1. Multiple choice. Circle all that apply.

   (a) [3 pts] If a particle moves along a straight line, what can you say about its acceleration vector?

   (i) The acceleration vector is parallel to the tangent vector.

   (ii) The acceleration vector has magnitude equal to one.

   (iii) The acceleration vector equals the velocity vector.

   (iv) The acceleration vector is parallel to the unit normal vector.

   (v) The acceleration vector has a magnitude equal to zero.

   (b) [3 pts] If a particle moves with constant speed along a curve, what can you say about its acceleration vector?

   (i) The acceleration vector is parallel to the tangent vector.

   (ii) The acceleration vector has a magnitude of one.

   (iii) The acceleration vector equals the velocity vector.

   (iv) The acceleration vector is parallel to the unit normal vector.

   (v) The acceleration vector has a magnitude of zero.

   (c) [3 pts] Let $\mathbf{r}_1(t)$ and $\mathbf{r}_2(t)$ be two parametrizations of the same space curve $\mathcal{C}$. Then at any time t the velocity vectors $\mathbf{v}_1(t)$ and $\mathbf{v}_2(t)$ are equal.

   (i) True.
   (ii) False.
   (iii) Indeterminable.

2. A leaf tumbles down following the curve of intersection between the hyperbolic paraboloid $z = x^2 - y^2$ and the cylinder $x^2 + y^2 = 64$.

   (a) [3 pts] Find a vector-valued function $\mathbf{r}(t)$ that parametrizes the path taken by the falling leaf.

   (b) [3 pts] How far does the *shadow* (i.e. the projection of the space curve $\mathbf{r}(t)$ onto the xy-plane) of the leaf travel from $t = 0$ to $t = \pi$?

Points earned: ______
out of a possible 6 points

3. [4 pts] Consider the space curve $\mathcal{C}$ parametrized by

$$\mathbf{r}(t) = \begin{bmatrix} 3\sin(t) \\ \cos(t) - \sin(t) \\ -3\cos(t) + 6 \end{bmatrix} \quad -\infty < t < \infty$$

Show that $\mathcal{C}$ lies entirely in a single plane. Provide an equation for the plane.