Straight lines JEE Main PYQ -2

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. If the x-intercept of some line L is double as that of the line, $3x + 4y = 12$ and the y-intercept of L, is half as that of the same line, then the slope of L is: **(+4)**

   a. -3

   b. $-3/8$

   c. $-3/2$

   d. $-3/16$

---

2. Let $A(-3, 2)$ and $B(-2, 1)$ be the vertices of a triangle ABC. If the centroid of this triangle lies on the line $3x + 4y + 2 = 0$, then the vertex C lies on the line : **(+4)**

   a. $4x + 3y + 5 = 0$

   b. $3x + 4y + 3 = 0$

   c. $4x + 3y + 3 = 0$

   d. $3x + 4y + 5 = 0$

---

3. Let the orthocenter an centroid of a triangle be $A(-3, 5)$ and $B(3, 3)$ respectively. If C is the circumcentre of this triangle, then the radius of the circle having line segment AC as diameter, is: **(+4)**

   a. $\sqrt{10}$

   b. $2\sqrt{10}$

   c. $3\sqrt{\frac{5}{2}}$

   d. $\frac{3\sqrt{5}}{2}$

---

4. Two vertices of a triangle are $(0, 2)$ and $(4, 3)$. If its orthocentre is at the origin, then its third vertex lies in which quadrant ? **(+4)**

a. Fourth

b. Second

c. Third

d. First

---

5. Slope of a line passing through P(2, 3) and intersecting the line, x + y = 7 at a distance of 4 units from P, is (+4)

a. $\frac{\sqrt{5}-1}{\sqrt{5}+1}$

b. $\frac{1-\sqrt{5}}{1+\sqrt{5}}$

c. $\frac{1-\sqrt{7}}{1+\sqrt{7}}$

d. $\frac{\sqrt{7}-1}{\sqrt{7}+1}$

---

6. Two sides of a rhombus are along the lines, $x-y+1=0$ and $7x-y-5=0$. If its diagonals intersect at $(-1,-2)$, then which one of the following is a vertex of this rhombus? (+4)

a. (-3 , -9)

b. (-3 , -8)

c. $(\frac{1}{3},-\frac{8}{3})$

d. $(-\frac{10}{3},-\frac{7}{3})$

---

7. The line passing through the points (5, 1, a) and (3, b, 1) crosses the yz- plane at the point 0, $\frac{17}{2}$, $\frac{-13}{2}$. Then; (+4)

a. (A) a = 2, b = 8

b. (B) a = 4, b = 6

c. (C) a = 6, b = 4

d. (D) a = 8, b = 6

---

8. For $\alpha, \beta \in R$, suppose the system of linear equations $x - y + z = 5$ $2x + 2y + \alpha z = 8$ $3x - y + 4z = \beta$ has infinitely many solutions Then α and β are the roots of **(+4)**

a. $x^2 - 18x + 56 = 0$

b. $x^2 + 14x + 24 = 0$

c. $x^2 - 10x + 16 = 0$

d. $x^2 + 18x + 56 = 0$

---

9. If the x-intercept of a focal chord of the parabola $y^2 = 8x + 4y + 4$ is 3 , then the length of this chord is equal to ___ **(+4)**

---

10. Let S be the set of all $a \in N$ such that the area of the triangle formed by the tangent at the point $P(b, c), b, c \in N$, on the parabola $y^2 = 2$ ax and the lines $x = b, y = 0$ is 16 unit ^{2}, then $\sum_{a \in S} a$ is equal to _____ **(+4)**

Answers

1. Answer: d

Explanation:

Given line $3x + 4y = 12$ can be rewritten as
$\frac{3x}{12} + \frac{4y}{12} = 1 \Rightarrow \frac{x}{4} + \frac{y}{3} = 1$
$\Rightarrow$ x-intercept=4 and y-intercept= 3 Let the required line be
$L : \frac{x}{a} + \frac{y}{b} = 1$ where
$a = x-$intercept and $b = y-$ intercept
According to the question
$a = 4 \times 2 = 8$ and $b = 3/2$
$\therefore$ Required line is $\frac{x}{8} + \frac{2y}{3} = 1$
$\Rightarrow 3x + 16y = 24$
$\Rightarrow y = \frac{-3}{16}x + \frac{24}{16}$
Hence, required slope $= \frac{-3}{16}$.

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

$$y = mx + c$$

2. Answer: b

Explanation:

$Let\, C = (x_1, y_1)$

Centroid, E= $\left(\frac{x_1-5}{3}, \frac{y_1+3}{3}\right)$

Since centroid lies on the line

3x + 4y + 2 = 0

$\therefore\ 3\left(\frac{x_1-5}{3}\right) + 4\left(\frac{y_1+3}{3}\right) + 2 = 0$

$\Rightarrow 3x_1 + 4y_1 + 3 = 0$

Hence vertex (x_1, y_1) lies on the line

$3x + 4y + 3 = 0$

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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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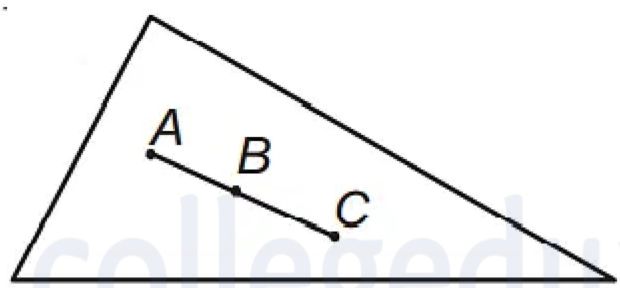
3. **Answer: c**

Explanation:

$A(-3,5)$
$B(3,3)$



So, $AB = 2\sqrt{10}$
Now, as, $AC = \frac{3}{2}AB$
So, radius $= \frac{3}{4}AB = \frac{3}{2}\sqrt{10} = 3\sqrt{\frac{5}{2}}$

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---

4. **Answer: b**

Explanation:

$$m_{BD} \times m_{AD} = -1$$
$$\Rightarrow \left(\frac{3-2}{4-0}\right) \times \left(\frac{b-0}{a-0}\right) = -1$$

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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

$y = m x + c$

5. **Answer: c**

Explanation:

$x = 2 + rcos\theta \ y = 3 + rsin\theta \Rightarrow 2 + rcos\theta + 3 + rsin\theta = 7 \Rightarrow r(cos\theta + sin\theta) = 2 \Rightarrow \ sin\theta + cos\theta = \frac{2}{r} = \frac{2}{\pm 4} = \pm\frac{1}{2} \Rightarrow \ 1 + sin2\theta = \frac{1}{4} \Rightarrow \ sin2\theta = -\frac{3}{4} \Rightarrow \frac{2m}{1+m^2} = -\frac{3}{4} \Rightarrow 3m^2 + 8m + 3 = 0$
$\Rightarrow \ m = \frac{-4\pm\sqrt{7}}{1-7} \ \frac{1-\sqrt{7}}{1+\sqrt{7}} = \frac{(1-\sqrt{7})^2}{1-7} = \frac{8-2\sqrt{7}}{-6} = \frac{-4+\sqrt{7}}{3}$

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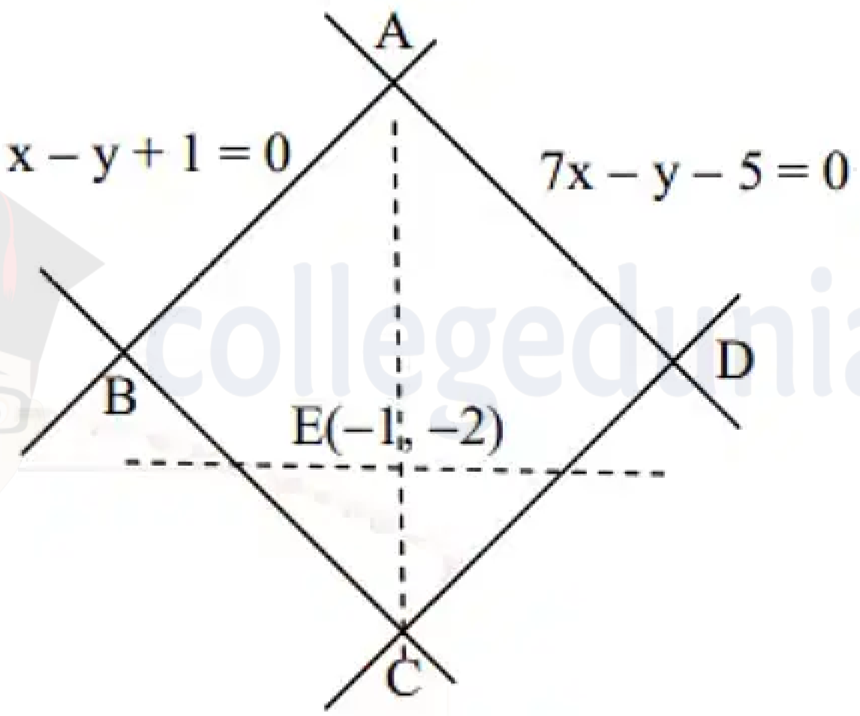
6. **Answer: c**

Explanation:



Coordinates of $A \equiv (1, 2)$

$\therefore$ Slope of $AE = 2$

$\Rightarrow$ Slope of $BD = -\frac{1}{2} \Rightarrow$

E of BD is $\frac{y+2}{x+1} = -\frac{1}{2}$

$\Rightarrow x + 2y + 5 = 0$

$\therefore$ Co-ordinates of $D = \left(\frac{1}{3}, \frac{-8}{3}\right)$

So, the correct option is (C): $\left(\frac{1}{3}, -\frac{8}{3}\right)$

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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

$y = mx + c$

---

7. **Answer: c**

Explanation:

Explanation:
Given:The line passing through the points (5, 1, a) and (3, b, 1) crosses the yz- plane at the point 0, $\frac{17}{2}$, $\frac{-13}{2}$We have to find values of a, b.We know, Equation of Line in Symmetrical Form passing through points (x1, y1, z1) and (x, y, z) is given by
$\frac{-_2}{_1-_2} = \frac{-_2}{_1-_2} = \frac{-_2}{_1-_2}$ ...(i)Thus, the equation of line passing through (5, 1,) and (3, , 1) is$\frac{-3}{5-3} = \frac{-}{1-} = \frac{-1}{-1}$since the line passes through the point (0, $\frac{17}{2}$, $\frac{-13}{2}$). It satisfies equation (i), $\frac{0-3}{2} = \frac{\frac{17}{2}-}{1-} = \frac{\frac{-13}{2}-1}{-1}$ $\frac{-3}{2} = \frac{17-2}{2-2} = \frac{-15}{2-2}$...(ii)For $\frac{-3}{2} = \frac{17-2}{2-2}$ [using (ii)]
$-6+6 = 34-4$ $10 = 40$ $b = \frac{40}{10} = 4$For $\frac{-3}{2} = \frac{-15}{2-2}$ [using (ii)] $-30 = -6 + 6$
$6 = 36$ $= \frac{36}{6} = 6$ $= 6,$ $= 4$Hence, the correct option is (C).

---

8. **Answer: a**

Explanation:

$$\begin{vmatrix} 1 & -1 & 1 \\ 2 & 2 & \alpha \\ 3 & -1 & 4 \end{vmatrix}$$

$= 0; 8 + \alpha - 2(-4 + 1) + 3(-\alpha - 2) = 0$

$\Rightarrow 8 + \alpha + 6 - 3\alpha - 6 = 0$

$\alpha = 4$

So, the correct Option is (A): $x^2 - 18x + 56 = 0$

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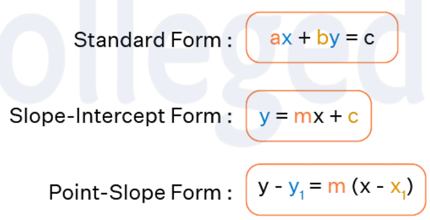

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$y - y_0 = m (x - x_0)$

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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

$$y = mx + c$$

---

9. Answer: 16 - 16

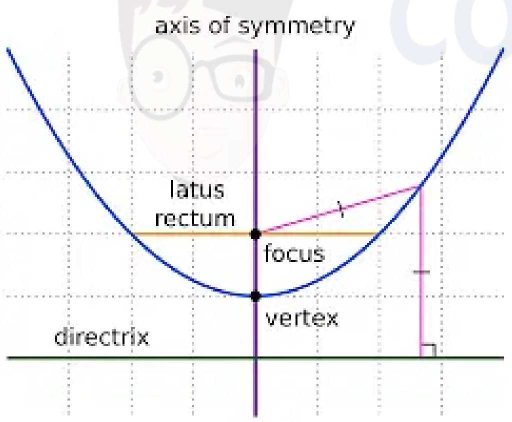
Explanation:

The correct answer is 16.
$y^2 = 8x + 4y + 4$
$(y-2)^2 = 8(x+1)$
$y^2 = 4ax$
$a = 2, X = x+1, Y = y-2$
focus $(1,2)$
$y - 2 = m(x-1)$
Put $(3,0)$ in the above line $m = -1$
Length of focal chord $= 16$

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 **$y^2 = 4ax$**.

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

=> $MP^2 = PS^2$

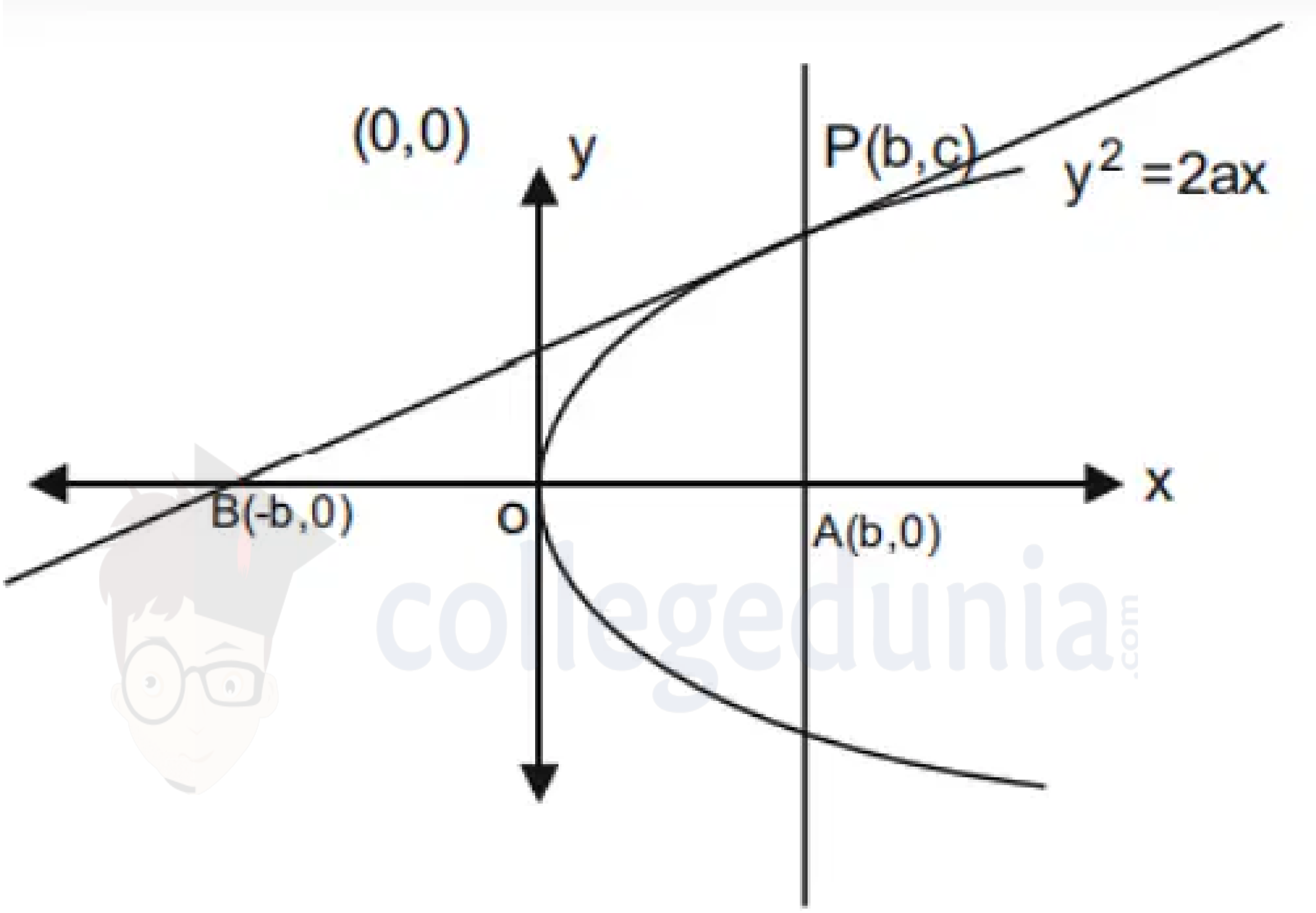
So, $(b + y)^2 = (y - b)^2 + x^2$

- As a result, the vertical parabola equation is **$x^2 = 4by$**.

10. **Answer: 146 - 146**

Explanation:

The correct answer is 146.



As $P(b,c)$ lies on parabola so $c^2 = 2ab$....(1)
Now equation of tangent to parabola $y^2 = 2ax$ in point
form is $yy_1 = 2a\frac{(x+x_1)}{2}, (x_1, y_1) = (b, c)$
$\Rightarrow yc = a(x+b)$
For point B, put $y = 0$, now $x = -b$
So, area of $\triangle PBA$, $\frac{1}{2} \times AB \times AP = 16$
$\Rightarrow \frac{1}{2} \times 2b \times c = 16$
$\Rightarrow bc = 16$
As b and c are natural number so possible values of (b, c) are $(1,16), (2,8), (4,4), (8,2)$ and $(16,1)$
Now from equation (1) $a = \frac{c^2}{2b}$ and $a \in N$, so values of (b, c) are $(1,16), (2,8)$ and $(4,4)$
now values of are $128, 16$ and 2 .
Hence sum of values of a is 146 .

Concepts:

1. Conjugate of a Complex Number:

A complex conjugate of a complex number is equivalent to the complex number whose real part is identical to the original complex number and the magnitude of the imaginary part is identical to the opposite sign.

A complex number is of the expression **a + ib**,

where,

a, b = real numbers, 'a' is named as the real part, 'b' is named as the imaginary part, and 'i' is an imaginary number equivalent to the root of negative 1.

The complex conjugate of a + ib with real part 'a' and imaginary part 'b' is stated by a - ib whose real part is 'a' and imaginary part is '-b'.

a - ib is the reflection of a + ib with reference to the real axis (X-axis) in the argand plane.