3.) Let path C be determined by $\vec{r}(t) = (t)\,\vec{i} + (t^2)\,\vec{j}$ for $t \geq 0$.

a.) Plot C in the xy-plane.

b.) Find the velocity vector $\vec{v}(t)$, the acceleration vector $\vec{a}(t)$, the unit tangent vector $\vec{T}(t)$, and the principal unit normal vector $N(t)$.

c.) Find the speed and acceleration of motion when $t = 1$.

6.) Give a formula $\vec{F}(x, y) = M(x, y)\,\vec{\imath} + N(x, y)\,\vec{\jmath}$ for a vector field in the plane that has the following two properties :

i.) It points away from the origin.
ii.) Its magnitude is equal to the cube of the distance from (x, y) to the origin.

6.) Let path C be given by $\vec{r}(t) = (e^t - t)\,\vec{\imath} + (4e^{(1/2)t})\,\vec{\jmath} + 3\,\vec{k}$ for $0 \le t \le 2$. Compute the length of C.

7.) Let path C be given by $\vec{r}(t) = (5\cos t)\,\vec{\imath} + (5\sin t)\,\vec{\jmath} + (12t)\,\vec{k}$ for $t \geq 0$. Write time t as a function of arc length s.

8.) Evaluate the following line integrals

b.) $\int_C xz \; ds$, where C : line segment from $(3, 0, -1)$ to $(2, 2, 1)$

1.) Find the Flux for $\vec{F}(x,y) = (xy)\,\vec{\imath} + (x^2)\,\vec{\jmath}$ across the loop C : the ellipse $\left(\frac{x}{16}\right)^2 + \left(\frac{y}{9}\right)^2 = 1$.

2.) Show that the following vector field is conservative. Then find a scalar function $f(x,y,z)$ satisfying $\vec{F} = \vec{\nabla} f(x,y,z)$.

$$\vec{F}(x,y,z) = (y\cos z - yze^x)\,\vec{i} + (x\cos z - ze^x)\,\vec{j} + (-xy\sin z - ye^x + 1)\vec{k}$$

3.) Show that $\int_{(0,0)}^{(1,2)} (y^2 + 2xy)dx + (x^2 + 2xy)dy$ is path independent. Then calculate value of line integral.

5.) Use Green's Theorem to find the Circulation of $\vec{F}(x,y) = (x^2+y^2)\,\vec{i}+(-2xy)\,\vec{j}$ around the triangle with vertices $(0,0)$, $(1,0)$, and $(0,2)$.

The following EXTRA CREDIT PROBLEM is OPTIONAL.

1.) In class we showed that the integral for the Flux of the vector field $\vec{F}(x,y) = M(x,y)\,\vec{i} + N(x,y)\,\vec{j}$ on loop $C : \vec{r}(t) = (f(t))\,\vec{i} + (g(t))\,\vec{j}$ for $a \le t \le b$ is

$$\int_C \vec{F} \cdot \vec{n}\; ds = \int_C M dy - N dx \; .$$

Show that Flux can also be calculated using

$$\int_C \vec{F} \cdot \vec{n}\; ds = -\int_C \vec{F} \cdot \vec{a}(t)\, \frac{|\vec{v}(t)|}{|\vec{a}(t)|}\; dt \; ,$$

where $\vec{v}(t)$ and $\vec{a}(t)$ are the velocity vector and acceleration vector for $\vec{r}(t)$, resp.