

■ 1. Given $x(t) = t^3 - 3t^2 + 4$ and $y(t) = 6t^2 - 2t$, find $\frac{d^2y}{dx^2}$ when $t = 3$.

A $\frac{24}{9}$

B $-\frac{20}{9}$

C $-\frac{100}{243}$

D $-\frac{24}{9}$

■ 2. Write the equation of the tangent line at $t = \frac{\pi}{3}$ for the parametric equation $x(t) = -\cos t$ and $y(t) = \sin t$.

A $y - \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{3} \left(x + \frac{1}{2} \right)$

B $y - \frac{1}{2} = \sqrt{3} \left(x + \frac{\sqrt{3}}{2} \right)$

C $y + \frac{\sqrt{3}}{2} = \frac{\sqrt{3}}{3} \left(x - \frac{1}{2} \right)$

D $y + \frac{1}{2} = \sqrt{3} \left(x - \frac{\sqrt{3}}{2} \right)$

■ 3. Which of the following gives the length of the curve defined by the parametric equations $x(t) = \frac{2}{3}t^3$ and $y(t) = t^2$ from $t = 1$ to $t = 3$?

A $\int_1^3 \sqrt{1 + 2t} \, dt$

B $\int_1^3 \sqrt{1 + 4t^2} \, dt$

C $\int_1^3 \sqrt{2t^2 + 2t} \, dt$

D $\int_1^3 \sqrt{4t^4 + 4t^2} \, dt$

■ 4. Find the velocity vector given the position vector $\langle t \ln t, \ln t^2 \rangle$.

A $\left\langle 1, \frac{1}{t^2} \right\rangle$

B $\left\langle 1 + \ln t, \frac{2}{t} \right\rangle$

C $\left\langle 1, \frac{2}{t} \right\rangle$

D $\left\langle \ln t, \frac{1}{t^2} \right\rangle$

■ 5. The position of a particle moving in the xy -plane is given by the parametric curve $f(x) = \langle x(t), y(t) \rangle$, where $\frac{dx}{dt} = t^2 e^t$ and $\frac{dy}{dt} = \frac{5}{3} t^2$. If

$f(1) = \left\langle e - 2, \frac{5}{9} \right\rangle$, use a calculator to find $f(3)$.

A $\langle 180.770, 15 \rangle$

B $\langle 98.428, 15 \rangle$

C 99.061

D 181.391

■ 6. For time $t > 0$, the position of an object moving in the xy -plane is given by the parametric equation $x(t) = \cos 2t$ and $y(t) = -3t^2 + 7t$. Which of the following represents the speed of the object?

A $\int_0^1 \sqrt{(\cos 2t)^2 + (-3t^2 + 7t)^2} dt$

B $\sqrt{(\cos 2t)^2 + (-3t^2 + 7t)^2}$

C $\int_0^1 \sqrt{(-2 \sin 2t)^2 + (-6t + 7)^2} dt$

D $\sqrt{(-2 \sin 2t)^2 + (-6t + 7)^2}$

■ 7. What is the slope of the line tangent to the polar curve $r = \sin(2\theta)$ when $\theta = \frac{2\pi}{3}$?

A $-\frac{3\sqrt{3}}{5}$

B 1

C $\frac{3\sqrt{3}}{5}$

D -1

■ 8. Use a calculator to find any points on the interval $0 \leq \theta < \frac{\pi}{2}$ at which the slope of the tangent line to $r = 2 - 3 \sin \theta$ is horizontal.

I. $\theta = 0.340$

II. $\theta = 0.730$

III. $\theta = 1.571$

A I only

B II only

C I and III

D II and III

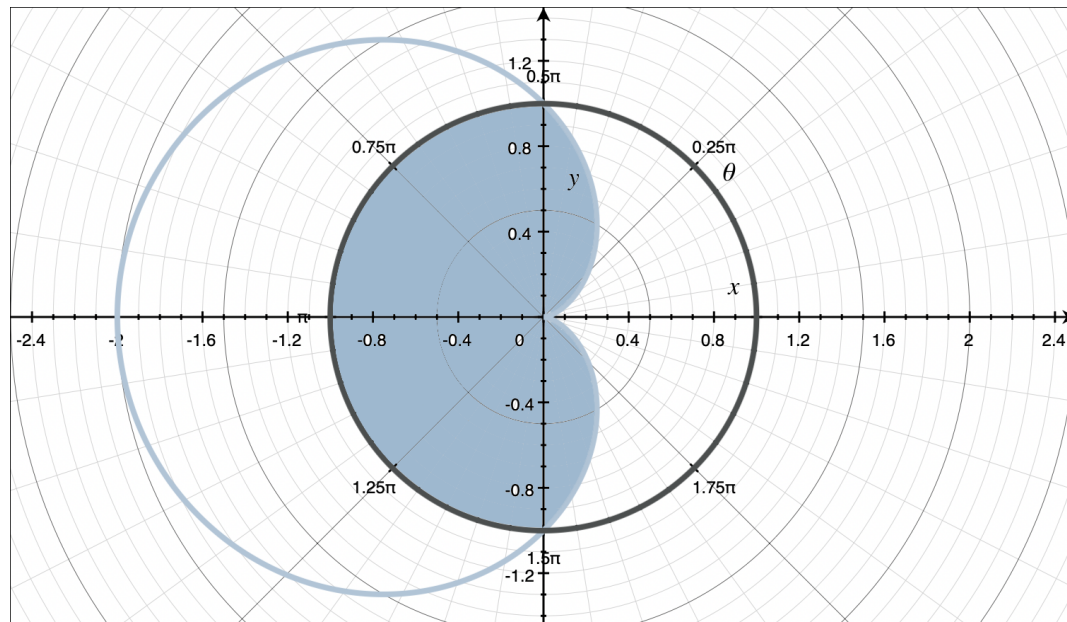
■ 9. Which integral represents the area of the inner loop of $r = 1 + 2 \cos \theta$.

A $\int_{\frac{2\pi}{3}}^{\frac{4\pi}{3}} (1 + 2 \cos \theta)^2 d\theta$

B $\int_0^{\pi} (1 + 2 \cos \theta)^2 d\theta$

C $\frac{1}{2} \int_{\frac{2\pi}{3}}^{\frac{4\pi}{3}} (1 + 2 \cos \theta)^2 d\theta$

D $\frac{1}{2} \int_0^{\pi} (1 + 2 \cos \theta)^2 d\theta$



■ 10. Find the area enclosed by $r = 1 - \cos \theta$ and $r = 1$ as shown in the graph above.

A $\frac{3\pi}{4} - 2$

B $\frac{5\pi}{4} - 2$

C $\frac{3\pi}{4} + 2$

D $\frac{5\pi}{4} + 2$

■ 11. A particle moves along the xy -plane, and the position of the particle at time t , measured in seconds, is represented by $(x(t), y(t))$, measured in centimeters. The particle starts at the position $(0,0)$ at $t = 0$, and $x'(t) = 2.5 \cos(3t)$ and $y'(t) = 4 \sin(1.5t)$.

- Find the speed of the particle at time $t = 4$ seconds. Indicate the units of measure.
- At time $t = 1.5$ seconds, use a calculator to determine whether the speed of the particle is increasing or decreasing. Explain your answer.
- Use a calculator to find the total distance the particle traveled from $t = 1$ to $t = 4$ seconds.

- d. Find the x -coordinate of the position of the particle at time $t = 2$ seconds.