Answer on Question #51100, Physics

1) A boy of mass 2 kg is thrown vertically upwards with an initial velocity of 20 m/s. What will be its potential energy at the end of 2s?

Solution

We direct coordinate axis vertically upwards. Assume that the initial coordinate $y_0 = 0$. The formula which describes the change in position over time

$$y(t) = y_0 + v_0 t - \frac{gt^2}{2} \tag{1}$$

where $v_0 = 20m/s$ is the initial velocity of movement; $g = 10m/s^2$ is the acceleration of gravity.

Than the frame at time $t = 2s$ is

$$y(2) = 20 \cdot 2 - \frac{10 \cdot 2^2}{2} = 20m \tag{2}$$

The potential energy is given by Eq.(3)

$$E = mgy(2) = 2kg \cdot 10m/s^2 \cdot 20m = 400J \tag{3}$$

Answer: $E = 400J$

2) A girl sits and stands repeatedly for 5 minutes. Draw a graph to show the variation in potential energy of her body with time.

Solution

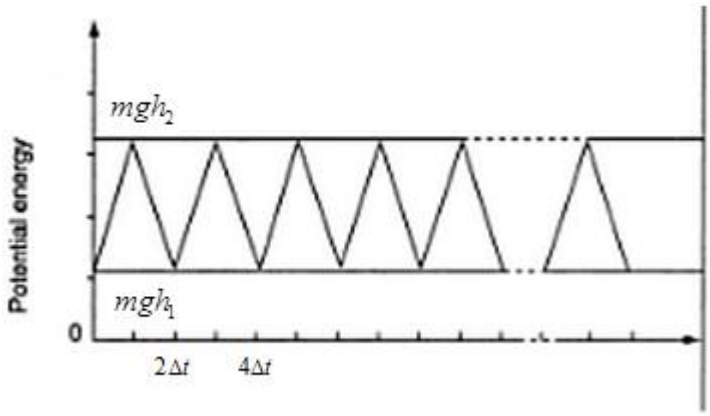

Fig.1

Assume that the centre of gravity of the girl is the navel where her weight m acts. Let the height of navel from the floor be h_1 while the girl is sitting. In this case, the potential energy is mgh_1. Now as the girl rises and stands up, her navel also rises and

finally (in the standing position), the height of navel from the floor becomes h_2. As a result the potential energy of the girl changes from mgh_1 to mgh_2. This process is repeated for 5 minutes. Let h be the height of navel at time t. Suppose the time taken by her in coming back to the sitting position, from the standing position. Let this time be constant and be denoted by Δt. Suppose the girl starts from the sitting position at $t = 0$. Then at $t = 0, 2\Delta t, 4\Delta t$, etc., her potential energy will be mgh_1 and at $\Delta t, 3\Delta t$,,..., her potential energy will be mgh_2. At other points of time, in between above moments, the potential energy may be assumed to be proportional to time which is proportional to height h).