1. What is the value of the integral \( \int_C y\sin(z) \, ds \) where \( C \) is the circular helix given by the equations \( x = \cos t \), \( y = \sin t \) and \( z = t \) for \( 0 \leq t \leq 2\pi \)?

A. \(-2\sqrt{2\pi}\)
B. \(-2\pi\)
C. \(\sqrt{2\pi}\)
D. \(-\sqrt{2\pi}\)
E. \(2\sqrt{2\pi}\)
2. What is the value of the line integral \( \int_C \mathbf{F} \cdot d\mathbf{r} \), where \( \mathbf{F}(x, y) = \langle x^2, y^2 \rangle \) and \( C \) is the arc of the parabola \( y = 2x^2 \) from \((0, 0)\) to \((1, 2)\)?

A. 1  
B. -3  
C. 5  
D. -5  
E. 3
3. Let $R$ be the region in the first quadrant between the lines $y = 0$, $\sqrt{3}x - y = 0$, and inside the circle $x^2 + y^2 = 4$. Evaluate
\[ \iint_R xy \, dA. \]

A. $3/2$
B. $1/3$
C. $1/2$
D. $3/4$
E. $3/8$
4. Let $E$ be the solid region in the first octant that is bounded by the planes $x = 2$, $y = 0$, $y = x$, $z = 0$, and $z = x$. Evaluate

$$\iiint_E x \, dV.$$ 

A. $\frac{4}{3}$  
B. 2  
C. $\frac{3}{2}$  
D. 4  
E. $\frac{8}{3}$
5. A lamina $L$ occupies the triangular region in the $xy$-plane with vertices $(0, 0)$, $(0, 1)$ and $(1, 0)$. If the mass density at $(x, y)$ is $\rho(x, y) = 1 + x$, then the $x$-coordinate of the center of mass of $L$ is equal to:

A. $\frac{5}{9}$  
B. $\frac{1}{2}$  
C. $\frac{2}{3}$  
D. $\frac{3}{5}$  
E. $\frac{3}{8}$
6. Use the method of Lagrange multipliers to find the \textit{x components only} of the points where the absolute maximum and absolute minimum occur for

\[ f(x, y) = (x - 2)^2 + (y - 4)^2 \]

on the curve

\[ x^2 + y^2 = 5. \]

A. 2 and -2  
B. 0 and -1  
C. 1 and -1  
D. -2 and 1  
E. 1 and 0
7. Use the midpoint rule with \( m = n = 2 \) to approximate

\[
\int \int_{R} x^2 y \, dA
\]

where \( R \) is the region \( \{(x, y)|0 \leq x \leq 4, \quad 2 \leq y \leq 4\} \).

A. 108
B. 120
C. 136
D. 128
E. 114
8. Let $E$ be the solid region enclosed by the cylinder $x^2 + y^2 = 1$, and the planes $z = 0$ and $y + z = 2$. Which of the following triple integrals is equal to the volume of $E$?

A. \[ \int_0^{2\pi} \int_0^1 \int_0^{2-r\sin\theta} r\,dz\,dr\,d\theta \]

B. \[ \int_0^{2\pi} \int_0^1 \int_0^{r^2-\sin\theta} r\,dz\,dr\,d\theta \]

C. \[ \int_0^{2\pi} \int_0^1 \int_0^{2-r\sin\theta} r\,dz\,dr\,d\theta \]

D. \[ \int_0^{2\pi} \int_0^1 \int_0^{2-\sin\theta} r\,dz\,dr\,d\theta \]

E. \[ \int_0^{2\pi} \int_0^{\sin\theta} \int_0^2 r\,dz\,dr\,d\theta \]
9. Which of the following converts
\[ \int_{-2}^{2} \int_{\sqrt{4-x^2}}^{\sqrt{4-x^2}} \int_{\sqrt{x^2+y^2}}^{2} z \, dz \, dy \, dx \]
to spherical coordinates?

A. \[ \int_{0}^{2\pi} \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \int_{0}^{2/\cos \phi} \rho^3 \cos \phi \cdot \sin \phi \, d\rho \, d\phi \, d\theta \]

B. \[ \int_{0}^{2\pi} \int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \int_{0}^{2/\cos \phi} \rho^3 \cos \phi \cdot \sin \phi \, d\rho \, d\phi \, d\theta \]

C. \[ \int_{0}^{2\pi} \int_{0}^{\frac{\pi}{4}} \int_{0}^{2} 2\rho^2 \cos \phi \cdot \sin \phi \, d\rho \, d\phi \, d\theta \]

D. \[ \int_{0}^{2\pi} \int_{0}^{\frac{\pi}{4}} \int_{0}^{2/\cos \phi} 2\rho^2 \cos \phi \cdot \sin \phi \, d\rho \, d\phi \, d\theta \]

E. \[ \int_{0}^{2\pi} \int_{\frac{\pi}{4}}^{\pi} \int_{0}^{2/\cos \phi} 2\rho^2 \cos \phi \cdot \sin \phi \, d\rho \, d\phi \, d\theta \]
10. The point with rectangular coordinates \((-\sqrt{3}, 0, 1)\) has spherical coordinates \((\rho, \theta, \phi)\) equal to

A. \((2, \pi, \frac{\pi}{6})\)
B. \((2, \pi, \frac{\pi}{3})\)
C. \((1, \pi, \frac{\pi}{6})\)
D. \((1, \pi, \frac{\pi}{3})\)
E. \((3, 0, \frac{\pi}{3})\)