1. [Q. # 43 p. 747]
The slope of the parametric curve $x = e^t, y = e^{-t}$ at $t = 1$ is

(a) $-\frac{1}{e^2}$ (correct)
(b) e^2
(c) $-\frac{1}{e}$
(d) $\frac{1}{e}$
(e) e

2. [Q. # 101 p. 748]
The number of intersection points of the two polar curves $r = 1 - \cos\theta$ and $r = 1 + \sin\theta$ over $[0, 2\pi)$ is

(a) 3 (correct)
(b) 2
(c) 4
(d) 1
(e) 0

3. [Q. # 86 p. 796]
Let (a, b, c) be the intersection point of the plane $5x + 3y = 17$ and the line $\dfrac{x-4}{2} = \dfrac{y+1}{-3} = \dfrac{z+2}{5}$. Then $a + b + c =$

(a) 1 (correct)

(b) -2

(c) 4

(d) -3

(e) 0

4. [Q. # 24 p. 982]
The directional derivative of the function $f(x, y, z) = xy + yz + xz$ at the point $P(1, 2, -1)$ in direction of $\vec{v} = \langle 2, 1, -1\rangle$ is

(a) $-\dfrac{1}{\sqrt{6}}$ (correct)

(b) $\dfrac{2}{\sqrt{6}}$

(c) $-\dfrac{2}{\sqrt{6}}$

(d) $\dfrac{3}{\sqrt{6}}$

(e) $-\dfrac{5}{\sqrt{6}}$

5. [Q. # 40 p. 937]
The $x-$coordinate of the point on the surface

$$z = 4x^2 + 4xy - 2y^2 + 8x - 5y - 4$$

at which the tangent plane is horizontal is

(a) $-\dfrac{1}{4}$ (correct)

(b) $-\dfrac{1}{3}$

(c) -1

(d) $\dfrac{1}{12}$

(e) $-\dfrac{5}{12}$

6. [Example # 7 p. 926]
A normal vector to the level curve of $f(x, y) = y - \sin x$ at the point $(\pi, 0)$ is

(a) $\langle 1, 1 \rangle$ (correct)

(b) $\langle -1, 1 \rangle$

(c) $\langle 2, 1 \rangle$

(d) $\langle 1, 2 \rangle$

(e) $\langle -1, 2 \rangle$

7. [Q. # 17 p. 785]
A vector orthogonal to both $\mathbf{u} = -3\mathbf{i} + 2\mathbf{j} - 5\mathbf{k}$ and $\mathbf{v} = \mathbf{i} - \mathbf{j} + 4\mathbf{k}$, is

(a) $-3\mathbf{i} - 7\mathbf{j} - \mathbf{k}$ (correct)
(b) $3\mathbf{i} - 7\mathbf{j} - \mathbf{k}$
(c) $3\mathbf{i} - \mathbf{j} - 3\mathbf{k}$
(d) $\mathbf{i} + 7\mathbf{j} - 3\mathbf{k}$
(e) $7\mathbf{i} + \mathbf{j} - 3\mathbf{k}$

8. [Q. # 50 p. 893]
$$\lim_{(x,y)\to(0,0)} \frac{x^2 + 2xy^2 + y^2}{x^2 + y^2} =$$

(a) 1 (correct)
(b) 0
(c) -1
(d) 2
(e) DNE

9. [Q. #20 sec. 13.8]
The function $f(x,y) = \sqrt[3]{x^2+y^2} + 2$ has

(a) a relative minimum at $(0,0)$ (correct)

(b) a relative maximum at $(0,0)$

(c) a saddle point at $(0,0)$

(d) no extrema

(e) a critical point at $(0,1)$

10. [Q. #42 sec. 13.8]
Let T be the triangular region in the xy-plane with vertices $(2,0)$, $(0,1)$, and $(1,2)$ respectively. If M and m represent respectively the absolute maximum and absolute minimum of the function $f(x,y) = (2x-y)^2$ over the region T, then $M + m =$

(a) 16 (correct)

(b) 17

(c) 18

(d) 19

(e) 14

11. [≃ Q. #12 sec. 13.9]
A box without a top is to be made, where the material for the base costs twice as much per square unit as the material for the sides. If the sides cost \$4 per square unit and the total cost of materials is \$600, then the sum of length, width, and height of the largest possible box is:

(a) 15 units (correct)
(b) 30 units
(c) 20 units
(d) 60 units
(e) 35 units

12. [Q. # 16 sec. 13.10]
The minimum value of $f(x, y) = e^{-xy/4}$ subject to the constraint $x^2+y^2 = 1$ is equal to

(a) $e^{-\frac{1}{8}}$ (correct)
(b) $e^{\frac{1}{8}}$
(c) e^{-1}
(d) e
(e) 1

13. [Q. # 14 sec. 14.1]
$$\int_0^{\ln 4}\int_0^{\ln 3} e^{x+y}\, dydx =$$

(a) 6 (correct)

(b) 5

(c) 4

(d) 3

(e) 1

14. [Q. # 65 sec. 14.1]
$$\int_0^{1}\int_x^{1} \cos(y^2)\, dydx =$$

(a) $\frac{1}{2}\sin(1)$ (correct)

(b) $\sin(1)$

(c) $\cos(1)$

(d) $\frac{1}{2}\cos(1)$

(e) 0

15. [Q. # 22 sec. 14.3]

$$\int_0^{\sqrt{2}} \int_y^{\sqrt{4-y^2}} \sqrt{x^2+y^2}\, dx\, dy =$$

(a) $\frac{2\pi}{3}$ (correct)

(b) $\frac{4\pi}{3}$

(c) 2π

(d) $\frac{5\pi}{3}$

(e) $\frac{\pi}{2}$

16. [Q. # 24 sec. 14.2]

The volume of the solid bounded by $z = 4 - x - y$, $z = 0$, $y = 2$, $y = x$, and $x = 0$ is equal to

(a) 4 (correct)

(b) 3

(c) 2

(d) 1

(e) 5

17. [Q. # 27 sec. 14.6]

If $\int_0^4 \int_0^{(4-x)/2} \int_0^{(12-3x-6y)/4} dz\, dy\, dx = \int_0^a \int_0^b \int_0^c dy\, dx\, dz$, then

(a) $a = 3,\ b = \dfrac{12-4z}{3},\ c = \dfrac{12-4z-3x}{6}$ (correct)

(b) $a = \dfrac{12-4z}{3},\ b = 3,\ c = \dfrac{12-4z-3x}{6}$

(c) $a = \dfrac{12-4z}{3},\ b = \dfrac{12-4z-3x}{6},\ c = 3$

(d) $a = 3,\ b = \dfrac{12-4z-3x}{6},\ c = \dfrac{12-4z}{3}$

(e) $a = 12,\ b = 4,\ c = \dfrac{12-4z}{3}$

18. [Q. # 46 sec. 11.7]

An equation in spherical coordinates for the surface $x^2 + y^2 - 3z^2 = 0$ is

(a) $\phi = \dfrac{\pi}{3}$ or $\phi = \dfrac{2\pi}{3}$ (correct)

(b) $\phi = \dfrac{\pi}{6}$ or $\phi = \dfrac{5\pi}{6}$

(c) $\phi = \dfrac{\pi}{4}$ or $\phi = \dfrac{3\pi}{4}$

(d) $\phi = \dfrac{\pi}{4}$ or $\phi = \dfrac{\pi}{3}$

(e) $\phi = \dfrac{\pi}{2}$ or $\phi = \dfrac{3\pi}{2}$

19. [Q. # 16 sec. 14.7]
The volume of the solid inside $x^2+y^2+z^2=16$ and outside $z=\sqrt{x^2+y^2}$ is equal to

(a) $\frac{64\pi}{3}(2+\sqrt{2})$ (correct)

(b) $\frac{32\pi}{3}(2+\sqrt{2})$

(c) $\frac{64\pi}{3}(1+\sqrt{2})$

(d) $\frac{32\pi}{3}(1+\sqrt{2})$

(e) $\frac{\pi}{3}$

20. [$\simeq$ Example # 1, sec. 14.7 p. 1025]
If the volume of the solid region cut from the sphere $x^2+y^2+z^2=4$ by the cylinder $x^2+y^2-2y=0$ is given by

$$\int_0^{a\pi}\int_0^{b\sin\theta}\int_{-\sqrt{c-r^2}}^{\sqrt{c-r^2}} r\,dz\,dr\,d\theta.$$

Then $a+b+c=$

(a) 7 (correct)

(b) 8

(c) 5

(d) 6

(e) 10