King Fahd University of Petroleum and Minerals
Department of Mathematics

Math 201

Major Exam I

243

Wednesday, 2 July 2025

Net Time Allowed: 90 minutes

MASTER VERSION

1. [Q.34, p.747]
A rectangular equation of the parametric curve

$$x = 2\cot\theta \text{ and } y = 4\sin\theta\cos\theta, \quad 0 < \theta < \pi$$

is

(a) $y(4 + x^2) = 8x$ (correct)
(b) $y(4 + x^2) = 16x$
(c) $y(4 - x^2) = -8x$
(d) $4 + x^2 = y^2$
(e) $4 + y^2 = x^2$

2. [Q.44, p.707]
A set of parametric equations of the line passing through $(-3, 1)$ and $(1, 9)$ is

(a) $x = -3 + t,\ y = 1 + 2t$ (correct)
(b) $x = -3 + 2t,\ y = 1 + t$
(c) $x = 1 + 4t,\ y = 9 + t$
(d) $x = 1 - t,\ y = 9 + 2t$
(e) $x = -3t\,,\ y = t$

3. `[Q.13, p.715]`
The slope of the parametric curve

$$x = -4\cos\theta,\ \ y = 4\sin\theta$$

at $\theta = \dfrac{\pi}{4}$ is

(a) 1 (correct)
(b) -1
(c) 4
(d) -4
(e) $\dfrac{\sqrt{2}}{2}$

4. `[Q.31, p.715]`
The parametric curve $x = \cos\theta + \theta\sin\theta,\ \ y = \sin\theta - \theta\cos\theta$ has

(a) a horizontal tangent at $\theta = \pi$ (correct)
(b) a vertical tangent at $\theta = -\dfrac{\pi}{4}$
(c) a horizontal tangent at $\theta = \dfrac{\pi}{2}$
(d) a vertical tangent at $\theta = \dfrac{\pi}{4}$
(e) a horizontal tangent at $\theta = \dfrac{3\pi}{2}$

5. `[Q.51, p.715]`
The length of the parametric curve

$$x = e^{-t}\cos t,\ \ y = e^{-t}\sin t, \quad 0 \le t \le 1$$

is equal to

(a) $\sqrt{2}(1 - e^{-1})$ (correct)
(b) $2\sqrt{2}e^{-1}$
(c) $1 + e$
(d) $1 - e^{-1}$
(e) $1 + e^{-1}$

6. `[Q.38, p.726]`
The polar curve $r = 5\cos\theta$ is a circle with center $C(a, b)$ and radius c. Then $a + b + c =$

(a) 5 (correct)
(b) $\frac{5}{2}$
(c) 10
(d) $\frac{15}{2}$
(e) 20

7. `[Q.7, p.748]`

A rectangular equation of the polar curve $\theta = \dfrac{3\pi}{4}$ is

(a) $y = -x$ (correct)

(b) $y = x$

(c) $y = \dfrac{\sqrt{2}}{2}x$

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

(e) $y = -x + 1$

8. `[∼Example 5, p.734]`

The area of the surface formed by revolving the circle $r = 2\cos\theta$, $\theta \in [0, \pi]$ about the line $\theta = \dfrac{\pi}{2}$ is

(a) $4\pi^2$ (correct)

(b) π^2

(c) π

(d) 2π

(e) 4π

9. [Q.21, p.735]
The area of the inner loop of $r = 1 + 2\sin\theta$ is

(a) $\int_{\frac{7\pi}{6}}^{\frac{3\pi}{2}} (1 + 2\sin\theta)^2 \, d\theta$ (correct)

(b) $\int_{\frac{\pi}{6}}^{\frac{\pi}{2}} (1 + 2\sin\theta)^2 \, d\theta$

(c) $\frac{1}{2}\int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} (1 + 2\sin\theta)^2 \, d\theta$

(d) $\frac{1}{2}\int_{\frac{-\pi}{6}}^{\frac{\pi}{6}} (1 + 2\sin\theta)^2 \, d\theta$

(e) $\frac{1}{2}\int_{0}^{2\pi} (1 + 2\sin\theta)^2 \, d\theta$

10. [∼Q.71, p.760]
Which one of the following vectors is perpendicular to the tangent to the graph of $f(x) = \sqrt{25 - x^2}$ at the point $(4, 3)$?

(a) $\langle 4, 3 \rangle$ (correct)

(b) $\langle -4, 3 \rangle$

(c) $\langle 3, 4 \rangle$

(d) $\langle -3, 4 \rangle$

(e) $\langle 4, 4 \rangle$

11. `[Q.48, p.760]`
Let $\vec{u} = \langle a, b \rangle$ be the vector of magnitude 2 in the same direction as $\langle \sqrt{3}, 3 \rangle$. Then $a + b^2 =$

(a) 4 (correct)

(b) 3

(c) 2

(d) 1

(e) $\sqrt{3}$

12. `[∼Q.90, p.768]`
If $R(a, b, c)$ is the point that lies one-third of the way from $P(1, 2, 5)$ to $Q(6, 8, 2)$, then $3a + b + c =$

(a) 16 (correct)

(b) $\frac{8}{3}$

(c) 0

(d) $\frac{4}{3}$

(e) 8

13. `[∼Example 6, p.775]`
Let $\langle a, b, c\rangle$ be the vector projection of $\vec{u} = \langle 3, -5, 2\rangle$ onto $\vec{v} = \langle 7, 1, -2\rangle$. Then $a + b + c =$

(a) $\dfrac{4}{3}$ (correct)

(b) $\dfrac{7}{9}$

(c) $\dfrac{14}{9}$

(d) $\dfrac{1}{9}$

(e) $-\dfrac{5}{3}$

14. `[∼Example 5, p.784]`
Consider the following three vectors

$$\vec{u} = \langle b, -5, 1\rangle, \quad \vec{v} = \langle 0, 1, -1\rangle, \quad \vec{w} = \langle 3, 1, 1\rangle.$$

If $\vec{u} \cdot (\vec{v} \times \vec{w}) = 36$, then $b =$

(a) 12 (correct)

(b) 6

(c) 10

(d) 3

(e) 4

15. `[Q.17, p.785]`
A vector orthogonal to both $\vec{u} = \langle -3, 2, -5 \rangle$ and $\vec{v} = \langle 1, -1, 4 \rangle$ is

(a) $\langle 3, 7, 1 \rangle$ (correct)
(b) $\langle -3, -2, 1 \rangle$
(c) $\langle 3, 7, 3 \rangle$
(d) $\langle -1, 1, 1 \rangle$
(e) $\langle -4, 0, 1 \rangle$