1. (a) center \((-1, -2, 3)\), radius 2
   (b) distance = \(\sqrt{14}\)
   (c) closest distance is \(\sqrt{14} - 2\)

2. (a) normal direction is \(\langle 3, 6, 2 \rangle\)
   (b) the equation is \(3x + 6y + 2z = 6\)
   (c) the distance is \(\frac{6}{7}\)

3. (a) the parametric equations are \(x = 3t, y = 2t, z = t\) for all \(t\)
   (b) the direction is \(\langle -1, -2, 1 \rangle\)
   (c) the intersection point is \((9, 6, 3)\)
   (d) \(\pm \sqrt{\frac{2}{7}}\)

4. (a) \(\mathbf{a}(0) = \langle 1, -1, 0 \rangle\)
   (b) speed = \(\sqrt{2}\)
   (c) \(\mathbf{r}(t) = \langle e^t + 7, 1 + \ln(1 + t), \frac{1}{3}t^3 - 2 \rangle\)

5. (a) \(f_x = 2x \ln(x^2 + y^2) + \frac{2x^3}{x^2 + y^2}, f_y = \frac{2x^2y}{x^2 + y^2}\)
   (b) \(L(x, y) = 2x - 2\)
   (c) \(f(0.99, 0.01) \approx L(0.99, 0.01) = -0.02\)

6. (a) \(\nabla f(1, 3) = \langle 7, 7 \rangle\)
   (b) \(D_u f(1, 3) = \frac{-7}{5}\)
   (c) the maximum value of \(D_v f(1, 3)\) is \(|\nabla f(1, 3)| = \sqrt{98}\) for any unit vector \(\mathbf{v}\), and \(10 > \sqrt{98}\)

7. (a) \((0, -1)\)
   (b) local minimum

8. (a) \(224\)
   (b) \(\frac{688}{3}\)
   (c) under-estimate

9. (a) volume
   (b) \(D = \{(x, y) : 0 \leq y \leq 1, y - 1 \leq x \leq 1 - y\}\)
   (c) \(\frac{1}{90}\)

10. (a) \(\frac{19}{8}\)
    (b) \(\int_0^1 \int_0^1 \int_0^{\sqrt{1-x^2-y^2}} \sin(xyz) \, dz \, dy \, dx\)