1. Which of the following lines is parallel to $y=-\frac{3}{2}x+12$?

   A. $2y=-6x+24$ B. $6x+4y=18$ C. $2x-3y=-12$ D. $4x+6y=9$ E. NOTA

2. Find the distance from the point (1, 1, 1) to the plane that contains the points (6, 1, 2), (2, 4, 2), and (6, –2, 1).

   A. $\frac{3}{13}$ B. $\frac{10}{13}$ C. $\frac{3}{5}$ D. $\frac{4}{5}$ E. NOTA

3. Which of the following polar coordinates does not represent the polar point $(3, 40°)$?

   A. $(-3, -140°)$ B. $(3, 400°)$ C. $(-3, 220°)$ D. $(3, -320°)$ E. NOTA

4. There are two values of *r* for which the distance from $(5, 80°)$ to $(r, 20°)$ is $\sqrt{21}$. Find the positive difference between these two values of *r*.

   A. 1 B. 2 C. 3 D. 4 E. NOTA

5. Identify the type of triangle whose vertices are located at (1, 10), (–3, –2), and (3, 16).

   A. isosceles B. right C. scalene D. equilateral E. NOTA

6. Find the range of $y=\frac{x^4+x^3-9x^2-3x+18}{x^3+3x^2-4x-12}$.

   A. $[-2, \infty)$ B. $(-\infty, -6]\cup[-2, \infty)$ C. $[-6, -2]$ D. $(-\infty, -4]\cup[-2, \infty)$ E. NOTA

7. The graph of $y=\frac{x^4+x^3-9x^2-3x+18}{x^3+3x^2-4x-12}$ has slant (oblique) asymptote $y=ax+b$ and vertical asymptote $x=c$. Find the value of $ac+b$.

   A. 0 B. –1 C. –3.5 D. –4 E. NOTA

8. Find the equation of the line that bisects the acute angle formed by $x-2y+3=0$ and $x+2y-7=0$.

   A. $x=2$ B. $y=2.5$ C. $2x-2y+1=0$ D. $3x+2y-1=0$ E. NOTA

9. Find the Cartesian form of the polar equation $\cos 2\theta - 2\sin 2\theta = 0$.

   A. $x^2+4xy-y^2=0$ B. $x^2-4xy-y^2=0$ C. $x^2+8xy-y^2=0$ D. $x^2-4xy-y^2=0$ E. NOTA

10. Which conic section is the intersection between a plane and a double napped cone where the plane is perpendicular to a circular cross section of the cone?

A. a parabola B. an ellipse C. a hyperbola D. circle E. NOTA

11. Find the coordinates of point *P* that lies between points $A\left(-1,\frac{5}{2}\right)$ and $B(3,4)$ given *AB*:*PB* = 4.

A. $\left(-\frac{1}{5},\frac{14}{5}\right)$ B. $\left(\frac{1}{2},\frac{13}{8}\right)$ C. $\left(0,\frac{23}{8}\right)$ D. $\left(2,\frac{29}{8}\right)$ E. NOTA

12. Find the area of the ellipse $7x^2-6\sqrt{3}xy+13y^2-16=0.$

A. $\frac{\pi}{18}$ B. $\frac{\pi}{6}$ C. $\frac{13\pi}{7}$ D. 2π E. NOTA

13. Find the length of the major axis of $7x^2-6\sqrt{3}xy+13y^2-16=0.$

A. 2 B. 4 C. $2\sqrt{3}$ D. $4\sqrt{3}$ E. NOTA

14. The graph of $25x^2+16y^2+150x-128y-1119=0$ generates a conic with directrix of $y=d$, where $d>0.$ Find the value of *d*.

A. 16 B. $\frac{38}{3}$ C. $\frac{62}{3}$ D. 18 E. NOTA

15. The product of two odd functions is:

A. odd B. even C. neither D. not enough information E. NOTA

16. Find the area of parallelogram *ABCD* with $\overrightarrow{AB}=\begin{pmatrix}4\\-3\\0\end{pmatrix}$ and $\overrightarrow{BC}=\begin{pmatrix}0\\3\\1\end{pmatrix}$.

A. 6.5 B. 13 C. 59.5 D. 119 E. NOTA

17. A hyperbola has its center at (5, 2), a vertex at (5, 5), and an asymptote with equation $y=2x-8.$ Find the distance from the center to one of the foci.

A. $\frac{9}{4}\sqrt{17}$ B. $\frac{3}{2}\sqrt{5}$ C. $\frac{3}{2}\sqrt{3}$ D. $3\sqrt{5}$ E. NOTA

18. Which of the following equations do not represent the line that passes through (2, –1, 3) and (1, 4, –3)?

A. $\frac{x-1}{2}=\frac{y-4}{-1}=\frac{z+3}{3}$ B. $\frac{x-2}{1}=\frac{y+1}{-5}=\frac{z-3}{6}$

C. $\frac{x-1}{6}=\frac{y-4}{-30}=\frac{z+3}{36}$ D. $\frac{x-1.5}{-8}=\frac{y-1.5}{40}=\frac{z}{-48}$ E. NOTA

19. Find k, in terms of p and m, if the line $y = mx + k$ is tangent to the parabola $y^2 = 4px$.

A. $\frac{m}{p}$ B. $\frac{3p}{m}$ C. $\frac{2m}{p}$ D. $\frac{p}{m}$ E. NOTA

20. How many of the following polar equations generate an 8-petal rose?

$r = 8\cos\theta$ $r = 8\sin 4\theta$ $r = 8\cos 4\theta$ $r = 8\sin 8\theta + 8$

A. 1 B. 2 C. 3 D. 4 E. NOTA

21. Find the value of $|k|$ in the equation $2x + 3y + k = 0$ so that this line will form a triangle with the coordinate axes whose area is 27 square units.

A. 15 B. 16 C. 18 D. 20 E. NOTA

22. Find the length of the projection of the segment joining (4, –1, 3) and (5, –1, 4) onto the plane $x + y + z = 7$.

A. $\frac{2\sqrt{3}}{3}$ B. $\frac{\sqrt{6}}{3}$ C. $\frac{2\sqrt{6}}{3}$ D. $\frac{4\sqrt{3}}{3}$ E. NOTA

23. Find the rectangular equation for the curve represented by the parametric equations $x = 3t^2$ and $y = 2t + 1$.

A. $2x^2 + 3y^2 - 1 = 0$ B. $2x - 3y + 3 = 0$ C. $3y^2 - 4x + 1 = 0$ D. $3y^2 - 4x - 6y - 3 = 0$ E. NOTA

24. Find $\text{comp}_{\mathbf{b}}\mathbf{a}$, the scalar component of $\mathbf{a}$ along $\mathbf{b}$, if $\mathbf{a} = \langle 4, -2 \rangle$ and $\mathbf{b} = \langle 2, -3 \rangle$.

A. $\frac{7\sqrt{5}}{5}$ B. $\frac{7\sqrt{65}}{65}$ C. $\frac{14\sqrt{13}}{13}$ D. $\frac{14\sqrt{65}}{65}$ E. NOTA

25. Find the equation of the perpendicular bisector of the line segment joining (1, 3) and (–5, 5).

A. $3x - y = 0$ B. $3x - y + 10 = 0$ C. $x - 3y - 10 = 0$ D. $3x + y + 10 = 0$ E. NOTA

26. Let $\vec{a}$ and $\vec{b}$ be unit vectors such that $\vec{a} \cdot \vec{b} = 0$. For some $x, y \in \mathbb{R}$, let $\vec{c} = x\vec{a} + y\vec{b} + (\vec{a} \times \vec{b})$. If $|\vec{c}| = 2$ and $\vec{c}$ is inclined at the same angle θ to both $\vec{a}$ and $\vec{b}$, what is the value of $8\cos^2\theta$?

A. 3 B. 4 C. 6 D. 8 E. NOTA

27. Which of the following is a vector of length 5 in the opposite direction of the vector $\langle -2, 6, -3 \rangle$?

A. $\left\langle \frac{14}{5}, -\frac{42}{5}, \frac{21}{5} \right\rangle$ B. $\langle 10, -30, 15 \rangle$ C. $\left\langle \frac{10}{7}, -\frac{30}{7}, \frac{15}{7} \right\rangle$ D. $\left\langle \frac{10}{49}, -\frac{30}{49}, \frac{15}{49} \right\rangle$ E. NOTA

28. Let the orthocenter and centroid of a triangle be $A(-3, 5)$ and $B(3, 3)$, respectively. If C is the circumcenter of the triangle, then the radius of the circle having $\overline{AC}$ as diameter is:

A. $\frac{3}{2}\sqrt{5}$ B. $\frac{3}{2}\sqrt{10}$ C. $\sqrt{10}$ D. $2\sqrt{10}$ E. NOTA

29. Find the distance between the vertices of $r = \frac{15}{4+\cos\theta}$.

A. 2 B. $\frac{15}{4}$ C. $\frac{15}{2}$ D. 8 E. NOTA

30. Tangents are drawn to the hyperbola $4x^2 - y^2 = 36$ at points A and B. If these tangents intersect at $C(0, 3)$, find the area in square units of $\triangle ABC$.

A. $36\sqrt{5}$ B. $45\sqrt{5}$ C. $54\sqrt{3}$ D. $60\sqrt{3}$ E. NOTA