(1) 12 Points. Match the following vector fields with their plots on the cherry page:

(For uniformity, mark one of a,b,c,d,e or f next to each of the capital roman numbers I,II,III,IV,V and VI on the colored vector field page and turn in the vector field page.)

(a) \( \vec{F} = \vec{i} + x^2 \vec{j} \)  
(b) \( \vec{F} = x \vec{i} + y \vec{j} \)  
(c) \( \vec{F} = -y \vec{i} + x \vec{j} \)  

(d) \( \vec{F} = (x^2 + y^2)(\vec{i} + \vec{j}) \)  
(e) \( \vec{F} = -y^2 \vec{i} + x^2 \vec{j} \)  
(f) \( \vec{F} = \vec{i} - 2\vec{j} \)

(2) 12 Points. Find the velocity vector, \( \vec{v} \), and the acceleration vector, \( \vec{a} \), for a particle which has position \( \vec{r} = t^3 \vec{i} + \sin(t^2) \vec{j} - e^{-5t} \vec{k} \) at time \( t \).

(3) 12 Points. Find the standard parametric description for the straight line segment from the point \( (5, -2, 4) \) to the point \( (3, 0, 7) \).

(4) 12 Points. If \( \vec{F} = (x^2 - 2y^3) \vec{i} + (y^3 - 3z^4) \vec{j} + (z^4 - 4x^5) \vec{k} \), find both \( \text{div}(\vec{F}) \) and \( \text{curl}(\vec{F}) \).

(5) Let \( \vec{F} = (3x^2 + e^z \sin y) \vec{i} + (5e^{5y} + xe^z \cos y) \vec{j} + (2z + xe^z \sin y) \vec{k} \).

(a) 12 Points. Find a function \( w \) such that \( \vec{F} = \nabla w \).

(b) 12 Points. Evaluate the line integral \( \int_C \vec{F} \cdot d\vec{r} \) if the curve \( C \) is described parametrically by \( x = 2t^2 - t, \quad y = \pi t, \quad z = 3t \) for \( 0 \leq t \leq 1 \).

(6) 14 Points. A particle travels along the curve \( C \) which is the intersection of the circular paraboloid \( z = x^2 + y^2 + 1 \) with the plane \( x = 1 \) from \( (1, 0, 2) \) to \( (1, 2, 6) \). If the particle is subject to the force \( \vec{F} = e^{xy} \vec{i} + z \vec{j} + xy \vec{k} \), find the total work done on the particle by the force.

(7) 14 Points. Evaluate \( \int_C z^2 \, ds \) if the curve \( C \) is described parametrically by \( \vec{r} = \frac{4}{3}(t^{3/2} - 1) \vec{i} + (\frac{1}{2}t^2 - 2t) \vec{j} + \frac{4}{3}t^{3/2} \vec{k} \) for \( 0 \leq t \leq 1 \).