

Answer on Question #49225 – Physics – Other

1. The potential energy function associated with the force $\mathbf{F}=4xy\mathbf{i}^{\wedge}+2x^2\mathbf{j}^{\wedge}$ is

- (1) $U=-2x^2y$
- (2) $U=-2x^2y+\text{constant}$
- (3) $U=2x^2y+\text{constant}$
- (4) Not defined

Solution.

The force equals to the gradient of the potential energy and taken with minus sign: $\vec{F} = -\vec{\nabla} U$.

The gradient is $\vec{\nabla} U = \left(\frac{\partial U}{\partial x}; \frac{\partial U}{\partial y} \right)$.

$$\text{So, } \begin{cases} 4xy = -\frac{\partial U}{\partial x} \\ 2x^2 = -\frac{\partial U}{\partial y} \end{cases}$$

$$U = -4y \int x dx = -4y \cdot \frac{x^2}{2} + C(y) = -2x^2y + C(y).$$

$$\frac{\partial U}{\partial y} = -2x^2 + C'(y).$$

$$2x^2 = -[-2x^2 + C'(y)], \quad C'(y) = 0, \quad C(y) = C_1, \quad C_1 \in R.$$

$$\text{Thus, } U = -2x^2y + C_1, \quad C_1 \in R.$$

Answer: 2)