Classroom Voting Questions: Multivariable Calculus

16.5 Integrals in Cylindrical and Spherical Coordinates

1. What are the Cartesian coordinates of the point with cylindrical coordinates $(r, \theta, z) = (4, \pi, 6)$?

   (a) $(x, y, z) = (0, -4, 4)$
   (b) $(x, y, z) = (0, 4, 6)$
   (c) $(x, y, z) = (-4, 4, 4)$
   (d) $(x, y, z) = (4, 0, 4)$
   (e) $(x, y, z) = (-4, 0, 6)$

2. What are the cylindrical coordinates of the point with Cartesian coordinates $(x, y, z) = (3, 3, 7)$?

   (a) $(r, \theta, z) = (3, \pi, 7)$
   (b) $(r, \theta, z) = (3, \pi/4, 3)$
   (c) $(r, \theta, z) = (3\sqrt{2}, \pi/4, 7)$
   (d) $(r, \theta, z) = (3\sqrt{2}, \pi, 7)$
   (e) $(r, \theta, z) = (3\sqrt{2}, \pi, 3)$

3. What are the Cartesian coordinates of the point with spherical coordinates $(\rho, \phi, \theta) = (4, \pi, 0)$?

   (a) $(x, y, z) = (0, 0, -4)$
   (b) $(x, y, z) = (0, 0, 4)$
   (c) $(x, y, z) = (4, 0, 0)$
   (d) $(x, y, z) = (-4, 0, 0)$
   (e) $(x, y, z) = (0, 4, 0)$

4. What are the spherical coordinates of the point with Cartesian coordinates $(x, y, z) = (0, -3, 0)$?

(a) $(\rho, \phi, \theta) = (3, \pi, \frac{\pi}{2})$
(b) $(\rho, \phi, \theta) = (3, \pi, -\frac{\pi}{2})$
(c) $(\rho, \phi, \theta) = (3, \frac{\pi}{2}, \frac{\pi}{2})$
(d) $(\rho, \phi, \theta) = (3, \frac{\pi}{2}, -\frac{\pi}{2})$
(e) $(\rho, \phi, \theta) = (3, \frac{\pi}{2}, \pi)$

5. Which of the following regions represents the portion of a cylinder of height 4 and radius 3 above the 3rd quadrant of the xy plane?

(a) $1 \le r \le 3,\ 0 \le z \le 4,\ 0 \le \theta \le \pi/2$
(b) $0 \le r \le 3,\ 0 \le z \le 4,\ \pi \le \theta \le 3\pi/2$
(c) $0 \le r \le 4,\ 0 \le z \le 3,\ \pi \le \theta \le 3\pi/2$
(d) $0 \le r \le 3,\ 0 \le z \le 4,\ 0 \le \theta \le \pi/2$

6. Which of the following is equivalent to

$$\int_{-5}^{5} \int_{0}^{3} \int_{-\sqrt{25-x^2}}^{\sqrt{25-x^2}} x\, dydzdx$$

(a) $\int_0^3 \int_0^3 \int_0^{\pi} r^2 \cos\theta\, d\theta dzdr$
(b) $\int_0^5 \int_0^3 \int_0^{\pi} r^2 \cos\theta\, d\theta dzdr$
(c) $\int_0^3 \int_0^5 \int_0^{2\pi} r \cos\theta\, d\theta dzdr$
(d) $\int_0^5 \int_0^3 \int_0^{2\pi} r^2 \cos\theta\, d\theta dzdr$

7. Which of the following describes the bottom half of a sphere of radius 4 centered on the origin?

(a) $0 \le \rho \le 4,\ \pi/2 \le \phi \le \pi,\ 0 \le \theta \le 2\pi$
(b) $0 \le \rho \le 4,\ 0 \le \phi \le \pi/2,\ 0 \le \theta \le 2\pi$
(c) $0 \le \rho \le 4,\ 0 \le \phi \le \pi,\ 0 \le \theta \le \pi$
(d) $0 \le \rho \le 4,\ 0 \le \phi \le \pi,\ 0 \le \theta \le 2\pi$

8. Which of the following describes the surface of the cylinder of radius 3 centered on the z-axis?

(a) $0 \le \rho < \infty,\ \theta = \pi,\ 0 \le \phi \le \pi$

(b) $r = 3$, $\theta = \frac{\pi}{2}$, $-\infty < z < \infty$

(c) $1 \leq r \leq 4$, $0 \leq \theta \leq 2\pi$, $-5 \leq z \leq 2$

(d) $r = 3$, $0 \leq \theta \leq 2\pi$, $-\infty < z < \infty$

9. Which of the following describes the solid cylinder of radius 4, centered on the z-axis, with the central cylindrical core removed?

   (a) $0 \leq \rho < \infty$, $\theta = \pi$, $0 \leq \phi \leq \pi$

   (b) $r = 3$, $\theta = \frac{\pi}{2}$, $-\infty < z < \infty$

   (c) $1 \leq r \leq 4$, $0 \leq \theta \leq 2\pi$, $-5 \leq z \leq 2$

   (d) $r = 3$, $0 \leq \theta \leq 2\pi$, $-\infty < z < \infty$

10. Which of the following integrals give the volume of the unit sphere?

   (a) $\int_0^{2\pi} \int_0^{2\pi} \int_0^1 d\rho d\theta d\phi$

   (b) $\int_0^{\pi} \int_0^{2\pi} \int_0^1 d\rho d\theta d\phi$

   (c) $\int_0^{\pi} \int_0^{2\pi} \int_0^1 \rho^2 \sin \phi d\rho d\theta d\phi$

   (d) $\int_0^{\pi} \int_0^{2\pi} \int_0^1 \rho^2 \sin \phi d\rho d\phi d\theta$

   (e) $\int_0^{\pi} \int_0^{2\pi} \int_0^1 \rho d\rho d\phi d\theta$