(1) Evaluate the integral
\[ \int_0^4 (\sqrt{t} \mathbf{i} + te^{-t} \mathbf{j} + \frac{1}{t^2} \mathbf{k}) \, dt \]

(2) The curves \( \mathbf{r}_1(t) = \langle t, t^2, t^3 \rangle \) and \( \mathbf{r}_2(t) = \langle \sin t, \sin 2t, t \rangle \) intersect at the origin. Find their angle of intersection correct to the nearest degree.

(3) Find the curvature of \( \mathbf{r}(t) = \langle e^t \cos t, e^t \sin t, t \rangle \) at the point \((1, 0, 0)\).

(4) Parameterize the curve \( \mathbf{r}(t) = \langle 3 \sin t, 4t, 3 \cos t \rangle \) with respect to arc length measured from the point where \( t = 0 \) in the direction of increasing \( t \).

(5) Find the equations of the osculating circles of the ellipse \( 9x^2 + 4y^2 = 36 \) at the points \((2, 0) \) and \((0, 3)\).

(6) Find the vectors \( \mathbf{T}, \mathbf{N} \) and \( \mathbf{B} \) at the point \((0, \pi, -2)\) of the curve \( \mathbf{r}(t) = \langle 2 \sin 3t, t, 2 \cos 3t \rangle \). Find the equation of the osculating plane at the same point.

(7) A gun is fired with angle of elevation 30 degree. What is the muzzle speed if the maximum height of the shell is 500?