Q. No. 2 Part (i) $3(x^2-1) = 4x+4$

a. Standard form $(ax^2 + bx + c = 0)$

$$3x^2 - 3 - 4x - 4 = 0$$

$$\boxed{3x^2 - 4x - 7 = 0}$$

b. Value of a, b, c

$$3x^2 - 4x - 7 = 0$$

$$ax^2 + bx + c = 0 \quad \text{(comparing)}$$

$$\Rightarrow \quad \boxed{a = 3} \quad \boxed{b = -4} \quad \boxed{c = -7}$$

b. Solution

$$3x^2 - 4x - 7 = 0$$

By using quadratic formula:

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

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(3)(-7)}}{2(3)}$$

$$x = \frac{4 \pm \sqrt{100}}{6}$$

$$x = \frac{4 \pm 10}{6}$$

Either $x = \frac{4+10}{6}$ or $x = \frac{4-10}{6}$

$x = \frac{14}{6}$ or $x = \frac{-6}{6}$

$\boxed{x = \frac{7}{3}}$ or $\boxed{x = -1}$

Solution Set $= \left\{ \frac{7}{3}, -1 \right\}$

Q. No. 2 Part (ii) $4 \cdot 4^x + \frac{4}{4^x} = 10$

Let $4^x = y$

$$4 \cdot y + \frac{4}{y} = 10$$

Multiplying 'y' with each term:

$$y(4y) + \left(\frac{4}{\cancel{y}}\right)\cancel{y} = 10(y)$$

$$4y^2 + 4 = 10y$$

$$4y^2 - 10y + 4 = 0$$

$$ay^2 + by + c = 0 \quad \text{(standard form)}$$

$\Rightarrow$ $a = 4$, $b = -10$, $c = 4$

By using quadratic formula:

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

$$y = \frac{-(-10) \pm \sqrt{(-10)^2 - 4(4)(4)}}{2(4)}$$

$$y = \frac{10 \pm 6}{8}$$

Either $y = \frac{10+6}{8}$ or $y = \frac{10-6}{8}$

$\boxed{y = 2}$ or $\boxed{y = \frac{1}{2}}$

Putting value of 'y':

$4^x = 2$ or $4^x = \frac{1}{2}$

$2^{2x} = 2^1$ or $2^{2x} = 2^{-1}$

Equating bases:

$\boxed{x = \frac{1}{2}}$ or $\boxed{x = \frac{-1}{2}}$

Solution set $= \{\pm(1/2)\}$

Q. No. 2 Part (iii) $3x^2 - 4x + 6 = 0$

$ax^2 + bx + c = 0$ (standard form)

$\Rightarrow a = 3, \; b = -4, \; c = 6$

a- $\alpha + \beta$

$$\alpha + \beta = \frac{-b}{a}$$

$$= \frac{-(-4)}{3}$$

$$\boxed{\alpha + \beta = \frac{4}{3}}$$

b- $\alpha\beta$

$$\alpha\beta = \frac{c}{a}$$

$$\alpha\beta = \frac{\cancel{6}^{2}}{\cancel{3}_{1}}$$

$$\boxed{\alpha\beta = 2}$$

c- $\frac{1}{\alpha^2} + \frac{1}{\beta^2}$

$$\frac{1}{\alpha^2} + \frac{1}{\beta^2} = \frac{\beta^2 + \alpha^2}{\alpha^2\beta^2}$$

$$\because \alpha^2 + \beta^2 = (\alpha+\beta)^2 - 2\alpha\beta$$

$$\frac{1}{\alpha^2} + \frac{1}{\beta^2} = \frac{(\alpha+\beta)^2 - 2(\alpha\beta)}{(\alpha\beta)^2}$$

$$= \frac{(4/3)^2 - 2(2)}{(2)^2}$$

$$= \frac{(16/9) - 4}{4}$$

$$= \left(\frac{16}{9} - 4\right) \div 4$$

$$= \frac{-\cancel{20}^{5}}{9} \times \frac{1}{\cancel{4}_{1}}$$

$$\boxed{\frac{1}{\alpha^2} + \frac{1}{\beta^2} = \frac{-5}{9}}$$

Q. No. 2 Part (v) $\frac{5a+c}{5a-c} = \frac{5b+d}{5b-d}$

Let $\frac{a}{b} = \frac{c}{d} = k$

$\because \frac{a}{b} = k \Rightarrow \boxed{a = bk}$

$\because \frac{c}{d} = k \Rightarrow \boxed{c = dk}$

$$\frac{5a+c}{5a-c} = \frac{5b+d}{5b-d}$$

$$\frac{5(bk)+(dk)}{5(bk)-(dk)} = \frac{5b+d}{5b-d}$$

$$\frac{5bk+dk}{5bk-dk} = \frac{5b+d}{5b-d}$$

$$\frac{k\cancel{(5b+d)}}{k\cancel{(5b-d)}} = \frac{\cancel{(5b+d)}}{\cancel{(5b-d)}}$$

$$\frac{\cancel{k}}{\cancel{k}} = 1$$

$$\boxed{1 = 1}$$

L.H.S = R.H.S

$$\frac{5a+c}{5a-c} = \frac{5b+d}{5b-d}$$

Q. No. 2 Part (vi)

$I \propto E$ and $I \propto \frac{1}{R}$

$\Rightarrow I \propto \frac{E}{R}$

$I = k \cdot \frac{E}{R}$

I = 32 ampere, E = 128 volts, R = 80 ohms

$32 = k \times \frac{128}{80}$

$k = \frac{32 \times 80}{128}$

$\boxed{k = 20}$

$I = 20 \times \frac{E}{R}$

I = ? when E = 150 volts and R = 180 ohms

$I = 20 \times \frac{E}{R}$

$I = 20 \times \frac{150}{180}$

$I = \frac{50}{3}$

$\boxed{I = 16.67 \text{ ampere}}$

Current is 16.67 A when e.m.f is 150 V and resistance is 180 Ω.

Q. No. 2 Part (vii) Let Assumed Mean (A) = 25

Ages (C.B)	Frequency	Midpoint (X)	D = X − A	fD
1 − 10	12	5.5	−19.5	−234
11 − 20	8	15.5	−9.5	−76
21 − 30	13	25.5	0.5	6.5
31 − 40	17	35.5	10.5	178.5
	$\Sigma f = 50$			$\Sigma fD = -125$

$$\overline{X} = A + \frac{\Sigma fD}{\Sigma f}$$

$$\overline{X} = (25) + \frac{(-125)}{(50)}$$

$$\overline{X} = 25 + (-2.5)$$

$$\boxed{\overline{X} = 22.5}$$

Arithmetic mean of given data is 22.5
i.e. average age is 22.5 years.

Q. No. 2 Part (ix)

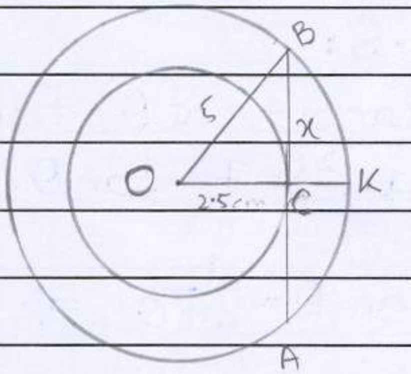
GIVEN:

$m\overline{OC} = 2.5$ (unit)

$m\overline{OB} = 5$ (unit)

TO FIND:

$m\overline{AB} = ?$



SOLUTION:

In $\angle rt\ \Delta OBC$,

By Pythagoras theorem:

$$(Hyp)^2 = (Base)^2 + (Perp)^2$$

$$|\overline{OB}|^2 = |\overline{OC}|^2 + |\overline{BC}|^2$$

$$(5)^2 = (2.5)^2 + (x)^2$$

$$x^2 = 25 - 6.25$$

$$x^2 = 18.75$$

Taking square root on both sides:

$$\sqrt{x^2} = \sqrt{18.75}$$

$$\boxed{x = 4.33 \text{ (unit)}}$$

$$m\overline{AB} = m\overline{AC} + m\overline{BC}$$

$\because$ Perpendicular from centre of circle on a chord bisects it.

$$m\overline{AC} = m\overline{BC} = 4.33\text{cm}$$

$$m\overline{AB} = 4.33 + 4.33$$

$$\boxed{m\overline{AB} = 8.66 \text{(unit)}}$$

RESULT:

Length of chord $\overline{AB}$ is 8.66 (unit).

Q. No. 2 Part (xi) $(\tan\theta + \cot\theta)\tan\theta = \sec^2\theta$

L.H.S:

$= (\tan\theta + \cot\theta)\tan\theta$

$= \tan^2\theta + \tan\theta \cdot \cot\theta$

$\because \tan\theta = \frac{1}{\cot\theta} \Rightarrow \tan\theta \cdot \cot\theta = 1$

$= \tan^2\theta + 1$

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

$= \sec^2\theta$

R.H.S:

$= \sec^2\theta$

L.H.S = R.H.S

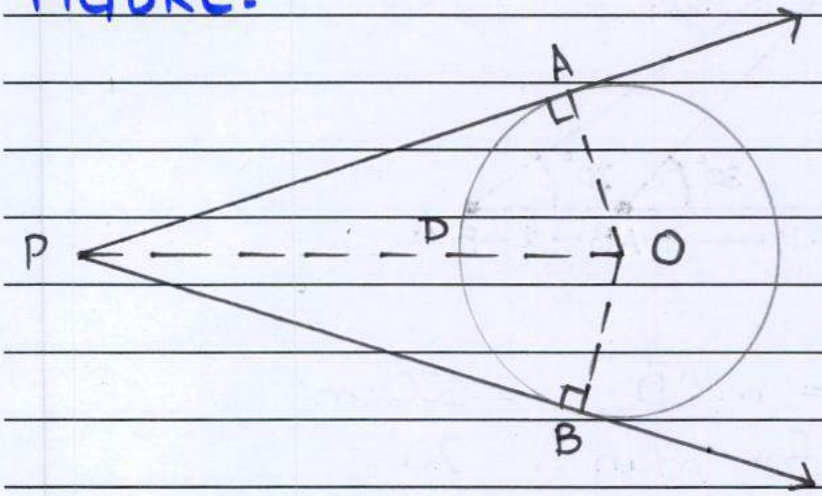
$(\tan\theta + \cot\theta)\tan\theta = \sec^2\theta$

Q. No. 2 Part (xiii)

STATEMENT:

"Two tangents drawn to a circle from a point outside it, are equal."

FIGURE:



GIVEN:

Using a circle with centre O, point P lies outside it and two tangents $\overrightarrow{PA}$ and $\overrightarrow{PB}$ are drawn to the circle from P

TO PROVE:

$\overline{PA} = \overline{PB}$

CONSTRUCTION:

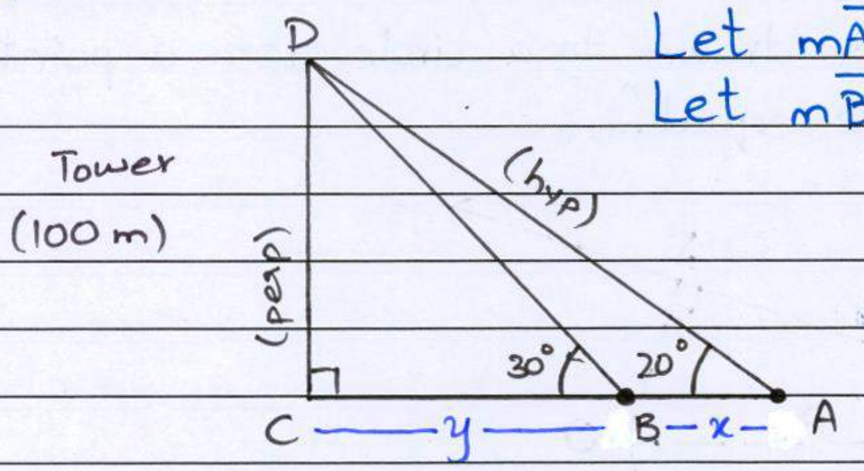
Join O to A, B and P.

PROOF:

Statements	Reasons
In $\Delta OAP \longleftrightarrow \Delta OBP$	(Construction)
$m\angle OAP = m\angle OBP$	$m\angle OAP = m\angle OBF = 90°$ Tangent $\perp$ Radius
$m\overline{OA} = m\overline{OB}$	Radii of same circle
(hyp) $m\overline{OP} = m\overline{OP}$ (hyp)	Common
$\therefore \Delta OAP \cong \Delta OBP$	H.S postulate
$\overline{PA} = \overline{PB}$	Corresponding sides of congruent triangles

Q. No. 4 (Page 1/2)

GIVEN:



Let $m\overline{AB} = x$
Let $m\overline{BC} = y$

Height of tower $= m\overline{CD} = 100$ m
Angle of elevation for man A $= 20°$
Angle of elevation for man B $= 30°$

TO FIND:

Distance b/w man A and B $= m\overline{AB} = ?$

SOLUTION:

In ΔBCD:

$$\tan\theta = \frac{\text{perp}}{\text{base}}$$

$$\tan(30°) = \frac{\overline{CD}}{\overline{BC}}$$

$$\frac{\sqrt{3}}{3} = \frac{100}{y}$$

Cross multiplication

$$\sqrt{3}\,y = 3 \times 100$$

$$y = (300) \div \sqrt{3}$$

$$\boxed{y = 173.205\text{ m}}$$

In $\triangle ACD$:

$$\tan\theta = \frac{perp}{base}$$

$$\tan(20^\circ) = \frac{\overline{CD}}{\overline{AC}}$$

$$0.36397 = \frac{100}{x+y}$$

$$x + y = \frac{100}{0.36397}$$

$$x + 173.205 = 274.748$$

$$x = (274.748) - (173.205)$$

$$\boxed{x = 101.543\ m}$$

$$\boxed{x \approx 101.5\ m}$$

RESULT:

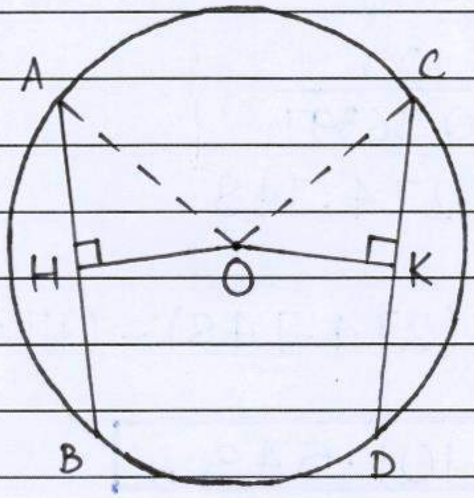
The two men (A and B) are 101.5 m apart.

Q. No. 6 (Page 1/2)

STATEMENT:

"If two chords of a circle are congruent, they will be equidistant from the centre."

FIGURE:



GIVEN:

In a circle with centre O, $\overline{AB}$ and $\overline{CD}$ are two chords such that $\overline{AB} \cong \overline{CD}$ ($m\overline{AB} = m\overline{CD}$)
From the centre O, $\overline{OH} \perp \overline{AB}$ and $\overline{OK} \perp \overline{CD}$

TO PROVE:

$m\overline{OH} = m\overline{OK}$

CONSTRUCTION:

Join O to A and C to form two right triangles: ΔOHA and ΔOKC

PROOF:

Statements	Reasons
$m\overline{AH} = \frac{1}{2} m\overline{AB}$ ... (i)	$\overline{OH} \perp \overline{AB}$ (perp. from centre of circle on a chord bisects it)
$m\overline{CK} = \frac{1}{2} m\overline{CD}$ ... (ii)	$\overline{OK} \perp \overline{CD}$ (perp. from centre of circle on a chord bisects it)
$m\overline{AB} = m\overline{CD}$ ... (iii)	Given
$m\overline{AH} = m\overline{CK}$ ... (α)	From (i), (ii) & (iii)
In $\Delta OHA \longleftrightarrow OKC$	
$m\angle OHA = m\angle OKC$	$m\angle OHA = m\angle OKC = 90^\circ$ (Line segment from centre of circle bisecting a chord is perpendicular to it)
(hyp) $m\overline{OA} = m\overline{OC}$ (hyp)	Radii of same circle
$m\overline{AH} = m\overline{CK}$	Already proved in (α)
$\therefore \Delta OHA \cong \Delta OKC$	H.S postulate
Hence $m\overline{OH} = m\overline{OK}$	Corresponding sides of equal triangles

Q. No. 5 (Page 1/2)

$U = \{1, 2, 3, \dots 10\}$

$A = \{1, 3, 5, 7, 9\}$

$B = \{2, 4, 6, 8, 10\}$

$$(A \cup B)' = A' \cap B'$$

L.H.S:

$= (A \cup B)'$

First we find $(A \cup B)$:

$A \cup B = \{1, 3, 5, 7, 9\} \cup \{2, 4, 6, 8, 10\}$

$A \cup B = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$

Now we find $(A \cup B)'$

$(A \cup B)' = U - (A \cup B)$

$= \{1, 2, 3, \dots, 10\} - \{1, 2, 3, \dots, 10\}$

$(A \cup B)' = \{\}$

R.H.S:

$= A' \cap B'$

First we find A':

$A' = U - A$

$= \{1, 2, 3, \dots, 10\} - \{1, 3, 5, 7, 9\}$

$A' = \{2, 4, 6, 8, 10\}$

Then we find B':

$B' = U - B$

$= \{1, 2, 3, \dots, 10\} - \{2, 4, 6, 8, 10\}$

$B' = \{1, 3, 5, 7, 9\}$

Now we find $A' \cap B'$

$A' \cap B' = \{2, 4, 6, 8, 10\} \cap \{1, 3, 5, 7, 9\}$

$A' \cap B' = \{\}$

$\therefore$ L.H.S = R.H.S

$(A \cap B)' = A' \cup B'$

L.H.S:

$= (A \cap B)'$

First we find $A \cap B$:

$A \cap B = \{1,3,5,7,9\} \cap \{2,4,6,8,10\}$

$A \cap B = \{\}$

Now we find $(A \cap B)'$

$(A \cap B)' = U - (A \cap B)$

$= \{1,2,3,\dots,10\} - \{\}$

$(A \cap B)' = \{1,2,3,\dots,10\}$

R.H.S:

$= A' \cup B'$

First we find A':

$A' = U - A$

$= \{1,2,3,\dots,10\} - \{1,3,5,7,9\}$

$A' = \{2,4,6,8,10\}$

Then we find B':

$B' = U - B$

$= \{1,2,3,\dots,10\}$

$B' = \{1,3,5,7,9\}$

Now we find $A' \cup B'$:

$A' \cup B' = \{2,4,6,8,10\} \cup \{1,3,5,7,9\}$

$A' \cup B' = \{1,2,3,\dots,10\}$

$\therefore$ L.H.S = R.H.S

De Morgan's laws are verified.

$(A \cup B)' = A' \cap B'$

$(A \cap B)' = A' \cup B'$