) Spinner I - Spinner II

Red (R) - Red (R) { RR,

Red (R) - Blue (B) RB,

Red (R) - Green (G) RG,

Green (G) - Red (R) GR,

Green (G) - Blue (B) GB,

Green (G) - Green (G) GG,

~~B~~ Yellow (Y) - Red (R) YR,

Yellow (Y) - Blue (B) YB,

Yellow (Y) - Green (G) YG }

Total no. of outcomes = $\boxed{9}$

(ii) $X = \{RB\}$

Favourable outcomes = 1

$$P\left(\begin{matrix}\text{making}\\ \text{purple}\end{matrix}\right) = \frac{\text{No. of favourable outcomes}}{\text{Total no. of outcomes}} = \boxed{\frac{1}{9}}$$

(iii) (a) No. of participants = 99

Winning

No. $= \frac{1}{9} \times 99 = 11$

Amount = ₹(−10) (school has to pay)

Value = ₹(−110) [loss]

Loss

No. = 99 − 11 = 88

Amount = ₹5 (pay to school)

Value = ₹440 [gain]

Net = + 440 − 110

= + 330

∴ So, the school most likely collected $\boxed{\text{Rs. } 330}$

38.

(i) $p(t) = 20t - 16t^2$

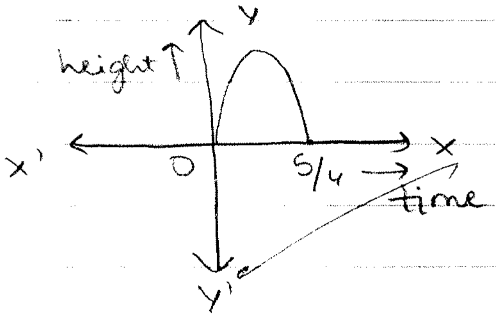
$20t - 16t^2 = 0$

$\Rightarrow -4t(4t-5) = 0$

$\Rightarrow t = 0$ or $t = \frac{5}{4}$

$\therefore$ Zeroes of $p(t) = 20t - 16t^2$ are $\boxed{0 \text{ and } \frac{5}{4}}$

(ii) (a).



→ opens downwards $(a < 0)$

→ intersects x-axis at $(0,0)$ and $\left(\frac{5}{4}, 0\right)$

(iii) (b) Water level is hit when $h = 0$

$h = 20t - 16t^2$

$\Rightarrow 0 = -4t(4t-5)$

$\Rightarrow t = 0$ or $t = \frac{5}{4}$

$\because$ Dolphin has started at $t = 0$

$\Rightarrow$ at $t = \frac{5}{4}$, dolphin reaches water level again.

distance covered = speed $\times$ time

$= 20 \text{ cm}/\text{s} \times \frac{5}{4} \text{ s}$ 2

$= \boxed{25 \text{ cm}}$

END :)