1. (a) \(2x + y + 3z = 6\)  
   (b) \(\kappa(t) = \frac{2\sqrt{1+9t^2+9t^4}}{|1+4t^2+9t^4|^{3/2}}\)

2. (a) \(\hat{T}(1) = \frac{(2,0,1)}{\sqrt{5}}\)  
   (b) \(\frac{1}{3}[5^{3/2} - 8]\)

3. (a) \(\nabla \times \mathbf{F} = \mathbf{0}\). \(\mathbf{F}\) is conservative.  
   (b) \(\int_C \mathbf{F} \cdot d\mathbf{r} = 2\pi^2\)

4. (a) 8  
   (b) \(4\sqrt{3}\)

5. (a) \(\mathbf{r}(\theta, z) = \frac{2}{3}(3-z) \cos \theta \hat{i} + \frac{2}{3}(3-z) \sin \theta \hat{j} + z \hat{k}\) \(0 \leq \theta < 2\pi, \ 0 \leq z \leq 3\).  
   (b) 1

6. (a) \(\frac{1}{\sqrt{3}}(-1,-1,1)\)  
   (b) \(-\frac{27\pi}{2}\)  
   (c) \(-\frac{81\pi}{2}\)

7. (a) \(\nabla \cdot \mathbf{F} = 2 + 2z\)  
   (b) \(\pi \frac{23}{6} 5^3 = 479\frac{1}{6}\pi\)

   (c) Let \(S\) be an oriented surface that encloses a solid \(V\) and has outward pointing normal. If \(\bar{z} = -\frac{9}{2|V|} - 1\), where \(|V|\) is the volume of \(V\) and \(\bar{z}\) is the \(z\)-component of the centroid (i.e. centre of mass with constant density) of \(V\), then \(\iint_S \mathbf{F} \cdot \hat{n} \, dS = -9\). One surface which obeys this condition is the unit cube (with outward normal) centred on \((0, 0, -\frac{11}{2})\).

8. (a) True  
   (b) True  
   (c) True  
   (d) False  
   (e) True  

   (f) That depends. If \(\kappa = 0\), the curve is part of a straight line. If \(\kappa > 0\) it is part of a circle of radius \(\frac{1}{\kappa}\).

   (g) False  
   (h) False  
   (i) False