1. An equation of the tangent line to the curve
\[ x = e^{t+1}, \quad y = t^2 - 2 \]
at the point \((1, -1)\) is:

(a) \[ 2x + y = 1 \]
(b) \[ x + 2y = -1 \]
(c) \[ x = -y \]
(d) \[ 2x - y = 3 \]
(e) \[ x - 2y = 3 \]

2. Area of the surface obtained by rotating the curve
\[ x = a \cos^3 \theta, \quad y = a \sin^3 \theta, \quad 0 \leq \theta \leq \frac{\pi}{2} \]
about \(x\)-axis is:

(a) \[ \frac{6\pi a^2}{5} \]
(b) \[ \frac{2\pi a^2}{5} \]
(c) \[ \frac{3\pi a^2}{5} \]
(d) \[ \frac{\pi a^2}{5} \]
(e) \[ \frac{4\pi a^2}{5} \]
3. Area of the region that lies inside both the curves $r = 1$ and $r = 1 - \sin \theta$ is equal to:

(a) $\frac{5\pi}{4} - 2$

(b) $\frac{\pi}{4} + 2$

(c) $\pi$

(d) $\frac{\pi}{4}$

(e) $\frac{\pi}{4} - 1$

4. Volume of a parallelepiped with three adjacent sides $\vec{a} = 2\hat{i} - \hat{j} + 3\hat{k}$, $\vec{b} = \hat{i} + 2\hat{j} - \hat{k}$ and $\vec{c} = -\hat{i} + 3\hat{j} + 2\hat{k}$ is:

(a) 30

(b) 32

(c) 28

(d) 18

(e) 0
5. An equation of the plane that passes through the point 
(-1, 2, 1) and contains the line of intersection of the planes 
\(x + y - z = 2\) and \(2x - y + 4z = 1\) is:

(a) \(x - y + 3z = 0\)
(b) \(-x + y + 3z = 6\)
(c) \(x + y + 3z = 4\)
(d) \(2x - y + z = -3\)
(e) \(x - 2y + z = -4\)

6. The line passing through \((1, 0, 1)\) and \((4, -2, 2)\) intersect
the plane \(2x + 3y - 4z = 6\) at the point:

(a) \((-5, 4, -1)\)
(b) \((-2, 6, 2)\)
(c) \((-1, 4, 1)\)
(d) \((5, -2, 0)\)
(e) \((3, 4, 3)\)
7. If \( L = \lim_{(x, y) \to (0, \frac{\pi}{2})} \frac{x^2 + \cos y}{\sqrt{x^2 + \cos y + 9 - 3}} \), then:

(a) \( L = 6 \)

(b) \( L \) does not exist

(c) \( L = 0 \)

(d) \( L = 3 \)

(e) \( L = \frac{1}{6} \)

8. If \( f(x, y) = e^{\frac{y}{x}} \), then \( \frac{\partial^5 f}{\partial y^3 \partial x \partial y^2}(-1, 1) \) is equal to:

(a) \( \frac{3}{e} \)

(b) \( -\frac{5}{e} \)

(c) \( \frac{5}{e} \)

(d) \( -\frac{3}{e} \)

(e) \( \frac{4}{e} \)
9. If \( f(x, y, z) = xz + x^2y^3 \) and \( x = s^2 + t^2, \ y = st, \ z = \sqrt{s - t}, \) then \( \frac{\partial f}{\partial s} + \frac{\partial f}{\partial t} \) at \( s = 1 \) and \( t = 0 \) is equal to:

(a) 2
(b) -2
(c) 1
(d) 0
(e) 3

10. Directional derivative of \( f(x, y, z) = e^x \ln(xy + z^2) \) at the point \((-1, 1, 2)\) in the direction of \(2 \hat{i} - \hat{j} + 2\hat{k}\) is:

(a) \( \frac{11}{9e} + \frac{2 \ln 3}{3e} \)
(b) \( \frac{11}{3e} + \frac{\ln 3}{3e} \)
(c) \( \frac{1}{e} + \frac{2 \ln 3}{3e} \)
(d) \( \frac{4}{3e} + \frac{2 \ln 3}{e} \)
(e) \( \frac{5}{9e} + \frac{\ln 3}{3e} \)
11. The average value of \( f(x, y) = \cos(x^2 + y^2) \) over the region \( x^2 + y^2 \leq 2 \) is:

(a) \( \frac{\sin 2}{2} \)
(b) \( \frac{\pi \sin 2}{2} \)
(c) \( \frac{\pi \cos 2}{2} \)
(d) \( \frac{\cos 4}{2} \)
(e) \( \frac{\sin 4}{2} \)

12. If \( L_1 : \frac{x-1}{1} = \frac{y+2}{2} = \frac{z}{2} \) and \( L_2 : \frac{x-1}{2} = \frac{y+2}{2} = \frac{z}{1} \) are two lines lying on the tangent plane to the surface \( S \) at the point \((1, 0, -1)\), then the equations of the normal line to the surface \( S \) at \((1, 0, -1)\) are:

(a) \( \frac{x - 1}{-6} = \frac{y}{3} = \frac{z + 1}{6} \)
(b) \( \frac{x - 1}{6} = \frac{y}{-3} = \frac{z + 1}{6} \)
(c) \( \frac{x - 1}{4} = \frac{y}{2} = \frac{z + 1}{-2} \)
(d) \( \frac{x - 1}{-2} = \frac{y}{1} = \frac{z + 1}{-2} \)
(e) \( \frac{x - 1}{-6} = \frac{y}{-3} = \frac{z + 1}{6} \)
13. If $A$ and $B$ are respectively the absolute maximum and absolute minimum of $f(x, y) = x^2 + 2y^2 - 2y$ on the closed disk $D = \{(x, y)|x^2 + y^2 \leq 5\}$, then $A + B$ is equal to:

(a) $\frac{19}{2} + 2\sqrt{5}$
(b) $12 + 2\sqrt{5}$
(c) $-\frac{1}{2} + 2\sqrt{5}$
(d) $\frac{19}{2}\sqrt{5}$
(e) $\sqrt{5} - \frac{1}{2}$

14. The volume of the solid below $z = x^2 - 2xy + 3$ and above the rectangle $R = \{(x, y)|0 \leq x \leq 1, -1 \leq y \leq 1\}$

(a) $\frac{20}{3}$
(b) $\frac{5}{3}$
(c) $\frac{2}{3}$
(d) 6
(e) $\frac{5}{6}$
15. The value of the double integral \( \int_0^1 \int_{\sqrt{y}}^1 \sqrt{x^3 + 1} \, dx \, dy \)

(a) \( \frac{2}{9} \left( 2\sqrt{2} - 1 \right) \)

(b) \( 2\sqrt{2} + \frac{2}{9} \)

(c) \( 1 + \frac{2\sqrt{2}}{9} \)

(d) \( 9 + 2\sqrt{2} \)

(e) \( \frac{2}{9} \left( \sqrt{2} + 2 \right) \)

16. Let \( V \) be the volume of the solid under the surface \( z = 2x + y^2 \) and above the region bounded by the curves \( x - y^2 = 0 \) and \( x - y^3 = 0 \). Then:

(a) \( V = \frac{19}{210} \)

(b) \( V = \frac{13}{42} \)

(c) \( V = \frac{84}{19} \)

(d) \( V = \frac{65}{84} \)

(e) \( V = \frac{19}{65} \)
17. The volume of the solid which lies below the sphere
\[ x^2 + y^2 + z^2 = 4, \] above the \( xy \)-plane and inside the cylinder
\[ x^2 + y^2 = 3 \] is equal to:

(a) \( \frac{14\pi}{3} \)

(b) \( \frac{7\pi}{14} \)

(c) \( \frac{3\pi}{4} \)

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

(e) \( \frac{3\pi}{7} \)

18. The value of the iterated integral
\[ \int_0^1 \int_0^z \int_0^{\sqrt[3]{y^2}} x \, dx \, dy \, dz \] is:

(a) \( \frac{1}{16} \)

(b) \( \frac{3}{14} \)

(c) \( \frac{7}{15} \)

(d) \( \frac{1}{8} \)

(e) \( \frac{3}{17} \)
19. The value of \( \iiint_E (yz) \, dz \, dy \, dx \), where \( E \) is the solid in the first octant bounded by \( y = 0 \), \( y = \sqrt{1 - x^2} \), and \( x = z \) is:

(a) \( \frac{1}{30} \)

(b) \( \frac{1}{15} \)

(c) \( \frac{2}{15} \)

(d) \( \frac{1}{25} \)

(e) \( \frac{1}{16} \)

20. The volume of the solid that lies within the sphere \( x^2 + y^2 + z^2 = 4 \), above the plane \( z = 0 \) and below the cone \( z^2 = x^2 + y^2 \) is:

(a) \( \frac{8\sqrt{2} \pi}{3} \)

(b) \( \frac{16\pi}{3} - \frac{8\sqrt{2} \pi}{3} \)

(c) \( \frac{4\sqrt{2} \pi}{3} \)

(d) \( \frac{64\sqrt{2} \pi}{3} \)

(e) \( \frac{32\sqrt{2} \pi}{3} \)