1. Write down the formulas for $\mathbf{T}, \mathbf{N}, \mathbf{B}, a_T, a_N, a, \kappa(t)$, speed, and arclength
2. Given $\mathbf{r}(t)$, write:
   (a) 3 different ways to determine $\mathbf{N}$
   (b) 2 different ways to determine a_T
   (c) 2 different ways to determine a_N
3. Find the arclength of
4. $\mathbf{r}(t) =< t^2, -2t^3, 6t^3 >$ for $0 \leq t \leq 1$
5. Find $\kappa, \mathbf{T}, \mathbf{N}, \mathbf{B}$ at the given time
   $\mathbf{r}(t) =< \cos^3(t), 0, \sin^3(t) >$, $t = \frac{\pi}{2}$
6. (a) What does $\mathbf{u} \cdot \mathbf{v} = 0$ imply?
   (b) What does $\mathbf{u} \cdot \mathbf{u} = 0$ imply?
   (c) What does $\mathbf{u} \times \mathbf{v} = 0$ imply?
   (d) What is $\mathbf{u} \times \mathbf{u}$?
7. Find the distance between the parallel lines
   $-3x + 2y + z = 9$ and $6x - 4y - 2z = 19$
8. Prove that $\mathbf{u} \cdot \mathbf{v} = \frac{1}{4}|\mathbf{u} + \mathbf{v}|^2 - \frac{1}{4}|\mathbf{u} - \mathbf{v}|^2$
9. Find the equation of the plane passing through (-1,2,3) such that:
   (a) the plane is parallel to the plane $2x + 4y - z = 6$
   (b) the plane passes through (0, 1, 0) and (0, 0, 1)
10. Show that if $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$, $\mathbf{d}$ are all in the same plane, then
    $(\mathbf{a} \times \mathbf{b}) \times (\mathbf{c} \times \mathbf{d}) = \mathbf{0}$
11. Find the equation of the plane through (6,2,-1) that is perpendicular to the line of intersection of the planes
    $4x - 3y + 2z = -5$ and $3x + 2y - z = -11$
12. A bee is flying along a path described by $\mathbf{b}(t) =< 2t, \sin t, \cos t + 1 >$, and a fly flis along a path described by $\mathbf{f}(t) =< t + k, \sin(2t), \cos(2t) + 1 >$
    Can I choose a $k > 0$ such that the bee and the fly collide? Give a formula for this k if so.
13. Sketch the graph of:
    (a) $8x^2 + 18y^2 - 2z^2 = 0$
    (b) $8x^2 + 18y^2 - 2x^2 = 1$

14. Convert $\rho = 2\cos\phi$ to cylindrical coordinates

15. Write the equation of the paraboloid ($x^2 + y^2 - z = 0$) in cylindrical and spherical coordinates

16. Find the slope of the tangent line to the curve created by intersection of $2z = \sqrt{9x^2 + 9y^2 - 36}$ with the plane $y = 1$ at $(2, 1, \frac{3}{2})$

17. Find the following limits:

    (a) $lim_{(x,y)\to(0,0)} \frac{\tan(x^2+y^2)}{x^2+y^2}$

    (b) $lim_{(x,y)\to(0,0)} \frac{\cos(x^2+y^2)}{x^2+y^2}$

18. Find the tangent plane to:

    (a) $2z = \sqrt{9x^2 + 9y^2 - 36}$ at $(2, 1, \frac{3}{2}$

    (b) $z = 10x^2 + 4x + 9y^2 - 6xy + 4$ at $(2, 1, 45)$

19. Find the gradient of

    (a) $f(x, y, z) = xzln(x + y + z)$

    (b) $f(x, y, z) = \sin^3(x^2y)$