Name: .............................................................

1) For each of the vector-valued functions given below, find the unit tangent vector:
   (a) \( \mathbf{r}(t) = < t, t^2 > \)
   (b) \( \mathbf{r}(t) = < \cos^3 t, \sin^3 t > \)
   (c) \( \mathbf{r}(t) = < 3 \sin t, 5 \cos t, 4 \sin t > \).

2) For each of the vector-valued functions given below, find the unit tangent vector, the principal unit normal vector, the binormal vector and the equation of the osculating plane at the specified point:
   (a) \( \mathbf{r}(t) = < t, t^2, \frac{2}{3}t^3 >, \quad t = 1 \)
   (b) \( \mathbf{r}(t) = < e^t, e^{-t}, \sqrt{2}t >, \quad t = 0 \)
   (c) \( \mathbf{r}(t) = < \sin 2t, \cos 2t, t >, \quad t = \frac{\pi}{2} \)

3) Find the arc length of the curves defined by the vector-valued functions on the specified intervals:
   (a) \( \mathbf{r}(t) = < 3 \cos 4t, 3 \sin 4t >, \quad [0, \pi/2] \)
   (b) \( \mathbf{r}(t) = < 4 \sin t, t^{3/2}, -4 \cos t >, \quad [0, 4] \)

4) Show that the given vector-valued functions are not arc-length parametrization. Then find an arc length parametrization for the curves defined by those functions.
   (a) \( \mathbf{r}(t) = < \cos t, \sin t, t > \)
   (b) \( \mathbf{r}(t) = < 3 + 2t, 4 - t, -1 + 5t > \)

5) Find the curvature of the vector-valued functions:
   (a) \( \mathbf{r}(t) = < t, t^2, t^3 > \)
   (b) \( \mathbf{r}(t) = < t \sin t, t \cos t, t > \)