

**Multivariable Calculus Chapter 11 Practice Test****Multiple Choice**

Identify the choice that best completes the statement or answers the question.

- \_\_\_\_\_ 1. Find vectors  $\mathbf{u}$  and  $\mathbf{v}$  whose initial and terminal points are given. Determine whether  $\mathbf{u}$  and  $\mathbf{v}$  are equivalent.

$$\mathbf{u}: (6,5), (9,11) \quad \mathbf{v}: (3,-5), (6,1)$$

- a.  $\mathbf{u} = 6\mathbf{i} + 3\mathbf{j}, \mathbf{v} = 6\mathbf{i} + 3\mathbf{j}$ , which are equivalent
- b.  $\mathbf{u} = 3\mathbf{i} + 6\mathbf{j}, \mathbf{v} = 6\mathbf{j} + 3\mathbf{i}$ , which are not equivalent
- c.  $\mathbf{u} = 3\mathbf{i} + 6\mathbf{j}, \mathbf{v} = 3\mathbf{i} + 6\mathbf{j}$ , which are equivalent
- d.  $\mathbf{u} = 3\mathbf{i} - 6\mathbf{j}, \mathbf{v} = -3\mathbf{i} - 6\mathbf{j}$ , which are equivalent
- e.  $\mathbf{u} = -3\mathbf{i} + 6\mathbf{j}, \mathbf{v} = -3\mathbf{i} + 6\mathbf{j}$ , which are equivalent

- \_\_\_\_\_ 2. Find the vector  $\mathbf{v}$  whose initial and terminal points are given below.

$$(5,5), (7,2)$$

- a.  $\mathbf{v} = 2\mathbf{i} + 7\mathbf{j}$
- b.  $\mathbf{v} = 2\mathbf{i} - 3\mathbf{j}$
- c.  $\mathbf{v} = -2\mathbf{i} - 6\mathbf{j}$
- d.  $\mathbf{v} = 2\mathbf{i} - 4\mathbf{j}$
- e.  $\mathbf{v} = -2\mathbf{i} + 2\mathbf{j}$

- \_\_\_\_\_ 3. Given  $\mathbf{u} = \langle 6, 12 \rangle$  and  $\mathbf{v} = \langle 3, -12 \rangle$ , find  $2\mathbf{u} + 5\mathbf{v}$ .

- a.  $\langle 6, -36 \rangle$
- b.  $\langle 3, 84 \rangle$
- c.  $\langle 9, -52 \rangle$
- d.  $\langle 12, 60 \rangle$
- e.  $\langle 27, -36 \rangle$

\_\_\_\_\_ 4. The vector  $\mathbf{v}$  and its initial point is given. Find the terminal point.

$$\mathbf{v} = \langle 3, -2 \rangle, \text{ initial point } (-6, 10)$$

- a.  $(-3, -8)$
- b.  $(8, -3)$
- c.  $(3, 8)$
- d.  $(3, -8)$
- e.  $(-3, 8)$

\_\_\_\_\_ 5. Find the magnitude of the vector given below. Round your answer to four decimal places.

$$\mathbf{v} = \langle 5, -2 \rangle$$

- a. 0
- b.  $\sqrt{21}$  or 4.5826
- c.  $\sqrt{29}$  or 5.3852
- d.  $\sqrt{7}$  or 2.6458
- e.  $\sqrt{10}$  or 3.1623

\_\_\_\_\_ 6. Find the unit vector in the direction of  $\mathbf{u}$ .

$$\mathbf{u} = \langle 5, 4 \rangle$$

- a.  $\left\langle \frac{1}{\sqrt{41}}, \frac{1}{\sqrt{41}} \right\rangle$
- b.  $\left\langle \frac{1}{\sqrt{41}}, \frac{-1}{\sqrt{41}} \right\rangle$
- c.  $\left\langle \frac{-5}{\sqrt{41}}, \frac{-4}{\sqrt{41}} \right\rangle$
- d.  $\left\langle \frac{-1}{\sqrt{41}}, \frac{-1}{\sqrt{41}} \right\rangle$
- e.  $\left\langle \frac{5}{\sqrt{41}}, \frac{4}{\sqrt{41}} \right\rangle$

\_\_\_\_\_ 7. Find the vector  $\mathbf{v}$  with the given magnitude  $\|\mathbf{v}\| = 185$  and the same direction as  $\mathbf{u} = \langle -11, 8 \rangle$ .

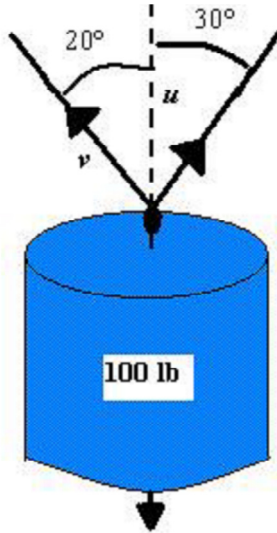
- a.  $\langle 11\sqrt{187}, 8\sqrt{187} \rangle$
- b.  $\langle 8\sqrt{185}, -11\sqrt{185} \rangle$
- c.  $\langle -11\sqrt{185}, 8\sqrt{185} \rangle$
- d.  $\langle 8\sqrt{187}, 8\sqrt{187} \rangle$
- e.  $\langle \sqrt{2618}, 4\sqrt{187} \rangle$

\_\_\_\_\_ 8. Find the component form of vector  $\mathbf{v}$  given its magnitude is  $\|\mathbf{v}\| = 7$  and the angle it makes with the positive  $x$ -axis is  $\theta = 120^\circ$ .

- a.  $\left\langle \frac{7\sqrt{3}}{2}, \frac{7\sqrt{3}}{4} \right\rangle$
- b.  $\left\langle -\frac{\sqrt{5}}{3}, 7\frac{\sqrt{3}}{3} \right\rangle$
- c.  $\left\langle \frac{7\sqrt{3}}{4}, \frac{7\sqrt{3}}{4} \right\rangle$
- d.  $\left\langle -\frac{7}{2}, 7\frac{\sqrt{3}}{2} \right\rangle$
- e.  $\left\langle \frac{7}{2}, \frac{7\sqrt{5}}{2} \right\rangle$

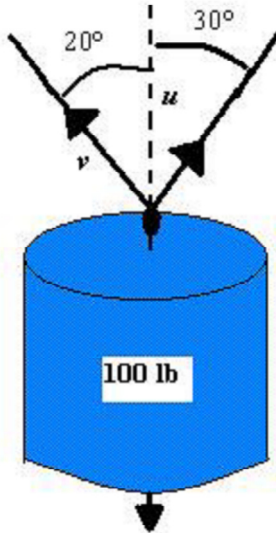
- \_\_\_\_\_ 9. Find the component form of vector  $\mathbf{u} + \mathbf{v}$  given  $\|\mathbf{u}\| = 2$  and  $\|\mathbf{v}\| = 3$  and the angles that  $\mathbf{u}$  and  $\mathbf{v}$  make with the positive  $x$ -axis are  $\theta_{\mathbf{u}} = 0^\circ$  and  $\theta_{\mathbf{v}} = 45^\circ$ .
- a.  $\left\langle \frac{4+3\sqrt{3}}{2}, \frac{9\sqrt{2}}{2} \right\rangle$
- b.  $\left\langle \frac{2+3\sqrt{2}}{2}, \frac{9\sqrt{2}}{2} \right\rangle$
- c.  $\left\langle \frac{22+9\sqrt{2}}{2}, \frac{6\sqrt{2}}{2} \right\rangle$
- d.  $\left\langle \frac{4+3\sqrt{2}}{2}, \frac{3\sqrt{2}}{2} \right\rangle$
- e.  $\left\langle \frac{2+9\sqrt{2}}{2}, \frac{9\sqrt{2}}{2} \right\rangle$
- \_\_\_\_\_ 10. Three forces with magnitudes 80 pounds, 110 pounds and 25 pounds act on an object at angles  $30^\circ$ ,  $-70^\circ$ , and  $120^\circ$  respectively, with the positive  $x$ -axis. Find the direction and magnitude of the resultant force. (The choices below are given to two decimal places.)
- a. 136.12 pounds at an angle of  $-66.16^\circ$  with the positive  $x$ -axis
- b. 103.21 pounds at an angle of  $23.84^\circ$  with the positive  $x$ -axis
- c. 103.21 pounds at an angle of  $-66.16^\circ$  with the positive  $x$ -axis
- d. 136.12 pounds at an angle of  $-23.84^\circ$  with the positive  $x$ -axis
- e. 103.21 pounds at an angle of  $-23.84^\circ$  with the positive  $x$ -axis
- \_\_\_\_\_ 11. Suppose a gun with a muzzle velocity of 1200 feet per second is fired at an angle of  $4^\circ$  above the horizontal. Find the horizontal component of the velocity. Round your answer to two decimal places.
- a. 1,240.08 ft/sec
- b. 2,395.15 ft/sec
- c. 1,197.08 ft/sec
- d. 2,393.15 ft/sec
- e. 1,209.08 ft/sec

12. To carry a 100-pound cylindrical weight, two workers lift on the ends of short ropes tied to an eyelet on the top center of the cylinder. One rope makes a  $20^\circ$  angle away from the vertical and the other makes a  $30^\circ$  angle as shown in the figure below. Find each rope's tension if the resultant force is vertical. Round your answer to two decimal places.



- a.  $\|\mathbf{u}\| = 44.65 \text{ lb}; \|\mathbf{v}\| = 65.27 \text{ lb}$   
b.  $\|\mathbf{u}\| = 144.65 \text{ lb}; \|\mathbf{v}\| = 165.27 \text{ lb}$   
c.  $\|\mathbf{u}\| = 88.30 \text{ lb}; \|\mathbf{v}\| = 129.54 \text{ lb}$   
d.  $\|\mathbf{u}\| = 55.65 \text{ lb}; \|\mathbf{v}\| = 76.27 \text{ lb}$   
e.  $\|\mathbf{u}\| = 90.30 \text{ lb}; \|\mathbf{v}\| = 131.54 \text{ lb}$

- \_\_\_\_\_ 13. To carry a 100-pound cylindrical weight, two workers lift on the ends of short ropes tied to an eyelet on the top center of the cylinder. One rope makes a  $20^\circ$  angle away from the vertical and the other makes a  $30^\circ$  angle as shown in the figure below. Find the vertical component of each worker's force. Round your answer to two decimal places.



- a.  $\|\mathbf{u}\| \sin 60^\circ \approx 55.67 \text{ lb}$ ;  $\|\mathbf{v}\| \sin 110^\circ \approx 78.33 \text{ lb}$   
 b.  $\|\mathbf{u}\| \sin 60^\circ \approx 85.67 \text{ lb}$ ;  $\|\mathbf{v}\| \sin 110^\circ \approx 108.33 \text{ lb}$   
 c.  $\|\mathbf{u}\| \sin 60^\circ \approx 78.33 \text{ lb}$ ;  $\|\mathbf{v}\| \sin 110^\circ \approx 123.67 \text{ lb}$   
 d.  $\|\mathbf{u}\| \sin 60^\circ \approx 156.67 \text{ lb}$ ;  $\|\mathbf{v}\| \sin 110^\circ \approx 179.33 \text{ lb}$   
 e.  $\|\mathbf{u}\| \sin 60^\circ \approx 38.67 \text{ lb}$ ;  $\|\mathbf{v}\| \sin 110^\circ \approx 61.33 \text{ lb}$
- \_\_\_\_\_ 14. Suppose a plane flies at a constant groundspeed of 500 miles per hour due east and encounters a 50 mile-per-hour wind from the northwest. Both the airspeed and the compass direction must change to for the plane to maintain its groundspeed and eastward direction. Find the airspeed to maintain its groundspeed and eastward direction. Round your answer to two decimal places.
- a. 526.99 mi/h  
 b. 507.99 mi/h  
 c. 485.99 mi/h  
 d. 643.99 mi/h  
 e. 465.99 mi/h

\_\_\_\_\_ 15. Find the distance between the points given below.

$$(-4, 2, -3), (0, 5, 1)$$

- a.  $\sqrt{41}$  or 6.4031 to four decimal places.
- b.  $2\sqrt{10}$  or 6.3246 to four decimal places.
- c.  $\sqrt{42}$  or 6.4807 to four decimal places.
- d.  $\sqrt{43}$  or 5.9161 to four decimal places.
- e.  $\sqrt{43}$  or 6.5574 to four decimal places.

\_\_\_\_\_ 16. Find the coordinates of the midpoint of the line segment joining the points given below.

$$(4, 8, 4), (7, 10, 7)$$

- a. (5.5, 1, 5.5)
- b. (1.5, 1, 5.5)
- c. (1.5, 9, 5.5)
- d. (1.5, 9, 1.5)
- e. (5.5, 9, 5.5)

\_\_\_\_\_ 17. Find the standard equation of the sphere with center (2, 8, 4), and radius 2.

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

\_\_\_\_\_ 18. Find the standard equation of a sphere that has diameter with the end points given below.

$$(3, -2, 4), (7, 12, 4)$$

- a.  $(x-5)^2 + (y-5)^2 + (z-4)^2 = 53$
- b.  $(x-5)^2 + (y-5)^2 + (z-4)^2 = 9$
- c.  $(x+5)^2 + (y-5)^2 + (z-4)^2 = 53$
- d.  $(x-5)^2 + (y+5)^2 + (z+4)^2 = 53$
- e.  $(x-5)^2 + (y+5)^2 + (z-4)^2 = 53$

\_\_\_\_ 19. Find the standard equation of the sphere with center at  $(-2, 3, 6)$  and tangent to the  $yz$ -plane.

a.  $(x+2)^2 + (y-3)^2 + (z-6)^2 = 4$

b.  $(x+2)^2 + (y-3)^2 + (z-6)^2 = 9$

c.  $(x+2)^2 + (y-3)^2 + (z-6)^2 = 45$

d.  $(x-2)^2 + (y+3)^2 + (z+6)^2 = 4$

e.  $(x-2)^2 + (y+3)^2 + (z+6)^2 = 45$

\_\_\_\_ 20. Find the component form of the vector  $\mathbf{u}$  with the given initial and terminal points.

Initial point:  $(5, 7, 8)$

Terminal point:  $(-2, 10, 10)$

a.  $\mathbf{u} = 7\mathbf{i} - 3\mathbf{j} - 2\mathbf{k}$

b.  $\mathbf{u} = 3\mathbf{i} + 17\mathbf{j} + 18\mathbf{k}$

c.  $\mathbf{u} = -7\mathbf{i} + 3\mathbf{j} - 2\mathbf{k}$

d.  $\mathbf{u} = -7\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$

e.  $\mathbf{u} = 7\mathbf{i} + 3\mathbf{j} + 2\mathbf{k}$

\_\_\_\_ 21. Given the vector  $\mathbf{v}$  and its initial point find the terminal point of the vector.

$$\mathbf{v} = \langle 3, 2, 1 \rangle, \quad \text{initial point } (2, -4, 5)$$

a.  $(5, 4, -6)$

b.  $(5, -2, 6)$

c.  $(-5, -2, 6)$

d.  $(5, 4, 6)$

e.  $(-5, 4, 6)$

\_\_\_\_ 22. Find the magnitude of the vector given below.

$$\mathbf{v} = \langle -5, -4, -3 \rangle$$

a.  $\sqrt{54}$  or 7.3485

b.  $\sqrt{100}$  or 10.0000

c.  $\sqrt{50}$  or 7.0711

d.  $\sqrt{12}$  or 3.4641

e.  $\sqrt{56}$  or 7.4833



\_\_\_\_\_ 23. Find the unit vector in the direction of  $\mathbf{u}$ .

$$\mathbf{u} = \langle -5, -2, -1 \rangle$$

a.  $\left\langle \frac{-5}{\sqrt{30}}, \frac{-2}{\sqrt{30}}, \frac{-1}{\sqrt{30}} \right\rangle$

b.  $\left\langle \frac{-1}{\sqrt{30}}, \frac{-1}{\sqrt{30}}, \frac{-1}{\sqrt{30}} \right\rangle$

c.  $\left\langle \frac{5}{\sqrt{30}}, \frac{2}{\sqrt{30}}, \frac{1}{\sqrt{30}} \right\rangle$

d.  $\left\langle \frac{25}{\sqrt{30}}, \frac{4}{\sqrt{30}}, \frac{1}{\sqrt{30}} \right\rangle$

e.  $\left\langle \frac{-150}{\sqrt{30}}, \frac{-60}{\sqrt{30}}, \frac{-30}{\sqrt{30}} \right\rangle$

\_\_\_\_\_ 24. Find a unit vector  $\mathbf{u}$  in the direction opposite of  $\mathbf{v} = \langle 2, 8, -3 \rangle$ .

a.  $\mathbf{u} = (-1/\sqrt{77})\langle 2, 8, -3 \rangle$

b.  $\mathbf{u} = (1/\sqrt{59})\langle 2, 8, -3 \rangle$

c.  $\mathbf{u} = (-1/\sqrt{59})\langle 2, 8, -3 \rangle$

d.  $\mathbf{u} = (1/\sqrt{77})\langle 2, 8, -3 \rangle$

e.  $\mathbf{u} = (-1/6\sqrt{2})\langle 2, 8, -3 \rangle$

\_\_\_\_\_ 25. Find the vector  $\mathbf{v}$  with the magnitude  $\frac{15}{2}$  and direction of  $\mathbf{u} = \langle 18, -18, 9 \rangle$ .

a.  $\mathbf{v} = \left\langle 5, -5, \frac{5}{2} \right\rangle$

b.  $\mathbf{v} = \langle 5, -5, 5 \rangle$

c.  $\mathbf{v} = \left\langle 9, -9, \frac{9}{2} \right\rangle$

d.  $\mathbf{v} = \left\langle \frac{5}{2}, -\frac{5}{2}, \frac{5}{18} \right\rangle$

e.  $\mathbf{v} = \left\langle \frac{5}{18}, -\frac{5}{18}, \frac{5}{6} \right\rangle$

\_\_\_\_\_ 26. Given the vector  $\mathbf{v}$  lies in the  $yz$ -plane, has magnitude 8, and makes an angle of  $150^\circ$  with the positive  $y$ -axis. Find the component form of  $\mathbf{v}$ .

a.  $\mathbf{v} = \langle 0, -4\sqrt{3}, \pm 4 \rangle$

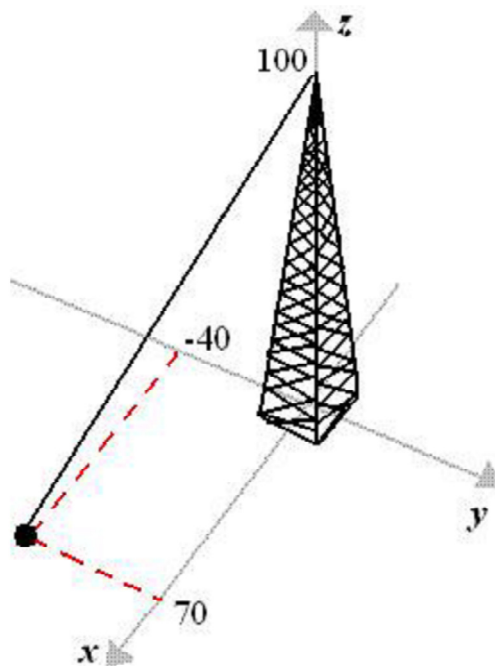
b.  $\mathbf{v} = \langle 4\sqrt{3}, 0, 4 \rangle$

c.  $\mathbf{v} = \langle 0, -4\sqrt{3}, 4 \rangle$

d.  $\mathbf{v} = \langle -4\sqrt{3}, 0, \pm 4 \rangle$

e.  $\mathbf{v} = \langle 0, 4\sqrt{3}, \pm 4 \rangle$

\_\_\_\_\_ 27. Suppose the guy wire to a 100-foot tower has a tension of 500 pounds. Using the distances shown in the figure, write the component form of the vector  $\mathbf{F}$  representing the tension in the wire. Round numerical values in your answer to the nearest integer.



a.  $\mathbf{F} = \langle 302, 186, 419 \rangle$

b.  $\mathbf{F} = \langle 261, 145, 378 \rangle$

c.  $\mathbf{F} = \langle 302, 186, 419 \rangle$

d.  $\mathbf{F} = \langle 272, -156, -389 \rangle$

e.  $\mathbf{F} = \langle 272, 156, 389 \rangle$

\_\_\_\_\_ 28. Given  $\mathbf{u} = \langle 1, 3 \rangle$  and  $\mathbf{v} = \langle -2, 2 \rangle$  find  $\mathbf{u} \cdot \mathbf{v}$ .

- a. -8
- b. -4
- c. 4
- d. 7
- e. -1

\_\_\_\_\_ 29. Given  $\mathbf{u} = \langle -4, 2 \rangle$ , find  $\mathbf{u} \cdot \mathbf{u}$ .

- a. -6
- b. 12
- c. -8
- d. -2
- e. 20

\_\_\_\_\_ 30. Given  $\mathbf{u} = 2\mathbf{i} + \mathbf{j} - 5\mathbf{k}$  and  $\mathbf{v} = \mathbf{i} - 7\mathbf{j} + 2\mathbf{k}$  find  $(\mathbf{u} \cdot \mathbf{v})\mathbf{v}$ .

- a.  $(\mathbf{u} \cdot \mathbf{v})\mathbf{v} = -15\mathbf{i} + 105\mathbf{j} - 30\mathbf{k}$
- b.  $(\mathbf{u} \cdot \mathbf{v})\mathbf{v} = -30\mathbf{i} - 15\mathbf{j} + 75\mathbf{k}$
- c.  $(\mathbf{u} \cdot \mathbf{v})\mathbf{v} = 5\mathbf{i} - 35\mathbf{j} + 10\mathbf{k}$
- d.  $(\mathbf{u} \cdot \mathbf{v})\mathbf{v} = 30\mathbf{i} + 15\mathbf{j} - 75\mathbf{k}$
- e.  $(\mathbf{u} \cdot \mathbf{v})\mathbf{v} = 15\mathbf{i} - 105\mathbf{j} + 30\mathbf{k}$

\_\_\_\_\_ 31. Find the angle between the vectors for  $\mathbf{u}$  and  $\mathbf{v}$  given below.

$$\mathbf{u} = \langle 1, 1 \rangle, \mathbf{v} = \langle 3, -1 \rangle$$

- a.  $63.43^\circ$
- b.  $24.09^\circ$
- c.  $26.57^\circ$
- d.  $69.62^\circ$
- e.  $84.26^\circ$

\_\_\_\_\_ 32. Find the angle between the vectors for  $\mathbf{u}$  and  $\mathbf{v}$ .

$$\mathbf{u} = 6\mathbf{i} + 4\mathbf{j}, \mathbf{v} = 5\mathbf{i} + 3\mathbf{j}$$

- a.  $48.22^\circ$
- b.  $2.73^\circ$
- c.  $87.27^\circ$
- d.  $44.97^\circ$
- e.  $88.64^\circ$

\_\_\_\_\_ 33. Find the direction cosines of the vector  $\mathbf{u}$  given below.

$$\mathbf{u} = 4\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}$$

a.  $\cos(\alpha) = \frac{16}{\sqrt{57}}, \cos(\beta) = \frac{16}{\sqrt{57}}, \cos(\gamma) = \frac{25}{\sqrt{57}}$

b.  $\cos(\alpha) = \frac{-8}{\sqrt{57}}, \cos(\beta) = \frac{-8}{\sqrt{57}}, \cos(\gamma) = \frac{-10}{\sqrt{57}}$

c.  $\cos(\alpha) = \frac{4}{\sqrt{57}}, \cos(\beta) = \frac{4}{\sqrt{57}}, \cos(\gamma) = \frac{5}{\sqrt{57}}$

d.  $\cos(\alpha) = \frac{8}{\sqrt{57}}, \cos(\beta) = \frac{8}{\sqrt{57}}, \cos(\gamma) = \frac{10}{\sqrt{57}}$

e.  $\cos(\alpha) = \frac{-4}{\sqrt{57}}, \cos(\beta) = \frac{-4}{\sqrt{57}}, \cos(\gamma) = \frac{-5}{\sqrt{57}}$

\_\_\_\_\_ 34. Given  $\mathbf{u} = \langle 9, 7 \rangle$  and  $\mathbf{v} = \langle 2, 3 \rangle$ , find the projection of  $\mathbf{u}$  onto  $\mathbf{v}$ .

a.  $\langle 27, 21 \rangle$

b.  $\langle 6, 9 \rangle$

c.  $\langle 31, 25 \rangle$

d.  $\langle 10, 13 \rangle$

e.  $\langle 27, 9 \rangle$

\_\_\_\_\_ 35. Given  $\mathbf{u} = \langle 36, 9, 0 \rangle$  and  $\mathbf{v} = \langle 5, 1, -1 \rangle$ , find the vector component of  $\mathbf{u}$  orthogonal to  $\mathbf{v}$ .

a.  $\langle 1, 16, -7 \rangle$

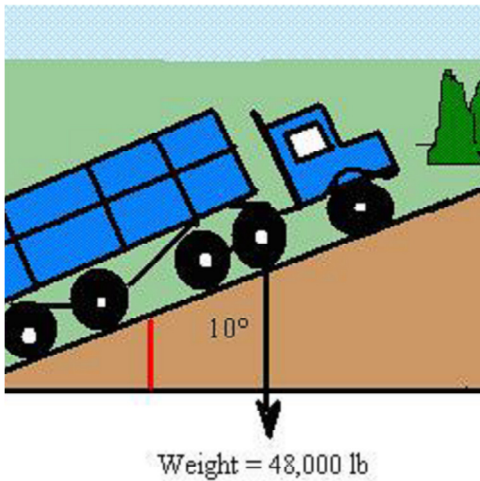
b.  $\langle 40, 8, -8 \rangle$

c.  $\langle 71, 16, -7 \rangle$

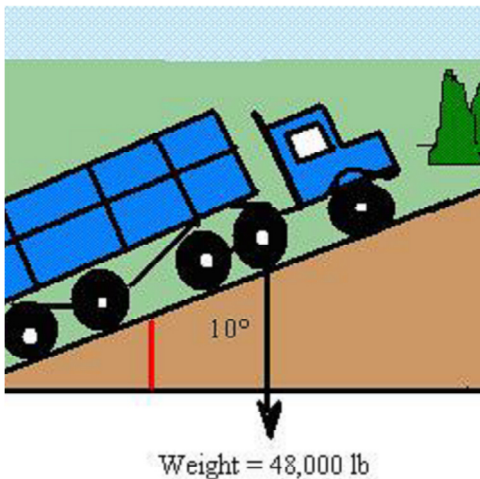
d.  $\langle 35, 2, -7 \rangle$

e.  $\langle -30, -6, 6 \rangle$

- \_\_\_\_\_ 36. Suppose a 48000-pound truck is parked on a  $10^\circ$  slope as shown in the figure. Assume the only force to overcome is that due to gravity. Find the force required to keep the truck from rolling down the hill. Round your answer to two decimal places.



- a. 8,354.11 lb  
b. 8,335.11 lb  
c. 7,994.11 lb  
d. 8,392.11 lb  
e. 8,517.11 lb
- \_\_\_\_\_ 37. Suppose a 48000-pound truck is parked on a  $10^\circ$  slope as shown in the figure. Assume the only force to overcome is that due to gravity. Find the force perpendicular to the hill. Round your answer to one decimal place.



- a. 47,008.8 lb  
b. 47,426.8 lb  
c. 47,328.8 lb  
d. 47,270.8 lb  
e. 47,289.8 lb

- \_\_\_\_\_ 38. An object is pulled 5 feet horizontally across a floor, using a force of 95 pounds. The direction of the force is  $10^\circ$  above the horizontal. Find the work done. Round your answer to two decimal places.
- 467.78 ft-lb
  - 398.56 ft-lb
  - 82.48 ft-lb
  - 6.96 ft-lb
  - 511.94 ft-lb
- \_\_\_\_\_ 39. Find the cross product of the unit vector  $\mathbf{k} \times \mathbf{i}$ .
- $\mathbf{j}$
  - $\mathbf{i}$
  - $-\mathbf{k}$
  - $-\mathbf{j}$
  - $\mathbf{k}$
- \_\_\_\_\_ 40. Given  $\mathbf{v} = 4\mathbf{i} + 5\mathbf{j} - 4\mathbf{k}$ , find  $\mathbf{v} \times \mathbf{v}$ .
- $5\mathbf{i} + 4\mathbf{j}$
  - 0
  - $4\mathbf{i} + 5\mathbf{j}$
  - $4\mathbf{i} - 5\mathbf{j}$
  - $80\mathbf{k}$
- \_\_\_\_\_ 41. Given  $\mathbf{u} = \langle 8, 3, 3 \rangle$  and  $\mathbf{v} = \langle 2, -1, 5 \rangle$  find  $\mathbf{u} \times \mathbf{v}$ .
- $\langle 29, -22, 6 \rangle$
  - $\langle -18, -68, -14 \rangle$
  - $\langle 18, -34, -14 \rangle$
  - $\langle -18, 34, 14 \rangle$
  - $\langle 37, -34, -27 \rangle$
- \_\_\_\_\_ 42. Given  $\mathbf{u} = \mathbf{i} + 3\mathbf{j}$  and  $\mathbf{v} = -8\mathbf{i} + \mathbf{j} + \mathbf{k}$ , find  $\mathbf{u} \times \mathbf{v}$ .
- $6\mathbf{i} - \mathbf{j} + 26\mathbf{k}$
  - $3\mathbf{i} + \mathbf{j} + 24\mathbf{k}$
  - $3\mathbf{i} - \mathbf{j} + 25\mathbf{k}$
  - $4\mathbf{i} + \mathbf{j} - 25\mathbf{k}$
  - $3\mathbf{i} - \mathbf{j} - 25\mathbf{k}$

\_\_\_\_\_ 43. Find a unit vector that is orthogonal to both  $\mathbf{u} = \langle -16, -12, 8 \rangle$  and  $\mathbf{v} = \langle 20, -24, -4 \rangle$ .

a.  $\left\langle \frac{5}{7\sqrt{22}}, \frac{2}{7\sqrt{22}}, \frac{13}{7\sqrt{22}} \right\rangle$

b.  $\left\langle -\frac{5}{3\sqrt{22}}, -\frac{2}{3\sqrt{22}}, -\frac{13}{3\sqrt{22}} \right\rangle$

c.  $\left\langle \frac{5}{3\sqrt{23}}, \frac{2}{3\sqrt{23}}, \frac{13}{3\sqrt{23}} \right\rangle$

d.  $\left\langle -\frac{5}{7\sqrt{23}}, -\frac{2}{7\sqrt{23}}, -\frac{13}{7\sqrt{23}} \right\rangle$

e.  $\left\langle \frac{5}{3\sqrt{22}}, \frac{2}{3\sqrt{22}}, \frac{13}{3\sqrt{22}} \right\rangle$

\_\_\_\_\_ 44. Find the area of the parallelogram that has the given vectors  $\mathbf{u} = \mathbf{j}$  and  $\mathbf{v} = 2\mathbf{j} + \mathbf{k}$  as adjacent sides.

- a. 2
- b. 0
- c. 4
- d. 1
- e. 3

\_\_\_\_\_ 45. Find the area of a parallelogram that has the given vectors as adjacent sides. Round your answer to two decimal places.

$$\mathbf{u} = \langle -7, 9, 5 \rangle, \quad \mathbf{v} = \langle -2, -2, 5 \rangle$$

- a.  $\sqrt{9,348}$  or 96.69
- b.  $\sqrt{4,676}$  or 68.38
- c.  $\sqrt{4674}$  or 68.37
- d.  $\sqrt{9,701}$  or 98.49
- e.  $\sqrt{9,349}$  or 96.69

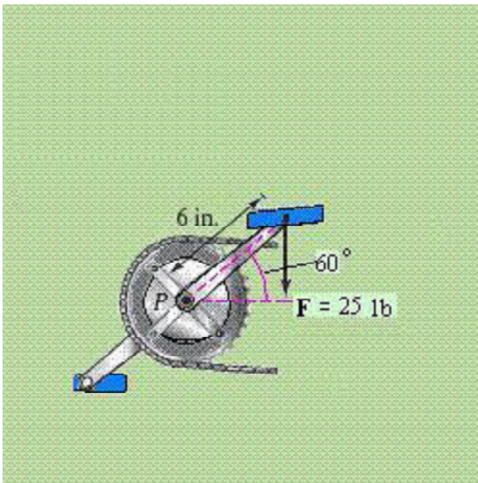
\_\_\_\_\_ 46. Find the area of the parallelogram with the vertices  $A = (3, 1, 0)$ ,  $B = (4, 3, 1)$ ,  $C = (6, 4, 4)$ , and  $D = (5, 2, 3)$ . Round your answer to two decimal places.

- a. 35.00
- b. 3.00
- c. 5.92
- d. 7.00
- e. 2.65

\_\_\_\_ 47. Find the area of the triangle with the vertices  $A = (0,0,0)$ ,  $B = (3,1,2)$ , and  $C = (1,1,2)$ . Round your answer to two decimal places.

- a. 20.00
- b. 8.00
- c. 6.00
- d. 2.24
- e. 4.47

\_\_\_\_ 48. A child applies the brakes on a bicycle by applying a downward force of 25 pounds on the pedal when the crank makes a  $60^\circ$  angle with the horizontal (see figure). The crank is 6 inches in length. Find the torque at  $P$ . Round your answer to two decimal places.



- a. 12.50 ft-lb
- b. 6.25 ft-lb
- c. 75.00 ft-lb
- d. 10.83 ft-lb
- e. 21.65 ft-lb

\_\_\_\_ 49. Find the triple scalar product  $(\mathbf{u} \times \mathbf{v}) \cdot \mathbf{w}$ .

$$\mathbf{u} = \langle -6, 7, 4 \rangle, \mathbf{v} = \langle -6, 3, -2 \rangle, \mathbf{w} = \langle 3, -3, 6 \rangle$$

- a. -46
- b. 46
- c. 174
- d. 178
- e. 348



- \_\_\_\_\_ 50. Use the triple scalar product to find the volume of the parallelepiped having adjacent edges given by the vectors

$$\mathbf{u} = \langle -4, 9, 5 \rangle, \mathbf{v} = \langle 3, 5, -1 \rangle, \mathbf{w} = \langle 8, -8, 7 \rangle$$

- a. 220
  - b. 689
  - c. 692
  - d. 516
  - e. 344
- \_\_\_\_\_ 51. Find the volume of the parallelepiped with the following vertices.

$$(0,0,0), (5,0,0), (0,9,3), (5,9,3), (2,0,4), (7,0,4), (2,9,7), (7,9,7)$$

- a. 180
  - b. 167
  - c. 60
  - d. 30
  - e. 22
- \_\_\_\_\_ 52. Find a set of parametric equations of the line through the point  $(-7, 5, 4)$  parallel to the vector  $\mathbf{v} = \langle 8, 5, 2 \rangle$ .

- a.  $x = -7 + 8s, y = -5 + 5s, z = 4 + 2s$
- b.  $x = -7 - 8s, z = 5 + 3s, y = -4 + 8s$
- c.  $x = -7 - 8s, y = 5 + 3s, z = 4 + 8s$
- d.  $x = -7 - 8s, y = 5 + 5s, z = 4 - 2s$
- e.  $x = -7 + 8s, y = 5 + 5s, z = 4 + 2s$

- \_\_\_\_\_ 53. Find a set of symmetric equations of the line through the point  $(8, 5, 3)$  parallel to the vector  $\mathbf{v} = \langle 2, 4, 4 \rangle$ .

- a.  $\frac{x-8}{-3} = \frac{z-5}{4} = \frac{y-3}{-7}$
- b.  $\frac{x-8}{2} = \frac{y-5}{4} = \frac{z-3}{4}$
- c.  $\frac{x-8}{2} = \frac{y+5}{4} = \frac{z+3}{4}$
- d.  $\frac{x-8}{-3} = \frac{y-5}{4} = \frac{z-3}{-7}$
- e.  $\frac{x-8}{2} = \frac{y+5}{4} = \frac{z-3}{4}$

- \_\_\_\_\_ 54. Find the set of parametric equations of the line through the point  $(-3, 6, 3)$  that is parallel to the line  $x = -8 + 5t$ ,  $y = -3 + 8t$ , and  $z = 4 + 4t$ .
- $x = -3 - 5t$ ,  $y = 6 + 8t$ ,  $z = 3 - 4t$
  - $x = -3 - 8t$ ,  $z = 6 - 3t$ ,  $y = 3 + 4t$
  - $x = -3 + 5t$ ,  $y = -6 + 8t$ ,  $z = 3 + 4t$
  - $x = -3 + 5t$ ,  $y = 6 + 8t$ ,  $z = 3 + 4t$
  - $x = -3 - 8t$ ,  $y = 6 - 3t$ ,  $z = 3 + 4t$
- \_\_\_\_\_ 55. Find a set of parametric equations of the line through the points  $(7, 8, 3)$  and  $(1, -7, -6)$ .
- $x = 7 - 2t$ ,  $y = 8 + 5t$ ,  $z = 3 - 3t$
  - $x = 7 + 7t$ ,  $y = 8 + 4t$ ,  $z = 3 + 8t$
  - $x = 7 + 2t$ ,  $y = -8 + 5t$ ,  $z = 3 + 3t$
  - $x = 7 + 7t$ ,  $z = 8 + 4t$ ,  $y = 3 + 8t$
  - $x = 7 - 6t$ ,  $y = 8 - 15t$ ,  $z = 3 - 9t$
- \_\_\_\_\_ 56. Find a set of symmetric equations of the line through the points  $(8, 6, 3)$  and  $(0, -1, -1)$ .
- $\frac{x-8}{8} = \frac{y-6}{7} = \frac{z-3}{4}$
  - $\frac{x-8}{3} = \frac{y-6}{9} = \frac{z-3}{-5}$
  - $\frac{x-8}{8} = \frac{y+6}{7} = \frac{z-3}{4}$
  - $\frac{x+8}{8} = \frac{y+6}{7} = \frac{z-3}{4}$
  - $\frac{x-8}{3} = \frac{z-6}{9} = \frac{y-3}{-5}$
- \_\_\_\_\_ 57. Find a set of parametric equations of the line that passes through the point  $(-2, 5, -1)$  and is parallel to the  $xy$ -plane and  $yz$ -plane.
- $x = -2$ ,  $y = 5 + t$ ,  $z = -1$
  - $x = -2 + t$ ,  $y = 5$ ,  $z = -1 + t$
  - $x = -2$ ,  $y = 5t$ ,  $z = -1$
  - $x = -2t$ ,  $y = 5$ ,  $z = -t$
  - $x = -2 + t$ ,  $y = 5 + t$ ,  $z = -1 + t$

\_\_\_\_\_ 58. Determine whether the lines given below intersect, and, if so, find the point of intersection.

$$x = -6 + 2t, y = 9 + 4t, z = -13 + 3t$$

$$x = 4 + 2s, y = 25 + 2s, z = 2 + 3s$$

- The lines intersect at  $(-4, 24, -4)$ .
- The lines are parallel.
- The lines intersect at  $(3, 24, -7)$ .
- The lines intersect at  $(0, 21, -4)$ .
- The lines are not parallel but do not intersect.

\_\_\_\_\_ 59. Determine whether the lines given below intersect, and, if so, find the point of intersection.

$$\frac{x-1}{5} = \frac{y-2}{7} = \frac{z+8}{5}$$

$$\frac{x-3}{1} = \frac{x-15}{-2} = \frac{z-5}{-2}$$

- The lines are parallel.
- The lines intersect at  $(2, 6, -33)$ .
- The lines intersect at  $(7, 11, -3)$ .
- The lines intersect at  $(6, 9, -1)$ .
- The lines are not parallel but do not intersect.

\_\_\_\_\_ 60. Find an equation of a plane passing through the given point and perpendicular to the given vector.

Point:  $(3, -1, -3)$     Vector:  $\mathbf{v} = \langle 6, 5, 4 \rangle$

- $6x - 5y + 4z - 1 = 0$
- $6x + 5y - 4z + 1 = 0$
- $6x + 5y + 4z - 1 = 0$
- $6x + 5y + 4z + 1 = 0$
- $6x + 5y + 4z - 3 = 0$

\_\_\_\_\_ 61. Find an equation of a plane passing through the following three points.

$$(1, 2, -2), (-4, 2, 5), (3, 4, 5)$$

- $14x + 49y + 10z + 104 = 0$
- $14x - 49y + 10z - 104 = 0$
- $-14x - 49y + 10z + 104 = 0$
- $14x - 49y - 10z + 104 = 0$
- $14x - 49y + 10z + 104 = 0$

\_\_\_\_\_ 62. Find an equation of a plane passing through the points

$$(2, 3, 40), (-1, -1, -7)$$

and perpendicular to the plane

$$3x + y + 5z + 8 = 0.$$

- a.  $3x - 14y + z = -4$
- b.  $3x - 14y + 2z - 4 = 0$
- c.  $3x - 14y + z - 4 = 0$
- d.  $3x - 14y + 2z = -4$
- e.  $3x - 14y + z = 0$

\_\_\_\_\_ 63. Determine whether the following planes are parallel, orthogonal, or neither. If they are neither parallel nor orthogonal, find the angle of intersection.

$$-2x - 31y + 5z + 3 = 0$$

$$-3x + y + 5z - 4 = 0$$

- a. The planes are neither parallel nor orthogonal, the angle of intersection is  $15^\circ$ .
- b. The planes are parallel.
- c. The planes are neither parallel nor orthogonal, the angle of intersection is  $30^\circ$ .
- d. The planes are orthogonal.

\_\_\_\_\_ 64. Find the distance between the point  $(2, -2, -3)$  and the plane  $2x - 3y + 4z = 8$ .

- a.  $\frac{15}{\sqrt{29}}$
- b.  $\frac{-10}{\sqrt{29}}$
- c.  $\frac{10}{\sqrt{29}}$
- d.  $\frac{20}{\sqrt{29}}$
- e.  $\frac{-20}{\sqrt{29}}$

\_\_\_\_\_ 65. Find the distance between the planes given below.

$$4x - 4y + 5z - 104 = 0$$

$$20x - 20y + 25z - 100 = 0$$

a.  $\frac{-84}{\sqrt{57}}$

b.  $\frac{84}{\sqrt{57}}$

c.  $\frac{89}{\sqrt{57}}$

d.  $\frac{-168}{\sqrt{57}}$

e.  $\frac{168}{\sqrt{57}}$

\_\_\_\_\_ 66. Find the distance between the point  $(1, 1, 1)$  and the line given by the set of parametric equations  $x = 1 - 3t$ ,  $y = 3 + t$ ,  $z = -t$ .

a.  $5\sqrt{22}/11$

b. 2

c.  $3\sqrt{110}/11$

d. 4

e. 1

\_\_\_\_\_ 67. Identify the following quadric surface.

$$z = \frac{x^2}{6} - \frac{y^2}{16}$$

- a. hyperboloid of one sheet
- b. elliptic cone
- c. elliptic paraboloid
- d. hyperboloid of two sheets
- e. hyperbolic paraboloid

\_\_\_\_\_ 68. Identify the following quadric surface.

$$\frac{x^2}{3} + \frac{y^2}{2} - \frac{z^2}{4} = 0$$

- a. Elliptic cone
- b. Hyperboloid of two sheets
- c. Elliptic paraboloid
- d. ellipsoid
- e. Hyperboloid of one sheet

\_\_\_\_\_ 69. Find an equation for the surface of revolution generated by revolving the curve  $xz = 3$  in the  $xz$ -plane about the  $z$ -axis.

a.  $y^2 + z^2 = \frac{9}{x^2}$

b.  $z^2 + x^2 = \frac{9}{y^2}$

c.  $y^2 + z^2 = \frac{3}{x^2}$

d.  $y^2 + x^2 = \frac{3}{z}$

e.  $y^2 + x^2 = \frac{9}{z^2}$

\_\_\_\_\_ 70. Given the equation of a surface of revolution  $x^2 + z^2 - 3y = 0$ , find the equation of its generating curve in the  $yz$ -plane rotating about the  $y$ -axis.

a.  $x = \sqrt{3y}$  or  $z = \sqrt{3y}$

b.  $x^2 + z^2 = 9y^2$

c.  $x^2 + z^2 = \sqrt{3y}$

d.  $x = 9y^2$  or  $z = 9z^2$

e.  $x = 3y$  or  $z = 3y$

\_\_\_\_ 71. Convert the following point from cylindrical coordinates to rectangular coordinates.

$$\left(4, \frac{\pi}{3}, 2\right)$$

a.  $\left(4, 4\sqrt{3}, 2\right)$

b.  $\left(8, 8\sqrt{3}, 2\right)$

c.  $\left(2\sqrt{3}, 2, 2\right)$

d.  $\left(2, 2\sqrt{3}, 2\right)$

e.  $\left(4\sqrt{3}, 4, 2\right)$

\_\_\_\_ 72. Convert the following point from rectangular coordinates to cylindrical coordinates. Give any angles in radians.

$$(-4, -4, 5)$$

a.  $\left(4\sqrt{2}, \frac{5\pi}{2}, 5\right)$

b.  $\left(8\sqrt{2}, \frac{5\pi}{4}, 5\right)$

c.  $\left(4\sqrt{2}, \frac{5\pi}{4}, 5\right)$

d.  $\left(4, \frac{5\pi}{4}, 5\right)$

e.  $\left(4, \frac{5\pi}{2}, 5\right)$

\_\_\_\_\_ 73. Find an equation in cylindrical coordinates for the equation given in rectangular coordinates.

$$z = 9x^2 + 9y^2 - 2$$

a.  $z = 9r + 2$

b.  $z = 9r^2 - 2$

c.  $z^2 = 9r - 2$

d.  $z = \frac{9}{2}r^2 + 2$

e.  $z = \frac{9}{2}r^2 - 2$

\_\_\_\_\_ 74. Find an equation in cylindrical coordinates for the equation given in rectangular coordinates.

$$9x^2 + 9y^2 = 8x$$

a.  $r^2 = \frac{8}{9} \sin \theta$

b.  $r = \frac{8}{9} \sin \theta$

c.  $r = \frac{8}{9} \cos^{-1} \theta$

d.  $r = \frac{8}{9} \cos \theta$

e.  $r = \frac{9}{8} \cos \theta$



\_\_\_\_\_ 75. Find an equation in rectangular coordinates for the equation given in cylindrical coordinates.

$$r = 6 \sin \theta$$

a.  $x^2 + y^2 = 6y$

b.  $x^2 + y^2 = 6x$

c.  $x^2 + y^2 = \frac{x}{6}$

d.  $x^2 + y^2 = \frac{y}{6}$

e.  $x^2 + z^2 = 6x$

\_\_\_\_\_ 76. Find an equation in rectangular coordinates for the equation given in cylindrical coordinates.

$$r = 4z$$

a.  $x^2 + y^2 = \frac{z}{4}$

b.  $x^2 + y^2 = \frac{y}{4}$

c.  $x^2 + z^2 = 4y$

d.  $x^2 + y^2 = 16z^2$

e.  $x^2 + y^2 = 4z$

\_\_\_\_ 77. Find an equation in rectangular coordinates for the equation given in cylindrical coordinates.

$$r^2 + z^2 = 4$$

a.  $x + y + z = 2$

b.  $x^2 + y^2 + z^2 = 4$

c.  $x^2 + y^2 + \left(\frac{z}{2}\right)^2 = 0$

d.  $x^2 + y^2 = -4z^2$

e.  $x^2 + y^2 + z^2 = 2$

\_\_\_\_ 78. Convert the point  $(-7, 7\sqrt{3}, 14)$  from rectangular coordinates to spherical coordinates.

a.  $\left(14\sqrt{2}, \frac{\pi}{4}, \frac{2\pi}{3}\right)$

b.  $\left(28\sqrt{2}, \frac{2\pi}{3}, \frac{\pi}{4}\right)$

c.  $\left(14\sqrt{2}, \frac{2\pi}{3}, \frac{\pi}{4}\right)$

d.  $\left(28\sqrt{2}, \frac{\pi}{4}, \frac{2\pi}{3}\right)$

e.  $\left(14\sqrt{2}, \frac{\pi}{3}, \frac{\pi}{4}\right)$

\_\_\_ 79. Convert the point from spherical coordinates to rectangular coordinates.

$$\left(9, \frac{2\pi}{3}, \frac{5\pi}{6}\right)$$

a.  $\left(\frac{9}{4}, -\frac{9\sqrt{3}}{4}, \frac{9\sqrt{3}}{2}\right)$

b.  $\left(\frac{9}{4}, \frac{9\sqrt{3}}{4}, \frac{9\sqrt{3}}{2}\right)$

c.  $\left(-\frac{9}{4}, \frac{9\sqrt{3}}{4}, -\frac{9\sqrt{3}}{2}\right)$

d.  $\left(\frac{9}{4}, -\frac{9\sqrt{3}}{4}, -\frac{9\sqrt{3}}{2}\right)$

e.  $\left(-\frac{9}{4}, -\frac{9\sqrt{3}}{4}, \frac{9\sqrt{3}}{2}\right)$

\_\_\_ 80. Find an equation in spherical coordinates for the equation given in rectangular coordinates.

$$y = 4$$

a.  $\rho = 4 \cos \phi \cos \theta$

b.  $\rho = 4 \sec \phi \sec \theta$

c.  $\rho = 4 \sin \phi \sin \theta$

d.  $\rho = 4 \sec \phi \csc \theta$

e.  $\rho = 4 \csc \phi \csc \theta$

\_\_\_\_\_ 81. Find an equation in spherical coordinates for the equation given in rectangular coordinates.

$$x^2 + y^2 - 4z^2 = 3$$

a.  $\rho^2 = \frac{3}{(\sin^2 \phi - 4 \cos^2 \phi)}$

b.  $\rho^2 = \frac{3}{(\sin^2 \theta - 4 \cos^2 \theta)}$

c.  $\rho^2 = \frac{3}{(\sin^2 \phi - 4 \cos^2 \theta)}$

d.  $\rho^2 = \frac{3}{(\cos^2 \phi - 4 \sin^2 \phi)}$

e.  $\rho = -\sqrt{\frac{3}{4}}$

\_\_\_\_\_ 82. Find an equation in rectangular coordinates for the equation given in spherical coordinates. Express the coefficients to two decimal places.

$$\theta = \frac{\pi}{16}$$

a.  $y = 0.20x$

b.  $x = 0.20y$

c.  $y = 5.03x$

d.  $z = 0.20x$

e.  $y = 0.20z$

\_\_\_\_\_ 83. Find an equation in rectangular coordinates for the equation given in spherical coordinates.

$$\rho = -7 \csc \phi \sec \theta$$

a.  $y = -7$

b.  $x = -\frac{1}{7}$

c.  $x = -7$

d.  $z = -7$

e.  $y = -\frac{1}{7}$

\_\_\_\_\_ 84. Convert the following point from spherical coordinates to cylindrical coordinates.

$$\left(7, \frac{\pi}{4}, \frac{5\pi}{6}\right)$$

a.  $\left(\frac{7}{2}, \frac{\pi}{4}, \frac{-7\sqrt{3}}{2}\right)$

b.  $\left(\frac{7}{2}, \frac{\pi}{4}, \frac{7\sqrt{3}}{2}\right)$

c.  $\left(7, \frac{\pi}{4}, \frac{-7\sqrt{3}}{2}\right)$

d.  $\left(\frac{7\sqrt{3}}{2}, \frac{\pi}{4}, \frac{7}{2}\right)$

e.  $\left(\frac{-7\sqrt{3}}{2}, \frac{\pi}{4}, \frac{7}{2}\right)$

**Multivariable Calculus Chapter 11 Practice Test  
Answer Section****MULTIPLE CHOICE**

1. C
2. B
3. E
4. E
5. C
6. E
7. C
8. D
9. D
10. E
11. C
12. A
13. E
14. E
15. A
16. E
17. E
18. A
19. A
20. D
21. B
22. C
23. A
24. A
25. A
26. A
27. D
28. C
29. E
30. A
31. A
32. B
33. C
34. B
35. D
36. B
37. D
38. A
39. A

- 40. B
- 41. C
- 42. C
- 43. E
- 44. D
- 45. C
- 46. C
- 47. D
- 48. B
- 49. C
- 50. B
- 51. A
- 52. E
- 53. B
- 54. D
- 55. E
- 56. A
- 57. A
- 58. D
- 59. D
- 60. C
- 61. E
- 62. C
- 63. D
- 64. C
- 65. B
- 66. C
- 67. E
- 68. A
- 69. E
- 70. A
- 71. D
- 72. C
- 73. B
- 74. D
- 75. A
- 76. D
- 77. B
- 78. C
- 79. C
- 80. E
- 81. A
- 82. A
- 83. C
- 84. A