

1. (T/F)  $\int_C F \cdot ds = 0$  for all closed curved C.
2. (T/F) If  $F = \nabla\phi$ , then  $\nabla \times F = 0$ .
3. If  $F = \nabla\phi$ , with  $\phi = x - y$ , calculate  $\int F \cdot ds$  on a curve from  $(1, 1)$  to  $(3, 6)$ .
4. (T/F) The following limits exist

$$\lim_{(x,y) \rightarrow (0,0)} \frac{\sin(x)y^2}{x^2 + y^2} \quad \left( \text{also} \quad \lim_{(x,y) \rightarrow (0,0)} \frac{xy}{x^2 + y^2} \right).$$

5. Calculate  $f_x$ , with  $f(x, y, z) = \sin(xyz)e^x$ .
6. Evaluate  $u \times v$ , with  $u = (1, 1, 8)$  and  $v = (3, 1, 6)$ .
7. Is  $F = \langle 1, x^2, y \rangle$  a conservative vector field?
8. Find the potential function for  $F = \langle xy^2, yx^2 \rangle$ .
9. (T/F)  $F(x, y) = \frac{x(1+y)}{1-y^2}$  is continuous.
10. Write the volume infinitesimal dV in spherical coordinates.
11. Write the volume infinitesimal dV in cylindrical coordinates.
12. Write the formulae which convert cartesian to polar coordinates.
13. Write  $z = \cos(x^2 + y^2)$  in cylindrical coordinates.
14. Find the tangent plane to  $z = \cos(x^2 + y^2)$  at  $(0, \sqrt{\pi}, -1)$ .
15. Draw the level set of  $f(x, y) = \exp(-x^2 - y^2)$ , corresponding to  $z = 1$ .
16. Are  $u = \langle 1, 2, -1 \rangle$  and  $v = \langle 0, 3, 3 \rangle$  orthogonal?
17. Find a vector perpendicular to  $u$  and  $v$ .
18. Find the equation for the line in the direction of  $u$  through  $\langle 1, 1, -2 \rangle$ .
19. (T/F) The volume of the region between  $z = x^2 + y^2$  and  $z = \sqrt{x^2 + y^2}$  can be found with
$$\int_0^1 \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} \int_{x^2+y^2}^{\sqrt{x^2+y^2}} dz dy dx \quad \left( \text{or} \quad \int_0^1 \int_0^{2\pi} \int_{r^2}^r dz d\theta dr \right)$$
20. Write a formula for the curvature  $\kappa$ .
21. Write the formula for the arclength,  $s$ , of a curve  $r(t)$  for  $t \in [a, b]$ .
22. Find a unit tangent vector to  $r(t) = \langle t, t^2, 1 - \tan(t) \rangle$ .