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Chapter-11

Conic Sections

Ex-11.1

1. $(x-h)^2+(y-K)^2=r^2$

$(x-0)^2+(y-2)^2=2^2$

$x^2+y^2+4-4y=4$

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

2. $(x-h)^2+(y-K)^2=r^2$

$(x+2)^2+(y-3)^2=4^2$

$x^2+4x+4+y^2-6y+9=16$

$x^2+y^2+4x-6y-3=0$

3. $(x-h)^2+(y-K)^2=r^2$

$\left(x-\frac{1}{2}\right)^2+\left(y-\frac{1}{4}\right)^2=\frac{1}{12^2}$

$x^2+\frac{1}{4}-x+y^2+\frac{1}{16}-\frac{y}{2}=\frac{1}{144}$

$144x^2+144x+36+144y^2-72y+9-1=0$

$144x^2-144x+144y^2-72y+44=0$

$36x^2+36x+36y^2-18y+11=0$

$36x^2+36y^2-36x-18y+11=0$

4. $(x-h)^2+(y-K)^2=r^2$

$(x-1)^2+(y-1)^2=\sqrt{2}^2$

$x^2-2x+1+y^2-2y+1=2$

$x^2+y^2-2x-2y+2=0$

$x^2+y^2-2x-2y=0$

5. $(x-h)^2+(y-K)^2=r^2$

$(x+a)^2+(y+b)^2=(\sqrt{a^2-b^2})^2$

$x^2+a^2+2ax+y^2+b^2+2by=a^2-b^2$

$x^2+y^2+2ax+2by+2b^2=0$

6. $(x+5)^2+(y-3)^2=36$

$(x-(-5))^2+(y-3)^2=6^2$

$(x-h)^2+(y-K)^2=r^2$

$h=-5 \quad K=3 \quad r=6$

7. $x^2-y^2-4x-8y-45=0$

$(x^2-4x)+(y^2-8y)=45$

$x^2-4x+(2)^2-(2)^2+y^2-8y+(4)^2-(4)^2-45=0$

$(x-2)^2+(y-4)^2-4-16-45=0$

$(x-2)^2+(y-4)^2-65=0$

$(x-2)^2+(y-4)^2=65$

On comparing

$h=2 \quad K=4 \quad r^2=65$

Centre $(h,K)=(2,4)$

radius $=\sqrt{65}$

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9. $2x^2 + 2y^2 - x = 0$

Divided by 2

$x^2 + y^2 - \frac{x}{2} = 0$

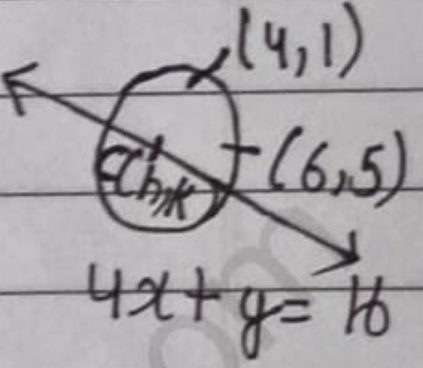
$x^2 - \left[\frac{1}{2}\right]^2 + \left[\frac{1}{4}\right]^2 - \left[\frac{1}{4}\right]^2 + y^2 = 0$

$\left[x - \frac{1}{4}\right]^2 + (y-0)^2 = \left[\frac{1}{4}\right]^2$

$(x-h)^2 + (y-K)^2 = r^2$

$h = \frac{1}{4}$ $K = 0$ $r = \frac{1}{4}$ Centre $\left[\frac{1}{4}, 0\right]$ $r = \frac{1}{4}$

10. Let eqn of circle as $(x-h)^2 + (y-k)^2 = r^2$ — ①



① passes through (4,1)

$(4-h)^2 + (1-k)^2 = r^2$ — ②

passes through (6,5)

$(6-h)^2 + (5-k)^2 = r^2$ — ③

Centre (h,k) is on line $4x + y = 16$

$4h + k = 16$

$k = 16 - 4h$ — ④

subtract ③ − ②

$(6-h)^2 + (5-k)^2 = r^2$

$(4-h)^2 + (1-k)^2 = r^2$

$(6-h+4-h)(6-h-4+h) + (5-k+1-k)(5-k-1+k) = 0$

$(10-2h) \times 2 + (16-2k) \times 4 = 0$

$(5-h) \times 4 + (16-2k) \times 4 = 0$

$(5-h) + 6 - 2 \times (16 - 4h) = 0$ from eqn ④

$5 - h + 6 - 32 + 8h = 0$

$7h = 21$ $h = 3$

$4k = 16 - 4 \times 3 \Rightarrow 16 - 12 = 4$

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$(4-3)^2 + (1-4)^2 = r^2$

$1+9 = r^2 \qquad r = \sqrt{10}$

$(x-3)^2 + (y-4)^2 = 10$

11. Let eq^n of circle is $(x-h)^2 + (y-k)^2 = r^2$ - (1)

passes through (2,3)

$(2-h)^2 + (3-k)^2 = r^2$ - (2)

passes through (-1,1)

$(-1-h)^2 + (1-k)^2 = r^2$

$(1+h)^2 + (1-k)^2 = r^2$ - (3)

Centre (h,k) lie on $x - 3y - 11 = 0$

$h - 3k - 11 = 0$ (4)

(2) - (3)

$(2-h)^2 + (3-k)^2 = r^2$

$(1+h)^2 + (1-k)^2 = r^2$

$(2-h+1+h)(2-h-1-h) + (3-k+1-k)(3-k-1+k) = 0$

$3(1-2h) + (4-2k)2 = 0$

$3 - 6h + 8 - 4k = 0$

$6h + 4k = 11$ - (5)

(4) $\Rightarrow h = 3k + 11$ in (5)

$6(3k+11) + 4k = 11$

$18k + 66 + 4k = 11$

$22k = 11 - 66$

$22k = -55 \qquad k = \frac{-5}{2}$

(4) $h = 3\left(\frac{-5}{2}\right) + 11 = \frac{-15+22}{2} = \frac{7}{2}$ $\boxed{h = \frac{7}{2}}$

(3) $\left[1 + \frac{7}{2}\right]^2 + \left[1 + \frac{5}{2}\right]^2 = r^2$

$\left[\frac{9}{2}\right]^2 + \left[\frac{7}{2}\right]^2 = r^2$

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$\frac{81}{4} + \frac{49}{4} = r^2 \qquad r^2 = \frac{130}{4}$

Eq^n of circle $= \left[x - \frac{7}{2}\right]^2 + \left[y + \frac{5}{2}\right]^2 = \frac{130}{4}$

$x^2 + \frac{49}{4} - 7x + y^2 + \frac{25}{4} + 5y = \frac{130}{4}$

Multiply by 4

$4x^2 + 49 - 28x + 4y^2 + 25 + 20y = 130$

$4x^2 + 4y^2 - 28x + 20y = 56$

$x^2 + y^2 - 7x + 5y - 14 = 0$

12. $r = 5$ unit Let centre $(h, 0)$

Eq^n of circle $= (x-h)^2 + (y-0)^2 = 5^2$

$(x-h)^2 + y^2 = 25 \quad -(1)$

Passes through $(2, 3)$

$(2-h)^2 + (3)^2 = 25$

$(2-h)^2 = 25 - 9 = 16$

$(2-h) = \pm 4$

$2 - h = 4 \Rightarrow 2 - 4 = h \Rightarrow h = -2$

$2 - h = -4 \Rightarrow 2 + 4 = h \Rightarrow h = 6$

$(x+2)^2 + y^2 = 25$

$x^2 + 4 + 4x + y^2 = 25$

$x^2 + y^2 + 4x - 21 = 0$

$(x-6)^2 + y^2 - 25 = 0$

$x^2 + 36 - 12x + y^2 - 25 = 0$

$x^2 + y^2 - 12x + 11 = 0$

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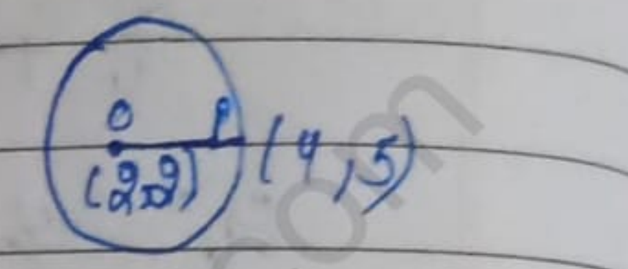
14. Centre (2,2) point (4,5)

eq^n of circle :- $(x-2)^2+(y-2)^2=r^2$



passes through (4,5)

$(4-2)^2+(5-2)^2=r^2$

$4+9=r^2$

$r^2=13$

$(x-2)^2+(y-2)^2=13$

$x^2+2^2-4x+y^2+2^2-2y(-2)=13$

$x^2+4-4x+y^2+4+4y=13=0$

$x^2+y^2-4x-4y-5=0$

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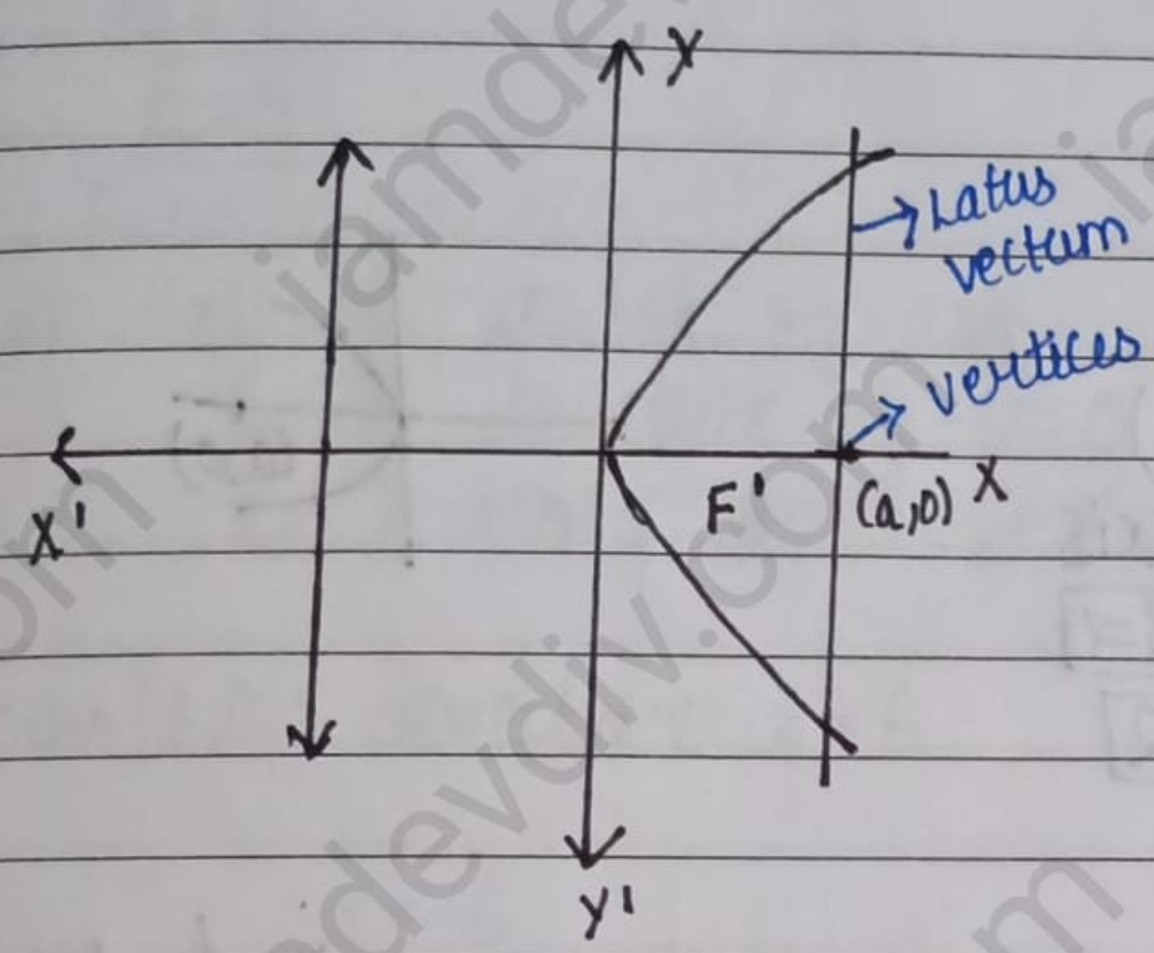
Parabola

1.)



$y^2 = 4ax$

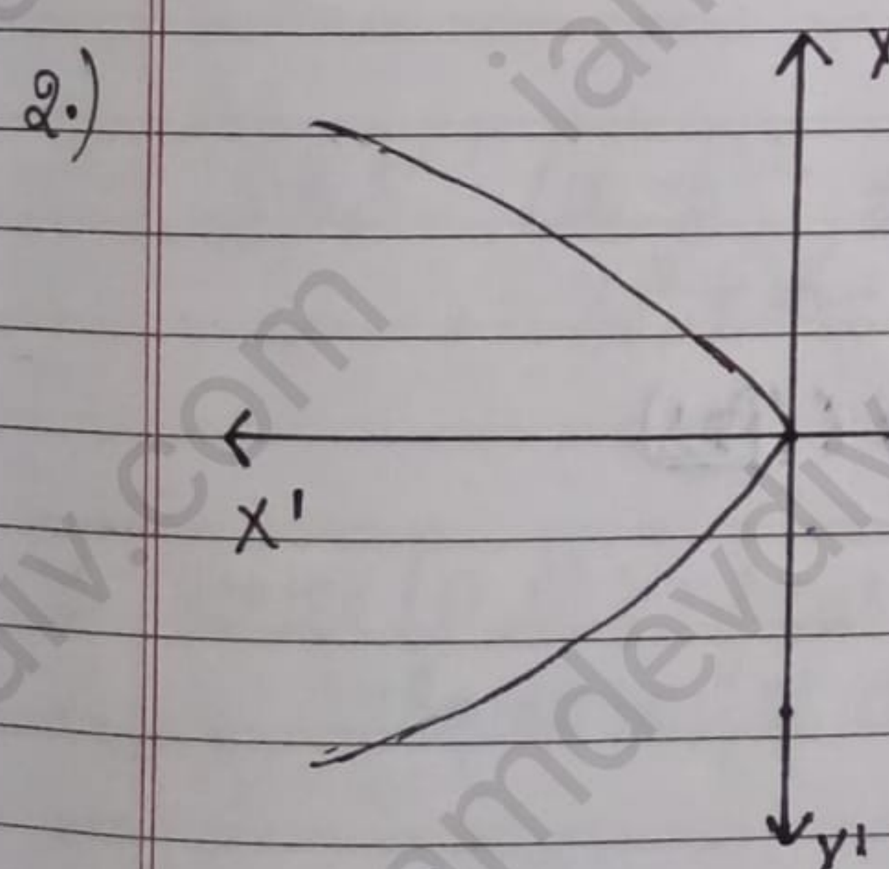
Focus $F(a,0)$

directrix $x+a=0$

Latus rectum $=4a$

axis $= x$-axis

2.)



$y^2 = -4ax$

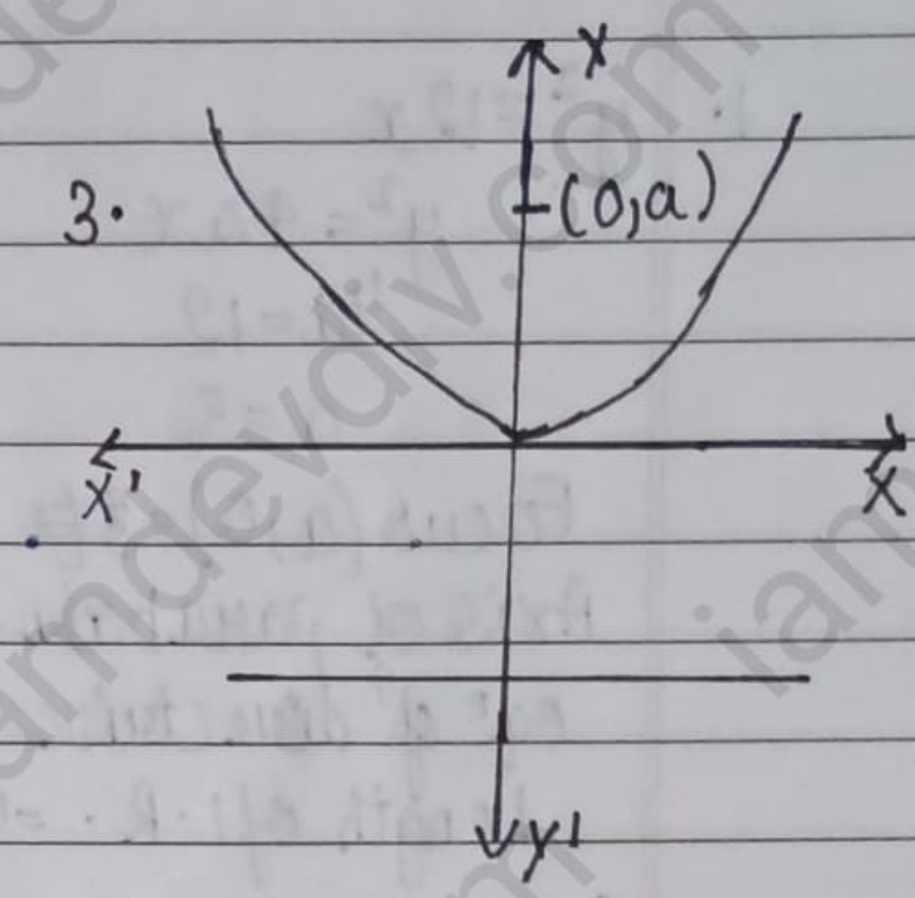
$F = (-a,0)$

directrix $= x-a=0$

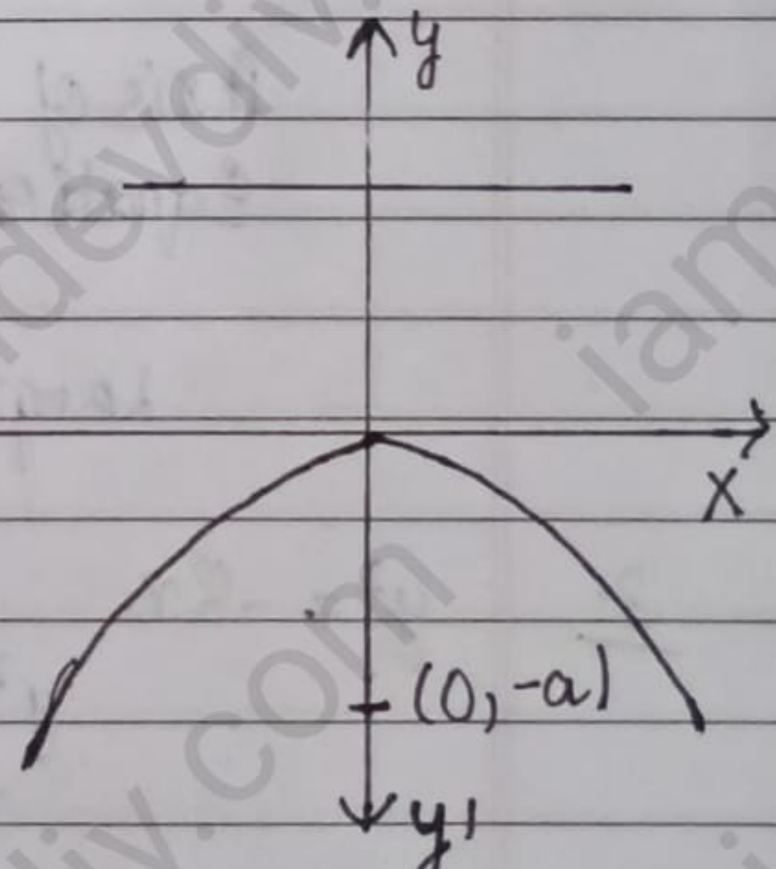
$L.R. = 4a$

axis $= x$-axis

3.



4.



$x^2 = -4ay$

$F = (0,-a)$

directrix $y-a=0$

$L.R. = 4a$

axis $= y$-axis

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Exercise = 11.2

1. $y^2 = 12x$

$y^2 = 4ax$

$4a = 12$

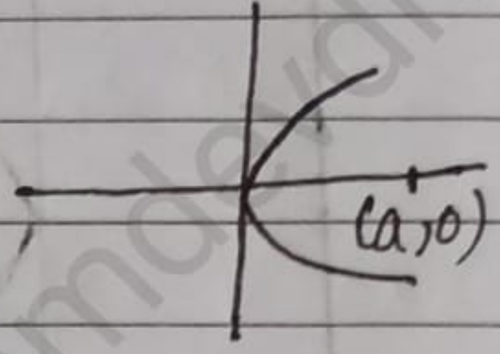
$a = 3$

Focus $(a, 0) = (3, 0)$

Axis of parabola = x-axis

eqⁿ of directrix = $x + 3 = 0$

Length of L.R. $= 4a = 12$



2. $x^2 = 6y$

$x^2 = 4ay$

$4a = 6$

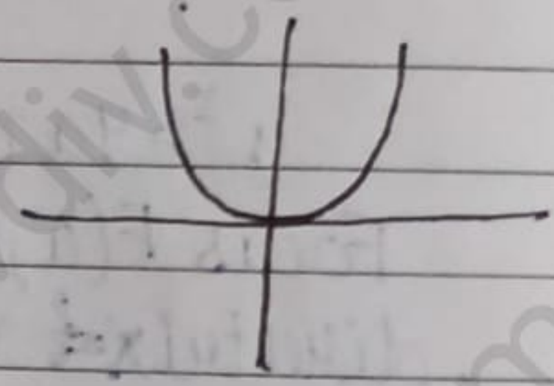
$a = \frac{3}{2}$

Focus $(0, a) = \left(0, \frac{3}{2}\right)$

Axis of parabola = y-axis

Equation of directrix $= y + \frac{3}{2} = 0$

Length of L.R. $4a = 4 \times \frac{3}{2} = 6$ (Ans)



3. $y^2 = -8x$

$y^2 = -4ax$

$-4a = -8$

$a = 2$

Focus $(-a, 0) = (-2, 0)$

Axis of parabola = x-axis

Eqⁿ of directrix = $x - 2 = 0$

L.R. = 8

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4. $x^2 = -16y$

$x^2 = -4ay$

$4a = 16$

$\boxed{a = 4}$.

Focus $(0, -a) = (0, -4)$

Axis of parabola = y-axis

Eq^n of directrix $= y - 4 = 0$

Length of L.R. $= 4a = 16$

7. Focus $(6, 0)$; directrix $x = 6$

$x = -6$

$x + 6 = 0$

$P(x, y)$

$PF = PM$.

$$\sqrt{(x-6)^2 + (y-0)^2} = \frac{x+6}{\sqrt{(1)^2}}$$

S.B.S. $(x-6)^2 + y^2 = (x+6)^2$

$x^2 + 36 - 12x + y^2 = x^2 + 36 + 12$

$y^2 = 24x$

10. Vertex $(0, 0)$; focus $(-2, 0)$

Equation of directrix $\Rightarrow \boxed{x - 2 = 0}$

$P(x, y)$

$PF = PM$

$$\sqrt{(x+2)^2 + (y-0)^2} = \frac{x-2}{\sqrt{(1)^2}}$$

$(x+2)^2 + y^2 = (x-2)^2$

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$$x^2+4+4x+y^2 = x^2+4-4x$$
$$4x+y^2 = -4x$$
$$y^2 = -4x-4x$$
$$y^2 = -8x$$

11. Vertex (0,0) passing through (2,3) and axis is along x-axis

Let the equation of parabola whose vertex (0,0) and axis is along x-axis

$$y^2 = 4ax$$

It passes through (2,3)

$$3^2 = 4a \times 2$$
$$9 = 8a$$
$$a = \frac{9}{8}$$

$$y^2 = 4ax$$
$$y^2 = 4 \times \frac{9}{8} x$$
$$2y^2 = 9x$$

5. $y^2 = 10x$

$$y^2 = 4ax$$
$$4a = 10 \Rightarrow a = \frac{5}{2}$$

Focus $= \left(\frac{5}{2}, 0\right)$

Axis of parabola = x-axis

Equation of directrix $\Rightarrow x + \frac{5}{2} = 0$, $2x+5=0$

Latus ~~Rectum~~ Rectum $\Rightarrow 4a = 4 \times \frac{5}{2} = 10$

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5. ~~y^2~~ & $x^2 = -9y$

$x^2 = -4ay$

$-4a = -9 \Rightarrow a = \frac{9}{4}$

Focus $= \left(0, -\frac{9}{4}\right)$

Axis of parabola $= y$-axis

Directrix $= y - \frac{9}{4} = 0 \quad , 4y - 9 = 0$

Latus Rectum $= 4a \Rightarrow 4 \times \frac{9}{4} = 9$

8. Focus $(0,-3)$; directrix $y = 3$

$P(x,y)$

$PF = PM$

$\sqrt{(x-0)^2 + (y+3)^2} = \frac{y-3}{\sqrt{(1)^2}}$

$x^2 + (y+3)^2 = (y-3)^2$

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

$x^2 = -12y$

9. Vertex $(0,0)$; focus $(3,0)$

directrix $x+3$

$P(x,y)$

$PF = PM$

$\sqrt{(x-3)^2 + (y-0)^2} = \frac{x+3}{\sqrt{(1)^2}}$

$(x-3)^2 + y^2 = (x+3)^2$

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

$y^2 = 12x$

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12. Vertex (0,0) passing through (5,2) and symmetric with respect to y-axis

Let the equation be $x^2 = 4ay$

It passes through (5,2)

$(5)^2 = 4a \times 2$

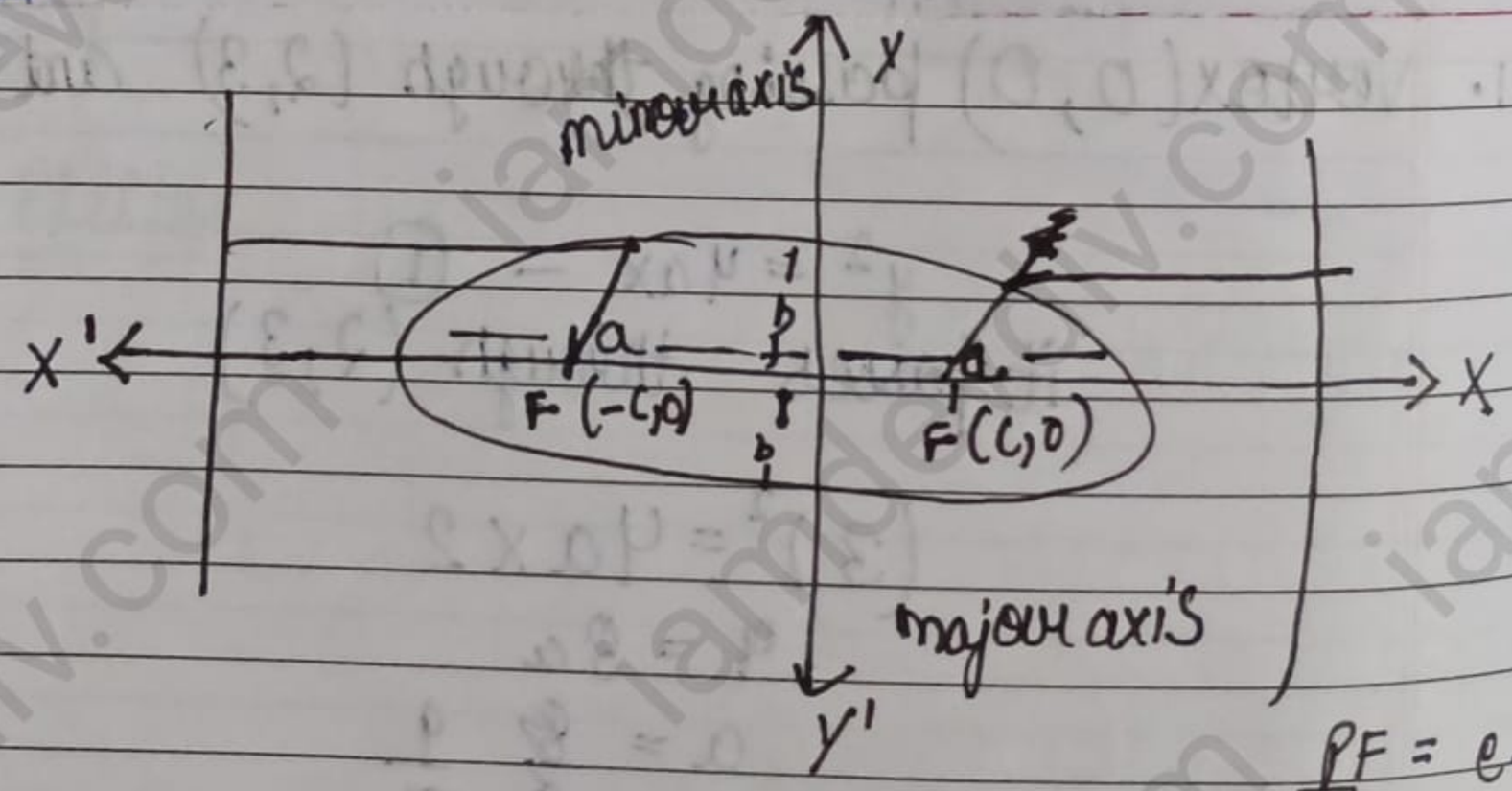
$25 = 8a$

$a = \frac{25}{8}$

$x^2 = 4ay$

$x^2 = 4 \times \frac{25}{8} y$

$x^2 = \frac{25}{2} y$ $= 2x^2 - 25y$



$PF = e\,PM$

$c = ae$

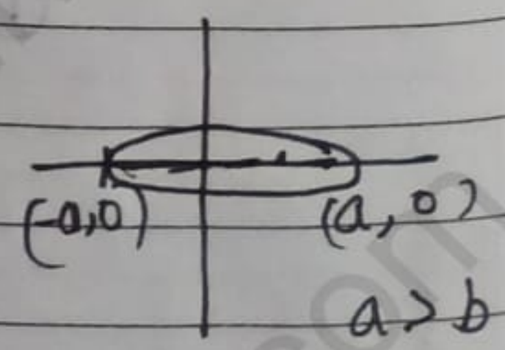
$\frac{PF}{PM} = e < 1$

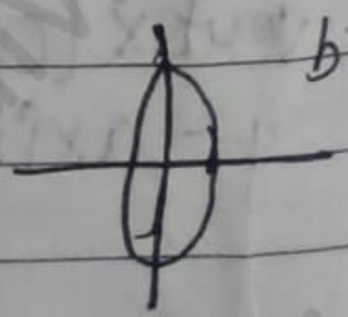
$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

Length of major axis $= 2a$

Length of minor axis $= 2b$

$c^2 = a^2 + b^2$





Length of Latus rectum $= \frac{2b^2}{a}$

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Exercise = 11.3

1. $\frac{x^2}{36} + \frac{y^2}{16} = 1$

$\left[\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1\right]$

$a > b$, x-axis / major

$\frac{x^2}{6^2} + \frac{y^2}{4^2} = 1$

$a = 6 \qquad b = 4$

$c^2 = a^2 - b^2$

$c^2 = 6^2 - 4^2$

$c^2 = 36 - 16$

$c^2 = 20$ $\qquad \boxed{c = 2\sqrt{5}}$

Foci $(\pm c, 0)$

$\boxed{\text{Foci} = (\pm 2\sqrt{5}, 0)}$

Vertices $(\pm a, 0)$

$\boxed{\text{Vertices } (\pm 6, 0)}$

Length of major axis $= 2a$

$= 2 \times 6 = 12$

Length of minor axis $= 2b$

$= 2 \times 4 = 8$

$e = \frac{c}{a} = \frac{2\sqrt{5}}{6} \qquad e = \frac{\sqrt{5}}{3}$

Length of Latus Rectum $= \frac{2b^2}{a}$

$= \frac{2 \times 4^2}{6} = \frac{16}{3}$ (Ans)

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8. $16x^2 + y^2 = 16$

$$\frac{16x^2}{16} + \frac{y^2}{16} = \frac{16}{16}$$

$$\frac{x^2}{1} + \frac{y^2}{16} = 1$$

$$\frac{x^2}{1^2} + \frac{y^2}{4^2} = 1$$

$$\boxed{\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1}$$

$a = 1 \qquad b = 4$

$b > a$ (major axis $= y$)

$c^2 = b^2 - a^2$

$c^2 = 4^2 - 1^2$

$c = \sqrt{15}$

Foci $= (0, \pm c)$

Foci $= (0, \pm \sqrt{15})$

Vertices $= (0, \pm b)$

Vertices $= (0, \pm 4)$

Length of major axis $= 2b = 2 \times 4 = 8$

Length of minor axis $= 2a = 2 \times 1 = 2$

$\boxed{e = \frac{c}{b}} \rightarrow e = \frac{\sqrt{15}}{4}$

Length of latus rectum $= \frac{2a^2}{b}$

$\frac{2 \times 1^2}{4} = \frac{1}{2}$ (Ans)

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10. Vertices $(\pm 5, 0)$ foci $(\pm 4, 0)$

Vertices $= (\pm a, 0)$

$\boxed{a = 5}$

Foci $= (\pm c, 0)$

$\boxed{c = 4}$

$c^2 = a^2 - b^2$

$b^2 = a^2 - c^2$

$b^2 = 5^2 - 4^2$

$b^2 = 9$

$\boxed{b = 3}$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

$$\frac{x^2}{5^2} + \frac{y^2}{3^2} = 1$$

$$\boxed{\text{Eq}^n \text{ of ellipse} = \frac{x^2}{25} + \frac{y^2}{9} = 1}$$

11. Vertices $(0, \pm 13)$ foci $(0, \pm 5)$

Foci $(0, \pm 5)$

$(0, \pm c)$

$\boxed{c = 5}$

Vertices $(0, \pm 13)$

Vertices $(0, \pm b)$

$\boxed{b = 13}$

$c^2 = b^2 - a^2$

$a^2 = b^2 - c^2$

$a^2 = 13^2 - 5^2$

$a^2 = 169 - 25$

$\boxed{a = 12}$

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Eqⁿ of ellipse $= \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\frac{x^2}{12^2} + \frac{y^2}{13^2} = 1$

$$\boxed{\frac{x^2}{144} + \frac{y^2}{169} = 1}$$

13. Ends of major axis $(\pm 3, 0)$ ends of ~~major~~ minor axis $(0, \pm 2)$

~~Mc~~ Major axis $= (\pm a, 0)$

$\boxed{a = 3}$

Minor axis $(0, \pm b)$

$\boxed{b = 2}$

Eqⁿ of ellipse $= \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\frac{x^2}{a^2} + \frac{y^2}{2^2} = 1$

$\frac{x^2}{9} + \frac{y^2}{4} = 1$

15. Length of major axis 26, foci $(\pm 5, 0)$

Major axis $= 2a$

$2a = 26$

$\boxed{a = 13}$

foci $(\pm c, 0)$

$c = 5$

$c^2 = a^2 - b^2$

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$b^2 = a^2 - c^2$

$b^2 = 13^2 - 5^2$

$b^2 = 169 - 25$

$\boxed{b = 12}$

Eqⁿ of ellipse $= \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\frac{x^2}{13^2} + \frac{y^2}{12^2} = 1$

$\boxed{\frac{x^2}{169} + \frac{y^2}{144} = 1}$

17. Foci $(\pm 3, 0)$ $a = 4$

Foci $(\pm 3, 0)$

Foci $(\pm c, 0)$

$\boxed{c = 3}$

$c^2 = a^2 - b^2$

$b^2 = a^2 - c^2$

$b^2 = 4^2 - 3^2$

$b^2 = 16 - 9$

$b = \sqrt{7}$

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\frac{x^2}{4^2} + \frac{y^2}{\sqrt{7}^2} = 1$

$\boxed{\text{Eqⁿ of ellipse} = \frac{x^2}{16} + \frac{y^2}{7} = 1}$

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19. Centre at (0,0) major axis on the y-axis and passes through the points (3,2) and (1,6)

Let eqⁿ of ellipse be $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ — ①

① passes through (3,2)

$$\frac{3^2}{a^2} + \frac{2^2}{b^2} = 1$$

$$\frac{9}{a^2} + \frac{4}{b^2} = 1 \quad \text{— ②}$$

② passes through (1,6)

$$\frac{1^2}{a^2} + \frac{6^2}{b^2} = 1$$

$$\frac{1}{a^2} + \frac{36}{b^2} = 1 \quad \text{— ③}$$

② × 9 − ③

$$\frac{81}{a^2} + \frac{36}{b^2} = 9$$

$$\frac{1}{a^2} + \frac{36}{b^2} = 1$$

$$\frac{80}{a^2} = 8$$

$$\boxed{a^2 = 10}$$

$$\frac{1}{10} + \frac{36}{b^2} = 1$$

$$\frac{36}{b^2} = \frac{1-1}{10} \Rightarrow \frac{36}{b^2} = \frac{9}{10} \Rightarrow \boxed{b^2 = 40}$$

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$$\boxed{\text{eq}^n \text{ of Ellipse} = \frac{x^2}{10} + \frac{y^2}{40} = 1}$$

20. Major axis on the x-axis and passes through the points (4, 3) and (6, 2)

Let eq^n of ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \quad -(1)$$

(1) passes through (4, 3)

$$\frac{16}{a^2} + \frac{9}{b^2} = 1 \quad -(2)$$

(1) passes through (6, 2)

$$\frac{36}{a^2} + \frac{4}{b^2} = 1 \quad -(3)$$

From eq^n (2)

$$\frac{16}{a^2} = \frac{b^2 - 9}{b^2}$$

$$a^2 = \frac{16b^2}{b^2 - 9}$$

Put it in eq^n (3)

$$\frac{36}{16b^2}(b^2 - a) + \frac{4}{b^2} = 1$$

$$9b^2 - 81 + 16 = 4b^2$$

$$5b^2 = 65$$

$$\boxed{b^2 = 13}$$

$$a^2 = \frac{16 \times 13}{13 - 9}$$

$$a^2 = \frac{208}{9} = 52$$

Eq^n of ellipse

$$\boxed{\frac{x^2}{52} + \frac{y^2}{13} = 1}$$

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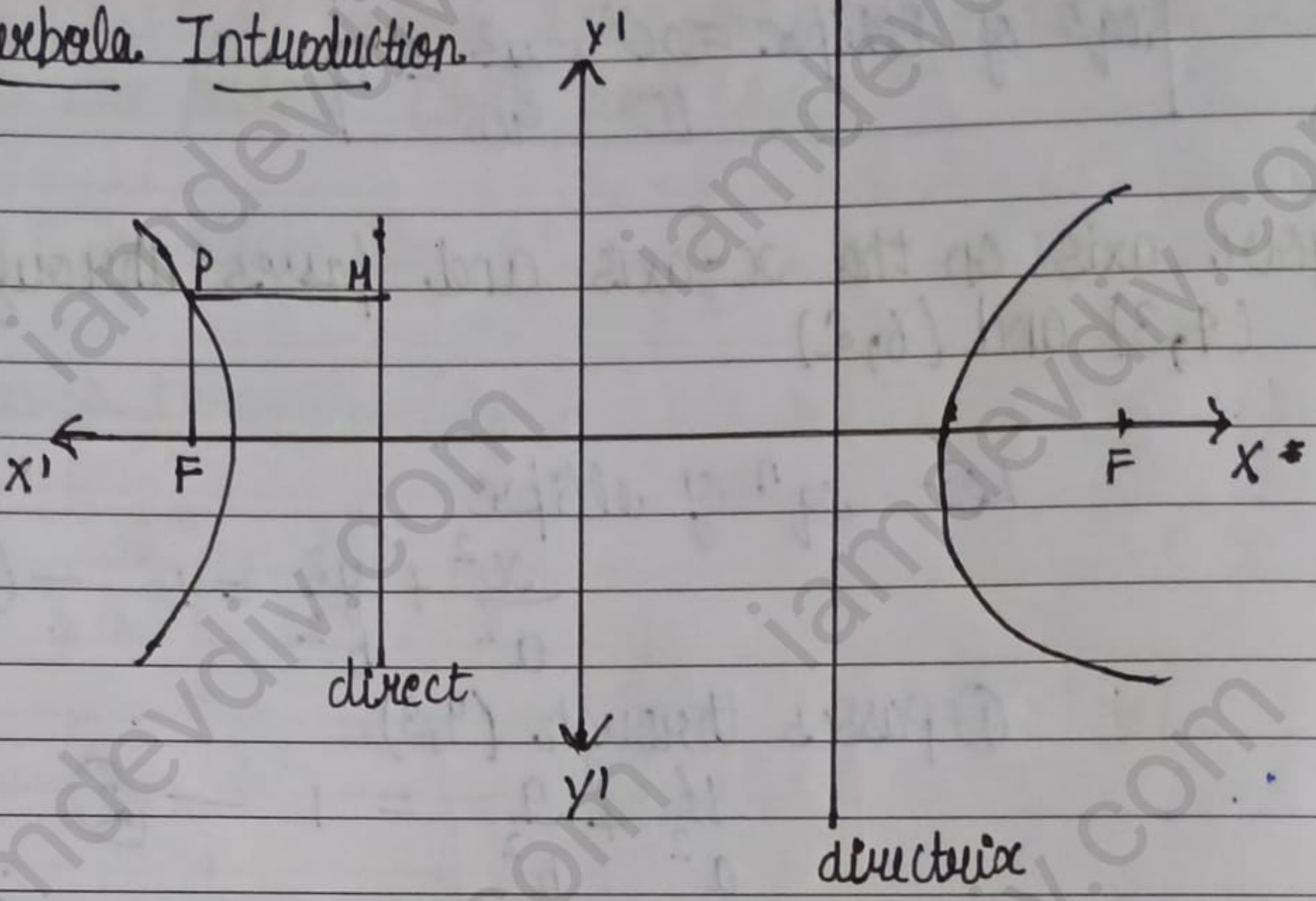
Hyperbola Introduction



Length of conjucate axis = $2a$
Length of tranverse axis = $2b$
distance b/w two foci = $2ae$

$$\frac{PF}{PM} \quad \frac{PF}{PM} = e$$

$e > 1$

Foci $(\pm c, 0)$

directrix $x = \pm ae$

$c^2 = a^2 + b^2$

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Exercise = 11.4

1. $\frac{x^2}{16} - \frac{y^2}{9} = 1$

$\frac{x^2}{4^2} - \frac{y^2}{3^2} = 1$

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$a = 4, \quad b = 3$

$c^2 = a^2 + b^2$

$c^2 = 4^2 + 3^2$

$c^2 = 16 + 9$

$c = \sqrt{25} = 5$

Foci $(\pm c, 0)$

$(\pm 5, 0)$

vertices $(\pm a, 0) = (\pm 4, 0)$

$e = \frac{c}{a} = \frac{5}{4}$

Length of L.R. $= \frac{2b^2}{a}$

$= \frac{2 \times 3^2}{4} = \frac{9}{2}$ (Ans)

2. $\frac{y^2}{9} - \frac{x^2}{27} = 1$

$\frac{y^2}{3^2} - \frac{x^2}{(3\sqrt{3})^2} = 1$

$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$

$a = 3 \quad b = 3\sqrt{3}$

$c^2 = a^2 + b^2$

$c = \sqrt{9+27} = 6$

Foci $(0, \pm c) = (0, \pm 6)$

vertices $(0, \pm a) = (0, \pm 3)$

$e = \frac{c}{a} = \frac{6}{3} = 2$

L.R. $= \frac{2b^2}{a}$

$= \frac{2 \times 27}{3} 9$

$= 18$ (Ans)

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3. $9y^2 - 4x^2 = 36$

$\frac{9y^2}{36} - \frac{4x^2}{36} = 1$

$\frac{y^2}{4} - \frac{x^2}{9} = 1$

$\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$

$a = 2 \quad b = 3$

$c = \sqrt{4+9}$

$c = \sqrt{13}$

Foci $(0, \pm c)$

$(0, \pm\sqrt{13})$

Vertices $(0, \pm a)$

$(0, \pm 2)$

$e = \frac{c}{a} = \frac{\sqrt{13}}{2}$

$L.R. = \frac{2 \times 9}{2}$

$= 9$ (Ans)

4. $16x^2 - 9y^2 = 576$

$\frac{x^2}{9} - \frac{y^2}{16} = 1$

$a = 3 \quad b = 4$

$c = \sqrt{16+9}$

$c = \sqrt{25}$

$= 5$

Foci $(0, \pm c)$

$(0, \pm 5)$

$e = \frac{c}{a} = \frac{5}{3}$

Vertices $(0, \pm a)$

$= (0, \pm 3)$

$L.R. = \frac{2 \times 16}{3}$

$= \frac{32}{3}$

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Ques - In each - conditions.

8. Vertices $(0, \pm 5)$, foci $(0, \pm 8)$

$0, \pm b$ $\quad$ $0, \pm c$

$b = 5$, $c = 8$

$c^2 = a^2 + b^2$

$8^2 = a^2 + 5^2$

$64 - 25 = a^2$

$a^2 = 39$

$\frac{y^2}{b^2} - \frac{x^2}{a^2} = 1$

$\frac{y^2}{25} - \frac{x^2}{39} = 1$

10. Foci $(\pm 5, 0)$ $(\pm c, 0)$ $\quad$ $c = 5$

Transverse axis $= 8$

$2a = 8$ 4

$a = 4$

$c^2 = a^2 + b^2$

$5^2 = 4^2 + b^2$

$b^2 = 25 - 16$

$b^2 = 9$

eqn of hyperbola

$\frac{x^2}{a^2} - \frac{y^2}{9} = 1$

$\frac{x^2}{16} - \frac{y^2}{9} = 1$

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~~11. Foci(0,±13)~~

13. Foci $(\pm 4, 0)$ $(\pm c, 0) = 4$

Latus Rectum = 12

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1 \qquad \frac{x^2}{4^2} - \frac{y^2}{12} = 1$$

$$\text{Latus Rectum} = \frac{2b^2}{a}$$

$$12 = \frac{2b^2}{a}$$

$$b^2 = 6a$$

$$c^2 = a^2 + b^2$$

$$c^2 = a^2 + 6a$$

$$= a^2 + 6a - 16 = 0$$

$$= a^2 + 8a - 2a - 16 = 0$$

$$a(a+8) - 2(a+8) = 0$$

$$(a-2)(a+8) = 0$$

$$a = 2 \quad a = -8 \text{ (invalid)}$$

$$a^2 = 4 \quad b^2 = 12$$

$$\frac{x^2}{4} - \frac{y^2}{12} = 1$$

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15. Foci $(0, \pm\sqrt{10})$, passing through $(2, 3)$

$(0, \pm c)$

$c = \sqrt{10}$ passing through $(2, 3)$:

$c^2 = a^2 + b^2$

$(\sqrt{10})^2 =$

$c^2 = a^2 +$

$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

$(2, 3)$ $\frac{y^2}{a^2} - \frac{x^2}{b^2} = 1$ — (1)

$x^2 - y^2 = 1$

$4x^2 - 2y^2 = 1$

$2y^2 = 4x^2 - 1$

$\frac{9}{a^2} - \frac{4}{b^2} = 1$

$9b^2 - 4a^2 = a^2b^2$ — (2)

$\frac{y^2}{5} - \frac{x^2}{5} = 1$

$c^2 = a^2 + b^2$

$10 = a^2 + b^2$

$a^2 = 10 - b^2$

Put value of a^2 in eqn (2)

$9b^2 - 40 + 4b^2 = 10b^2 - b^4$

$b^4 + 3b^2 - 40 = 0$

$b^4 + 8b^2 - 5b^2 - 40 = 0$

$b^2(b^2 + 8) - 5(b^2 + 8) = 0$

$(b^2 + 8) \cdot (b^2 - 5) = 0$

$b^2 = 5$

$a^2 = 10 - 5$

$a^2 = 5$

Put these value in eq (1)

$\frac{y^2}{5} - \frac{x^2}{5} = 1$

$\boxed{y^2 - x^2 = 5}$

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Miscellaneous Exercise

1.

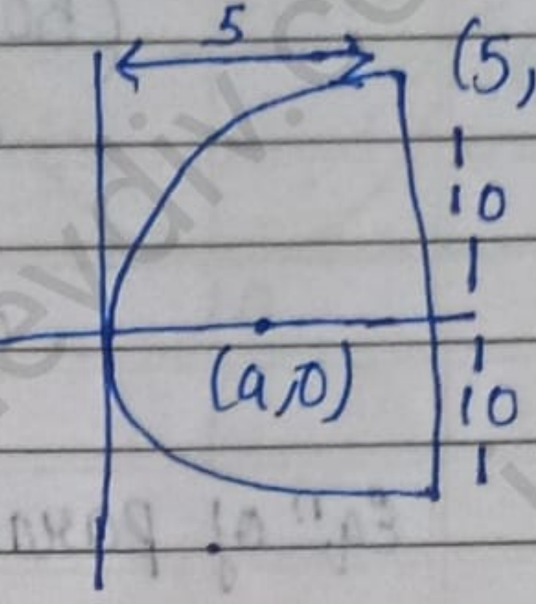
$y^2 = 4ax$

$(10)^2 = 4a \times 5$

$100 = 20a$

$\boxed{a = 5}$

Focus $(5, 0)$ (Ans)



2.

$x^2 = 4ay$

$\left(\frac{5}{2}\right)^2 = 4 \times a \times 10^2$

$\frac{5}{32} = a$

$x^2 = 4 \times \frac{5}{32} \times y$

$\frac{}{8}$

$y = 2$ then

$x^2 = \frac{5}{8} \times 2$

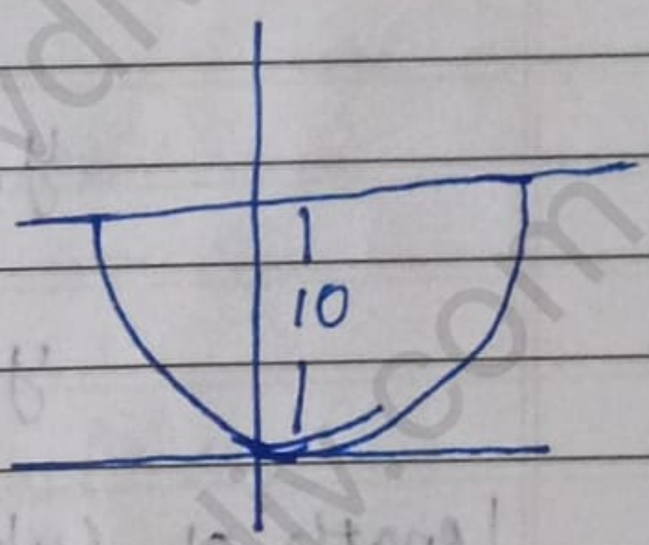
$\frac{}{4}$

$x = \frac{\sqrt{5}}{2}$

$AB = 2x$

$= 2 \times \frac{\sqrt{5}}{2}$

$= 2.23$



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3. the eqⁿ of parabola is

$x^2 = 4ay$

it passes through (50, 24)

$(50)^2 = 4a \times 24$

$a = \frac{2500}{4 \times 24}$ 625

$a = \frac{625}{24}$

Eqⁿ of parabola $\Rightarrow x^2 = 4 \times \frac{625}{24_6} y$

$x^2 = \frac{625}{6} y$

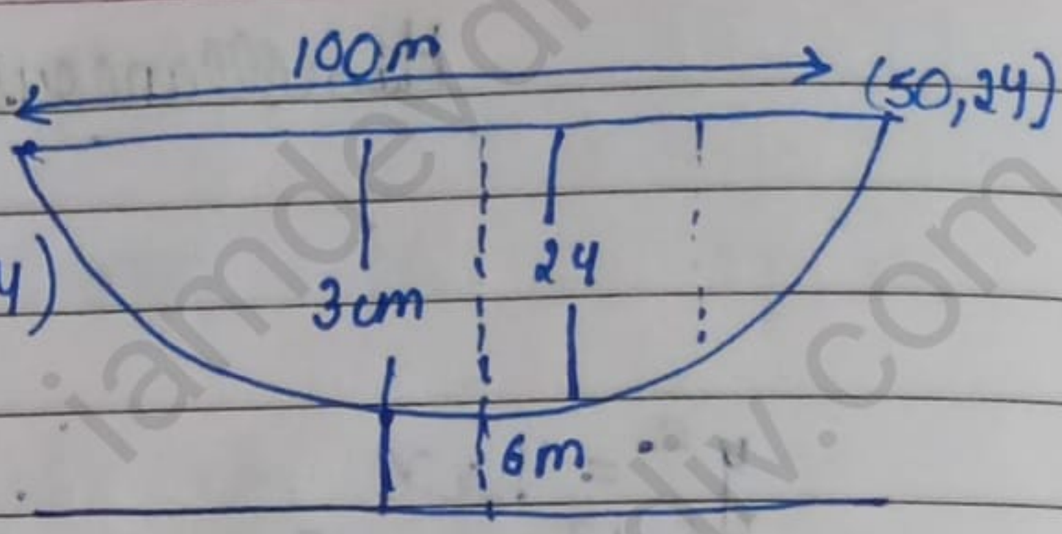
When $x = 18$ m

$(18)^2 = \frac{625}{6} y$

$y = \frac{18 \times 18 \times 6}{625}$

$y = \frac{1944}{625} = 3.11$ Approx

Length of supporting wire = 3.11 + 6m = 9.11m (Ans)



5.

Ap = 3cm

PB = 9cm $\quad \angle BPQ = \angle PAR = \theta$ (corresponding angles)

In $\triangle PBQ$

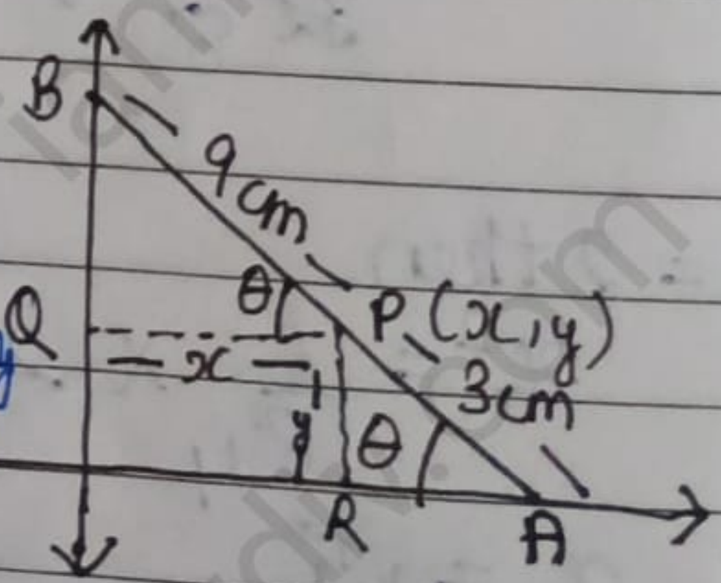
$\cos\theta = \frac{x}{9}$

In $\triangle PRA$,

$\sin\theta = \frac{y}{3}$

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

$\left(\frac{y}{3}\right)^2 + \left(\frac{x}{9}\right)^2 = 1$



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$$\frac{y^2}{9} + \frac{x^2}{9} = 1 \Rightarrow \frac{x^2}{81} + \frac{y^2}{9} = 1$$

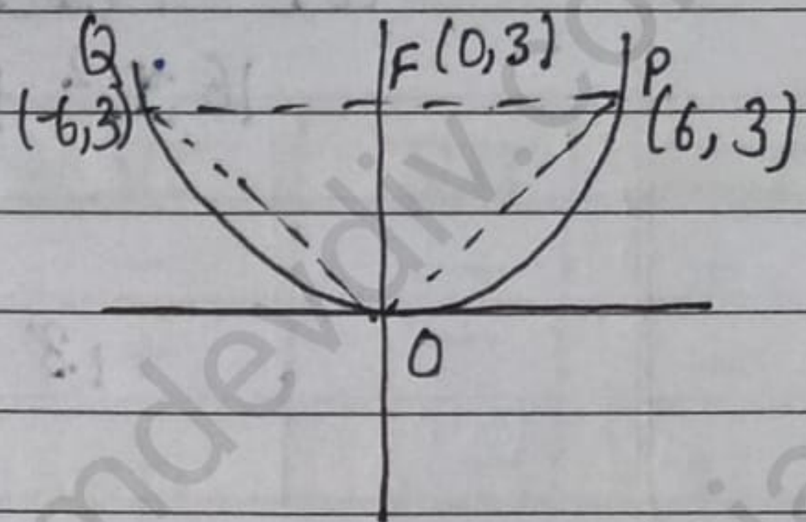
6.

$x^2 = 12y$

$x^2 = 4ay$

$4a = 12$

$a = 3$



$y = 3$

$① \Rightarrow x^2 = 12 \times 8 = 36$

$x = \pm 6$

$O(0,0)$ $P(6,3)$ $Q(-6,3)$

$PQ = 6+6 = 12\text{cm}$ $OF = 3\text{cm}$

$ar\triangle OPQ = \frac{1}{2} \times B \times H$

$= \frac{1}{2} \times PQ \times OF$

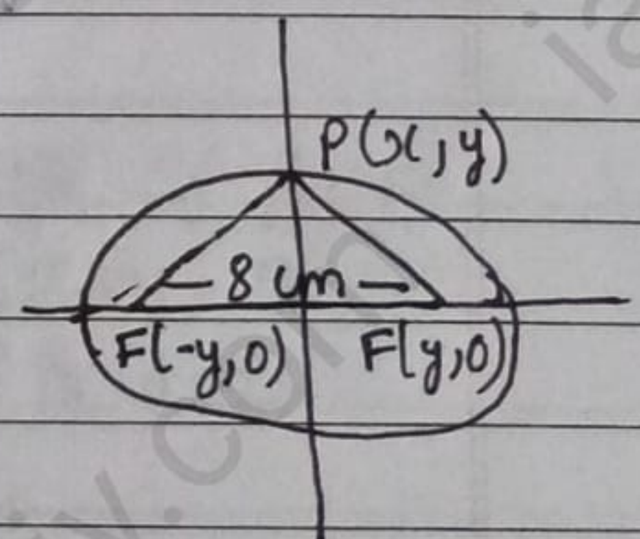
$= \frac{1}{2} \times 12^{6} \times 3 = 18 \text{ unit sq.}$

7.

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$FF' = 2c = 8 = c = 4$

$PF + PF' = 81$



$\sqrt{(x+4)^2 + (y-0)^2} + \sqrt{(x-4)^2 + (y-0)^2} = 10$

$\sqrt{(x+4)^2 + y^2} + \sqrt{(x-4)^2 + y^2} = 10$

$\sqrt{(x+4)^2 + y^2} = 10 - \sqrt{(x-4)^2 + y^2}$

$(x+4)^2 + y^2 = 100 + (x-4)^2 + y^2 - 20\sqrt{(x-4)^2 + y^2}$

$x^2 + 16 + 8x = 100 + x^2 + 16 - 8x - 20\sqrt{(x-4)^2 + y^2}$

$16x - 100 = -20\sqrt{(x-4)^2 + y^2}$

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$4(4x-25) = -20\sqrt{(x-4)^2+y^2}$

Squaring both sides

$16x^2 + 625 - 200x = 25x[(x-4)^2 + y^2]$

$16x^2 + 625 - 200x = 25x^2 + 400 - 200x + 25y^2$

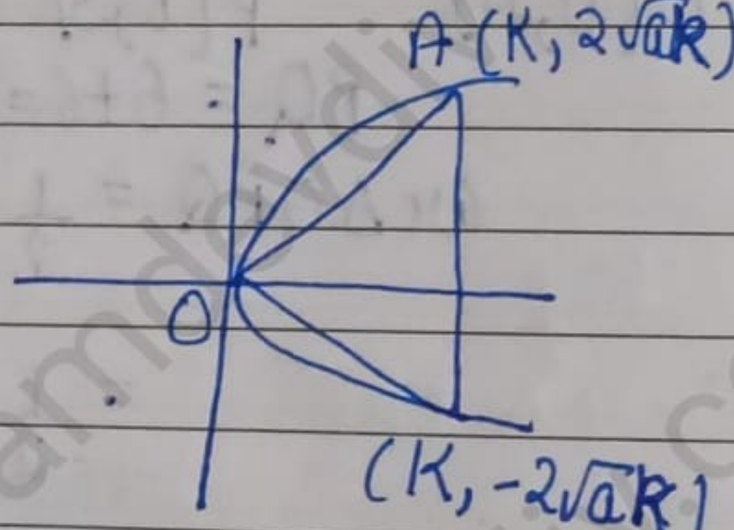
$9x^2 + 25y^2 + 400 - 625 = 0$

$9x^2 + 25y^2 - 225 = 0$

$\frac{9x^2}{225} + \frac{25y^2}{225} = 1$

$\frac{x^2}{25} + \frac{y^2}{9} = 1$

8.



when $x = K$

$y^2 = 4aK$

$y = \pm\sqrt{4aK}$

$y = \pm 2\sqrt{aK}$

$O(0,0)$ $A(K, 2\sqrt{aK})$ $B(K, -2\sqrt{aK})$

$OA = AB$

$\sqrt{k^2 + 4ak} = 2\sqrt{ak} + 2\sqrt{ak}$

$\sqrt{k^2+4ak} = 4\sqrt{ak}$

S.B.S.

$k^2 + 4ak = 16ak$

$k^2 = 12ak$

$k = 12a$

$AB = 4\sqrt{ak}$

$AB = 4\sqrt{a.12a} = 4a \times 2\sqrt{3} = 8\sqrt{3}a$

Side of Equilateral triangle is $8\sqrt{3}a$.