

**Extra Math Problems, Conservation of Energy in 2D:****Problem 1 (Paul's Online notes): let  $C$  be the prescribed path to take the integral.**Evaluate  $\int_C \vec{F} \cdot d\vec{r}$  where  $\vec{F}(x, y) = y^2 \vec{i} + (3x - 6y) \vec{j}$  and  $C$  is the line segment from  $(3, 7)$  to  $(0, 12)$ .Prove if  $\mathbf{F}$  is conservative/non-conservative**Problem 2 (Paul's Online notes): let  $C$  be the prescribed path to take the integral.**Evaluate  $\int_C \vec{F} \cdot d\vec{r}$  where  $\vec{F}(x, y) = y^2 \vec{i} + (x^2 - 4) \vec{j}$  and  $C$  is the portion of  $y = (x - 1)^2$  from  $x = 0$  to  $x = 3$ .Prove if  $\mathbf{F}$  is conservative/non-conservative**Problem 3 (OpenStax):**Are the following the vector fields conservative? If so, find the potential function  $f$  such that  $\mathbf{F} = \nabla f$ .

433.  $\mathbf{F}(x, y) = y\mathbf{i} + (x - 2e^y)\mathbf{j}$

434.  $\mathbf{F}(x, y) = (6xy)\mathbf{i} + (3x^2 - ye^y)\mathbf{j}$

435.  $\mathbf{F}(x, y, z) = (2xy + z^2)\mathbf{i} + (x^2 + 2yz)\mathbf{j} + (2xz + y^2)\mathbf{k}$

436.  $\mathbf{F}(x, y, z) = (e^x y)\mathbf{i} + (e^x + z)\mathbf{j} + (e^x + y^2)\mathbf{k}$