

Chapter 7 Problem 28 [†]

Given

$$U = 16x^2 - 4$$

Solution

a) Find the force when the particle is at $x = 2.1 \text{ m}$.

The relationship between force in the x direction and the potential energy is

$$F_x = -\frac{dU}{dx}$$

Substitute in the potential function given for this problem we get a force of

$$F_x = -\frac{d(16x^2 - 4)}{dx} = -(16(2x) - 0) = -32x \tag{1}$$

Substituting in the value of $x = 2.1 \text{ m}$ gives

$$F_x = -32(2.1 \text{ m}) = -67.2 \text{ N} = -67 \text{ N}$$

b) Find the force when the particle is at $x = 0 \text{ m}$.

Use equation (1) and substitute in $x = 0 \text{ m}$.

$$F_x = -32(0 \text{ m}) = 0 \text{ N}$$

c) Find the force when the particle is at $x = -1.4 \text{ m}$.

Use equation (1) and substitute in $x = -1.4 \text{ m}$.

$$F_x = -32(-1.4 \text{ m}) = 44.8 \text{ N} = 45 \text{ N}$$

[†]Problem from Essential University Physics, Wolfson