Straight lines JEE Main PYQ -1

Total Time: 20 Minute **Total Marks:** 40

Instructions

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1. Test will auto submit when the Time is up.
2. The Test comprises of multiple choice questions (MCQ) with one or more correct answers.
3. The clock in the top right corner will display the remaining time available for you to complete the examination.

Navigating & Answering a Question

1. The answer will be saved automatically upon clicking on an option amongst the given choices of answer.
2. To deselect your chosen answer, click on the clear response button.
3. The marking scheme will be displayed for each question on the top right corner of the test window.

Straight lines

1. A straight line through a fixed point $(2, 3)$ intersects the coordinate axes at distinct points P and Q. If O is the origin and the rectangle $OPRQ$ is completed, then the locus of R is: (+4)

a. 3x + 2y = 6

b. 2x + 3y = xy

c. 3x + 2y = xy

d. 3x + 2y = 6xy

---

2. The x-coordinate of the incentre of the triangle that has the coordinates of mid-points of its sides as $(0, 1), (1, 1)$ and $(1, 0)$ is (+4)

a. $2 + \sqrt{2}$

b. $2 - \sqrt{2}$

c. $1 + \sqrt{2}$

d. $1 - \sqrt{2}$

---

3. If a line intercepted between the coordinate axes is trisected at a point $A(4, 3)$, which is nearer to x-axis, then its equation is : (+4)

a. $4x?3y = 7$

b. $3x + 2y = 18$

c. $3x + 8y = 36$

d. $x + 3y = 13$

---

4. If a variable line drawn through the intersection of the lines $\frac{x}{3} + \frac{y}{4} = 1$ and $\frac{x}{4} + \frac{y}{3} = 1$, meets the coordinate axes at A and B, $(A \neq B)$, then the locus of the midpoint of AB is : (+4)

a. $6xy = 7(x+y)$

b. $4(x+y)^2 - 28(x+y) + 49 = 0$

c. $7xy = 6(x+y)$

d. $14(x+y)^2 - 97(x+y) + 168 = 0$

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5. If in a parallelogram $ABDC$, the coordinates of A, B and C are respectively $(1,2), (3,4)$ and $(2,5)$, then the equation of the diagonal AD is : **(+4)**

a. 5x + 3y - 11 = 0

b. 3x - 5y + 7 = 0

c. 3x + 5y - 13 = 0

d. 5x - 3y + 1 = 0

---

6. If the extremities of the base of an isosceles triangle are the points $(2a, 0)$ and $(0, a)$ and the equation of one of the sides is $x = 2a$, then the area of the triangle, in square units, is : **(+4)**

a. $\frac{5}{4}a^2$

b. $\frac{5}{2}a^2$

c. $\frac{25a^2}{4}$

d. $5a^2$

---

7. If the image of point $P(2,3)$ in a line L is $Q(4,5)$, then the image of point $R(0,0)$ in the same line is: **(+4)**

a. $(2,2)$

b. $(4,5)$

c. $(3,4)$

d. $(7, 7)$

---

8. If the three lines $x - 3y = p$, $ax + 2y = q$ and $ax + y = r$ form a right-angled triangle then : **(+4)**

a. $a^2 - 9a + 18 = 0$

b. $a^2 - 6a - 12 = 0$

c. $a^2 - 6a - 18 = 0$

d. $a^2 - 9a + 12 = 0$

---

9. Let the area enclosed by the x-axis, and the tangent and normal drawn to the curve $4x^3 - 3xy^2 + 6x^2 - 5xy - 8y^2 + 9x + 14 = 0$ at the point $(-2, 3)$ be A. Then $8A$ is equal to ______ **(+4)**

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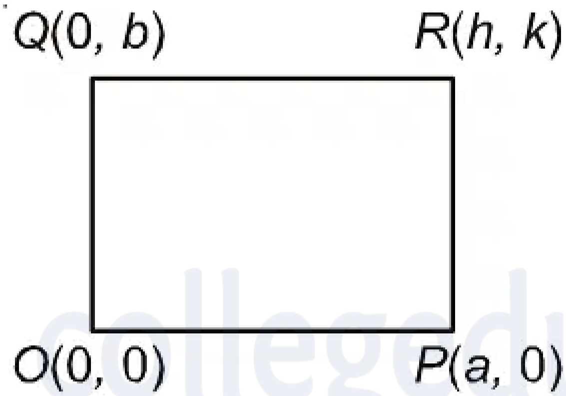
10. If the normal at point P ($^2_1$,2 $_1$) and ($^2_2$,2 $_2$) on the parabola ^{2} = 4 meet on the parabola, the $_1$ $_2$ equals **(+4)**

Answers

1. **Answer: c**

Explanation:

Let the equation of line be $\frac{x}{a}+\frac{y}{b}=1$
(i) passes through the fixed point $(2,3)$
$\Rightarrow \frac{2}{a}+\frac{3}{b}=1$
$P(a,0), Q(0,b), O(0,0)$, Let $R(h,k)$



Midpoint of OR is $\left(\frac{h}{2},\frac{k}{2}\right)$
Midpoint of PQ is $\left(\frac{a}{2},\frac{b}{2}\right)$
$\Rightarrow h=a, \quad k=b \quad \ldots$ (iii)
From (ii) & (iii),
$\frac{2}{h}+\frac{3}{k}=1 \quad \Rightarrow$ locus of $R(h,k)$
$\frac{2}{x}+\frac{3}{y}=1 \quad \Rightarrow 3x+2y=xy$

Concepts:

1. Straight lines:

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A straight line can be represented as an equation in various forms, as show in the image below:

Standard Form : $ax + by = c$

Slope-Intercept Form : $y = mx + c$

Point-Slope Form : $y - y_1 = m(x - x_1)$

The following are the many forms of the equation of the line that are presented in straight line-

1. Slope – Point Form

Assume P0(x0, y0) is a fixed point on a non-vertical line L with m as its slope. If P (x, y) is an arbitrary point on L, then the point (x, y) lies on the line with slope m through the fixed point (x0, y0) if and only if its coordinates fulfil the equation below.

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2. Two – Point Form

Let's look at the line. L crosses between two places. $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ are general points on L, while P (x, y) is a general point on L. As a result, the three points P_1, P_2, and P are collinear, and it becomes

The slope of P_2P = The slope of P_1P_2, i.e.

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Assume that a line L with slope m intersects the y-axis at a distance c from the origin, and that the distance c is referred to as the line L's y-intercept. As a result, the coordinates of the spot on the y-axis where the line intersects are (0, c). As a result, the slope of the line L is m, and it passes through a fixed point (0, c). The equation of the line L thus obtained from the slope – point form is given by

y – c =m(x - 0)

As a result, the point (x, y) on the line with slope m and y-intercept c lies on the line, if and only if

y = m x +c

---

2. **Answer: b**

Explanation:

Given m id-points of a triangle are (0, 1), (1, 1) and (1, 0). P lotting these points on a graph paper and make a triangle.
So, the sides of a triangle will be 2, 2 and $\sqrt{2^2+2^2} i.e. 2\sqrt{2}$
x-coordinate of incentre$= \frac{2\times0+2\sqrt{2}.0+2.2}{2+2+\sqrt{2}}$
$= \frac{2}{2+\sqrt{2}} \times \frac{2-\sqrt{2}}{2-\sqrt{2}} = 2-\sqrt{2}$

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---

3. **Answer: b**

Explanation:

$\Rightarrow 4 = \left(\frac{1\times0+2\times a}{1+2}\right) = \frac{2a}{3}$

$\Rightarrow a = 6 \Rightarrow$ coordinate of B is $B\,(6, 0)$

$3 = \left(\frac{1\times a+2\times0}{1+2}\right) = \frac{b}{3}$

$\Rightarrow b = 9$ and $C\,(0, 9)$

Slope of line passing through $(6, 0)\,, (0, 9)$

slope, $m = \frac{9}{-6} = -\frac{3}{2}$

Equation of line $y - 0 = \frac{-3}{2}\,(x - 6)$

$2y = -3x + 18$

$3x + 2y = 18$

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---

4. **Answer: c**

Explanation:

$L_1 : 4x + 3y - 12 = 0$

$L_2 : 3x + 4y - 12 = 0$

$L_1 + \lambda L_2 = 0$

$(4x + 3y - 12) + \lambda (3x + 4y - 12) = 0$

$x (4 + 3\lambda - 12) + y (3 + 4\lambda) - 12 (1 + \lambda) = 0$

Point $A \left(\frac{12(1+\lambda)}{4+3\lambda}, 0\right)$

Point $B \left(0, \frac{12(1+\lambda)}{3+4\lambda}\right)$

mid point $\Rightarrow h = \frac{6(1+\lambda)}{4+3\lambda} \ldots\ldots (i)$

$k = \frac{6(1+\lambda)}{3+4\lambda} \ldots\ldots (ii)$

Eliminate ? from (i) and (ii) then

$6 (h + k) => hk$

$6 (x + y) => xy$

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$y - c = m(x - 0)$

As a result, the point (x, y) on the line with slope m and y-intercept c lies on the line, if and only if

$y = mx + c$

---

5. **Answer: d**

Explanation:

co-ordinates of point D are $(4, 7)$
$\Rightarrow$ line AD is $5x - 3y + 1 = 0$

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---

6. **Answer: b**

Explanation:

Let y-coordinate of $C = b$

$AB = \sqrt{4a^2 + a^2} = \sqrt{5}a$

Now, $AC = BC \Rightarrow b = a^2\sqrt{4a^2 + (b-a)^2}$

$b^2 = 4a^2 + b^2 + a^2 - 2ab$

$\Rightarrow 2ab = 5a^2 \Rightarrow b = \frac{5a}{2}$

$\therefore C = \left(2a, \frac{5a}{2}\right)$

Hence area of the triangle

$= \frac{1}{2}\begin{vmatrix} 2a & 0 & 1 \\ 0 & a & 1 \\ 2a & \frac{5a}{2} & 1 \end{vmatrix} = \frac{1}{2}\begin{vmatrix} 2a & 0 & 1 \\ 0 & a & 1 \\ 0 & \frac{5a}{2} & 0 \end{vmatrix}$

$= \frac{1}{2} \times 2a\left(-\frac{5a}{2}\right) = -\frac{5a^2}{2}$

Since area is always +ve, hence area

$= \frac{5a^2}{2}$ sunit

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y – c =m(x - 0)

As a result, the point (x, y) on the line with slope m and y-intercept c lies on the line, if and only if

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7. Answer: d

Explanation:

Mid-point of $P(2,3)$ and $Q(4,5) = (3,4)$
Slope of $PQ = 1$
Slope of the line $L = -1$
Mid-point $(3,4)$ lies on the line L. Equation of line L,
$y - 4 = -1\,(x - 3) \Rightarrow x + y - 7 = 0$ ...(i)
Let image of point $R(0,0)$ be $S\ (x_1, y_1)$
Mid-point of $RS = \left(\frac{x_1}{2} \frac{y_1}{2}\right)$
Mid-point $\left(\frac{x_1}{2}, \frac{y_1}{2}\right)$ lies on the line (i)
$\therefore x_1 + y_1 = 14$

Slope of RS = $\frac{y_1}{x_1}$
Since RS $\perp$ line L
$\therefore \frac{y_1}{x_1} \times (-1) = -1$
$\therefore x_1 = y_1$
From (ii) and (iii),
$x_1 = y_1 = 7$
Hence the image of $R = (7, 7)$

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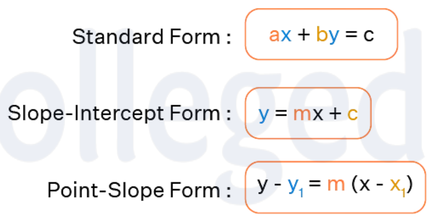

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$y = mx + c$

---

8. Answer: a

Explanation:

Since three lines $x - 3y = p$,
$ax + 2y = q$ and $ax + y = r$

form a right angled triangle

$\therefore$ product of slopes of any two lines $= -1$

Suppose $ax + 2y = q$ and $x - 3y = pare \perp$ to each other.

$\therefore \quad \frac{-a}{2} \times \frac{1}{3} = -1 \Rightarrow a = 6$

Now, consider option one by one

$a = 6$ satisfies only option

$\therefore$ Required answer is $a^2 - 9a + 18 = 0$

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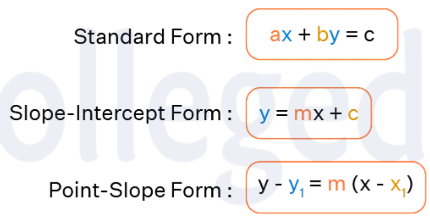

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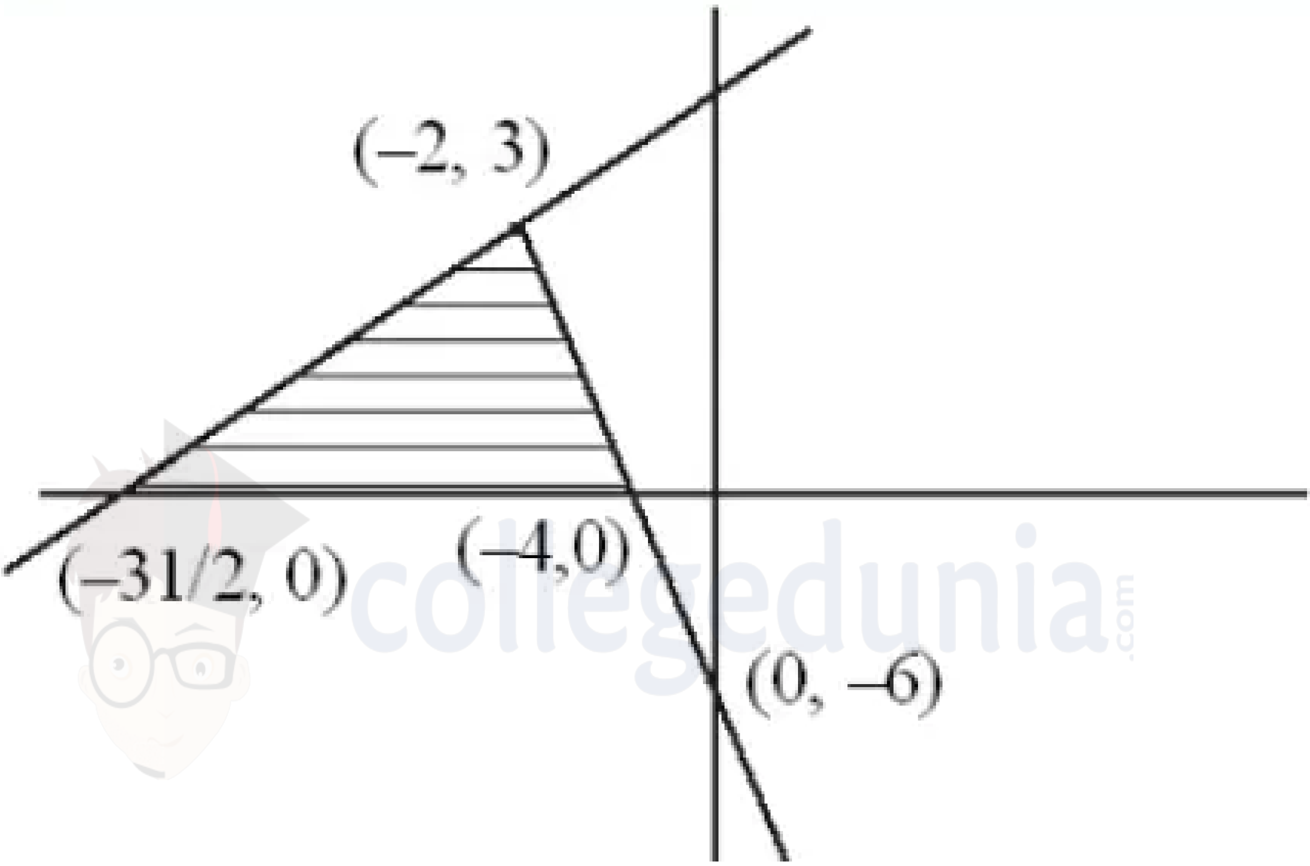
9. **Answer: 170 - 170**

Explanation:

The correct answer is 170

$4x^3 - 3xy^2 + 6x^2 - 5xy - 8y^2 + 9x + 14 = 0$ at $P(-2, 3)$

$12x^2 - 3\left(y^2 + 2yxy'\right) + 12x - 5\left(xy' + y\right) - 16yy' + 9 = 0$
$48 - 3\left(9 - 12y'\right) - 24 - 5\left(-2y' + 3\right) - 48y' + 9 = 0$
$y' = -9/2$
Tangent $y - 3 = -\frac{9}{2}(x+2) \Rightarrow 9x + 2y = -12$
Normal : $y - 3 = \frac{2}{9}(x+2) \Rightarrow 9y - 2x = 31$



Area $= \frac{1}{2}\left(\frac{31}{2} - 4\right) \times 3 = \frac{85}{4}$
$8A = 170$

Concepts:

1. Straight lines:

A **straight line** is a line having the shortest distance between two points.

A straight line can be represented as an equation in various forms, as show in the image below:

Standard Form : $ax + by = c$

Slope-Intercept Form : $y = mx + c$

Point-Slope Form : $y - y_1 = m(x - x_1)$

The following are the many forms of the equation of the line that are presented in straight line-

1. Slope – Point Form

Assume P0(x0, y0) is a fixed point on a non-vertical line L with m as its slope. If P (x, y) is an arbitrary point on L, then the point (x, y) lies on the line with slope m through the fixed point (x0, y0) if and only if its coordinates fulfil the equation below.

$$y - y_0 = m(x - x_0)$$

2. Two – Point Form

Let's look at the line. L crosses between two places. $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ are general points on L, while P (x, y) is a general point on L. As a result, the three points P_1, P_2, and P are collinear, and it becomes

The slope of P_2P = The slope of P_1P_2, i.e.

$$\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1}$$

Hence, the equation becomes:

$$y - y_1 = \frac{y_2-y_1}{x_2-x_1}(x - x1)$$

3. Slope-Intercept Form

Assume that a line L with slope m intersects the y-axis at a distance c from the origin, and that the distance c is referred to as the line L's y-intercept. As a result, the coordinates of the spot on the y-axis where the line intersects are (0, c). As a result, the slope of the line L is m, and it passes through a fixed point (0, c). The equation of the line L thus obtained from the slope – point form is given by

$y - c = m(x - 0)$

As a result, the point (x, y) on the line with slope m and y-intercept c lies on the line, if and only if

$y = mx + c$

10. **Answer: 2 - 2**

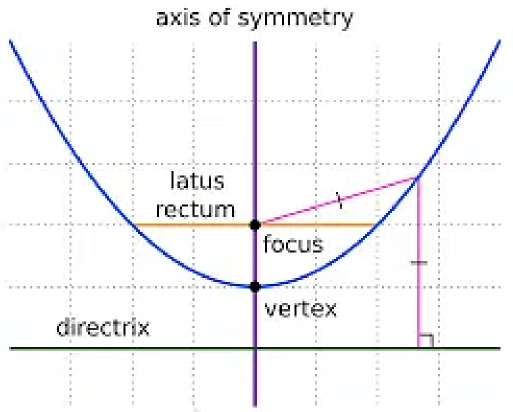
Explanation:

Explanation:
Given: Normals at and at the points $({}^{2}_{1}, 2 \ {}_{1})$ and $({}^{2}_{2}, 2 \ {}_{2})$ respectively meet the parabola $^{2} = 4$
We have to find the value of $_{1} \ _{2}$.
Let normal at meets on the parabola
$^{2} = 4$ at $(^{2}, 2 \ )$. .
then, by the property of normal to the parabola we have,
$= - \ _{1} - \frac{2}{_{1}}$ ....(i)
Similarly, normal at Q meets on the parabola
$^{2} = 4$ at $(^{2}, 2 \ )$
So, $= - \ _{2} - \frac{2}{_{2}}$....(ii)
Using (i) and (ii), we get
$_{1} - \frac{2}{_{1}} = - \ _{2} - \frac{2}{_{2}} (\ _{2} - \ _{1}) = 2(\frac{1}{_{1}} - \frac{1}{_{2}})$
⇒t1t2=2[∵t1≠t2]
Hence, the correct answer is 2.00.

Concepts:

1. Parabola:

Parabola is defined as the locus of points equidistant from a fixed point (called focus) and a fixed-line (called directrix).



Parabola

Standard Equation of a Parabola

For horizontal parabola

- Let us consider
- Origin (0,0) as the parabola's vertex A,

1. Two equidistant points S(a,0) as focus, and Z(- a,0) as a directrix point,
2. P(x,y) as the moving point.

- Let us now draw SZ perpendicular from S to the directrix. Then, SZ will be the axis of the parabola.
- The centre point of SZ i.e. A will now lie on the locus of P, i.e. AS = AZ.
- The x-axis will be along the line AS, and the y-axis will be along the perpendicular to AS at A, as in the figure.
- By definition PM = PS

=> $MP^2 = PS^2$

- So, $(a + x)^2 = (x - a)^2 + y^2$.
- Hence, we can get the equation of horizontal parabola as $\mathbf{y^2 = 4ax}$.

For vertical parabola

- Let us consider
- Origin (0,0) as the parabola's vertex A

1. Two equidistant points, S(0,b) as focus and Z(0, -b) as a directrix point
2. P(x,y) as any moving point

- Let us now draw a perpendicular SZ from S to the directrix.
- Then SZ will be the axis of the parabola. Now, the midpoint of SZ i.e. A, will lie on P's locus i.e. AS=AZ.
- The y-axis will be along the line AS, and the x-axis will be perpendicular to AS at A, as shown in the figure.
- By definition PM = PS

=> $MP^2 = PS^2$

So, $(b + y)^2 = (y - b)^2 + x^2$

- As a result, the vertical parabola equation is $\mathbf{x^2 = 4by}$.