

1. The rectangular equation of the curve

$$x = \cos \theta, \quad y = 2 \sin 2\theta, \quad 0 \leq \theta \leq \frac{\pi}{2}$$

is:

(a) $y = 4x\sqrt{1-x^2}$ _____(correct)

(b) $y = 2x\sqrt{1-x^2}$

(c) $y = -2x\sqrt{1-x^2}$

(d) $y = 2x\sqrt{1-x}$

(e) $y = -2x\sqrt{1-x}$

2. The area of the **surface** generated by revolving the curve

$$x = 5 \cos \theta, \quad y = 5 \sin \theta, \quad 0 \leq \theta \leq \frac{\pi}{2}$$

about the y -axis is:

(a) 50π _____(correct)

(b) 5π

(c) 25π

(d) 10π

(e) 100π

3. Which of the following polar equations does **NOT** represent a circle?

(a) $r = \sec \theta$ _____(correct)

(b) $r = 2$

(c) $r = -1$

(d) $r = \cos \theta$

(e) $r = \sin \theta$

4. Find the area of the region common to the two regions bounded by

$$r = 2 \cos \theta \quad \text{and} \quad r = 2 \sin \theta.$$

(a) $\frac{\pi}{2} - 1$ _____(correct)

(b) $\frac{\pi}{2} + 1$

(c) $\pi - 2$

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

(e) π

5. Which of the following statements is/are FALSE?

- (I) If $\mathbf{u} = a\mathbf{i} + b\mathbf{j}$ is a unit vector, then $a^2 + b^2 = 1$.
- (II) If $a + b = 0$, then $a\mathbf{i} + b\mathbf{j} = \mathbf{0}$.
- (III) If $a = b$, then $\|a\mathbf{i} + b\mathbf{j}\| = \sqrt{2}a$.

- (a) (II) and (III) only _____(correct)
- (b) (II) only
- (c) (III) only
- (d) (I) and (II) only
- (e) (I) only

6. The point that lies two-thirds of the way from $P(4, 3, 0)$ to $Q(1, -3, 3)$ is:

- (a) $(2, -1, 2)$ _____(correct)
- (b) $(3, -1, 2)$
- (c) $(2, 0, 2)$
- (d) $(2, -1, 1)$
- (e) $(3, 1, 2)$

7. If $\mathbf{u} \cdot \mathbf{v} = \mathbf{u} \cdot \mathbf{w}$ and $\mathbf{u} \neq \mathbf{0}$, which of the following must be TRUE?

- (a) $\mathbf{v} - \mathbf{w}$ is perpendicular to $\mathbf{u}$ _____(correct)
- (b) $\mathbf{v} = \mathbf{w}$
- (c) $\mathbf{v}$ is perpendicular to $\mathbf{w}$
- (d) $\|\mathbf{v}\| = \|\mathbf{w}\|$
- (e) $\mathbf{v} + \mathbf{w}$ is perpendicular to $\mathbf{u}$

8. The volume of the **parallelepiped** that has

$$\mathbf{u} = 3\mathbf{i} - 5\mathbf{j} + \mathbf{k}, \quad \mathbf{v} = 2\mathbf{j} - 2\mathbf{k}, \quad \mathbf{w} = 3\mathbf{i} + \mathbf{j} + \mathbf{k}$$

as adjacent edges is:

- (a) 36 _____(correct)
- (b) 18
- (c) 24
- (d) 30
- (e) 42

9. The number of **points of intersection** of the polar curves

$$r = 3 - 2 \sin \theta \quad \text{and} \quad r = 5 \cos 2\theta$$

is:

- (a) 7 _____(correct)
- (b) 4
- (c) 5
- (d) 6
- (e) 8

10. The equation of the **tangent line** to the curve

$$x = t^4 + 2, \quad y = t^3 + t$$

at the point $(3, -2)$ is:

- (a) $y = -x + 1$ _____(correct)
- (b) $y = x - 5$
- (c) $y = -x + 5$
- (d) $y = x + 1$
- (e) $y = -2x + 4$

11. Given that $-\infty < t < \infty$, the set of parametric equations that represents exactly the same graph as

$$x = t, \quad y = 2t + 1$$

is:

- (a) $x = -t^3, \quad y = -2t^3 + 1$ _____(correct)
(b) $x = e^t, \quad y = 2e^t + 1$
(c) $x = \cos t, \quad y = 2 \cos t + 1$
(d) $x = t^2, \quad y = 2t^2 + 1$
(e) $x = t + 1, \quad y = 2t + 1$

12. For the triangle with vertices

$$A(-3, 0, 0), \quad B(0, 0, 0), \quad C(1, 2, 3),$$

which of the following is correct?

- (a) It is an obtuse triangle. _____(correct)
(b) It is an acute triangle.
(c) It is a right triangle.
(d) It is an equilateral triangle.
(e) Its type cannot be determined.

13. The **length** of the parametric curve

$$x = \theta - \sin \theta, \quad y = 1 - \cos \theta, \quad 0 \leq \theta \leq 2\pi,$$

is:

- (a) 8 _____(correct)
- (b) 4
- (c) $8\sqrt{2}$
- (d) 4π
- (e) 8π

14. Consider the parametric curve

$$x(t) = t^5 - 4t^3 + 3t + 4, \quad y(t) = t^2 - 1.$$

At how many distinct points does the curve **cross itself**?

- (a) 2 _____(correct)
- (b) 0
- (c) 1
- (d) 3
- (e) 4

15. Which of the following is **NOT** equal to $\mathbf{u} \cdot (\mathbf{v} \times \mathbf{w})$?

(a) $\mathbf{u} \cdot (\mathbf{w} \times \mathbf{v})$ _____(correct)

(b) $\mathbf{v} \cdot (\mathbf{w} \times \mathbf{u})$

(c) $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{w}$

(d) $\mathbf{w} \cdot (\mathbf{u} \times \mathbf{v})$

(e) $(\mathbf{v} \times \mathbf{w}) \cdot \mathbf{u}$