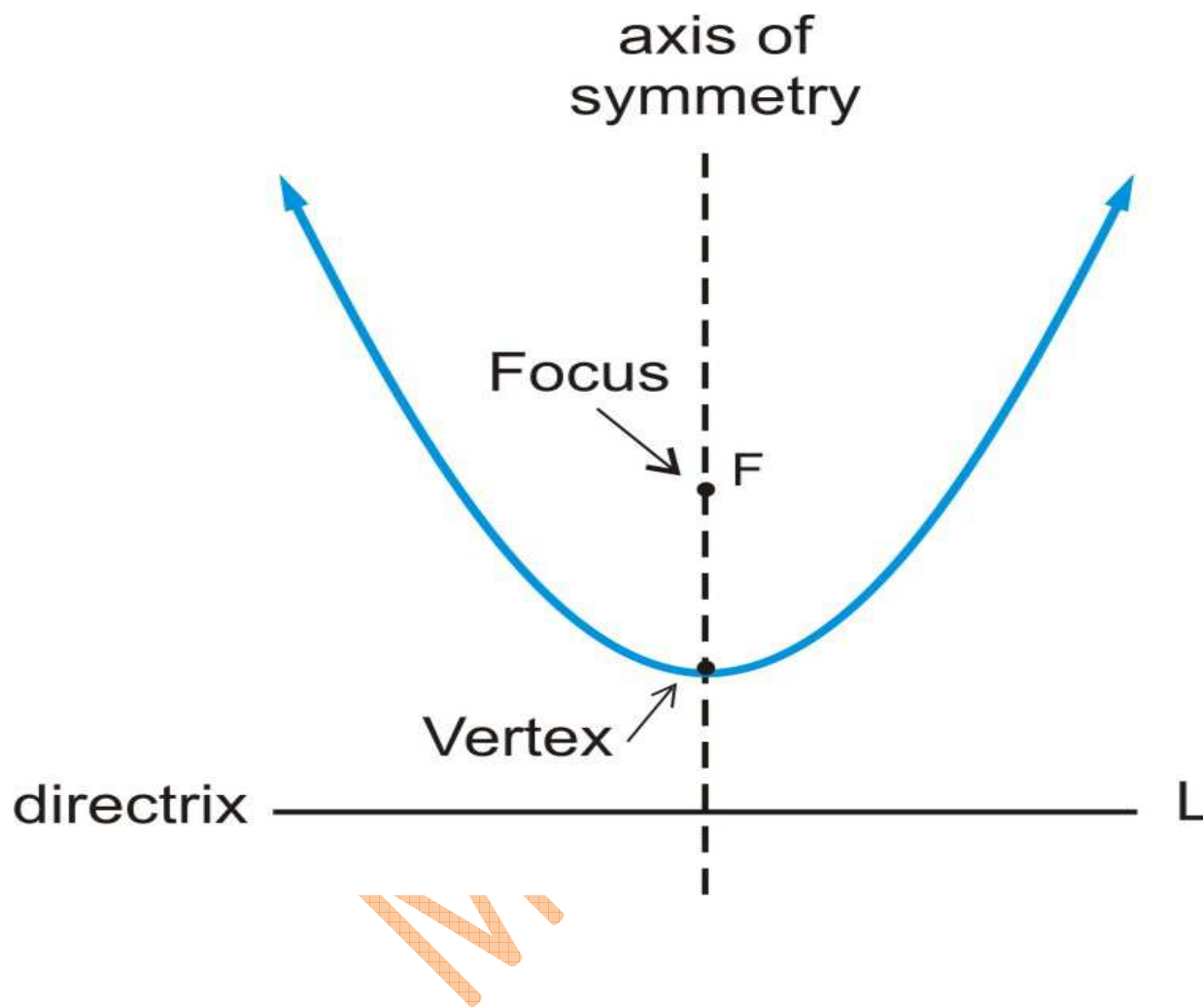


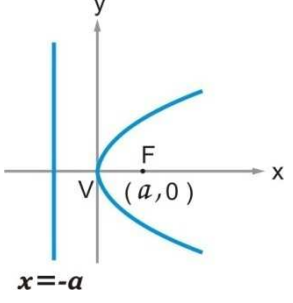
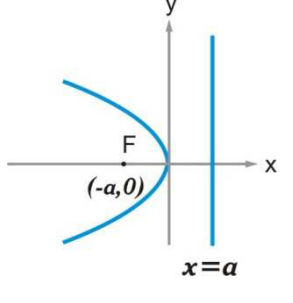
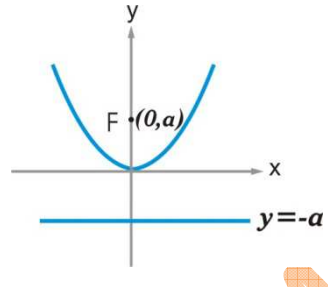
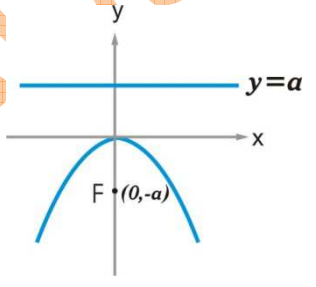
MAQSOOD ALI

Chapter 8

PARABOLAS



PARABOLA VERTEX AT ORIGIN

<p>(1) Axis along x-axis, open right:</p>  <p>(i) Equation of parabola $y^2 = 4ax$</p> <p>(ii) Focus at $(a, 0)$.</p> <p>(iii) Equation of directrix $x = -a$</p>	<p>(2) Axis along x-axis, open left:</p>  <p>(i) Equation of parabola $y^2 = -4ax$</p> <p>(ii) Focus at $(-a, 0)$.</p> <p>(iii) Equation of directrix $x = a$</p>
<p>(3) Axis along y-axis, open up:</p>  <p>(i) Equation of parabola $x^2 = 4ay$</p> <p>(ii) Focus at $(0, a)$.</p> <p>(iii) Equation of directrix $y = -a$</p>	<p>(4) Axis along y-axis, open down:</p>  <p>(i) Equation of parabola $x^2 = -4ay$</p> <p>(ii) Focus at $(0, -a)$.</p> <p>(iii) Equation of directrix $y = a$</p>

Formula:Length of latus rectum = $4a$ **MCQ-1 :**What is the focus of parabola $x^2 = 12y$?

- (a)
- $(0, 3)$
- (b)
- $(3, 0)$
- (c)
- $(0, -3)$
- (d)
- $(-3, 0)$

Solution:

$$x^2 = 12y$$

There are only two terms, so vertex at origin. The power of y is 1, so axis of parabola is along y -axis.
The coefficient of y is positive (i.e. 12) so it is open up.

Standard equation of parabola

$$x^2 = 4ay$$

$$4a = 12$$

$$a = 3$$

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

The answer is (a).

MCQ- 2:What is the focus of parabola $y^2 + 18x = 0$?

- (a)
- $(0, \frac{9}{2})$
- (b)
- $(0, -\frac{9}{2})$
- (c)
- $(\frac{9}{2}, 0)$
- (d)
- $(-\frac{9}{2}, 0)$

Solution:

$$y^2 + 18x = 0$$

$$y^2 = -18x$$

Vertex at origin, axis of parabola is along x -axis and open left because the coefficient of x is negative (i.e. -18).

Standard equation of parabola

$$y^2 = -4ax$$

$$4a = 18$$

$$a = \frac{9}{2}$$

Focus at $(-a, 0) = (-\frac{9}{2}, 0)$

The answer is (d).

MCQ- 3:

What is the length of latus rectum of parabola $x^2 = -28y$?

- (a) 7 (b) 28 (c) 192 (d) -7

Solution:

$$x^2 = -28y$$

Standard equation of parabola

$$x^2 = -4ay$$

Length of latus rectum = $4a$

$$4a = 28$$

The answer is (b).

EXERCISE-1

- (1) What are the coordinates of focus of the parabola $x^2 = -20y$?
 (a) $(-20, 0)$ (b) $(0, -20)$ (c) $(-5, 0)$ (d) $(0, -5)$
- (2) What is the length of the latus rectum of the parabola $y^2 = -24x$?
 (a) 24 (b) 6 (c) 4 (d) 12
- (3) What is the equation of the directrix of the parabola $x^2 + 32y = 0$?
 (a) $y = 32$ (b) $y = 8$ (c) $x = 8$ (d) $x = -8$
- (4) What is the equation of the directrix of the parabola $x^2 = 4ay$?
 (a) $y - a = 0$ (b) $x - a = 0$ (c) $y + a = 0$ (d) $x + a = 0$
- (5) e is the eccentricity of a parabola. What is the value of e ?
 (a) 0.5 (b) 1.5 (c) 0 (d) 1

PARABOLA VERTEX AT ORIGIN

S.No.	Axis of parabola	Open	Equation	Focus	Directrix
1	x-axis	Right	$y^2 = 4ax$	$(a, 0)$	$x = -a$
2	x-axis	Left	$y^2 = -4ax$	$(-a, 0)$	$x = a$
3	y-axis	Right	$x^2 = 4ay$	$(0, a)$	$y = -a$
4	y-axis	Left	$x^2 = -4ay$	$(0, -a)$	$y = a$

PARABOLA VERTEX AT (h , k)

S.No.	Axis of parabola	Open	Equation	Focus	Directrix
1	x-axis	Right	$(y - k)^2 = 4a(x - h)$	$(a + h, k)$	$x = -a + h$
2	x-axis	Left	$(y - k)^2 = -4a(x - h)$	$(-a + h, k)$	$x = a + h$
3	y-axis	Right	$(x - h)^2 = 4a(y - k)$	$(h, a + k)$	$y = -a + k$
4	y-axis	Left	$(x - h)^2 = -4a(y - k)$	$(h, -a + k)$	$y = a + k$

MCQ-4 :

What is the vertex of parabola $y^2 - 4y - 6x - 20 = 0$?

- (a) (0, 0) (b) (-2, -3) (c) (-4, 2) (d) (2, -3)

Solution:

$$y^2 - 4y - 6x - 20 = 0$$

$$y^2 - 4y = 6x + 20$$

$$\left(y - \frac{4}{2}\right)^2 = 6x + 20 + \left(\frac{4}{2}\right)^2$$

$$(y - 2)^2 = 6x + 20 + 2^2$$

$$(y - 2)^2 = 6x + 24$$

$$(y - 2)^2 = 6(x + 4)$$

$$h = -4, \quad k = 2$$

Vertex at $(h, k) = (-4, 2)$

The answer is (c).

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The answer is (d).

EXERCISE-2

- (1) What is the vertex of the parabola $x^2 - 6x - 12y - 51 = 0$?
[Hint: Find turning point, putting $dy/dx = 0$]
(a) (5, -3) (b) (-3, 5) (c) (3, -5) (d) (-5, 3)
- (2) What is the vertex of the parabola $y^2 + 4y + 4x - 12 = 0$?
(a) (-2, 4) (b) (4, -2) (c) (2, -4) (d) (-2, -4)
- (3) What are the coordinates of the vertex of the parabola $(y + 3)^2 = -4(x - 7)$?
(a) (-7, 3) (b) (-3, 7) (c) (7, -3) (d) (-1, -3)
- (4) What are the coordinates of focus of the parabola $(y - k)^2 = -4a(x - h)$?
(a) $(-a + h, k)$ (b) $(a + h, k)$ (c) $(a + k, h)$
(d) $(-a + h, 0)$
- (5) What are the coordinates of focus of the parabola $(y - 2)^2 = 8(x - 3)$?
(a) (5, 2) (b) (2, 3) (c) (2, 0) (d) (4, 3)
- (6) What are the coordinates of focus of the parabola $(y - 5)^2 = -12(x + 2)$?
(a) (-1, 5) (b) (-3, 5) (c) (-5, 5) (d) (2, -2)
- (7) What are the coordinates of focus of the parabola $(x + 6)^2 = 20(y - 4)$?
(a) (-6, 5) (b) (-1, 4) (c) -6, 9) (d) (3, 2)
- (8) What are the coordinates of focus of the parabola $(x - 5)^2 = -8(y - 7)$?
(a) (5, 5) (b) (5, 7) (c) (-2, 7) (d) (3, 7)
- (9) What is the equation of the directrix of the parabola $(x - h)^2 = 4a(y - k)$?
(a) $x + a = h$ (b) $y + a = k$ (c) $y - a = k$ (d) $y = -a$
- (10) What is the equation of the directrix of the parabola $(y - k)^2 = 4a(x - h)$?
(a) $x = h + a$ (b) $x = h - a$ (c) $y = k - a$ (d) $y = h + a$
- (11) What is the equation of the directrix of the parabola $(x - h)^2 = -4a(y - k)$?
(a) $y = k + a$ (b) $x = h + a$ (c) $y = k - a$ (d) $x = k - a$

(12) What is the equation of the directrix of the parabola

$$(y - 2)^2 = 16(x - 5)?$$

- (a) $x = 5$ (b) $x = -2$ (c) $x = 1$ (d) $y + 2 = 0$

(13) What is the equation of the directrix of the parabola

$$(x + 7)^2 = -4(y - 6)?$$

- (a) $y = 7$ (b) $y = 5$ (c) $y = 1$ (d) $y = -8$

(14) Which is the equation of the directrix of the parabola

$$(x - h)^2 = 4a(y - k)?$$

- (a) $x + a = h$ (b) $y + a = k$ (c) $y - a = k$ (d) $y = -a$

EQUATION OF PARABOLA**MCQ-7 :**

What is the equation of parabola vertex at origin and focus $(-8, 0)$?

- (a) $x^2 = -8y$ (b) $y^2 = -8x$ (c) $x^2 = -32y$ (d) $y^2 = -32x$

Solution:

Vertex at origin , focus $(-8, 0)$

since ordinate = 0

\therefore axis of parabole is along x-axis.

abscissa = -8

Negative sign shows that parabola is open left and

$$a = 8$$

The equation of parabola is

$$y^2 = -4ax$$

$$y^2 = -32x$$

The answer is (d).

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$$4a = 16$$

$$a = 4$$

Equation of tangent

$$xx_1 = 2a(y + y_1)$$

$$-4x = 8(y + 1)$$

$$-x = 2(y + 1)$$

$$x + 2y + 2 = 0$$

The answer is (b).

Note: Tangent at the vertex of the parabola is parallel to x-axis (if axis of parabola is along y-axis) or parallel to y-axis (if axis of parabola is along x-axis).

Vertex at (h, k) :

i) Equation of tangent, axis of parabola is along x-axis.

$$x = h$$

ii) Equation of tangent, axis of parabola is along y-axis.

$$y = k$$

EXERCISE-4

- (1) What is the equation of tangent of the parabola $y^2 = 32x$ at $(3, -5)$?
- (a) $32x - 5y + 36 = 0$ (b) $16x + 5y + 48 = 0$
 (c) $8x + 5y + 24 = 0$ (d) $32x + 5y + 96 = 0$
- (2) A tangent is drawn to parabola $y^2 = 8x$. What is the equation of tangent at vertex?
- (a) $y = 0$ (b) $x = 0$ (c) $x = 2$ (d) $y = -2$
- (3) A tangent is drawn at vertex to the parabola $(x - 8)^2 = 12(y - 3)$. What is the equation of tangent?
- (a) $y = 6$ (b) $y = 3$ (c) $y = -3$ (d) $x = 8$

CONDITION OF TANGENCY

S. NO.	EQ. OF PARABOLA	EQ. OF STRAIGHT LINE	CONDITION OF TANGENCY
i	$y^2 = 4ax$	$y = mx + c$	$c = a/m$
ii	$x^2 = 4ay$	$y = mx + c$	$c = -am^2$

MCQ- 10:

$k = ?$, if the line $y = kx - 2$ is tangent to the parabola $x^2 = 8y$?

- (a) 1 (b) 2 (c) 4 (d) 8

Solution:

$$x^2 = 8y$$

$$4a = 8$$

$$a = 2$$

$$y = kx - 2$$

$$m = k, c = -2$$

Condition of tangency

$$c = -am^2$$

$$-2 = -2k^2$$

$$k^2 = 1$$

$$k = \pm 1$$

The answer is (a).

EXERCISE-5

(1) $k = ?$, if the line $y = 3x + k$ is tangent of the parabola $y^2 = 36x$?

- (a) 9 (b) 8 (c) 6 (d) 3

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