

Credit is given only if you choose the correct answer *and* show supporting work.

1. Consider the parametrized curve

$$x = 2t^3 + 3t^2 - 12t$$

$$y = 2t^3 + 3t^2 + 1.$$

Which of the following statements is true?

- A.) The curve has a horizontal tangent at $(13, 2)$ and a vertical tangent at $(-7, 6)$
- B.) The curve has a horizontal tangent at $(13, 2)$ and a vertical tangent at $(0, 1)$
- C.) The curve has a horizontal tangent at $(20, -3)$ and a vertical tangent at $(-7, 6)$
- D.) The curve has a horizontal tangent at $(0, 1)$ and a vertical tangent at $(4, 29)$
- E.) The curve has a horizontal tangent at $(4, 29)$ and a vertical tangent at $(20, -3)$
- F.) The curve has a horizontal tangent at $(20, -3)$ and a vertical tangent at $(0, 1)$

2. Sketch the graph of the parametrized curve

$$x = 3t - t^3$$

$$y = 3t^2$$

for the values of t between -2 and $+2$. You will see that the curve intersects itself at $(x, y) = (0, 9)$. What is the arc length of the loop of the curve that lies between the two different values of t corresponding to $(x, y) = (0, 9)$?

- A.) 9 B.) $9\sqrt{3}$ C.) 12 D.) $12\sqrt{3}$ E.) 18 F.) $18\sqrt{3}$

3. Consider the parametrized curve

$$x = 2 \cos t - \cos 2t$$

$$y = 2 \sin t - \sin 2t,$$

for the parameter values $0 \leq t \leq \pi$. If this curve is rotated about the x -axis, what is the area of the resulting surface?

A.) $\frac{32}{3}\pi$ B.) $\frac{64}{3}\pi$ C.) $\frac{128}{3}\pi$ D.) $\frac{32}{5}\pi$ E.) $\frac{64}{5}\pi$ F.) $\frac{128}{5}\pi$

Hint 1: To simplify the integral, use the double angle formulas

$$\cos 2t = 1 - 2 \sin^2 t, \quad \sin 2t = 2 \sin t \cos t.$$

Hint 2: To solve the integral, use the u -substitution $u = 1 - \cos t$.