



## MATHS

### BOOKS - CENGAGE PUBLICATION

## PARABOLA

#### ILLUSTRATION 5.1

1. Find the equation of parabola

having focus at  $(0, -3)$  its directrix is  $y = 3$ .



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2. Find the equation of parabola

(i) having end points of latus rectum  $(5,10)$  and  $(5,-10)$  and which opens towards right.

(ii) having vertex at origin and focus at  $(0,2)$

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## ILLUSTRATION 5.2

1. An arch is in the form of a parabola with its axis vertical.

The arch is 10 m high and 5 m wide at the base. How wide is it

2 m from the vertex of the parabola ?

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2. An arch is in the form of a parabola with its axis vertical.

The arch is 10 m high and 5 m wide at the base. How wide is it

2 m from the vertex of the parabola ?



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### ILLUSTRATION 5.3

1. If  $y = \sqrt{\sin x + y}$ , then find  $\frac{dy}{dx}$



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### ILLUSTRATION 5.4

1. Find the coordinates of a point on the parabola  $y^2 = 8x$  whose distance from the focus is 6.

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2. The coordinates of a point on the parabola  $y^2 = 8x$  whose distance from the circle  $x^2 + (y + 6)^2 = 1$  is minimum is (a) (2, 4) (b) (2, -4) (c) (18, -12) (d) (8, 8)

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## ILLUSTRATION 5.5

1.  $M$  is the foot of the perpendicular from a point  $P$  on a parabola  $y^2 = 4ax$  to its directrix and  $SPM$  is an equilateral



triangle, where  $S$  is the focus. Then find  $SP$ .



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## ILLUSTRATION 5.6

1. An equilateral triangle is inscribed in the parabola  $y^2 = 4ax$ , such that one vertex of this triangle coincides with the vertex of the parabola. Then find the side length of this triangle.



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## ILLUSTRATION 5.7

1. Find the equation of the chord of the parabola  $y^2 = 8x$  having slope 2 if midpoint of the chord lies on the line  $x=4$ .

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2. Find the equation of the chord of the parabola  $y^2 = 8x$  having slope 2 if midpoint of the chord lies on the line  $x=4$ .

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## ILLUSTRATION 5.8

1. Find the locus of midpoint of family of chords  $\lambda x + y = 5$  ( $\lambda$  is parameter) of the parabola  $x^2 = 20y$

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## ILLUSTRATION 5.9

1. Find the position of points  $P(1,3)$  w.r.t. parabolas  $y^2 = 4x$  and  $x^2 = 8y$ .

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2. Find the position of points  $P(1,3)$  w.r.t. parabolas  $y^2 = 4x$  and  $x^2 = 8y$ .

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## ILLUSTRATION 5.10

1. The point  $(a, 2a)$  is an interior point of the region bounded by the parabola  $y^2 = 16x$  and the double ordinate through the focus. then find the values of  $a$ .

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### ILLUSTRATION 5.11

1. Find the locus of the middle points of the chords of the parabola  $y^2 = 4ax$  which subtend a right angle at the vertex of the parabola.

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### ILLUSTRATION 5.12

1. In the following figure, find the locus of centroid of triangle PAB, where AP perpendicular to PB.



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### ILLUSTRATION 5.13

1. A quadrilateral is inscribed in a parabola  $y^2 = 4ax$  and three of its sides pass through fixed points on the axis. Show that the fourth side also passes through a fixed point on the axis of the parabola.

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## ILLUSTRATION 5.14

1. Find the equation of parabola

(i) having its vertex at  $A(1,0)$  and focus at  $S(3,0)$

(ii) having its focus at  $S(2,5)$  and one of the extremities of latus rectum is  $A(4,5)$



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2. Find the equation of parabola

(i) having its vertex at  $A(1,0)$  and focus at  $S(3,0)$

(ii) having its focus at  $S(2,5)$  and one of the extremities of latus rectum is  $A(4,5)$



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## ILLUSTRATION 5.15

1.  $y^2 + 2y - x + 5 = 0$  represents a parabola. Find equation of latus rectum.

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## ILLUSTRATION 5.16

1. The parametric equation of a parabola is  $x = t^2 - 1, y = 3t + 1$ . Then find the equation of the directrix.

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## ILLUSTRATION 5.17

1. Find the points on the parabola  $y^2 - 2y - 4x = 0$  whose focal length is 6.

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## ILLUSTRATION 5.18

1. Find the value of  $P$  such that the vertex of  $y = x^2 + 2px + 13$  is 4 units above the x-axis.

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## ILLUSTRATION 5.19



1. Find the equation of the parabola which has axis parallel to the  $y$ -axis and which passes through the points  $(0, 2)$ ,  $(-1, 0)$ , and  $(1, 6)$ .

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## ILLUSTRATION 5.20

1. Prove that the focal distance of the point  $(x, y)$  on the parabola  $x^2 - 8x + 16y = 0$  is  $|y - 5|$

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## ILLUSTRATION 5.21

1. If the focus of a parabola is  $(2, 3)$  and its latus rectum is 8, then find the locus of the vertex of the parabola.



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## ILLUSTRATION 5.22

1. Prove that the locus of the center of the circle which touches the given circle externally and the given line is a parabola.



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## ILLUSTRATION 5.23

1. In triangle ABC, base BC is fixed. Then prove that the locus of vertex A such that  $\tan B + \tan C = \text{Constant}$  is parabola.

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## ILLUSTRATION 5.24

1. Consider a square with vertices at  $(1, 1)$ ,  $(-1, 1)$ ,  $(-1, -1)$ , and  $(1, -1)$ . Set  $S$  be the region consisting of all points inside the square which are nearer to the origin than to any edge. Sketch the region  $S$  and find its area.

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## ILLUSTRATION 5.25

1. Find the value of  $\lambda$  if the equation  $9x^2 + 4y^2 + 2\lambda xy + 4x - 2y + 3 = 0$  represents a parabola.

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## ILLUSTRATION 5.26

1. Does equation  $(5x - 5)^2 + (5y + 10)^2 = (3x + 4y + 5)^2$  represents a parabola ?

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2. Does equation  $(5x - 5)^2 + (5y + 10)^2 = (3x + 4y + 5)^2$  represents a parabola ?

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### ILLUSTRATION 5.27

1. Find the equation of the parabola having focus  $(1, 1)$  and vertex at  $(-3, -3)$ .

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### ILLUSTRATION 5.28

1. Find the value of  $\lambda$  if the equation  $(x - 1)^2 + (y - 2)^2 = \lambda(x + y + 3)^2$  represents a parabola. Also, find its focus, the coordinates of its vertex, the equation of its latus rectum

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### ILLUSTRATION 5.29

1. Show that the curve whose parametric coordinates are  $x = t^2 + t + 1, y = t^2 - t + 1$  represents a parabola.

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### ILLUSTRATION 5.30

1. If  $(2, -8)$  is at an end of a focal chord of the parabola  $y^2 = 32x$ , then find the other end of the chord.

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### ILLUSTRATION 5.31

1. Let  $S$  is the focus of the parabola  $y^2 = 4ax$  and  $X$  the foot of the directrix,  $PP'$  is a double ordinate of the curve and  $PX$  meets the curve again in  $Q$ . Prove that  $P'Q$  passes through focus.

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### ILLUSTRATION 5.32

1. Length of the focal chord of the parabola  $y^2 = 4ax$  at a distance  $p$  from the vertex is:

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### ILLUSTRATION 5.33

1. If  $AB$  is a focal chord of  $x^2 - 2x + y - 2 = 0$  whose focus is  $S$  and  $AS = l_1$ , then find  $BS$ .

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### ILLUSTRATION 5.34



1. Circles are drawn with diameter being any focal chord of the parabola  $y^2 - 4x - y - 4 = 0$  with always touch a fixed line. Find its equation.

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### ILLUSTRATION 5.35

1. Find the equation of the tangent to the parabola  $y^2 = 8x$  having slope 2 and also find the point of contact.

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### ILLUSTRATION 5.36

1. A tangent to the parabola  $y^2 = 8x$  makes an angle of  $45^\circ$  with the straight line  $y = 3x + 5$ . Then find one of the points of contact.

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### ILLUSTRATION 5.37

1. Show that  $x \cos \alpha + y \sin \alpha = p$  touches the parabola  $y^2 = 4ax$  if  $p \cos \alpha + a \sin^2 \alpha = 0$  and that the point of contact is  $(a \tan^2 \alpha, -2a \tan \alpha)$ .

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### ILLUSTRATION 5.38

1. The parabola  $y^2 = 4x$  and the circle having its center at (6, 5) intersect at right angle. Then find the possible points of intersection of these curves.

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### ILLUSTRATION 5.39

1. Find the equation of tangents of the parabola  $y^2 = 12x$ , which passes through the point (2, 5).

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### ILLUSTRATION 5.40

1. The tangents to the parabola  $y^2 = 4ax$  at the vertex  $V$  and any point  $P$  meet at  $Q$ . If  $S$  is the focus, then prove that  $SPSQ$ , and  $SV$  are in GP.

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#### ILLUSTRATION 5.41

1. The equation of the common tangent to the parabolas  $y^2 = 4ax$  and  $x^2 = 4by$  is given by

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#### ILLUSTRATION 5.42

1. If a tangent to the parabola  $y^2 = 4ax$  meets the x-axis at  $T$  and intersects the tangents at vertex  $A$  at  $P$ , and rectangle  $TAPQ$  is completed, then find the locus of point  $Q$ .

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### ILLUSTRATION 5.43

1. Two tangents are drawn from the point  $(-2, -1)$  to parabola  $y^2 = 4x$ . if  $\alpha$  is the angle between these tangents, then find the value of  $\tan \alpha$ .

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### ILLUSTRATION 5.44

1. If two tangents drawn from the point  $(\alpha, \beta)$  to the parabola  $y^2 = 4x$  are such that the slope of one tangent is double of the other, then prove that  $\alpha = \frac{2}{9}\beta^2$ .

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### ILLUSTRATION 5.45

1. If the tangent at the point  $P(2, 4)$  to the parabola  $y^2 = 8x$  meets the parabola  $y^2 = 8x + 5$  at  $Q$  and  $R$ , then find the midpoint of chord  $QR$ .

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### ILLUSTRATION 5.46

1. The locus of foot of the perpendiculars drawn from the vertex on a variable tangent to the parabola  $y^2 = 4ax$  is

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### ILLUSTRATION 5.47

1. Find the equation of the tangent to the parabola  $y = x^2 - 2x + 3$  at point  $(2, 3)$ .

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### ILLUSTRATION 5.48

1. Find the equation of the tangent to the parabola  $x = y^2 + 3y + 2$  having slope 1.

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### ILLUSTRATION 5.49

1. Find the equation of tangents drawn to the parabola  $y = x^2 - 3x + 2$  from the point  $(1, -1)$ .

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### ILLUSTRATION 5.50



1. Find the shortest distance between the line  $y = x - 2$  and the parabola  $y = x^2 + 3x + 2$ .



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### ILLUSTRATION 5.51

1. If the lines  $L_1$  and  $L_2$  are tangents to  $4x^2 - 4x - 24y + 49 = 0$  and are normals for  $x^2 + y^2 = 72$ , then find the slopes of  $L_1$  and  $L_2$ .



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### ILLUSTRATION 5.52

1. Tangents are drawn from the point  $(-1, 2)$  on the parabola  $y^2 = 4x$ . Find the length that these tangents will intercept on the line  $x = 2$ .

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### ILLUSTRATION 5.53

1. Tangents are drawn to the parabola  $y^2 = 4ax$  at the point where the line  $lx + my + n = 0$  meets this parabola. Find the point of intersection of these tangents.

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### ILLUSTRATION 5.54

1. If the chord of contact of tangents from a point  $P$  to the parabola  $y^2 = 4ax$  touches the parabola  $x^2 = 4by$ , then the locus of  $P$ . is a) a circle b) a parabola c) a straight line d) none of these

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### ILLUSTRATION 5.55

1. From a variable point on the tangent at the vertex of a parabola  $y^2 = 4ax$ , a perpendicular is drawn to its chord of contact. Show that these variable perpendicular lines pass through a fixed point on the axis of the parabola.

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## ILLUSTRATION 5.56

1. Find the points of contact  $Q$  and  $R$  of a tangent from the point  $P(2, 3)$  on the parabola  $y^2 = 4x$ .

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## ILLUSTRATION 5.57

1. Tangents are drawn from any point on the line  $x + 4a = 0$  to the parabola  $y^2 = 4ax$ . Then find the angle subtended by the chord of contact at the vertex.

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## ILLUSTRATION 5.58

1. Two straight lines  $(y - b) = m_1(x + a)$  and  $(y - b) = m_2(x + a)$  are the tangents of  $y^2 = 4ax$ . Prove  $m_1m_2 = -1$ .

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## ILLUSTRATION 5.59

1. Mutually perpendicular tangents  $TA$  and  $TB$  are drawn to  $y^2 = 4ax$ . Then find the minimum length of  $AB$

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## ILLUSTRATION 5.60

1. Tangent  $PA$  and  $PB$  are drawn from the point  $P$  on the directrix of the parabola

$$(x - 2)^2 + (y - 3)^2 = \frac{(5x - 12y + 3)^2}{160} . \text{ Find the least}$$

radius of the circumcircle of triangle  $PAB$ .



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## ILLUSTRATION 5.61

1. Tangents are drawn to the parabola

$$(x - 3)^2 + (y + 4)^2 = \frac{(3x - 4y - 6)^2}{25} \text{ at the extremities}$$

of the chord  $2x - 3y - 18 = 0$ . Find the angle between the tangents.

A. A.  $90^\circ$

B. B.  $45^\circ$

C. C.  $60^\circ$

D. D.  $30^\circ$



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## ILLUSTRATION 5.62

1. Let  $3x - y - 8 = 0$  be the equation of tangent to a parabola at the point  $(7, 13)$ . If the focus of the parabola is at  $(-1, -1)$ . Its directrix is



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2. Let  $y=3x-8$  be the equation of the tangent at the point  $(7, 13)$  lying on a parabola whose focus is at  $(-1,-1)$ . Find the equation of directrix and the length of the latus rectum of the parabola.

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### ILLUSTRATION 5.63

1. Find the locus of the point of intersection of tangents in the parabola  $x^2 = 4ax$ . which are inclined at an angle  $\theta$  to each other. Which intercept constant length  $c$  on the tangent at the vertex. such that the area of  $ABR$  is constant  $c$ , where  $A$  and  $B$  are the points of intersection of tangents with the y-axis and  $R$  is a point of intersection of tangents.





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## ILLUSTRATION 5.64

1. Find the equations of normal to the parabola  $y^2 = 4ax$  at the ends of the latus rectum.



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## ILLUSTRATION 5.65

1. If  $y = x + 2$  is normal to the parabola  $y^2 = 4ax$ , then find the value of  $a$ .



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## ILLUSTRATION 5.66

1. Find the equation of line which is normal to the parabola  $x^2 = 4y$  and touches the parabola  $y^2 = 12x$ .

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2. Find the equation of line which is normal to the parabola  $x^2 = 4y$  and touches the parabola  $y^2 = 12x$ .

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## ILLUSTRATION 5.67

1. Find the equation of normal to the parabola  $y = x^2 - x - 1$  which has equal intercept on the axes. Also find the point where this normal meets the curve again.

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### ILLUSTRATION 5.68

1. Prove that the length of the intercept on the normal at the point  $P(at^2, 2at)$  of the parabola  $y^2 = 4ax$  made by the circle described on the line joining the focus and  $P$  as diameter is  $a\sqrt{1+t^2}$ .

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## ILLUSTRATION 5.69

1. A normal chord of the parabola  $y^2 = 4ax$  subtends a right angle at the vertex, find the slope of chord.

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## ILLUSTRATION 5.70

1. How many normals can be drawn to parabola  $y^2 = 4x$  from point  $(15, 12)$ ? Find their equation. Also, find corresponding feet of normals on the parabola.

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2. How many normals can be drawn to parabola  $y^2 = 4x$  from point  $(15, 12)$ ? Find their equation. Also, find corresponding feet of normals on the parabola.

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### ILLUSTRATION 5.71

1. Three normals are drawn from the point  $(7, 14)$  to the parabola  $x^2 - 8x - 16y = 0$ . Find the coordinates of the feet of the normals.

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### ILLUSTRATION 5.72

1. Find the minimum distance between the curves  $y^2 = 4x$  and  $x^2 + y^2 - 12x + 31 = 0$



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### ILLUSTRATION 5.73

1. If normals drawn at three different point on the parabola  $y^2 = 4ax$  pass through the point  $(h,k)$ , then show that  $h > 2a$ .



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### ILLUSTRATION 5.74

1. If three distinct normals to the parabola  $y^2 - 2y = 4x - 9$  meet at point  $(h,k)$ , then prove that  $h > 4$ .

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2. If three distinct normals to the parabola  $y^2 - 2y = 4x - 9$  meet at point  $(h,k)$ , then prove that  $h > 4$ .

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## ILLUSTRATION 5.75

1. In the parabola  $y^2 = 4ax$ , then tangent at  $P$  whose abscissa is equal to the latus rectum meets its axis at  $T$ , and

normal  $P$  cuts the curve again at  $Q$ . Show that

$$PT : PQ = 4 : 5.$$



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### ILLUSTRATION 5.76

1. Find the length of normal chord which subtends an angle of  $90^\circ$  at the vertex of the parabola  $y^2 = 4x$ .



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### ILLUSTRATION 5.77



1. Prove that the locus of the point of intersection of the normals at the ends of a system of parallel chords of a parabola is a straight line which is a normal to the curve.

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### ILLUSTRATION 5.78

1. Find the locus of the midpoint of normal chord of parabola  $y^2 = 4ax$ .

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### ILLUSTRATION 5.79

1. If the angle between the normal to the parabola  $y^2 = 4ax$  at point P and the focal chord passing through P is  $60^\circ$ , then find the slope of the tangent at point P.

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2. If the angle between the normal to the parabola  $y^2 = 4ax$  at point P and the focal chord passing through P is  $60^\circ$ , then find the slope of the tangent at point P.

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**ILLUSTRATION 5.80**

1. A parabola mirror is kept along  $y^2 = 4x$  and two light rays parallel to its axis are reflected along one straight line. If one of the incident light rays is at 3 units distance from the axis, then find the distance of the other incident ray from the axis.

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### ILLUSTRATION 5.81

1. If two of the three feet of normals drawn from a point to the parabola  $y^2 = 4x$  are  $(1, 2)$  and  $(1, -2)$ , then find the third foot.

A. A.  $(2,2)$

B. B.  $(2,-2)$

C. C. (0,0)

D. D. None of these

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## ILLUSTRATION 5.82

1. If the normals from any point to the parabola  $y^2 = 4x$  cut the line  $x = 2$  at points whose ordinates are in AP, then prove that the slopes of tangents at the co-normal points are in GP.

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## ILLUSTRATION 5.83

1. Find the locus of the point of intersection of two normals to a parabolas which are at right angles to one another.

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## ILLUSTRATION 5.84

1.  $P(t_1)$  and  $Q(t_2)$  are the point  $t_1$  and  $t_2$  on the parabola  $y^2 = 4ax$ . The normals at  $P$  and  $Q$  meet on the parabola. Show that the middle point  $PQ$  lies on the parabola  $y^2 = 2a(x + 2a)$ .

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## ILLUSTRATION 5.85

1. Normals are drawn at points  $A$ ,  $B$ , and  $C$  on the parabola  $y^2 = 4x$  which intersect at  $P$ . The locus of the point  $P$  if the slope of the line joining the feet of two of them is 2, is

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## SOLVED EXAMPLES 5.1

1. Prove that for a suitable point  $P$  on the axis of the parabola, chord  $AB$  through the point  $P$  can be drawn such that  $\left[ \left( \frac{1}{AP^2} \right) + \left( \frac{1}{BP^2} \right) \right]$  is same for all positions of the chord.

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## SOLVED EXAMPLES 5.2

1. A parabola of latus rectum  $l$  touches a fixed equal parabola. The axes of two parabolas are parallel. Then find the locus of the vertex of the moving parabola.



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## SOLVED EXAMPLES 5.3

1. Differentiate with respect to  $x$ ,  $y = e^{3x} \cos 2x$



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## SOLVED EXAMPLES 5.4

1. Find the radius of the largest circle, which passes through the focus of the parabola  $y^2 = 4(x + y)$  and is also contained in it.

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## SOLVED EXAMPLES 5.5

1. The vertices  $A$ ,  $B$  and  $C$  of a variable right triangle lie on a parabola  $y^2 = 4x$ . If the vertex  $B$  containing the right angle always remains at the point  $(1, 2)$ , then find the locus of the centroid of triangle  $ABC$ .

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## SOLVED EXAMPLES 5.6

1. Tangents are drawn to the parabola at three distinct points. Prove that these tangent lines always make a triangle and that the locus of the orthocentre of the triangle is the directrix of the parabola.

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## SOLVED EXAMPLES 5.7

1. Differentiate with respect to  $x$ ,  $y = e^{\sin \sqrt{x}}$

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## SOLVED EXAMPLES 5.8

1. Two lines are drawn at right angles, one being a tangent to  $y^2 = 4ax$  and the other  $x^2 = 4by$ . Then find the locus of their point of intersection.



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## SOLVED EXAMPLES 5.9

1. Differentiate with respect to  $x$ ,  $y = \tan^2 x$



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## SOLVED EXAMPLES 5.10

1. If the normals at P, Q, R of the parabola  $y^2 = 4ax$  meet in O and S be its focus, then prove that  $SP \cdot SQ \cdot SR = a \cdot (SO)^2$ .

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## SOLVED EXAMPLES 5.11

1. The shortest distance between the parabolas  $2y^2 = 2x - 1$  and  $2x^2 = 2y - 1$  is (a)  $2\sqrt{2}$  (b)  $\frac{1}{2\sqrt{2}}$  (c) 4 (d)  $\sqrt{\frac{36}{5}}$

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## SOLVED EXAMPLES 5.12

1. If two chords drawn from the point  $A(4, 4)$  to the parabola  $x^2 = 4y$  are bisected by the line  $y = mx$ , the interval in which  $m$  lies is (a)  $(-2\sqrt{2}, 2\sqrt{2})$  (b)  $(-\infty, -\sqrt{2}) \cup (\sqrt{2}, \infty)$  (c)  $(-\infty, -2\sqrt{2} - 2) \cup (2\sqrt{2} - 2, \infty)$  (d) none of these



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### SOLVED EXAMPLES 5.13

1. Tangent is drawn at any point  $(p, q)$  on the parabola  $y^2 = 4ax$ . Tangents are drawn from any point on this tangent to the circle  $x^2 + y^2 = a^2$ , such that the chords of contact pass through a fixed point  $(r, s)$ . Then  $p, q, r$  and  $s$  can hold the relation

(a)  $r^2q = 4p^2s$  (b)  $rq^2 = 4ps^2$  (c)  $rq^2 = -4ps^2$  (d)

$r^2q = -4p^2s$



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## SOLVED EXAMPLES 5.14

1. Differentiate with respect to  $x$ ,  $y = \sin^2(2x + 1)$



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## Concept Applications Exercise 5.1

1. Find the angle made by a double ordinate of length  $2a$  at the vertex of the parabola  $y^2 = ax$ .

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2. If focal distance of a point P on the parabola  $y^2 = 4ax$  whose abscissa is 5 10, then find the value of a.

A. A. 5

B. B. 10

C. C. 0

D. D. None of these

**Answer: 5**

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3. Analyze the equation if it represents parabola or a part of

parabola  $x = \sqrt{-y}$



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4. Find the range of values of  $\lambda$  for which the point  $(\lambda, -1)$

is exterior to both the parabolas  $y^2 = |x|$ .

A. A. (0,1)

B. B. (-1,1)

C. C. (-1,0)

D. D. None of these

**Answer:**  $-1 < \lambda < 1$



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5. The locus of a point on the variable parabola  $y^2 = 4ax$ , whose distance from the focus is always equal to  $k$ , is equal to ( $a$  is parameter)

a)  $4x^2 + y^2 - 4kx = 0$     b)  $x^2 + y^2 - 4ky = 0$

c)  $2x^2 + 4y^2 - 9kx = 0$     d)  $4x^2 - y^2 + 4kx = 0$

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6. Find the locus of the midpoint of chords of the parabola  $y^2 = 4ax$  that pass through the point  $(3a, a)$ .

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7. If chord BC subtends right angle at the vertex A of the parabola  $y^2 = 4x$  with  $AB = \sqrt{5}$  then find the area of triangle ABC.

- A. A. 20 sq. units
- B. B. 10 sq. units
- C. C. 40 sq. units
- D. D. None of these

**Answer: 20 sq. units**

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8. PQ is a chord of the parabola  $y^2 = 4x$  whose perpendicular bisector meets the axis at M and the ordinate of the

midpoint PQ meets the axis at N. Then the length MN is equal to

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9.  $LOL'$  and  $MOM'$  are two chords of parabola  $y^2 = 4ax$  with vertex  $A$  passing through a point  $O$  on its axis. Prove that the radical axis of the circles described on  $LL'$  and  $MM'$  as diameters passes through the vertex of the parabola.

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10. If focal distance of a point P on the parabola  $y^2 = 4ax$  whose abscissa is 5, then find the value of a.

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11. If chord BC subtends right angle at the vertex A of the parabola  $y^2 = 4x$  with  $AB = \sqrt{5}$  then find the area of triangle ABC.

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## Concept Applications Exercise 5.2

1. If the focus and vertex of a parabola are the points (0, 2) and (0, 4), respectively, then find the equation

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2. Find the equation of parabola whose focus is (0,1) and the directrix is  $x+2=0$ . Also find the vertex of the parabola.

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3. Find the vertex, focus and directrix of the parabola  $x^2 = 2(2x + y)$ .

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4. The vertex of a parabola is (2, 2) and the coordinates of its two extremities of latus rectum are ( - 2, 0) and (6, 0). Then find the equation of the parabola.

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5. A parabola passes through the point the point (1,2), (2,1), (3,4) and (4,3). Find the equation of the axis of parabola.

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6. Find the length of the common chord of the parabola  $x^2 = 4(x + 3)$  and the circle  $x^2 + y^2 + 4x = 0$ .

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7. The equation of the latus rectum of a parabola is  $x + y = 8$  and the equation of the tangent at the vertex is  $x + y = 12$ . Then find the length of the latus rectum.

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8. Find the length of the latus rectum of the parabola whose focus is at  $(2, 3)$  and directrix is the line  $x - 4y + 3 = 0$ .

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9. If  $(a, b)$  is the midpoint of a chord passing through the vertex of the parabola  $y^2 = 4(x + 1)$ , then prove that  $2(a + 1) = b^2$

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10. Check whether Rolle's theorem is applicable on  $f(x) = x^2 - 8x + 12$  on  $[2, 6]$ .

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**11.** Plot the region in the first quadrant in which points are nearer to the origin than to the line  $x = 3$ .

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**12.** Prove that the locus of a point, which moves so that its distance from a fixed line is equal to the length of the tangent drawn from it to a given circle, is a parabola.

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**13.** Prove that the locus of the center of a circle, which intercepts a chord of given length  $2a$  on the axis of  $x$  and passes through a given point on the axis of  $y$  distant  $b$  from the origin, is a parabola.



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14. Find the equation of the parabola whose focus is  $S(-1, 1)$  and directrix is  $4x + 3y - 24 = 0$ .



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15. The axis of parabola is along the line  $y=x$  and the distance of its vertex and focus from origin are  $\sqrt{2}$  and  $2\sqrt{2}$  respectively. If vertex and focus both lie in the first quadrant, then find the equation of the parabola



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16. Find the equation of parabola whose focus is (0,1) and the directrix is  $x+2=0$ . Also find the vertex of the parabola.



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17. Find the vertex, focus and directrix of the parabola  $x^2 = 2(2x + y)$ .



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### Concept Applications Exercise 5.3

1. If  $t_1$  and  $t_2$  are the ends of a focal chord of the parabola  $y^2 = 4ax$ , then prove that the roots of the equation  $t_1x^2 + ax + t_2 = 0$  are real.



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2. If the line passing through the focus  $S$  of the parabola  $y = ax^2 + bx + c$  meets the parabola at  $P$  and  $Q$  and if  $SP = 4$  and  $SQ = 6$ , then find the value of  $a$ .



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3. If a focal chord of  $y^2 = 4ax$  makes an angle  $\alpha \in [\pi/4, \pi/2]$  with the positive direction of the x-axis, then find the maximum length of this focal chord.



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4. If the length of focal chord of  $y^2 = 4ax$  is  $l$ , then find the angle between the axis of the parabola and the focal chord.

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5. If length of focal chord  $PQ$  is  $l$ , and  $p$  is the perpendicular distance of  $PQ$  from the vertex of the parabola, then prove that  $l \propto \frac{1}{p^2}$ .

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6. Circles drawn on the diameter as focal distance of any point lying on the parabola  $x^2 - 4x + 6y + 10 = 0$  will touch a fixed line whose equation is a.  $y=1$  b.  $y=-1$  c.  $y=2$  d.  $y=-2$

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7. A circle is drawn to pass through the extremities of the latus rectum of the parabola  $y^2 = 8x$ . It is given that this circle also touches the directrix of the parabola. Find the radius of this circle.

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## Concept Applications Exercise 5.4

1. Find the point on the curve  $y^2 = ax$  the tangent at which makes an angle of  $45^\circ$  with the x-axis.

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2. Find the equation of the common tangents to  $y^2 = 8ax$  and  $x^2 + y^2 = 2a^2$

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3. Find the angle at which the parabolas  $y^2 = 4x$  and  $x^2 = 32y$  intersect.

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4. If the line  $y = 3x + c$  touches the parabola  $y^2 = 12x$  at point  $P$ , then find the equation of the tangent at point  $Q$  where  $PQ$  is a focal chord.

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5. If the line  $x + y = a$  touches the parabola  $y = x - x^2$ , then find the value of  $a$ .

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6. Find the slopes of the tangents to the parabola  $y^2 = 8x$  which are normal to the circle  $x^2 + y^2 + 6x + 8y - 24 = 0$ .

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7. Find the equation of the tangent to the parabola  $9x^2 + 12x + 18y - 14 = 0$  which passes through the point  $(0, 1)$ .

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8. Find the locus of the point from which the two tangents drawn to the parabola  $y^2 = 4ax$  are such that the slope of one is thrice that of the other.

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9. From an external point  $P$ , a pair of tangents is drawn to the parabola  $y^2 = 4x$ . If  $\theta_1$  and  $\theta_2$  are the inclinations of these tangents with the x-axis such that  $\theta_1 + \theta_2 = \frac{\pi}{4}$ , then find the locus of  $P$ .

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10. Show that the common tangents to the circles  $x^2 + y^2 - 6x = 0$  and  $x^2 + y^2 + 2x = 0$  form an equilateral

triangle.



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11.  $TP$  and  $TQ$  are tangents to the parabola  $y^2 = 4ax$  at  $P$  and  $Q$ , respectively. If the chord  $PQ$  passes through the fixed point  $(-a, b)$ , then find the locus of  $T$ .



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12. At any point  $P$  on the parabola  $y^2 - 2y - 4x + 5 = 0$  a tangent is drawn which meets the directrix at  $Q$ . Find the locus of point  $R$  which divides  $QP$  externally in the ratio  $\frac{1}{2} : 1$



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13. If the distance of the point  $(\alpha, 2)$  from its chord of contact w.r.t. the parabola  $y^2 = 4x$  is 4, then find the value of  $\alpha$ .



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## Concept Applications Exercise 5.5

1. If the tangents at the points  $P$  and  $Q$  on the parabola  $y^2 = 4ax$  meet at  $T$ , and  $S$  is its focus, then prove that  $SP$ ,  $ST$ , and  $SQ$  are in GP.



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2. If PQ is the focal chord of parabola  $y = x^2 - 2x + 3$  such that  $P \equiv (2, 3)$ , then find slope of tangent at Q.

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3. If there exists at least one point on the circle  $x^2 + y^2 = a^2$  from which two perpendicular tangents can be drawn to parabola  $y^2 = 2x$ , then find the values of a.

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4. Find the angle between the tangents drawn to  $y^2 = 4x$ , where it is intersected by the line  $y = x - 1$ .

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5. Find the angle between the tangents drawn from the origin to the parabolas  $y^2 = 4a(x - a)$

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6. Find the locus of the point of intersection of the perpendicular tangents of the curve  $y^2 + 4y - 6x - 2 = 0$ .

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7. A tangent is drawn to the parabola  $y^2 = 4ax$  at  $P$  such that it cuts the  $y$ -axis at  $Q$ . A line perpendicular to this tangents is drawn through  $Q$  which cuts the axis of the parabola at  $R$ . If the rectangle  $PQRS$  is completed, then find the locus of  $S$ .



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8. Let  $y=x+1$  is axis of parabola,  $y+x-4=0$  is tangent of same parabola at its vertex and  $y=2x+3$  is one of its tangents. Then find the focus of the parabola.



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9. Let  $y=x+1$  is axis of parabola,  $y+x-4=0$  is tangent of same parabola at its vertex and  $y=2x+3$  is one of its tangents. Then find the focus of the parabola.



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1. Prove that the chord  $y - x\sqrt{2} + 4a\sqrt{2} = 0$  is a normal chord of the parabola  $y^2 = 4ax$ . Also find the point on the parabola when the given chord is normal to the parabola.

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2. Equation of normal to curve  $y = x^3 - 2x + 4$  at point (1,3).

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3. If  $y = 2x + 3$  is a tangent to the parabola  $y^2 = 24x$ , then find its distance from the parallel normal.

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4. For the parabola  $y^2 = 16x$  prove that whatever be the value of  $\theta$ , the line  $y = (x - 11)\cos \theta - \cos 3\theta$  is always normal to the parabola

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5. Find the locus of the midpoints of the portion of the normal to the parabola  $y^2 = 4ax$  intercepted between the curve and the axis.

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6. If the parabolas  $y^2 = 4ax$  and  $y^2 = 4c(x - b)$  have a common normal other than the x-axis ( $a, b, c$  being distinct positive real numbers), then prove that  $\frac{b}{a - c} > 2$ .



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7. Find the value of  $\tan^{-1}(\sqrt{3}) - \cot^{-1}(-\sqrt{3})$



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8. For the parabola  $y^2 = 16x$  prove that whatever be the value of  $\theta$ , the line  $y = (x - 11)\cos\theta - \cos 3\theta$  is always normal to the parabola



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Concept Applications Exercise 5.7

1. If the normal to the parabola  $y^2 = 4ax$  at point  $t_1$  cuts the parabola again at point  $t_2$ , then prove that  $t_2^2 \geq 8$ .

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2. Find the angle at which normal at point  $P(at^2, 2at)$  to the parabola meets the parabola again at point  $Q$ .

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3. If normal to parabola  $y^2 = 4ax$  at point  $P(at^2, 2at)$  intersects the parabola again at  $Q$ , such that sum of ordinates of the points  $P$  and  $Q$  is 3, then find the length of latus rectum in terms of  $t$ .

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4. If tangents are drawn to  $y^2 = 4ax$  from any point  $P$  on the parabola  $y^2 = a(x + b)$ , then show that the normals drawn at their point for contact meet on a fixed line.

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5. If line  $x-2y-1=0$  intersects parabola  $y^2 = 4x$  at  $P$  and  $Q$ , then find the point of intersection of normals at  $P$  and  $Q$ .

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6. Find the locus of the point of intersection of the normals at the end of the focal chord of the parabola  $y^2 = 4ax$ .



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7. If incident ray from point  $(-2,4)$  parallel to the axis of the parabola  $y^2 = 4x$  strikes the parabola, then find the equation of the reflected ray.

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8. Let  $L_1, L_2$  and  $L_3$  be the three normals to the parabola  $y^2 = 4ax$  from point P inclined at the angle  $\theta_1, \theta_2$  and  $\theta_3$  with x-axis, respectively. Then find the locus of point P given that  $\theta_1 + \theta_2 + \theta_3 = \alpha$  (constant).

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9. If line  $x-2y-1=0$  intersects parabola  $y^2 = 4x$  at P and Q, then find the point of intersection of normals at P and Q.



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### EXERCISE (SINGLE CORRECT ANSWER TYPE )

1. Which one of the following equation represent parametric equation to a parabolic curve?

A.  $x = 3 \cos t, y = 4 \sin t$

B.  $x^2 - 2 = 2 \cos t, y = 4 \cos^2 \frac{t}{2}$

C.  $\sqrt{x} = \tan t, \sqrt{y} = \sec t$

D.  $x = \sqrt{1 - \sin t}, y = \sin \frac{t}{2} + \cos \frac{t}{2}$

**Answer: B**



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2. A point  $P(x, y)$  moves in the  $xy$ -plane such that  $x = a \cos^2 \theta$  and  $y = 2a \sin \theta$ , where  $\theta$  is a parameter. The locus of the point  $P$  is a/an

- A. circle
- B. ellipse
- C. unbounded parabola
- D. part of the parabola

**Answer: D**



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3. A line  $L$  passing through the focus of the parabola  $y^2 = 4(x - 1)$  intersects the parabola at two distinct points.

If  $m$  is the slope of the line  $L$ , then

A.  $-1 < m < 1$

B.  $m < -1$  or  $m > 1$

C.  $m \in \mathbb{R}$

D. none of these

**Answer: D**



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4. The circle  $x^2 + y^2 + 2\lambda x = 0$ ,  $\lambda \in R$ , touches the parabola  $y^2 = 4x$  externally. Then,

A.  $\lambda > 0$

B.  $\lambda < 0$

C.  $\lambda > 1$

D. none of these

**Answer: A**



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5. A set of parallel chords of the parabola  $y^2 = 4ax$  have their midpoint on A. any straight line through the vertex B.

any straight line through the focus C. a straight line parallel to the axis D. another parabola



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6. If the points A (1,3) and B (5,5) lying on a parabola are equidistant from focus, then the slope of the directrix is

A.  $\frac{1}{2}$

B.  $-\frac{1}{2}$

C. 2

D. -2

**Answer: A**



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7. The radius of the circle whose centre is  $(-4,0)$  and which cuts the parabola  $y^2 = 8x$  at A and B such that the common chord AB subtends a right angle at the vertex of the parabola is equal to

A.  $4\sqrt{13}$

B.  $3\sqrt{5}$

C.  $3\sqrt{2}$

D.  $2\sqrt{5}$

**Answer: A**



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8. The circle  $x^2 + y^2 = 5$  meets the parabola  $y^2 = 4x$  at  $P$  and  $Q$ . Then the length  $PQ$  is equal to (a) 2 (b)  $2\sqrt{2}$  (c) 4 (d) none of these

A. 2

B.  $2\sqrt{2}$

C. 4

D. none of these

**Answer: C**



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9. If  $y_1, y_2,$  and  $y_3$  are the ordinates of the vertices of a triangle inscribed in the parabola  $y^2 = 4ax$ , then its area is

A.  $\frac{1}{2a} |(y_1 - y_2)(y_2 - y_3)(y_3 - y_1)|$

B.  $\frac{1}{4a} |(y_1 - y_2)(y_2 - y_3)(y_3 - y_1)|$

C.  $\frac{1}{8a} |(y_1 - y_2)(y_2 - y_3)(y_3 - y_1)|$

D. none of these

**Answer: C**



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**10.** let  $P$  be the point  $(1, 0)$  and  $Q$  be a point on the locus

$y^2 = 8x$ . The locus of the midpoint of  $PQ$  is

A.  $y^2 + 4x + 2 = 0$

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

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

D.  $x^2 + 4y + 2 = 0$

**Answer: B**



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11. An equilateral triangle is inscribed in the parabola

$$y^2 = 4ax,$$

such that one vertex of this coincides with the vertex of the parabola. Then find the side the length of this triangle.

A.  $2a(2 - \sqrt{3})$

B.  $4a(2 - \sqrt{3})$

C.  $a(2 - \sqrt{3})$

D.  $8a(2 - \sqrt{3})$

**Answer: B**



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12. C is the centre of the circle with centre  $(0, 1)$  and radius unity.  $y = ax^2$  is a parabola. The set of the values of ' $a$ ' for which they meet at a point other than the origin, is

A.  $a > 0$

B.  $a \in (0, 1/2)$

C.  $(1/4, 1/2)$

D.  $(1/2, \infty)$

**Answer: D**



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13.  $P(x, y)$  is a variable point on the parabola  $y^2 = 4ax$  and  $Q(x + c, y + c)$  is another variable point, where  $c$  is a constant. The locus of the midpoint of  $PQ$  is

- A. parabola
- B. ellipse
- C. hyperbola
- D. circle

**Answer: A**



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14. AB is a chord of the parabola  $y^2 = 4ax$  with its vertex at A. BC is drawn perpendicular to AB meeting the axis at C. The projection of BC on the axis of the parabola is

A. a

B. 2a

C. 4a

D. 8a

**Answer: C**



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15. Set of value of  $\alpha$  for which the point  $(\alpha, 1)$  lies inside the circle  $x^2 + y^2 - 4 = 0$  and parabola  $y^2 = 4x$  is

A. A)  $|\alpha| < \sqrt{3}$

B. B)  $|\alpha| < 2$

C. C)  $\frac{1}{4} < \alpha < \sqrt{3}$

D. D) none of these

**Answer: C**



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**16.** If X is the foot of the directrix on the a parabola. PP' is a double ordinate of the curve and PX meets the curve again in Q. Then prove that PQ passes through the focus of the parabola.

A. vertex

B. focus

C. midpoint of vertex and focus

D. none of these

**Answer: B**



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17. A water jet from a function reaches its maximum height of 4 m at a distance 0.5 m from the vertical passing through the point  $O$  of water outlet. The height of the jet above the horizontal  $OX$  at a distance of 0.75 m from the point  $O$  is 5 m (b) 6 m (c) 3 m (d) 7 m

A. 5 m

B. 6 m



C. 3 m

D. 7 m

**Answer: C**



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**18.** Area of the triangle formed by the vertex, focus and one end of latusrectum of the parabola  $(x + 2)^2 = -12(y - 1)$  is

A. 36

B. 18

C. 9

D. 6

**Answer: C**



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**19.** The locus of the vertex of the family of parabolas

$$y = \frac{a^3 x^2}{3} + \frac{a^{2x}}{2} - 2a \text{ is } xy = \frac{105}{64} \text{ (b) } xy = \frac{3}{4} \text{ } xy = \frac{35}{16}$$

$$\text{(d) } xy = \frac{64}{105}$$

A.  $xy=105/64$

B.  $xy=3/4$

C.  $xy=35/16$

D.  $xy=64/105$

**Answer: A**



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20. Two parabola have the same focus. If their directrices are the x-axis and the y-axis respectively, then the slope of their common chord is :

A.  $\pm 1$

B.  $4/3$

C.  $3/4$

D. none of these

**Answer: A**



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21. The locus of the point  $(\sqrt{3h}, \sqrt{3k+2})$  if it lies on the line  $x - y - 1 = 0$  is (a) straight line (b) a circle (c) a parabola (d) none of these

- A. a straight line
- B. a circle
- C. a parabola
- D. none of these

**Answer: C**

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22. A circle touches the x-axis and also touches the circle with centre  $(0,3)$  and radius 2. The locus of the centre of the circle

is

- A. a circle
- B. an ellipse
- C. a parabola
- D. a hyperbola

**Answer: C**



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**23.** If parabolas  $y^2 = \lambda x$  and  $25[(x - 3)^2 + (y + 2)^2] = (3x - 4y - 2)^2$  are equal, then the value of  $\lambda$  is 9 (b) 3 (c) 7 (d) 6

A. 9

B. 3

C. 7

D. 6

**Answer: D**



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**24.** The length of the latus rectum of the parabola whose

focus is a.  $\left(\frac{u^2}{2g}\sin 2\alpha, -\frac{u^2}{2g}\cos 2\alpha\right)$  and directrix is

$y = \frac{u^2}{2g}$  is

A.  $\frac{u^2}{g}\cos^2 \alpha$

B.  $\frac{u^2}{g}\cos 2\alpha$

C.  $\frac{2u^2}{g}\cos 2\alpha$

D.  $\frac{2u^2}{g} \cos^2 \alpha$

**Answer: D**



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25. The graph of the curve  $x^2 + y^2 - 2xy - 8x - 8y + 32 = 0$  falls wholly in the (a) first quadrant (b) second quadrant (c) third quadrant (d) none of these

- A. first quadrant
- B. second quadrant
- C. third quadrant
- D. none of these

**Answer: A**



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**26.** The vertex of the parabola whose parametric equation is

$$x = t^2 - t + 1, y = t^2 + t + 1; t \in R, \text{ is}$$

A. (1,1)

B. (2,2)

C. (1/2, 1/2)

D. (3,3)

**Answer: A**



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27. If the line  $y - \sqrt{3}x + 3 = 0$  cut the parabola  $y^2 = x + 2$  at  $P$  and  $Q$ , then  $APAQ$  is equal to [where  $A = (\sqrt{3}, 0)$ ]

- (a)  $\frac{2(\sqrt{3} + 2)}{3}$  (b)  $\frac{4\sqrt{3}}{2}$  (c)  $\frac{4(2 - \sqrt{2})}{3}$  (d)  $\frac{4(\sqrt{3} + 2)}{3}$

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28. A line is drawn from  $A(-2, 0)$  to intersect the curve

$y^2 = 4x$  at  $P$  and  $Q$  in the first quadrant such that

$\frac{1}{AP} + \frac{1}{AQ} < \frac{1}{4}$ . Then the slope of the line is always. (a)

$> \sqrt{3}$  (b)  $< \frac{1}{\sqrt{3}}$  (c)  $> \sqrt{2}$  (d)  $> \frac{1}{\sqrt{3}}$

A.  $> \sqrt{3}$

B.  $< 1/\sqrt{3}$

C.  $> \sqrt{2}$

D.  $> 1/\sqrt{3}$

**Answer: A**



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29. The length of the chord of the parabola  $y^2 = x$  which is bisected at the point  $(2, 1)$  is  $2\sqrt{3}$  (b)  $4\sqrt{3}$  (c)  $3\sqrt{2}$  (d)  $2\sqrt{5}$

A.  $2\sqrt{3}$

B.  $4\sqrt{3}$

C.  $3\sqrt{2}$

D.  $2\sqrt{5}$

**Answer: D**



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30. If a line  $y = 3x + 1$  cuts the parabola  $x^2 - 4x - 4y + 20 = 0$  at  $A$  and  $B$ , then the tangent of the angle subtended by line segment  $AB$  at the origin is

A.  $8\sqrt{3}/205$

B.  $8\sqrt{3}/209$

C.  $8\sqrt{3}/215$

D. none of these

**Answer: B**



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31. If P be a point on the parabola  $y^2 = 3(2x - 3)$  and M is the foot of perpendicular drawn from the point P on the directrix of the parabola, then find length of each sides of an equilateral triangle SMP (where S is the focus of the parabola).

A. 2

B. 4

C. 6

D. 8

**Answer: C**



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32. A parabola  $y = ax^2 + bx + c$  crosses the x-axis at  $(\alpha, 0)(\beta, 0)$  both to the right of the origin. A circle also passes through these two points. The length of a tangent from the origin to the circle is: (a)  $\sqrt{\frac{bc}{a}}$  (b)  $ac^2$  (c)  $b/a$  (d)

$$\sqrt{\frac{c}{a}}$$

A.  $\sqrt{bc/a}$

B.  $ac^2$

C.  $b/a$

D.  $\sqrt{c/a}$

**Answer: D**



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**33.** The number of common chords of the parabolas

$x = y^2 - 6y + 11$  and  $y = x^2 - 6x + 11$  is 1 (b) 2 (c) 4 (d) 6

A. 1

B. 2

C. 4

D. 6

**Answer: D**



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**34.** Two parabola have the same focus. If their directrices are the x-and the y-axis, respectively, then the slope of their common chord is

A. -1

B.  $-1/2$

C.  $-\sqrt{3}/2$

D. none of these

**Answer: A**



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35.  $PSQ$  is a focal chord of a parabola whose focus is  $S$  and vertex is  $A$ .  $PA$ ,  $QA$ , are produced to meet the directrix in  $R$  and  $T$ . Then  $\angle RST$  is equal to

A.  $30^\circ$

B.  $90^\circ$

C.  $60^\circ$

D.  $45^\circ$

**Answer: B**



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**36.** If  $PSQ$  is a focal chord of the parabola  $y^2 = 8x$  such that  $SP = 6$ , then the length of  $SQ$  is

A. 6

B. 4

C. 3

D. none of these

**Answer: C**





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37. The triangle  $PQR$  of area  $A$  is inscribed in the parabola  $y^2 = 4ax$  such that the vertex  $P$  lies at the vertex of the parabola and the base  $QR$  is a focal chord. The modulus of the difference of the ordinates of the points  $Q$  and  $R$  is

A.  $A/2a$

B.  $A/a$

C.  $2A/a$

D.  $4A/a$

**Answer: C**



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38. If  $A_1B_1$  and  $A_2B_2$  are two focal chords of the parabola  $y^2 = 4ax$ , then the chords  $A_1A_2$  and  $B_1B_2$  intersect on

- A. directrix
- B. axis
- C. tangent at vertex
- D. none of these

**Answer: A**



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39. If  $a$  and  $c$  are the lengths of segments of any focal chord of the parabola  $y^2 = 2bx$ , ( $b > 0$ ), then the roots of the

equation  $ax^2 + bx + c = 0$  are (a) real and distinct (b) real and equal (c) imaginary (d) none of these

A. real and distinct

B. real and equal

C. imaginary

D. none of these

**Answer: C**



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**40.** If  $y = mx + c$  touches the parabola  $y^2 = 4a(x + a)$ , then (a)  $c = \frac{a}{m}$  (b)  $c = am + \frac{a}{m}$  (c)  $c = a + \frac{a}{m}$  (d) none of these

A.  $c = \frac{1}{m}$

B.  $c = am + \frac{a}{m}$

C.  $c = a + \frac{a}{m}$

D. none of these

**Answer: B**



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**41.** The area of the triangle formed by the tangent and the normal to the parabola  $y^2 = 4ax$ , both drawn at the same end of the latus rectum, and the axis of the parabola is (a)  $2\sqrt{2}a^2$  (b)  $2a^2$  (c)  $4a^2$  (d) none of these

A.  $2\sqrt{2}a^2$

B.  $2a^2$

C.  $4a^2$

D. none of these

**Answer: C**



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**42.** Parabola  $y^2 = 4a(x - c_1)$  and  $x^2 = 4a(y - c_2)$  where  $c_1$  and  $c_2$  are variables, touch each other. Locus of their point of contact is

A.  $xy = 2a^2$

B.  $xy = 4a^2$

C.  $xy = a^2$

D. none of these

**Answer: B**



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**43.** Let  $y = f(x)$  be a parabola, having its axis parallel to the

$y$ -axis, which is touched by the line  $y = x$  at  $x = 1$ . Then, (a)

$$2f(0) = 1 - f'(0) \quad (b) \quad f(0) + f'(0) + f(0) = 1 \quad (c)$$

$$f'(1) = 1 \quad (d) \quad f'(0) = f'(1)$$

A.  $2f(0)=1-f'(0)$

B.  $f(0)+f'(0)+f(0)=1$

C.  $f'(1)=1$

D. none of these

**Answer: A**



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**44.** If  $y = 2x - 3$  is tangent to the parabola  $y^2 = 4a\left(x - \frac{1}{3}\right)$ , then  $a$  is equal to  $\frac{22}{3}$  (b)  $-1$  (c)  $\frac{14}{3}$  (d)  $-\frac{14}{3}$

A.  $\frac{22}{3}$

B.  $-1$

C.  $\frac{14}{3}$

D.  $\frac{14}{3}$

**Answer: D**



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45. The center of the circle which cuts parabola orthogonally the parabola  $y^2 = 4x$  at (1,2) passes through

A. (3,4)

B. (4,3)

C. (5,3)

D. (2,4)

**Answer: A**



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46. If the curve  $y = ax^2 - 6x + b$  pass through (0, 2) and has its tangent parallel to the x-axis at  $x = \frac{3}{2}$ , then find the



values of  $a$  and  $b$ .

A.  $a=2, b=-2$

B.  $a=2, b=2$

C.  $a=-2, b=2$

D.  $a=-2, b=-2$

**Answer: B**



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47. Double ordinate  $AB$  of the parabola  $y^2 = 4ax$  subtends an angle  $\frac{\pi}{2}$  at the focus of the parabola. Then the tangents drawn to the parabola at  $A$  and  $B$  will intersect at

A.  $(-4a, 0)$

B.  $(-2a, 0)$

C.  $(-3a, 0)$

D. none of these

**Answer: A**



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**48.** find the equation of hyperbola where foci are  $(0, 12)$  and  $(0, -12)$  and the length of the latus rectum is 36



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**49.** A tangent is drawn to the parabola  $y^2 = 4x$  at the point  $P$  whose abscissa lies in the interval  $(1, 4)$ . The maximum

possible area of the triangle formed by the tangent at  $P$ , the ordinates of the point  $P$ , and the x-axis is equal to

- A. 8
- B. 16
- C. 24
- D. 32

**Answer: B**



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**50.** The straight lines joining any point  $P$  on the parabola  $y^2 = 4ax$  to the vertex and perpendicular from the focus to the tangent at  $P$  intersect at  $R$ . Then the equation of the locus of  $R$  is

$$(a)x^2 + 2y^2 - ax = 0 \quad (b)2x^2 + y^2 - 2ax = 0 \quad (c)$$

$$2x^2 + 2y^2 - ay = 0 \quad (d) 2x^2 + y^2 - 2ay = 0$$

A.  $x^2 + 2y^2 - ax = 0$

B.  $2x^2 + y^2 - ax = 0$

C.  $2x^2 + 2y^2 - ay = 0$

D.  $2x^2 + y^2 - ay = 0$

**Answer: B**



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**51.** Through the vertex  $O$  of the parabola  $y^2 = 4ax$ , two chords  $OP$  and  $OQ$  are drawn and the circles on  $OP$  and  $OQ$  as diameters intersect at  $R$ . If  $\theta_1, \theta_2$ , and  $\varphi$  are the angles made with the axis by the tangents at  $P$  and  $Q$  on the

parabola and by  $OR$ , then value of  $\cot \theta_1 + \cot \theta_2$  is (a)

$-2 \tan \varphi$  (b)  $-2 \tan(\pi - \varphi)$  (c) 0 (d)  $2 \cot \varphi$

A.  $-2 \tan \phi$

B.  $-2 \tan(\pi - \phi)$

C. 0

D.  $2 \cot \phi$

**Answer: A**



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**52.**  $AB$  is a double ordinate of the parabola  $y^2 = 4ax$ .

Tangents drawn to the parabola at  $A$  and  $B$  meet the  $y$ -axis at

$A_1$  and  $B_1$ , respectively. If the area of trapezium  $A_1A_1B_1B$  is

equal to  $12a^2$ , then the angle subtended by  $A_1B_1$  at the focus of the parabola is equal to

A.  $2 \tan^{-1} (3)$

B.  $\tan^{-1} (3)$

C.  $2 \tan^{-1} (2)$

D.  $\tan^{-1} (2)$

**Answer: C**



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**53.** If the locus of the middle of point of contact of tangent drawn to the parabola  $y^2 = 8x$  and the foot of perpendicular drawn from its focus to the tangents is a conic, then the length of latus rectum of this conic is  $\frac{9}{4}$  (b) 9 (c) 18 (d)  $\frac{9}{2}$

A.  $9/4$

B. 9

C. 18

D.  $9/2$

**Answer: B**



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**54.** If the bisector of angle  $APB$ , where  $PA$  and  $PB$  are the tangents to the parabola  $y^2 = 4ax$ , is equally inclined to the coordinate axes, then the point  $P$  lies on the

A. tangent at vertex of the parabola

B. directrix of the parabola

C. circle with center at the origin and radius

D. the line of latus rectum

**Answer: D**



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55. From a point  $A(t)$  on the parabola  $y^2 = 4ax$ , a focal chord and a tangent are drawn. Two circles are drawn in which one circle is drawn taking focal chord  $AB$  as diameter and other is drawn by taking the intercept of tangent between point  $A$  and point of the circles is

A. the line joining focus and  $p$

B. the line joining focus and  $A$

C. tangent to the parabola at point  $A$



D. none of these

**Answer: C**



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**56.** The point of intersection of the tangents of the parabola  $y^2 = 4x$  drawn at the endpoints of the chord  $x + y = 2$  lies on

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

A.  $x - 2y = 0$

B.  $x + 2y = 0$

C.  $y - x = 0$

D.  $x + y = 0$

**Answer: C**



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57. The angle between tangents to the parabola  $y^2 = 4ax$  at the points where it intersects with the line  $x - y - a = 0$  is  $(a > 0)$

A.  $\pi/3$

B.  $\pi/4$

C.  $\pi/6$

D.  $\pi/2$

**Answer: D**



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58.  $y = x + 2$  is any tangent to the parabola  $y^2 = 8x$ . The point  $P$  on this tangent is such that the other tangent from it which is perpendicular to it is (a)(2, 4) (b) ( - 2, 0) (c) ( - 1, 1) (d) (2, 0)

A. (2,4)

B. (-2,0)

C. (-1,1)

D. (2,0)

**Answer: B**



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59. If  $y = m_1x + c$  and  $y = m_2x + c$  are two tangents to the parabola  $y^2 + 4a(x + c) = 0$ , then

A.  $m_1 + m_2 = 0$

B.  $1 + m_1 + m_2 = 0$

C.  $m_1m_2 - 1 = 0$

D.  $1 + m_1m_2 = 0$

**Answer: D**



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60. Show that the tangents to the curve  $y = x^2 - 5x + 6$  at the point (2,0) and (3,0) are at right angle.

A.  $\frac{\pi}{2}$

B.  $\frac{\pi}{3}$

C.  $\frac{\pi}{6}$

D.  $\frac{\pi}{4}$

**Answer: A**



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**61.** Two mutually perpendicular tangents of the parabola  $y^2 = 4ax$  meet the axis at  $P_1$  and  $P_2$ . If S is the focal of the parabola, Then  $\frac{1}{SP_1} + \frac{1}{SP_2}$  is equal to

A. A.  $\frac{1}{2a}$

B. B.  $\frac{1}{a}$

C. C.  $\frac{2}{a}$

D. D.  $\frac{4}{a}$

**Answer: B**

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**62.** Radius of the circle that passes through the origin and touches the parabola  $y^2 = 4ax$  at the point  $(a, 2a)$  is

A.  $\frac{5}{\sqrt{2}}a$

B.  $2\sqrt{2}a$

C.  $\sqrt{\frac{5}{2}}a$

D.  $\frac{3}{\sqrt{2}}a$

**Answer: A**



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63. The mirror image of the parabola  $y^2 = 4x$  in the tangent to the parabola at the point  $(1, 2)$  is:

A.  $(x - 1)^2 = 4(y + 1)$

B.  $(x + 1)^2 = 4(y + 1)$

C.  $(x + 1)^2 = 4(y - 1)$

D.  $(x - 1)^2 = 4(y - 1)$

Answer: C



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**64.** Consider the parabola  $y^2 = 4x$ . Let  $A \equiv (4, -4)$  and  $B \equiv (9, 6)$  be two fixed points on the parabola. Let  $C$  be a moving point on the parabola between  $A$  and  $B$  such that the area of the triangle  $ABC$  is maximum. Then the coordinates of  $C$  are

A.  $(1/4, 1)$

B.  $(4, 4)$

C.  $(3, 2\sqrt{3})$

D.  $(3, -2\sqrt{3})$

**Answer: A**



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65. A line of slope  $\lambda$  ( $0 < \lambda < 1$ ) touches the parabola  $y + 3x^2 = 0$  at  $P$ . If  $S$  is the focus and  $M$  is the foot of the perpendicular of directrix from  $P$ , then  $\tan \angle MPS$  equals

A.  $2\lambda$

B.  $\frac{2\lambda}{-1 + \lambda^2}$

C.  $\frac{1 - \lambda^2}{1 + \lambda^2}$

D. none of these

**Answer: B**

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66. The tangent at any point  $P$  on the parabola  $y^2 = 4ax$  intersects the  $y$ -axis at  $Q$ . Then tangent to the circumcircle of

triangle  $PQS$  ( $S$  is the focus) at  $Q$  is

- A. a line parallel to axis
- B. y-axis
- C. a line parallel to y-axis
- D. none of these

**Answer: B**



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67. If  $P(t^2, 2t)$ ,  $t \in [0, 2]$ , is an arbitrary point on the parabola  $y^2 = 4x$ ,  $Q$  is the foot of perpendicular from focus  $S$  on the tangent at  $P$ , then the maximum area of  $PQS$  is  
(a) 1 (b) 2 (c)  $\frac{5}{16}$  (d) 5

A. 1

B. 2

C.  $5/16$

D. 5

**Answer: D**



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**68.** The minimum area of circle which touches the parabolas

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

A.  $\frac{9\pi}{16}$  sq. unit

B.  $\frac{9\pi}{32}$  sq. unit

C.  $\frac{9\pi}{8}$  sq. unit

D.  $\frac{9\pi}{4}$  sq. unit

**Answer: B**



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**69.** If the tangents and normals at the extremities of a focal chord of a parabola intersect at  $(x_1, y_1)$  and  $(x_2, y_2)$ , respectively, then (a)  $x_1 = y_2$  (b)  $x_1 = y_1$  (c)  $y_1 = y_2$  (d)

$x_2 = y_1$

A.  $x_1 = y_2$

B.  $x_1 = y_1$

C.  $y_1 = y_2$

D.  $x_2 = y_1$

**Answer: C**



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**70.** At what point on the parabola  $y^2 = 4x$  the normal makes equal angle with the axes?

A. A. (4,4)

B. B. (9,6)

C. B. (4,-4)

D. C. (1,  $\pm 2$ )

**Answer: D**



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71. The line  $2x + y + \lambda = 0$  is a normal to the parabola  $y^2 = 8x$ , is  $\lambda =$

A. 12

B. -12

C. 24

D. -24

**Answer: C**



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72. about to only mathematics

A.  $(-2a, 0)$

B. (a,0)

C. (2a,0)

D. none of these

**Answer: B**



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**73.** The equation of the line that passes through  $(10, -1)$  and is perpendicular to  $y = \frac{x^2}{4} - 2$  is (a)  $4x + y = 39$  (b)  $2x + y = 19$  (c)  $x + y = 9$  (d)  $x + 2y = 8$

A.  $4x+y=39$

B.  $2x+y=19$

C.  $x+y=9$

D.  $x+2y=8$

**Answer: D**



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**74.** Tangent and normal drawn to a parabola at  $A(at^2, 2at)$ ,  $t \neq 0$  meet the x-axis at point  $B$  and  $D$ , respectively. If the rectangle  $ABCD$  is completed, then the locus of  $C$  is

A.  $y=2a$

B.  $x = 2a - \frac{y^2}{4a}$

C.  $x=2a$

D. none of these



**Answer: B**



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**75.** The radius of the circle touching the parabola  $y^2 = x$  at  $(1, 1)$  and having the directrix of  $y^2 = x$  as its normal is

A.  $5\sqrt{5}/8$

B.  $10\sqrt{5}/3$

C.  $5\sqrt{5}/4$

D. none of these

**Answer: C**



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76. If two different tangents of  $y^2 = 4x$  are the normals to  $x^2 = 4by$ , then

A.  $|b| > 1/2\sqrt{2}$

B.  $|b| < 1/2\sqrt{2}$

C.  $|b| < 1/\sqrt{2}$

D.  $|b| > 1/\sqrt{2}$

**Answer: B**

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77. The equation of the common tangent to the parabolas  $y^2 = 4ax$  and  $x^2 = 4by$  is given by

A. 3

B. 4

C. 6

D. 5

**Answer: D**



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**78.** If line  $PQ$ , where equation is  $y = 2x + k$ , is a normal to the parabola whose vertex is  $(-2, 3)$  and the axis parallel to the x-axis with latus rectum equal to 2, then the value of  $k$  is

A. A.  $58/8$

B. B.  $50/8$

C. C. 1

**Answer: C****Watch Video Solution****79.** Evaluate,

$$\min \left[ (x_1 - x_2)^2 + \left( 5 + \sqrt{1 - x_1^2} - \sqrt{4x_2} \right)^2 \right], \forall x_1, x_2 \in \mathbb{R},$$

is

A.  $4\sqrt{1}$

B.  $3 - 2\sqrt{2}$

C.  $\sqrt{5} + 1$

D.  $4\sqrt{5} - 1$

**Answer: B**



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**80.** If the normals to the parabola  $y^2 = 4ax$  at three points  $(ap^2, 2ap)$ ,  $(aq^2, 2aq)$  and  $(ar^2, 2ar)$  are concurrent, then the common root of equations  $Px^2 + qx + r = 0$  and  $a(b - c)x^2 + b(c - a)x + c(a - b) = 0$  is

A. A. p

B. B. q

C. C. r

D. D. 1

**Answer: D**



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81. Normals  $AO$ ,  $AA_1$  and  $AA_2$  are drawn to the parabola  $y^2 = 8x$  from the point  $A(h, 0)$ . If triangle  $OA_1A_2$  is equilateral then the possible value of  $h$  is

A. 26

B. 24

C. 28

D. none of these

**Answer: C**



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82. If the normals to the parabola  $y^2 = 4ax$  at the ends of the latus rectum meet the parabola at  $Q$  and  $Q'$ , then  $QQ'$

is

A.  $10a$

B.  $4a$

C.  $20a$

D.  $12a$

**Answer: D**



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**83.** From a point  $(\sin \theta, \cos \theta)$ , if three normals can be drawn to the parabola  $y^2 = 4ax$  then the value of  $a$  is

A.  $\left(\frac{1}{2}, 1\right)$

B.  $\left[-\frac{1}{2}, 0\right)$

C. C.  $\left[\frac{1}{2}, 1\right]$

D. D.  $\left(-\frac{1}{2}, 0\right) \cup \left(0, \frac{1}{2}\right)$

**Answer: D**



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**84.** If the normals at  $P(t_1)$  and  $Q(t_2)$  on the parabola meet on the same parabola, then (A)  $t_1 t_2 = -1$  (B)  $t_2 = -t_1 - \frac{2}{t_1}$  (C)  $t_1 t_2 = 1$  (D)  $t_1 t_2 = 2$

A.  $t_1 t_2 = -1$

B.  $t_2 = -t_1 - \frac{2}{t_1}$

C.  $t_1 t_2 = 1$

D.  $t_1 t_2 = 2$



**Answer: D**



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**85.** If the normals to the parabola  $y^2 = 4ax$  at  $P$  meets the curve again at  $Q$  and if  $PQ$  and the normal at  $Q$  make angle  $\alpha$  and  $\beta$ , respectively, with the x-axis, then  $\tan\alpha(\tan\alpha + \tan\beta)$  has the value equal to

A. 0

B. -2

C.  $-1/2$

D. -1

**Answer: B**





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**86.** PQ is a normal chord of the parabola  $y^2 = 4ax$  at P, A being the vertex of the parabola. Through P, a line is drawn parallel to AQ meeting the x-axis at R. Then the line length of AR is

- A. equal to the length of the latus rectum
- B. equal to the focal distance of the point P
- C. equal to twice focal distance of the point P
- D. equal to the distance of the point P from the directrix

**Answer: C**



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87.  $P$ ,  $Q$ , and  $R$  are the feet of the normals drawn to a parabola  $(y - 3)^2 = 8(x - 2)$ . A circle cuts the above parabola at points  $P$ ,  $Q$ ,  $R$ , and  $S$ . Then this circle always passes through the point.

- A. (2,3)
- B. (3,2)
- C. (0,3)
- D. (2,0)

**Answer: A**



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88. Normals at two points  $(x_1, y_1)$  and  $(x_2, y_2)$  of the parabola  $y^2 = 4x$  meet again on the parabola, where  $x_1 + x_2 = 4$ .

Then  $|y_1 + y_2|$  is equal to  $\sqrt{2}$  (b)  $2\sqrt{2}$  (c)  $4\sqrt{2}$  (d) none of these

A.  $\sqrt{2}$

B.  $2\sqrt{2}$

C.  $4\sqrt{2}$

D. none of these

**Answer: C**



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**89.** The endpoints of two normal chords of a parabola are concyclic. Then the tangents at the feet of the normals will intersect at

a. Tangent at vertex of the parabola

- b. Axis of the parabola
- c. Directrix of the parabola
- d. None of these

- A. tangent at vertex of the parabola
- B. axis of the parabola
- C. directrix of the parabola
- D. none of these

**Answer: B**



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**90.** If normal at point  $P$  on the parabola  $y^2 = 4ax$ , ( $a > 0$ ), meets it again at  $Q$  in such a way that  $OQ$  is of minimum length, where  $O$  is the vertex of parabola, then  $OPQ$  is

- A. a right-angled triangle
- B. an obtuse-angled triangle
- C. an acute-angled triangle
- D. none of these

**Answer: A**



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**91.** The set of points on the axis of the parabola  $(x - 1)^2 = 8(y + 2)$  from where three distinct normals can be drawn to the parabola is the set  $(h,k)$  of points satisfying

A.  $h > 2$

B.  $h > 1$

C.  $k > 2$

D. none of these

**Answer: C**



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**92.** Tangent and normal are drawn at the point  $P \equiv (16, 16)$  of the parabola  $y^2 = 16x$  which cut the axis of the parabola at the points  $A$  and  $B$ , respectively. If the center of the circle through  $P$ ,  $A$  and  $B$  is  $C$ , then the angle between  $PC$  and the axis of  $x$  is

A. (a)  $\tan^{-1}\left(\frac{1}{2}\right)$

B. (b)  $\tan^{-1} 2$

C. (c)  $\tan^{-1}\left(\frac{3}{4}\right)$

D. (d)  $\tan^{-1}\left(\frac{4}{3}\right)$

**Answer: D**



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**93.** In parabola  $y^2 = 4x$ , From the point (15,12), three normals are drawn then centroid of triangle formed by three Co normal points is

A. A.  $\left(\frac{16}{3}, 0\right)$

B. B. (4, 0)

C. C.  $\left(\frac{26}{3}, 0\right)$

D. D. (6, 0)

**Answer: C**





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94. The line  $x - y = 1$  intersects the parabola  $y^2 = 4x$  at  $A$  and  $B$ . Normals at  $A$  and  $B$  intersect at  $C$ . If  $D$  is the point at which line  $CD$  is normal to the parabola, then the coordinates of  $D$  are (a)  $(4, -4)$  (b)  $(4, 4)$  (c)  $(-4, -4)$  (d) none of these

A.  $(4,-4)$

B.  $(4,4)$

C.  $(-4,-4)$

D. none of these

**Answer: B**



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95. If normals are drawn from a point  $P(h, k)$  to the parabola  $y^2 = 4ax$ , then the sum of the intercepts which the normals cut-off from the axis of the parabola is (a)  $(h + c)$  (b)  $3(h + a)$  (c)  $2(h + a)$  (d) none of these

A.  $(h+a)$

B.  $3(h+a)$

C.  $2(h+a)$

D. none of these

**Answer: C**



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96. The circle  $x^2 + y^2 + 2\lambda x = 0$ ,  $\lambda \in R$ , touches the parabola  $y^2 = 4x$  externally. Then,

A.  $\lambda > 0$

B.  $\lambda < 0$

C.  $\lambda > 1$

D. none of these

**Answer: A**



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97. The radius of the circle whose centre is  $(-4,0)$  and which cuts the parabola  $y^2 = 8x$  at A and B such that the common

chord  $AB$  subtends a right angle at the vertex of the parabola  
is equal to

A.  $4\sqrt{13}$

B.  $3\sqrt{5}$

C.  $3\sqrt{2}$

D.  $2\sqrt{5}$

**Answer: A**



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**98.** If normal at point  $P$  on the parabola  $y^2 = 4ax$ , ( $a > 0$ ),  
meets it again at  $Q$  in such a way that  $OQ$  is of minimum  
length, where  $O$  is the vertex of parabola, then  $OPQ$  is

- A. a right-angled triangle
- B. an obtuse-angled triangle
- C. an acute-angled triangle
- D. none of these

**Answer: A**



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## EXERCISE (MULTIPLE CORRECT ANSWER TYPE )

1. If the focus of the parabola  $x^2 - ky + 3 = 0$  is  $(0,2)$ , then a values of  $k$  is (are)

- A. 4

B. 6

C. 3

D. 2

**Answer: B::D**



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2. If the line  $x - 1 = 0$  is the directrix of the parabola

$y^2 - kx + 8 = 0$ , then one of the values of  $k$  is (a)  $\frac{1}{8}$  (b) 8 (c)

4 (d)  $\frac{1}{4}$

A. -8

B.  $\frac{1}{8}$

C.  $\frac{1}{4}$

Answer: A::D



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3. The extremities of latus rectum of a parabola are  $(1, 1)$  and

$(1, -1)$ . Then the equation of the parabola can be (a)

$y^2 = 2x - 1$     (b)     $y^2 = 1 - 2x$     (c)  $y^2 = 2x - 3$     (d)

$y^2 = 2x - 4$

A.  $y^2 + 2x - 1$

B.  $y^2 = 1 - 2x$

C.  $y^2 = 3 - 2x$

D.  $y^2 = 2x - 4$

**Answer: A::C**



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4. The value(s) of  $a$  for which two curves  $y = ax^2 + ax + \frac{1}{24}$  and  $x = ay^2 + ay + \frac{1}{24}$  touch each other is/are

A.  $\frac{2}{3}$

B.  $\frac{1}{3}$

C.  $\frac{3}{2}$

D.  $\frac{1}{2}$

**Answer: A::C**



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5. In which of the following cases, a unique parabola will be obtained ?

A. (a) Focus and equation of tangent at vertex are given.

B. (b) Focus and vertex are given

C. (c) Equation of directrix and vertex are given.

D. (d) Equation of directrix and equation of tangent at vertex are given.

**Answer: A::B::C**



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6. A quadrilateral is inscribed in a parabola. Then

A. the quadrilateral may be cyclic

B. diagonals of the quadrilateral may be equal

C. all possible pairs of adjacent sides may be perpendicular

D. none of these

**Answer: A::B**



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7. The locus of the midpoint of the focal distance of a variable point moving on the parabola  $y^2 = 4ax$  is a parabola whose

(a) latus rectum is half the latus rectum of the original

parabola (b) vertex is  $\left(\frac{a}{2}, 0\right)$  (c) directrix is y-axis. (d) focus has

coordinates  $(a, 0)$

A. latus rectum is half the latus rectum of the original parabola

B. vertex is  $(a/2, 0)$

C. directrix is y-axis

D. focus has coordinates  $(a, 0)$

**Answer: A::B::C::D**

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8. A square has one vertex at the vertex of the parabola  $y^2 = 4ax$  and the diagonal through the vertex lies along the axis of the parabola. If the ends of the other diagonal lie on the parabola, the coordinates of the vertices of the square are (a)  $(4a, 4a)$  (b)  $(4a, -4a)$  (c)  $(0, 0)$  (d)  $(8a, 0)$



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9. If two distinct chords of a parabola  $y^2 = 4ax$  , passing through  $(a, 2a)$  are bisected by the line  $x + y = 1$  ,then length of latus rectum can be a) 2 b) 7 c) 4 d) 5



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A. (16,8)

B. (16,-8)

C. (9,6)

D. (9,-6)

**Answer: A::B**



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**11.** If the parabola  $x^2 = ay$  makes an intercept of length  $\sqrt{40}$  unit on the line  $y - 2x = 1$  then  $a$  is equal to

A. A. -1

B. B. -2

C. C. 1

D. D. 2

**Answer: B::C**



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12. The equation of the directrix of the parabola with vertex at the origin and having the axis along the x-axis and a common tangent of slope 2 with the circle  $x^2 + y^2 = 5$  is (are)  $x = 10$  (b)  $x = 20$   $x = -10$  (d)  $x = -20$

A.  $x=10$

B.  $x=20$

C.  $x=-10$

D.  $x=-20$

**Answer: A::C**



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13. Tangent is drawn at any point  $(x_1, y_1)$  other than the vertex on the parabola  $y^2 = 4ax$ . If tangents are drawn from any point on this tangent to the circle  $x^2 + y^2 = a^2$  such that all the chords of contact pass through a fixed point  $(x_2, y_2)$ , then

A.  $x_1, a, x_2$  are in GP

B.  $\frac{y_1}{2}, a, y_2$  are in GP

C.  $-4, \frac{y_1}{y_2}, \frac{x_1}{x_2}$  are in GP

D.  $x_1x_2 + y_1y_2 = a^2$

**Answer: B::C::D**



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14. The parabola  $y^2 = 4x$  and the circle having its center at  $(6, 5)$  intersect at right angle. Then find the possible points of intersection of these curves.

A.  $(9,6)$

B.  $(2, \sqrt{8})$

C.  $(4,4)$

D.  $(3, 2\sqrt{3})$

**Answer: A::C**



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15. Which of the following line can be tangent to the parabola  $y^2 = 8x$ ?  
(a)  $x - y + 2 = 0$  (b)  $9x - 3y + 2 = 0$



$$x + 2y + 8 = 0 \text{ (d) } x + 3y + 12 = 0$$

A.  $x - y + 2 = 0$

B.  $9x - 3y + 2 = 0$

C.  $x + 2y + 8 = 0$

D.  $x + 3y + 12 = 0$

**Answer: A::B::C**



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**16.** If the line  $k^2(x - 1) + k(y - 2) + 1 = 0$  touches the parabola  $y^2 - 4x - 4y + 8 = 0$ , then k can be

A. -3

B.  $-\sqrt{5}$

C.  $\frac{7}{19}$

D. 1000

**Answer: A::B::C::D**

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17. The equation of a circle of radius 1 touching the circles

$x^2 + y^2 - 2|x| = 0$  is (a)  $x^2 + y^2 + 2\sqrt{2}x + 1 = 0$  (b)

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

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

A.  $y = 4\sqrt{5}x + 20$

B.  $y = 4\sqrt{3}x - 12$

C.  $y=0$

D.  $y = -4\sqrt{5}x - 20$

**Answer: A::B::C**



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A.  $y=4(x-1)$

B.  $y=0$

C.  $y=-4(x-1)$

D.  $y=-30x-50$

**Answer: A::B**



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19. The line  $x + y + 2 = 0$  is a tangent to a parabola at point A, intersect the directrix at B and tangent at vertex at C respectively. The focus of parabola is  $S(a, 0)$ . Then

- A. CS is perpendicular to AB
- B.  $AC \cdot BC = CS^2$
- C.  $AC \cdot BC = 8$
- D.  $AC=BC$

**Answer: A::B::C**



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20. Which of the following line can be normal to parabola

$y^2 = 12x$  ?

$x + y - 9 = 0$

(b)

$2x - y - 32 = 0$

$$2x + y - 36 = 0 \text{ (d) } 3x - y - 72 = 0$$

A.  $x+y-9=0$

B.  $2x-y-32=0$

C.  $2x+y-36=0$

D.  $3x-y-99=0$

**Answer: A::C::D**



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**21.** A normal drawn to the parabola  $y^2 = 4ax$  meets the curve again at  $Q$  such that the angle subtended by  $PQ$  at the vertex is  $90^\circ$ . Then the coordinates of  $P$  can be

A. A.  $(8a, 4\sqrt{2}a)$

B. B.  $(8a, 4a)$

C. C.  $(2a, -2\sqrt{2}a)$

D. D.  $(2a, 2\sqrt{2}a)$

**Answer: C::D**



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**22.** A circle is drawn having centre at  $C(0, 2)$  and passing through focus (S) of the parabola  $y^2 = 8x$ , if radius (CS) intersects the parabola at point P, then

A. distance of point P from directrix is  $(8 - 4\sqrt{2})$

B. distance of point C from point P is  $(6\sqrt{2} - 8)$

C. angle subtended by intercept made by circle on directrix at its centre is  $\frac{\pi}{2}$

D. point P is the midpoint of C and S

**Answer: A::B::C**

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**23.** From any point P on the parabola  $y^2 = 4ax$ , perpendicular PN is drawn on the meeting it at N. Normal at P meets the axis in G. For what value/values of t, the point N divides SG internally in the ratio 1 : 3, where S is the focus ? a.

$\sqrt{\frac{3}{5}}$  b.  $-\sqrt{\frac{5}{3}}$  c.  $-\sqrt{\frac{3}{5}}$  d.  $\sqrt{\frac{5}{3}}$

A.  $\sqrt{\frac{3}{5}}$

B.  $\sqrt{-\frac{5}{3}}$

C.  $\sqrt{-\frac{3}{5}}$

D.  $\sqrt{\frac{5}{3}}$

**Answer: B::D**



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**24.** Let P be the point (1,0) and Q be a point on the locus  $y^2 = 8x$ . The locus of the midpoint of PQ is

A.  $P_1$  lies on  $C_2$  and  $Q_1$  lies on  $C_1$

B.  $PQ \geq \min \{PP_1, QQ_1\}$

C. point  $P_0$  on  $C_1$  such that  $P_0Q_0 \leq PQ$  for all pairs of

points (P,Q) is  $\left(\frac{1}{3}, \frac{10}{9}\right)$



D. point  $Q_0$  on  $C_2$  such that  $P_0Q_0 \leq PQ$  for all pairs of

points (P,Q) is  $\left(\frac{10}{9}, \frac{1}{3}\right)$

**Answer: A:B**



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25. The value(s) of  $a$  for which two curves  $y = ax^2 + ax + \frac{1}{24}$  and  $x = ay^2 + ay + \frac{1}{24}$  touch each other is/are

A.  $\frac{2}{3}$

B.  $\frac{1}{3}$

C.  $\frac{3}{2}$

D.  $\frac{1}{2}$

Answer: A::C



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26. From any point P on the parabola  $y^2 = 4ax$ , perpendicular PN is drawn on the meeting it at N. Normal at P meets the axis in G. For what value/values of t, the point N divides SG internally in the ratio 1 : 3, where S is the focus ? a.

$\sqrt{\frac{3}{5}}$  b.  $-\sqrt{\frac{5}{3}}$  c.  $-\sqrt{\frac{3}{5}}$  d.  $\sqrt{\frac{5}{3}}$

A.  $\sqrt{\frac{3}{5}}$

B.  $\sqrt{-\frac{5}{3}}$

C.  $\sqrt{-\frac{3}{5}}$

D.  $\sqrt{\frac{5}{3}}$

Answer: B::D



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## LINKED COMPREHENSION TYPE

1. A tangent is drawn at any point  $P(t)$  on the parabola  $y^2 = 8x$  and on it is takes a point  $Q(\alpha, \beta)$  from which a pair of tangent QA and OB are drawn to the circle  $x^2 + y^2 = 8$ .

Using this information, answer the following questions :

The locus of the point of concurrency of the chord of contact AB of the circle  $x^2 + y^2 = 8$  is

A.  $y^2 - 2x = 0$

B.  $y^2 - x^2 = 4$

C.  $y^2 + 4x = 0$

D.  $y^2 - 2x^2 = 4$

**Answer: C**

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2. A tangent is drawn at any point  $P(t)$  on the parabola  $y^2 = 8x$  and on it is takes a point  $Q(\alpha, \beta)$  from which a pair of tangent  $QA$  and  $OB$  are drawn to the circle  $x^2 + y^2 = 8$ .

Using this information, answer the following questions :

The locus of the point of concurrency of the chord of contact  $AB$  of the circle  $x^2 + y^2 = 8$  is

A.  $(4, \pm \sqrt{3})$

B.  $(-1, \sqrt{2})$

C.  $(-\sqrt{2}, -\sqrt{2})$

D.  $(-2, \pm 2\sqrt{3})$

**Answer: D**

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3. A tangent is drawn at any point  $P(t)$  on the parabola  $y^2 = 8x$  and on it is takes a point  $Q(\alpha, \beta)$  from which a pair of tangent  $QA$  and  $OB$  are drawn to the circle  $x^2 + y^2 = 8$ .

Using this information, answer the following questions :

The locus of the point of concurrency of the chord of contact  $AB$  of the circle  $x^2 + y^2 = 8$  is

A.  $x-2y+2=0$

B.  $x+2y-4=0$

C.  $x-2y-4=0$

D.  $x+2y+4=0$

**Answer: A**

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4. Tangent to the parabola  $y = x^2 + ax + 1$  at the point of intersection of the y-axis also touches the circle  $x^2 + y^2 = r^2$ . Also, no point of the parabola is below the x-axis. The radius of circle when a attains its maximum value is

A. (a)  $1 / \sqrt{10}$

B. (b)  $1 / \sqrt{5}$

C. (c) 1

D. (d)  $\sqrt{5}$

**Answer: B**



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5. Tangent to the parabola  $y = x^2 + ax + 1$  at the point of intersection of the y-axis also touches the circle  $x^2 + y^2 = r^2$ . Also, no point of the parabola is below the x-axis.

The slope of the tangents when the radius of the circle is maximum is

A. (a) -1

B. (b) 1

C. (c) 0

D. (d) 2

**Answer: C**



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6. Tangent to the parabola  $y = x^2 + ax + 1$  at the point of intersection of the y-axis also touches the circle  $x^2 + y^2 = r^2$ . Also, no point of the parabola is below the x-axis.

The minimum area bounded by the tangent and the coordinate axes is

A. A. 1

B. B.  $1/3$

C. C.  $1/2$



**Answer: D**



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7. The locus of the circumcenter of a variable triangle having sides the  $y$ -axis,  $y=2$ , and  $lx+my=1$ , where  $(l,m)$  lies on the parabola  $y^2 = 4x$ , is a curve  $C$ .

The curve  $C$  is symmetric about the line

A.  $(-2, 3/2)$

B.  $(-2, -3/2)$

C.  $(2, 3/2)$

D.  $(2, -3/2)$

**Answer: A**



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8. If the normal chord of the parabola  $y^2 = 4x$  makes an angle  $45^\circ$  with the axis of the parabola, then its length, is

A.  $1/4$

B.  $1/12$

C.  $1/8$

D.  $1/16$

**Answer: C**



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9. The locus of the circumcenter of a variable triangle having sides the  $y$ -axis,  $y=2$ , and  $lx+my=1$ , where  $(1,m)$  lies on the parabola  $y^2 = 4x$ , is a curve C.

The curve C is symmetric about the line

A.  $x = 3/2$

B.  $y = -3/2$

C.  $x = -3/2$

D.  $y = 3/2$

**Answer: D**



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10.  $y=x$  is tangent to the parabola  $y = ax^2 + c$ .

If  $a=2$ , then the value of  $c$  is

A. A. 1

B. B.  $-1/2$

C. C.  $1/2$

D. D.  $1/8$

**Answer: D**



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11.  $y=x$  is tangent to the parabola  $y = ax^2 + c$ .

If  $(1,1)$  is the point of contact, then  $a$  is

A. A.  $1/4$

B. B.  $1/3$

C. C.  $1/2$

D. D.  $1/6$

**Answer: C**



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**12.**  $y=x$  is tangent to the parabola  $y = ax^2 + c$ .

If  $c=2$ , then the point of contact is

A. A. (3,3)

B. B. (2,2)

C. C. (6,6)

D. D. (4,4)

**Answer: D**



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**13.** find the area of triangle whose vertices are (3,8),(-4,2)and (5,1)

A. A. 37.5 sq.units

B. B. 75 sq.units

C. C. 150sq.units

D. D. None of these

**Answer: A**



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14. If  $l$  and  $m$  are variable real number such that  $5l^2 + 6m^2 - 4lm + 3l = 0$ , then the variable line  $lx+my=1$  always touches a fixed parabola, whose axes is parallel to the  $x$ -axis.

Then find the vertex of the parabola is

- A.  $(1/6, -7/6)$
- B.  $(5/3, 4/3)$
- C.  $(3/2, -3/2)$
- D.  $(-3/4, 3/4)$

**Answer: B**



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15. If  $|\vec{a} + \vec{b}| = 60$ ,  $|\vec{a} - \vec{b}| = 40$  and  $|\vec{a}| = 22$  then find  $|\vec{b}|$



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16. Consider the parabola whose focus is at  $(0,0)$  and tangent at vertex is  $x - y + 1 = 0$

The length of latus rectum is (a)  $4\sqrt{2}$  (b)  $2\sqrt{2}$  (c)  $8\sqrt{2}$  (d)  $3\sqrt{2}$

A.  $4\sqrt{2}$

B.  $2\sqrt{2}$

C.  $8\sqrt{2}$

D.  $3\sqrt{2}$

**Answer: B**





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17. Consider the parabola whose focus is at  $(0,0)$  and tangent at vertex is  $x-y+1=0$

The length of the chord of parabola on the x-axis is

A.  $4\sqrt{2}$

B.  $2\sqrt{2}$

C.  $8\sqrt{2}$

D.  $3\sqrt{2}$

**Answer: A**



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18. Consider the parabola whose focus is at  $(0,0)$  and tangent at vertex is  $x-y+1=0$

Tangents drawn to the parabola at the extremities of the chord  $3x+2y=0$  intersect at angle (a)  $\pi/6$  (b)  $\pi/3$  (c)  $\pi/2$  (d) none of these

A. (a)  $\pi/6$

B. (b)  $\pi/3$

C. (c)  $\pi/2$

D. (d) none of these

**Answer: C**



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19. Two tangents on a parabola are  $x-y=0$  and  $x+y=0$ .

$S(2,3)$  is the focus of the parabola.

The equation of the tangent at the vertex is

A.  $4x-6y+5=0$

B.  $4x-6y+3=0$

C.  $4x-6y+1=0$

D.  $4x-6y+3/2=0$

**Answer: A**



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20. Two tangents on a parabola are  $x-y=0$  and  $x+y=0$ .

$S(2,3)$  is the focus of the parabola.

If P and Q are ends of the focal chord of the parabola, then

$$\frac{1}{SP} + \frac{1}{SQ} =$$

- A. (a)  $6/\sqrt{3}$
- B. (b)  $10/\sqrt{13}$
- C. (c)  $2/\sqrt{13}$
- D. (d) none of these

**Answer: B**

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**21.** Two tangents on a parabola are  $x-y=0$  and  $x+y=0$ .

$S(2,3)$  is the focus of the parabola.

The length of latus rectum of the parabola is

A.  $2\sqrt{13}/3$

B.  $\frac{10}{\sqrt{13}}$

C.  $2\sqrt{13}/5$

D. none of these

**Answer: C**



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22.  $y^2 = 4x$  and  $y^2 = -8(x - a)$  intersect at points A and

C. Points  $O(0, 0)$ , A, B  $(a, 0)$ , and C are concyclic.

The length of the common chord of the parabolas is

A. (a)  $2\sqrt{6}$

B. (b)  $4\sqrt{3}$

C. (c)  $6\sqrt{5}$

D. (d)  $8\sqrt{2}$

**Answer: D**

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**23.**  $y^2 = 4x$  and  $y^2 = -8(x - a)$  intersect at points A and C. Points O(0, 0), A, B (a, 0), and C are concyclic.

The area of cyclic quadrilateral OABC is (a)  $24\sqrt{3}$  (b)  $48\sqrt{2}$  (c)  $12\sqrt{6}$  (d)  $18\sqrt{5}$

A. (a)  $24\sqrt{3}$

B. (b)  $48\sqrt{2}$

C. (c)  $12\sqrt{6}$

D. (d)  $18\sqrt{5}$

**Answer: B**



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24.  $y^2 = 4x$  and  $y^2 = -8(x - a)$  intersect at points A and C. Points O(0, 0), A, B (a, 0), and C are concyclic.

The area of cyclic quadrilateral OABC is (a)  $24\sqrt{3}$  (b)  $48\sqrt{2}$  (c)

$12\sqrt{6}$  (d)  $18\sqrt{5}$

A.  $96\sqrt{2}$

B.  $48\sqrt{3}$

C.  $54\sqrt{5}$

D.  $36\sqrt{6}$

**Answer: A**



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25. The focus of the parabola  $y = 2x^2 + x$  is

A. 96 sq. units

B. 64 sq. units

C. 72 sq. units

D. 48 sq. units

**Answer: B**



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26. The focus of the parabola  $y = 2x^2 + x$  is

A.  $6\sqrt{5}$

B.  $3\sqrt{6}$

C.  $\sqrt{10}$

D.  $5\sqrt{3}$

**Answer: C**



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27. The focus of the parabola  $y = 2x^2 + x$  is

A. 2: 1

B. 3: 2

C. 4: 3

D. 3: 1

**Answer: D**

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**28.** Consider the inequality,  $9^x - a \cdot 3^x - a + 3 \leq 0$ , where ' $a$ ' is a real parameter.

(a) Find the value of ' $a$ ' for which the inequality has at least one negative solution.

(b) Find the values of ' $a$ ' for which the inequality has at least one positive solution.

(c) Find the values of ' $a$ ' for which the inequality has at least one real solution.

A. (a)  $(-\infty, 2)$

B. (b)  $(3, \infty)$

C. (c)  $(-2, \infty)$

D. (d)  $(2, 3)$

**Answer: D**



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**29.** Consider the inequality,  $9^x - a \cdot 3^x - a + 3 \leq 0$ , where ' $a$ ' is a real parameter.

(a) Find the value of ' $a$ ' for which the inequality has at least one negative solution.

(b) Find the values of ' $a$ ' for which the inequality has at least one positive solution.

(c) Find the values of ' $a$ ' for which the inequality has at least one real solution.

A.  $(-\infty, -2)$

B.  $(3, \infty)$

C.  $(2, \infty)$

D.  $[-2, \infty)$

**Answer: C**



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**30.** Consider the inequality,  $9^x - a \cdot 3^x - a + 3 \leq 0$ , where ' $a$ ' is a real parameter.

(a) Find the value of ' $a$ ' for which the inequality has at least one negative solution.

(b) Find the values of 'a' for which the inequality has at least one positive solution.

(c) Find the values of 'a' for which the inequality has at least one real solution.

A.  $(-\infty, 3)$

B.  $[2, \infty)$

C.  $(3, \infty)$

D.  $[-2, \infty)$

**Answer: B**



**Watch Video Solution**

**31.** Consider one sides AB of a square ABCD in order on line

$y = 2x - 17$ , and other two vertices C, D on  $y = x^2$

The minimum intercept of line CD on the y-axis is

A. 3

B. 4

C. 2

D. 6

**Answer: A**



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**32.** Consider one sides AB of a square ABCD in order on line  $y = 2x - 17$ , and other two vertices C, D on  $y = x^2$

The maximum possible area of square ABCD is

A. 1180

B. 1250

C. 1280

D. none

**Answer: C**



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**33.** Let PQ be a focal chord of the parabola  $y^2 = 4ax$ . The tangents to the parabola at P and Q meet at a point lying on the line  $y = 2x + a$ ,  $a > 0$ . Length of chord PQ is

A.  $7a$

B.  $5a$

C.  $2a$

D. 3a

**Answer: B**



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**34.** Let PQ be a focal chord of the parabola  $y^2 = 4ax$ . The tangents to the parabola at P and Q meet at point lying on the line

$$y = 2x + a, a < 0.$$

If chord PQ subtends an angle  $\theta$  at the vertex of  $y^2 = 4ax$ , then  $\tan \theta =$

A.  $2\sqrt{7}/3$

B.  $-2\sqrt{7}/3$

C.  $2\sqrt{5}/3$



D.  $-2\sqrt{5}/3$

**Answer: D**



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**35.** Let  $a, r, s, t$  be non-zero real numbers. Let  $P(at^2, 2at), Q, R(ar^2, 2ar)$  and  $S(as^2, 2as)$  be distinct points on the parabola  $y^2 = 4ax$ . Suppose that  $PQ$  is the focal chord and lines  $QR$  and  $PK$  are parallel, where  $K$  is the point  $(2a, 0)$ . The value of  $r$  is

A.  $-\frac{1}{t}$

B.  $\frac{t^2 + 1}{t}$

C.  $\frac{1}{t}$

D.  $\frac{t^2 - 1}{t}$

**Answer: D**



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**36.** Let  $a, r, s, t$  be non-zero real numbers. Let  $P(at^2, 2at)$ ,  $Q(ar^2, 2ar)$  and  $S(as^2, 2as)$  be distinct points on the parabola  $y^2 = 4ax$ . Suppose that  $PQ$  is the focal chord and lines  $QR$  and  $PK$  are parallel, where  $K$  the point  $(2a, 0)$ .

If  $st=1$ , then the tangent at  $P$  and the normal at  $S$  to the parabola meet at a point whose ordinate is

A.  $\frac{(t^2 + 1)^2}{2t^3}$

B.  $\frac{a(t^2 + 1)^2}{2t^3}$

C.  $\frac{a(t^2 + 1)^2}{t^3}$

D.  $\frac{a(t^2 + 2)^2}{t^3}$

**Answer: B**

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**37.** Tangent to the parabola  $y = x^2 + ax + 1$  at the point of intersection of the  $y$ -axis also touches the circle  $x^2 + y^2 = r^2$ . Also, no point of the parabola is below the  $x$ -axis.

The radius of circle when  $a$  attains its maximum value is

A. (a)  $1/\sqrt{10}$

B. (b)  $1/\sqrt{5}$

C. (c) 1

D. (d)  $\sqrt{5}$

**Answer: B**



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**38.** Tangent to the parabola  $y = x^2 + ax + 1$  at the point of intersection of the y-axis also touches the circle  $x^2 + y^2 = r^2$ . Also, no point of the parabola is below the x-axis.

The slope of the tangents when the radius of the circle is maximum is

A. (a) -1

B. (b) 1

C. (c) 0

D. (d) 2

**Answer: C**



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**39.** Tangent to the parabola  $y = x^2 + ax + 1$  at the point of intersection of the y-axis also touches the circle  $x^2 + y^2 = r^2$ . Also, no point of the parabola is below the x-axis.

The minimum area bounded by the tangent and the coordinate axes is

A. 1

B.  $1/3$

C.  $1/2$

D.  $1/4$

**Answer: D**



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**40.** The locus of the circumcenter of a variable triangle having sides the  $y$ -axis,  $y=2$ , and  $lx+my=1$ , where  $(l,m)$  lies on the parabola  $y^2 = 4x$ , is a curve  $C$ .

The coordinates of the vertex of this curve  $C$  is

A.  $(-2, 3/2)$

B.  $(-2, -3/2)$

C.  $(2, 3/2)$

D.  $(2, -3/2)$

**Answer: A**



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**41.** The locus of the circumcenter of a variable triangle having sides the  $y$ -axis,  $y=2$ , and  $lx+my=1$ , where  $(l,m)$  lies on the parabola  $y^2 = 4x$ , is a curve  $C$ .

The length of the smallest chord of this  $C$  is

A.  $1/4$

B.  $1/12$

C.  $1/8$

D.  $1/16$

**Answer: C**



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42. The locus of the circumcenter of a variable triangle having sides the  $y$ -axis,  $y=2$ , and  $lx+my=1$ , where  $(1,m)$  lies on the parabola  $y^2 = 4x$ , is a curve C.

The curve C is symmetric about the line

A.  $x = 3/2$

B.  $y = -3/2$

C.  $x = -3/2$

D.  $y = 3/2$

**Answer: D**

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43.  $y=x$  is tangent to the parabola  $y = 2ax^2 + c$ .

If (1,1) is the point of contact, then  $a$  is

A.  $1/4$

B.  $1/3$

C.  $1/2$

D.  $1/6$

**Answer: C**



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44.  $y=x$  is tangent to the parabola  $y = ax^2 + c$ .

If  $c=2$ , then the point of contact is

A. (3,3)

B. (2,2)

C. (6,6)

D. (4,4)

**Answer: D**



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**45.** Consider the parabola whose focus is at (0,0) and tangent at vertex is  $x-y+1=0$

Tangents drawn to the parabola at the extremities of the chord  $3x+2y=0$  intersect at angle (a)  $\pi/6$  (b)  $\pi/3$  (c)  $\pi/2$  (d) none of these

A. (a)  $\pi/6$

B. (b)  $\pi/3$

C. (c)  $\pi/2$

D. (d) none of these

**Answer: C**

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## MATRIX MATCH TYPE

1. Consider the parabola

$$(x - 1)^2 + (y - 2)^2 = \frac{(12x - 5y + 3)^2}{169}$$
 and match the

following lists :



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2. Consider the parabola  $y^2 = 12x$  and match the following lists :



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3. If  $*$  is defined on the set  $R$  of all real numbers by  $a * b = \sqrt{a^2 + b^2}$ , find the identity element, if exists in  $r$  with respect to  $*$

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4. Match the following lists and then choose the correct code.

List I: Function	List II: Range
a. $f(x) = \log_3(5 - 4x - x^2)$	p. Function not defined
b. $f(x) = \log_3(x^2 - 4x - 5)$	q. $[0, \infty)$
c. $f(x) = \log_3(x^2 - 4x + 5)$	r. $(-\infty, 2]$
d. $f(x) = \log_3(4x - 5 - x^2)$	s. $R$

- A.  $a \quad b \quad c \quad d$   
 $p \quad r \quad q \quad q$
- B.  $a \quad b \quad c \quad d$   
 $q \quad p \quad r \quad s$
- C.  $a \quad b \quad c \quad d$   
 $s \quad p \quad q \quad r$
- D.  $a \quad b \quad c \quad d$   
 $r \quad s \quad q \quad p$

**Answer: B**



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5. If  $*$  is defined on the set  $Z$  of all integers by  $*$ :  $a * b = a + b - 4$ , find the inverse element, if exists in  $Z$  with respect

to \*



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## NUMERICAL VALUE TYPE

1. If the length of the latus rectum of the parabola  $169\{(x - 1)^2 + (y - 3)^2\} = (5x - 12y + 17)^2$  is  $L$  then the value of  $13\frac{L}{4}$  is \_\_\_\_\_.



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2. A circle is drawn through the point of intersection of the parabola  $y = x^2 - 5x + 4$  and the x-axis such that origin lies

outside it. The length of a tangent to the circle from the origin is \_\_\_\_\_ .



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3. The focal chord of  $y^2 = 16x$  is tangent to  $(x - 6)^2 + y^2 = 2$ .

Then the possible value of the square of slope of this chord is \_\_\_\_\_ .



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4. Two tangent are drawn from the point  $(-2, -1)$  to parabola  $y^2 = 4x$ . if  $\alpha$  is the angle between these tangents, then find the value of  $\tan \alpha$ .



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5. The equation of the line touching both the parabolas  $y^2 = 4x$  and  $x^2 = -32y$  is  $ax + by + c = 0$ . Then the value of  $a + b + c$  is \_\_\_\_\_ .

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6. If the point  $P(4, -2)$  is the one end of the focal chord  $PQ$  of the parabola  $y^2 = x$ , then the slope of the tangent at  $Q$ , is

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7. If the line  $x+y=6$  is a normal to the parabola  $y^2 = 8x$  at point  $(a,b)$ , then the value of  $a+b$  is \_\_\_\_\_ .



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8. The locus of the midpoints of the portion of the normal to the parabola  $y^2 = 16x$  intercepted between the curve and the axis is another parabola whose latus rectum is \_\_\_\_\_ .

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9. Consider the locus of center of the circle which touches the circle  $x^2 + y^2 = 4$  externally and the line  $x=4$ . The distance of the vertex of the locus from the origin is \_\_\_\_\_ .

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10. If on a given base BC[B(0,0) and C(2,0)], a triangle is described such that the sum of the base angles is 4, then the equation of the locus of the opposite vertex A is parabola whose directrix is  $y=k$ . The value of  $k$  is \_\_\_\_\_ .

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11. PQ is any focal chord of the parabola  $y^2 = 8x$ . Then the length of PQ can never be less than \_\_\_\_\_ .

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12. The length of focal chord to the parabola  $y^2 = 12x$  drawn from the point (3,6) on is \_\_\_\_\_ .

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**13.** From the point  $(-1,2)$ , tangent lines are to the parabola  $y^2 = 4x$ . If the area of the triangle formed by the chord of contact and the tangents is  $A$ , then the value of  $A / \sqrt{2}$  is \_\_\_\_\_ .

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**14.** Line  $y=2x-b$  cuts the parabola  $y = x^2 - 4x$  at points  $A$  and  $B$ . Then the value of  $b$  for which  $\angle AOB$  is a right is (where  $O$  is origin) \_\_\_\_\_ .

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15. A line through the origin intersects the parabola  $5y = 2x^2 - 9x + 10$  at two points whose x-coordinates add up to 17.

Then the slope of the line is \_\_\_\_\_ .

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16. IF the circle  $(x - 6)^2 + y^2 = r^2$  and the parabola  $y^2 = 4x$  have maximum number of common chords , then the least integral value of r is

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17. The slope of line which belongs to family  $(1+ l) x + (l-1)y + 2(1-l) = 0$  and makes shortest intercept on  $x^2 = 4y - 4$  is :



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18. If  $3x+4y+k=0$  represents the equation of tangent at the vertex of the parabola  $16x^2 - 24xy + 9y^2 + 14x + 2y + 7 = 0$ , then the value of  $k$  is \_\_\_\_\_.



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19. Normals at  $(x_1, y_1)$ ,  $(x_2, y_2)$  and  $(x_3, y_3)$  to the parabola  $y^2 = 4x$  are concurrent at point P. If  $y_1y_2 + y_2y_3 + y_3y_1 = x_1x_2x_3$ , then locus of point P is part of parabola, length of whose latus rectum is \_\_\_\_\_.



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20. Foot of perpendicular from point P on the parabola  $y^2 = 4ax$  to the axis is N. A straight line is drawn parallel to the axis which bisects PN and cuts the curve at Q. If NQ meets the tangent at the vertex A at a point T, then  $\frac{PN}{AT} = \text{-----}$ .

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21. Find the integrating factor of the following differential equation:  $x \log x \left( \frac{dy}{dx} \right) + y = 2 \log x$

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22. Normals are drawn from a point P with slopes  $m_1, m_2$  and  $m_3$  are drawn from the point p not from the parabola  $y^2 = 4x$ . For  $m_1 m_2 = \alpha$ , if the locus of the point P

is a part of the parabola itself, then the value of  $\alpha$  is (a) 1

(b)-2 (c) 2 (d) -1



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**23.** The curve be  $y = x^2$  whose slope of tangent is  $x$ , so find the point of intersection of the tangent and the curve.



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**24.** Find the point of intersection of the curves  $y = 2x^2 - x + 1$  and  $y = 3x + 4$  whose slopes of tangents are equal.



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25. Find the principal value of  $\cos^{-1}\left(-\frac{\sqrt{3}}{2}\right)$

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26. If the normals of the parabola  $y^2 = 4x$  drawn at the end points of its latus rectum are tangents to the circle  $(x - 3)^2 + (y + 2)^2 = r^2$  is

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27. If the length of the latus rectum of the parabola  $169\{(x - 1)^2 + (y - 3)^2\} = (5x - 12y + 17)^2$  is  $L$  then the value of  $13\frac{L}{4}$  is \_\_\_\_\_.

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28. If the line  $x+y=6$  is a normal to the parabola  $y^2 = 8x$  at point  $(a,b)$ , then the value of  $a+b$  is \_\_\_\_\_ .



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29. Consider the locus of center of the circle which touches the circle  $x^2 + y^2 = 4$  externally and the line  $x=4$ . The distance of the vertex of the locus from the origin is \_\_\_\_\_ .



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30. Line  $y=2x-b$  cuts the parabola  $y = x^2 - 4x$  at points A and B. Then the value of  $b$  for which  $\angle AOB$  is a right is (where O is origin) \_\_\_\_\_ .



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**31.** A line through the origin intersects the parabola  $5y = 2x^2 - 9x + 10$  at two points whose x-coordinates add up to 17.

Then the slope of the line is \_\_\_\_\_ .



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**32.** If  $3x+4y+k=0$  represents the equation of tangent at the vertex of the parabola  $16x^2 - 24xy^2 + 14x + 2y + 7 = 0$ , then the value of k is \_\_\_\_\_ .



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1. If two tangents drawn from a point P to the parabola  $y^2 = 4x$  are at right angles, then the locus of P is

A.  $2x-1=0$

B.  $x=1$

C.  $2x+1=0$

D.  $x=-1$

**Answer: D**



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2. Statement 1: An equation of a common tangent to the parabola  $y^2 = 16\sqrt{3}x$  and the ellipse  $2x^2 + y^2 = 4$  is  $y = 2x + 2\sqrt{3}$ . Statement 2: If the line  $y = mx + \frac{4\sqrt{3}}{m}$ , ( $m \neq 0$ ) is a common tangent to the parabola  $y^2 = 16\sqrt{3}x$  and the ellipse  $2x^2 + y^2 = 4$ , then  $m$  satisfies  $m^4 + 2m^2 = 24$ .

- A. Statement 1 is true, statement 2 is true, statement 2 is a correct explanation for statement 1.
- B. Statement 1 is true, statement 2 is true, statement 2 is not correct explanation for statement 1.
- C. Statement 1 is true, statement 2 is false.
- D. Statement 1 is false, statement 2 is true.

**Answer: B**



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3. The slope of the line touching both the parabolas  $y^2 = 4x$  and  $x^2 = -32y$  is

A.  $1/2$

B.  $3/2$

C.  $1/8$

D.  $2/3$

**Answer: A**



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4. Let O be the vertex and Q be any point on the parabola  $x^2 = 8y$ . IF the point P divides the line segment OQ internally in the ratio 1:3 , then the locus of P is

A.  $x^2 = y$

B.  $y^2 = x$

C.  $y^2 = 2x$

D.  $x^2 = 2y$

**Answer: D**



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5. Let P be the point on the parabola,  $y^2 = 8x$  which is at a minimum distance from the centre C of the circle,

$x^2 + (y + 6)^2 = 1$ . Then the equation of the circle, passing

through C and having its centre at P is :

$$x^2 + y^2 - x + 4y + 12 = 0$$

$$x^2 + y^2 - \frac{x}{4} + 2y - 24 = 0$$

$$x^3 + y^2 - 4x + 9y - 18 = 0$$

$$x^2 + y^2 - 4x + 8y + 12 = 0$$

A.  $x^2 + y^2 - x + 4y + 12 = 0$

B.  $x^2 + y^2 - \frac{x}{4} + 2y - 24 = 0$

C.  $x^3 + y^2 - 4x + 9y - 18 = 0$

D.  $x^2 + y^2 - 4x + 8y - 12 = 0$

**Answer: D**



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6. The radius of a circle, having minimum area, which touches the curve  $y = 4 - x^2$  and the lines  $y = |x|$  is :

A. (a)  $4(\sqrt{2} + 1)$

B. (b)  $2(\sqrt{2} + 1)$

C. (c)  $2(\sqrt{2} - 1)$

D. (d)  $4(\sqrt{2} - 1)$

**Answer: D**



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7. If the tangent at (1,7) to curve  $x^2 = y - 6$  touches the circle  $x^2 + y^2 + 16x + 12y + c = 0$  then the value of c is



A. 95

B. 195

C. 185

D. 85

**Answer: A**



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8. Tangent and normal are drawn at the point  $P \equiv (16, 16)$  of the parabola  $y^2 = 16x$  which cut the axis of the parabola at the points  $A$  and  $B$ , respectively. If the center of the circle through  $P$ ,  $A$  and  $B$  is  $C$ , then the angle between  $PC$  and the axis of  $x$  is

A.  $4/3$

B.  $1/2$

C. 2

D. 3

**Answer: C**



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## JEE ADVANCED SINGLE CORRECT ANSWER TYPE

1. Let  $(x,y)$  be any point on the parabola  $y^2 = 4x$ . Let P be the point that divides the line segment from  $(0,0)$  and  $(x,y)$  in the ratio 1:3. Then the locus of P is :

A.  $x^2 = y$

B.  $y^2 = 2x$

C.  $y^2 = x$

D.  $x^2 = 2y$

**Answer: C**



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2. about to only mathematics

A. 3

B. 6

C. 9

D. 15

**Answer: D**



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## MULTIPLE CORRECT ANSWER TYPE

1. about to only mathematics

A. vertex is  $(2a/3, 0)$

B. directrix is  $x=0$

C. latus rectum is  $2a/3$

D. focus is  $(a,0)$

**Answer: A::D**



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2. Let A and B be two distinct points on the parabola  $y^2 = 4x$ . If the axis of the parabola touches a circle of radius  $r$  having AB as its diameter, then find the slope of the line joining A and B.

A.  $-1/r$

B.  $1/r$

C.  $2/r$

D.  $-2/r$

**Answer: C::D**



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3. Let  $L$  be a normal to the parabola  $y^2 = 4x$ . If  $L$  passes through the point  $(9, 6)$ , then  $L$  is given by (a)  $y - x + 3 = 0$   
(b)  $y + 3x - 33 = 0$  (c)  $y + x - 15 = 0$  (d)  $y - 2x + 12 = 0$

A.  $y-x+3=0$

B.  $y+3x-33=0$

C.  $y+x-15=0$

D.  $y-2x+12=0$

**Answer: A::C::D**



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4. Let  $P$  and  $Q$  be distinct points on the parabola  $y^2 = 2x$  such that a circle with  $PQ$  as diameter passes through the

vertex O of the parabola. If P lies in the first quadrant and the area of the triangle  $\Delta OPQ$  is  $3\sqrt{2}$ , then which of the following is (are) the coordinates of P? (a)  $(4, 2\sqrt{2})$  (b)  $(9, 3\sqrt{2})$  (c)  $(14, 1\sqrt{2})$  (d)  $(1, \sqrt{2})$

A.  $(4, 2\sqrt{2})$

B.  $(9, 3\sqrt{2})$

C.  $\left(\frac{1}{4}, \frac{1}{\sqrt{2}}\right)$

D.  $(1, \sqrt{2})$

**Answer: A::D**



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5. Let P be the point on parabola  $y^2 = 4x$  which is at the shortest distance from the center S of the circle

$x^2 + y^2 - 4x - 16y + 64 = 0$  let Q be the point on the circle dividing the line segment SP internally. Then

A. (a)  $SP = 2\sqrt{5}$

B. (b)  $SQ : QP = (\sqrt{5} + 1) : 2$

C. (c) the x-intercept of the normal to the parabola at P is

6

D. (d) the slope of the tangent to the circle at Q is  $\frac{1}{2}$

**Answer: A::C::D**



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**6.** The circle  $C_1 : x^2 + y^2 = 3$ , with center at O, intersects the parabola  $x^2 = 2y$  at the point P in the first quadrant. Let the tangent to the circle  $C_1$  at P touches other two circles  $C_2$  and



C3 at R2 and R3, respectively. Suppose C2 and C3 have equal radii  $2\sqrt{3}$  and centers  $Q_2$  and  $Q_3$ , respectively. If  $Q_2$  and  $Q_3$  lies on the y-axis, then find  $Q_2Q_3 = 12$  and  $R_2R_3 = 4\sqrt{6}$



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7. If a chord, which is not a tangent, of the parabola  $y^2 = 16x$  has the equation  $2x + y = p$ , and midpoint  $(h,k)$ , then which of the following is (are) possible value(s) of  $p, h$  and  $k$  ?

- A. A.  $p=5, h=4, k=-3$
- B. B.  $p=-1, h=1, k=-3$
- C. C.  $p=-2, h=2, k=-4$
- D. D.  $p=2, h=3, k=-4$

**Answer: D**



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## Single Correct Answer Type

1. The equation  $x^2 - 2xy + y^2 + 3x + 2 = 0$  represents (a) a parabola (b) an ellipse (c) a hyperbola (d) pair of straight line

A. A parabola

B. An ellipse

C. A hyperbola

D. pair of straight line

**Answer: A**



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2. The length of the latus rectum of  $3x^2 - 4y + 6x - 3 = 0$  is

A. 3

B. 2

C.  $\frac{4}{3}$

D.  $\frac{3}{4}$

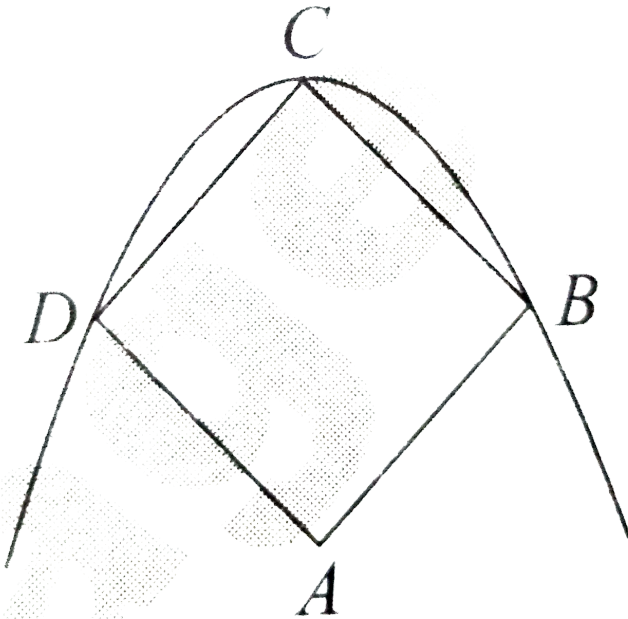
**Answer: C**



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3. In the adjacent figure a parabola is drawn to pass through the vertices B,C and D of the square ABCD. If  $A(2, 1)$ ,  $C(2, 3)$ ,

then focus of this parabola is



- A. A.  $\left(1, \frac{11}{4}\right)$
- B. B.  $\left(2, \frac{11}{4}\right)$
- C. C.  $\left(3, \frac{13}{4}\right)$
- D. D.  $\left(2, \frac{13}{4}\right)$

**Answer: B**

4. Length of the latus rectum of the parabola

$$\sqrt{x} + \sqrt{y} = \sqrt{a} \text{ is (a) } a\sqrt{2} \text{ (b) } \frac{a}{\sqrt{2}} \text{ (c) } a \text{ (d) } 2a$$

A.  $a\sqrt{2}$

B.  $\frac{a}{\sqrt{2}}$

C.  $a$

D.  $2a$

**Answer: A**

5. Consider the parabola  $x^2 + 4y = 0$ . Let  $P(a, b)$  be any fixed point inside the parabola and let  $S$  be the focus of the parabola. Then the minimum value at  $SQ + PQ$  as point  $Q$  moves on the parabola is (a)  $|1 - a|$  (b)  $|ab| + 1$  (c)  $\sqrt{a^2 + b^2}$  (d)  $1 - b$

A.  $|1 - a|$

B.  $|ab| + 1$

C.  $\sqrt{a^2 + b^2}$

D.  $1 - b$

**Answer: D**



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6. If the points  $(2,3)$  and  $(3,2)$  on a parabola are equidistant from the focus, then the slope of its tangent at vertex is

A. 1

B.  $-1$

C. 0

D.  $\infty$

**Answer: B**



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7. Let  $A(x_1, y_1)$  and  $B(x_2, y_2)$  be two points on the parabola  $y^2 = 4ax$ . If the circle with chord AB as a diameter touches the parabola, then  $|y_1 - y_2|$  is equal to

A.  $4a$

B.  $8a$

C.  $6\sqrt{2}a$

D. not a constant

**Answer: B**



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8.  $y = \sqrt{3}x + \lambda$  is drawn through focus S of the parabola  $y^2 = 8x + 16$ . If two intersection points of the given line and the parabola are A and B such that perpendicular bisector of AB intersects the x-axis at P then length of PS is

A.  $8/7$



B.  $7/17$

C.  $8\sqrt{3}$

D.  $16/3$

**Answer: D**



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9. If the point  $(2a, a)$  lies inside the parabola

$x^2 - 2x - 4y + 3 = 0$ , then  $a$  lies in the interval

A.  $\left[\frac{1}{2}, \frac{3}{2}\right]$

B.  $\left(\frac{1}{2}, \frac{3}{2}\right)$

C.  $(1, 3)$

D.  $\left(\frac{-3}{2}, \frac{-1}{2}\right)$

**Answer: B**



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10. If  $AFB$  is a focal chord of the parabola  $y^2 = 4ax$  such that  $AF = 4$  and  $FB = 5$  then the latus-rectum of the parabola is equal to (a) 80 (b)  $\frac{9}{80}$  (c) 9 (d)  $\frac{80}{9}$

A. 80

B.  $\frac{9}{80}$

C. 9

D.  $\frac{80}{9}$

**Answer: D**



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11. Length of the focal chord of the parabola  $(y + 3)^2 = -8(x - 1)$  which lies at a distance 2 units from the vertex of the parabola is

A. 8

B.  $6\sqrt{2}$

C. 9

D.  $5\sqrt{3}$

**Answer: A**



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12. Let  $A(0, 2)$ ,  $B$  and  $C$  be points on parabola  $y^2 + x + 4$  such that  $\angle CBA = \frac{\pi}{2}$ . Then the range of ordinate of  $C$  is (a)  $(-\infty, 0) \cup (4, \infty)$  (b)  $(-\infty, 0] \cup [4, \infty)$  (c)  $[0, 4]$  (d)  $(-\infty, 0) \cup [4, \infty)$

A.  $(-\infty, 0) \cup (4, \infty)$

B.  $(-\infty, 0] \cup [4, \infty)$

C.  $[0, 4]$

D.  $(-\infty, 0) \cup [4, \infty)$

**Answer: B**



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13.  $lx + my = 1$  is the equation of the chord PQ of  $y^2 = 4x$  whose focus is S. If PS and QS meet the parabola again at R and T respectively, then slope of RT is (a)  $-1/m$  (b)  $1/m$  (c)  $2/m$  (d) none of the above

A.  $-\frac{1}{m}$

B.  $\frac{l}{m}$

C.  $\frac{2}{m}$

D. none of these

**Answer: A**



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14. A line from  $(-1, 0)$  intersects the parabola  $x^2 = 4y$  at A and B. Then the locus of centroid of  $\triangle OAB$  is (where O is origin) (a)  $3x^2 - 2x = 4y$  (b)  $3y^2 - 2y = 4x$  (c)  $3x^2 + 2x = 4y$  (d) none of these

A.  $3x^2 - 2x = 4y$

B.  $3y^2 - 2y = 4x$

C.  $3x^2 + 2x = 4y$

D. none of these

**Answer: C**



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15. All the three vertices of an equilateral triangle lie on the parabola  $y = x^2$ , and one of its sides has a slope of 2. Then the sum of the x-coordinates of the three vertices is

A.  $\frac{5}{9}$

B.  $\frac{9}{13}$

C.  $\frac{6}{11}$

D. None of these

**Answer: C**



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16. Find the equations of the chords of the parabola  $y^2 = 4ax$  which pass through the point  $(-6a, 0)$  and which

subtends an angle of  $45^\circ$  at the vertex. (a)

$$y = \pm \frac{2}{7}(x + 6a) \quad (\text{b}) \quad y = \pm \frac{3}{8}(x + 6a) \quad (\text{c})$$

$$y = \pm \frac{7}{2}(x + 6a)$$

$$(\text{d}) \quad y = \pm \frac{5}{6}(x + 6a)$$

$$\text{A. } y = \pm \frac{2}{7}(x + 6a)$$

$$\text{B. } y = \pm \frac{3}{8}(x + 6a)$$

$$\text{C. } y = \pm \frac{7}{2}(x + 6a)$$

$$\text{D. } y = \pm \frac{5}{6}(x + 6a)$$

**Answer: A**



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**17.** Two equal circles of largest radii have following property:

(i) They intersect each other orthogonally,



(ii) They touch both the curves  $4(y + 2) = x^2$  and  $4(2 - y) = x^2$  in the region  $x \in [-2\sqrt{2}, 2\sqrt{2}]$ . Then radius of this circle is

A.  $\sqrt{2}$

B.  $\sqrt{3}$

C.  $\frac{1}{\sqrt{3}}$

D.  $\frac{3}{2}$

**Answer: A**



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**18.** The point at which the tangent to the curve  $y = x^2 - 4x$  is parallel to x-axis is

A.  $(0, 4)$

B.  $(-2, 4)$

C.  $(2, 4)$

D.  $(2, -4)$

**Answer: A**



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**19.** A line  $ax + by + c = 0$  through the point  $A(-2, 0)$  intersects the curve  $y^2 = 4a$  in P and Q such that  $\frac{1}{AP} + \frac{1}{AQ} = \frac{1}{4}$  (P,Q are in 1st quadrant). The value of  $\sqrt{a^2 + b^2 + c^2}$  is

A. 2

B. 4

C. 6

D. 8

**Answer: B**



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20. Suppose a parabola  $y = x^2 - ax - 1$  intersects the coordinate axes at three points A, B and C, respectively. The circumcircle of  $\triangle ABC$  intersects the y-axis again at the point  $D(0, t)$ . Then the value of t is

A.  $1/2$

B. 1

C.  $3/2$

D. 2

**Answer: B**



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21. The line  $x - b + \lambda y = 0$  cuts the parabola  $y^2 = 4ax$  ( $a > 0$ ) at  $P(t_1)$  and  $Q(t_2)$ . If  $b \in [2a, 4a]$  then range of  $t_1 t_2$  where  $\lambda \in R$  is

A.  $[-4, -2]$

B.  $[2, 4]$

C.  $[4, 16]$

D.  $[-16, -4]$

**Answer: A**



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22. If the parabola  $y = (a - b)x^2 + (b - c)x + (c - a)$  touches x-axis then the line  $ax + by + c = 0$

- A. A. always passes through a fixed point
- B. B. represents the family of parallel lines
- C. C. is always perpendicular to x-axis
- D. D. always has negative slope

**Answer: A**



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23. A normal to parabola, whose inclination is  $30^\circ$ , cuts it again at an angle of (a)  $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$  (b)  $\tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$  (c)  $\tan^{-1}(2\sqrt{3})$  (d)  $\tan^{-1}\left(\frac{1}{2\sqrt{3}}\right)$

A.  $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$

B.  $\tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$

C.  $\tan^{-1}(2\sqrt{3})$

D.  $\tan^{-1}\left(\frac{1}{2\sqrt{3}}\right)$

**Answer: D**



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24. If  $(-2, 5)$  and  $(3, 7)$  are the points of intersection of the tangent and normal at a point on a parabola with the axis of the parabola, then the focal distance of that point is

A.  $\frac{\sqrt{29}}{2}$

B.  $\frac{5}{2}$

C.  $\sqrt{29}$

D.  $\frac{2}{5}$

**Answer: A**



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25. The angle of intersection between the curves  $x^2 = 4(y + 1)$  and  $x^2 = -4(y + 1)$  is

A.  $\frac{\pi}{6}$

B.  $\frac{\pi}{4}$

C. 0

D.  $\frac{\pi}{2}$

**Answer: C**



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**26.** The parabolas  $y^2 = 4ax$  and  $x^2 = 4by$  intersect orthogonally at point  $P(x_1, y_1)$  where  $x_1, y_1 \neq 0$  provided

(A)  $b = a^2$  (B)  $b = a^3$  (C)  $b^3 = a^2$

(D) none of these

A.  $b = a^2$



B.  $b = a^3$

C.  $b^3 = a^2$

D. None of these

**Answer: D**



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27. Sum of slopes of common tangent to  $y = \frac{x^2}{4} - 3x + 10$  and  $y = 2 - \frac{x^2}{4}$  is (a) -6 (b) -3 (c)  $\frac{1}{2}$  (d) none of these

A. -6

B. -3

C.  $\frac{1}{2}$

D. none of these

**Answer: B**



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28. The slope of normal to the parabola  $y = \frac{x^2}{4} - 2$  drawn through the point  $(10, -1)$  is (a)  $-2$  (b)  $-\sqrt{3}$  (c)  $-\frac{1}{2}$  (d)  $-\frac{5}{3}$

A.  $-2$

B.  $-\sqrt{3}$

C.  $-\frac{1}{2}$

D.  $-\frac{5}{3}$

**Answer: C**



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29. The tangent and normal at the point  $P(4, 4)$  to the parabola,  $y^2 = 4x$  intersect the x-axis at the points Q and R, respectively. Then the circumcentre of the  $\Delta PQR$  is (a)  $(2, 0)$   
(b)  $(2, 1)$  (c)  $(1, 0)$  (d)  $(1, 2)$

A.  $(2, 0)$

B.  $(2, 1)$

C.  $(1, 0)$

D.  $(1, 2)$

**Answer: C**



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30. The point on the parabola  $y^2 = 8x$  at which the normal is inclined at  $60^\circ$  to the x-axis has the co-ordinates as (a)  $(6, -4\sqrt{3})$  (b)  $(6, 4\sqrt{3})$  (c)  $(-6, -4\sqrt{3})$  (d)  $(-6, 4\sqrt{3})$

A.  $(6, -4\sqrt{3})$

B.  $(6, 4\sqrt{3})$

C.  $(-6, -4\sqrt{3})$

D.  $(-6, 4\sqrt{3})$

**Answer: A**



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31. If two distinct chords of a parabola  $y^2 = 4ax$ , passing through  $(a, 2a)$  are bisected by the line  $x + y = 1$ , then

length of latus rectum can be a) 2 b) 7 c) 4 d) 5

A. 9

B. 3

C. 4

D. 5

**Answer: B**



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**32.** From an external point  $P$ , a pair of tangents is drawn to the parabola  $y^2 = 4x$ . If  $\theta_1$  and  $\theta_2$  are the inclinations of these tangents with the x-axis such that  $\theta_1 + \theta_2 = \frac{\pi}{4}$ , then find the locus of  $P$ .

A.  $x - y + 1 = 0$

B.  $x + y - 1 = 0$

C.  $x - y - 1 = 0$

D.  $x + y + 1 = 0$

**Answer: C**



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**33.** A variable parabola  $y^2 = 4ax$ ,  $a$  (where  $a \neq -\frac{1}{4}$ ) being the parameter, meets the curve  $y^2 + x - y - 2 = 0$  at two points. The locus of the point of intersection of tangents at these points is

A.  $x - 2y - 4 = 0$

B.  $x - 4y + 2 = 0$

C.  $x - 4y - 1 = 0$

D.  $2x - y + 1 = 0$

**Answer: B**



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**34.** If  $X$  is the foot of the directrix on the a parabola.  $PP'$  is a double ordinate of the curve and  $PX$  meets the curve again in  $Q$ . Then prove that  $PQ$  passes through the focus of the parabola.

A. line

B. circle

C. parabola

D. none of these

**Answer: A**



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**35.** The length of the latus rectum of the parabola

$$x^2 - 4x - 8y + 12 = 0 \text{ is}$$

A. 4

B. 6

C. 8

D. 10

**Answer: B**





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36. Through the vertex  $O$  of the parabola  $y^2 = 4ax$ , a perpendicular is drawn to any tangent meeting it at  $P$  and the parabola at  $Q$ . Then  $OP$ ,  $2a$  and  $OQ$  are in

A. (a) A.P.

B. (b) G.P.

C. (c) H.P.

D. (d) none of these

**Answer: B**



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37. Tangents PQ and PR are drawn to the parabola  $y^2 = 20(x + 5)$  and  $y^2 = 60(x + 15)$ , respectively such that  $\angle RPQ = \frac{\pi}{2}$ . Then the locus of point P is (a)  $x + 10 = 0$  (b)  $x + 30 = 0$  (c)  $x + 40 = 0$  (d)  $x + 20 = 0$

A.  $x + 10 = 0$

B.  $x + 30 = 0$

C.  $x + 40 = 0$

D.  $x + 20 = 0$

**Answer: D**



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38. The locus of centroid of triangle formed by a tangent to the parabola  $y^2 = 36x$  with coordinate axes is (a)  $y^2 = -9x$  (b)  $y^2 + 3x = 0$  (c)  $y^2 = 3x$  (d)  $y^2 = 9x$

A.  $y^2 = -9x$

B.  $y^2 + 3x = 0$

C.  $y^2 = 3x$

D.  $y^2 = 9x$

**Answer: B**



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39.  $PC$  is the normal at P to the parabola  $y^2 = 4ax$ ,  $C$  being on the axis.  $CP$  is produced outwards to Q so that

$PQ = CP$ ; show that the locus of  $Q$  is a parabola.

- A.  $(a, 0)$
- B.  $(-a, 0)$
- C.  $(-2a, 0)$
- D.  $(2a, 0)$

**Answer: D**



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**40.** If three parabols touch all the lines  $x = 0, y = 0$  and  $x + y = 2$ , then maximum area of the triangle formed by joining their foci is

- A.  $\sqrt{3}$

B. B.  $\sqrt{6}$

C. C.  $\frac{3\sqrt{3}}{4}$

D. D.  $\frac{3\sqrt{3}}{2}$

**Answer: D**



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**41.** If  $2x + 3y = \alpha$ ,  $x - y = \beta$  and  $kx + 15y = r$  are 3 concurrent normal of parabola  $y^2 = \lambda x$  then value of k is (a) 3 (b) 4 (c) 5 (d) 7

A. 3

B. 4

C. 5

D. 7

**Answer: C**



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**42.** Let  $(2, 3)$  be the focus of a parabola and  $x + y = 0$  and  $x - y = 0$  be its two tangents. Then equation of its directrix will be (a)  $2x - 3y = 0$  (b)  $3x + 4y = 0$  (c)  $x + y = 5$  (d)

$$12x - 5y + 1 = 0$$

A.  $2x - 3y = 0$

B.  $3x + 4y = 0$

C.  $x + y = 5$

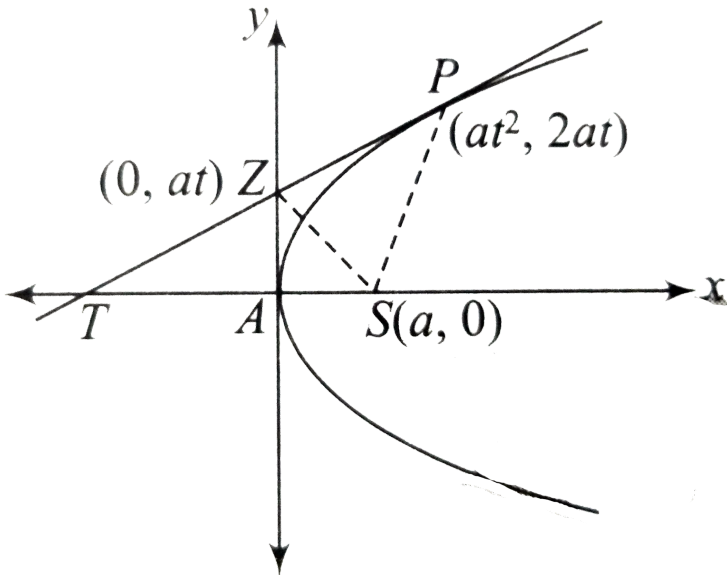
D.  $12x - 5y + 1 = 0$

Answer: A



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43. In the following figure,  $AS = 4$  and  $SP = 9$ . The value of  $SZ$  is



A. 6

B. 5.5

C. 6.5

D. none of these

**Answer: A**



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**44.** TP and TQ are any two tangents to a parabola and the tangent at a third point R cuts them in  $P$  and  $Q$ , prove that

$$\frac{TP'}{TP} + \frac{TQ'}{TQ} = 1.$$

A. 1

B. 2

C. 3

D. none of these



**Answer: A**



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**45.** The distance of two points P and Q on the parabola  $y^2 = 4ax$  from the focus S are 3 and 12 respectively. The distance of the point of intersection of the tangents at P and Q from the focus S is

A. 8

B. 6

C. 9

D. 12

**Answer: B**



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46. A parabola having directrix  $x + y + 2 = 0$  touches a line  $2x + y - 5 = 0$  at  $(2,1)$ . Then the semi-latus rectum of the parabola, is

A. 8

B.  $\frac{9}{\sqrt{2}}$

C.  $\frac{10}{\sqrt{2}}$

D.  $\frac{11}{\sqrt{2}}$

**Answer: B**

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1. A family of curve  $S$  is given by

$$S \equiv x^2 + 2xy + y^2 - 4x(1 - \lambda) - 4y(1 + \lambda) + 4, \quad \text{then}$$

$S = 0$  represents (a) pair of straight line  $\forall \lambda \in \mathbb{R}$  (b)

straight line for exactly one value of  $\lambda$  (c) parabola

$\forall \lambda \in \mathbb{R} - \{0\}$  (d) ellipse for three values of  $\lambda$

A. pair of straight line  $\forall \lambda \in \mathbb{R}$

B. straight line for exactly one value of  $\lambda$

C. parabola  $\forall \lambda \in \mathbb{R} - \{0\}$

D. ellipse for three values of  $\lambda$

**Answer: B::C**



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2. The curves  $x^2 + y^2 + 6x - 24y + 72 = 0$  and  $x^2 - y^2 + 6x + 16y - 46 = 0$  intersect in four points P,Q,R and S lying on a parabola. Let A be the focus of the parabola, then

A.  $AP + AQ + AR + AS = 20$

B.  $AP + AQ + AR + AS = 40$

C. vertex of the parabola is at  $(-3, 1)$

D. coordinates of A are  $(-3, 1)$

**Answer: B::C**

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3. If the parabols  $y^2 = 4kx (k > 0)$  and  $y^2 = 4(x - 1)$  do not have a common normal other than the axis of parabola,

then  $k \in$

(a)  $(0, 1)$  (b)  $(2, \infty)$  (c)  $(3, \infty)$  (d)  $(0, \infty)$

A.  $(0, 1)$

B.  $(2, \infty)$

C.  $(3, \infty)$

D.  $(0, \infty)$

**Answer: A::B::C**



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4. Find the length of normal chord which subtends an angle of  $90^\circ$  at the vertex of parabola  $y^2 = 4x$ .

A.  $PQ = 2a\sqrt{6}$

B.  $PR = 6a\sqrt{3}$

C. area of  $\Delta PQR = 18\sqrt{2}a^2$

D.  $PQ = 3a\sqrt{2}$

**Answer: A::B::C**

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5. Let  $y^2 - 5y + 3x + k = 0$  be a parabola, then

(a) its latus rectum is least when  $k = 1$

(b) its latus crectum is independent of k

(c) the line  $y = 2x + 1$  will touch the parabola if  $k = \frac{73}{16}$

(d)  $y = \frac{5}{2}$  is the only normal to the parabola whose slope is

zero

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**Answer: B::C::D**



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6. Let  $A, B$  and  $C$  be three distinct points on  $y^2 = 8x$  such that normals at these points are concurrent at  $P$ . The slope of  $AB$  is 2 and abscissa of centroid of  $\triangle ABC$  is  $\frac{4}{3}$ . Which of the following is (are) correct? (a) Area of  $\triangle ABC$  is 8 sq. units (b) Coordinates of  $P \equiv (6, 0)$  (c) Angle between normals are  $45^\circ, 45^\circ, 90^\circ$  (d) Angle between normals are  $30^\circ, 30^\circ, 60^\circ$

A. Area of  $\triangle ABC$  is 8 sq. units

B. Coordinates of  $P \equiv (6, 0)$

C. Angle between normals are  $45^\circ, 45^\circ, 90^\circ$

D. Angle between normals are  $30^\circ, 30^\circ, 60^\circ$

**Answer: A::B::C**



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7. If PQ and Rs are normal chords of the parabola  $y^2 = 8x$  and the points P,Q,R,S are concyclic, then

A. tangents at P and R meet on X-axis

B. tangents at P and R meet on Y-axis

C. PR is parallel to Y-axis



D. PR is parallel to X-axis

**Answer: A::C**



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8. find the angle of intersection of the curve  $xy=6$  and  $x^2y = 12$



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9. Find the equation of the tangent to the parabola  $y^2 = 4ax$  at the point  $(at^2, 2at)$  .



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10. If a parabola touches the lines  $y = x$  and  $y = -x$  at  $P(3, 3)$  and  $Q(2, -2)$  respectively, then (a) focus is  $(\frac{30}{13}, -\frac{6}{13})$  (b) equation of directrix is  $x + 5y = 0$  (c) equation of line through origin and focus is  $x + 5y = 0$  (d) equation of line through origin and parallel to axis is  $x - 5y = 0$

A. focus is  $(\frac{30}{13}, \frac{-6}{13})$

B. equation of directrix is  $x + 5y = 0$

C. equation of line through origin and focus is

$$x + 5y = 0$$

D. equation of line through origin and parallel to axis is

$$x - 5y = 0$$

**Answer: A::B::C::D**



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## Comprehension Type

1. If  $\cos^{-1} \cdot \frac{x}{2} + \cos^{-1} \cdot \frac{y}{3} = \frac{\pi}{6}$ , then prove that

$$\frac{x^2}{4} - \frac{xy}{2\sqrt{3}} + \frac{y^2}{9} = \frac{1}{4}$$

A.  $\frac{x^2}{4} + \frac{y^2}{3} = 1$

B.  $\frac{x^2}{4} + \frac{y^2}{5} = 1$

C.  $\frac{x^2}{3} + \frac{y^2}{4} = 1$

D.  $\frac{x^2}{5} + \frac{y^2}{4} = 1$

**Answer: A**



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2. A parabola is drawn through two given points  $A(1, 0)$  and  $B(-1, 0)$  such that its directrix always touches the circle  $x^2 + y^2 = 4$ . Then, the maximum possible length of semi latus rectum is

A.  $2 + \sqrt{3}$

B.  $3 + \sqrt{3}$

C.  $4 + \sqrt{3}$

D.  $1 + \sqrt{3}$

**Answer: A**



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Matching Column Type

1.  $AB$  is a chord of  $y^2 = 4x$  such that normals at  $A$  and  $B$  intersect at  $C(9, 6)$  and the tangent at  $A$  and  $B$  at point  $T$ , find  $(CT)^2 / 13$



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