Given

$U = 16x^2 - 4$

Solution

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

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 $x = 2.1\ m$ gives

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

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

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

$$F_x = -32(0\ m) = 0\ N$$

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

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

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

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†Problem from Essential University Physics, Wolfson