Potential Energy-Class notes

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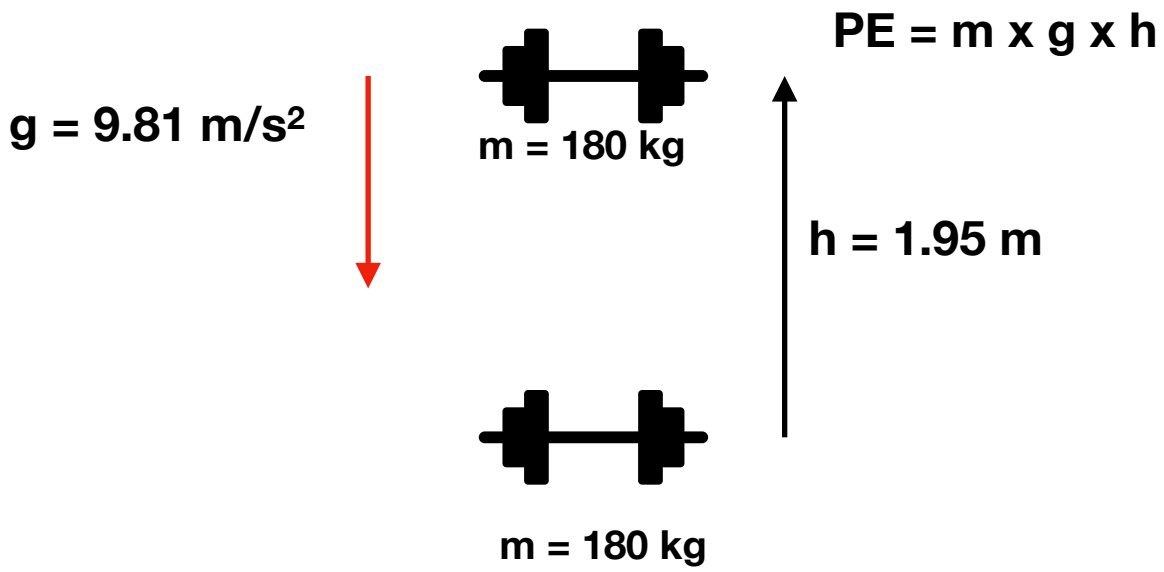
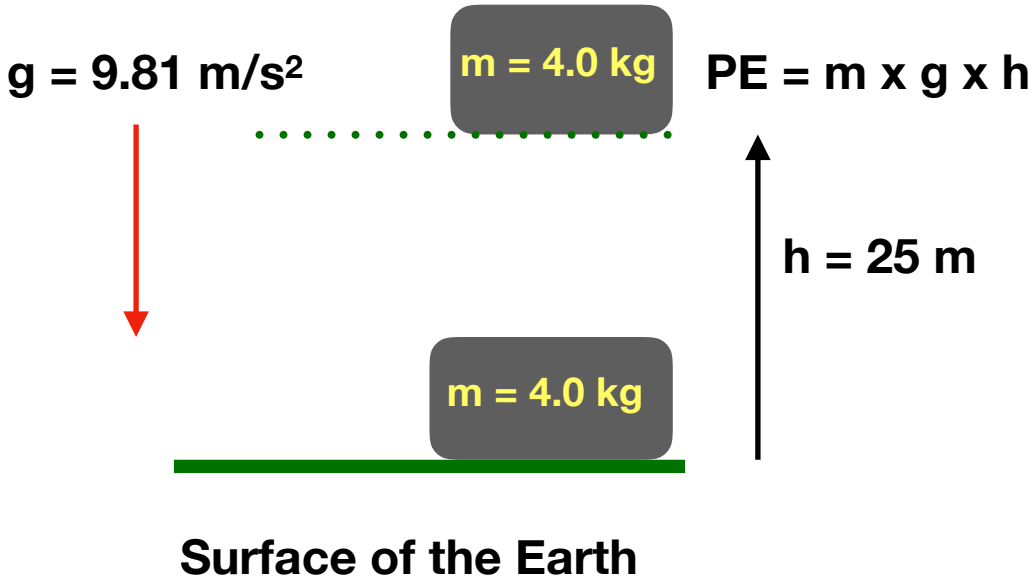
65. Weightlifting A weightlifter raises a 180-kg barbell to a height of 1.95 m. What is the increase in the potential energy of the barbell?



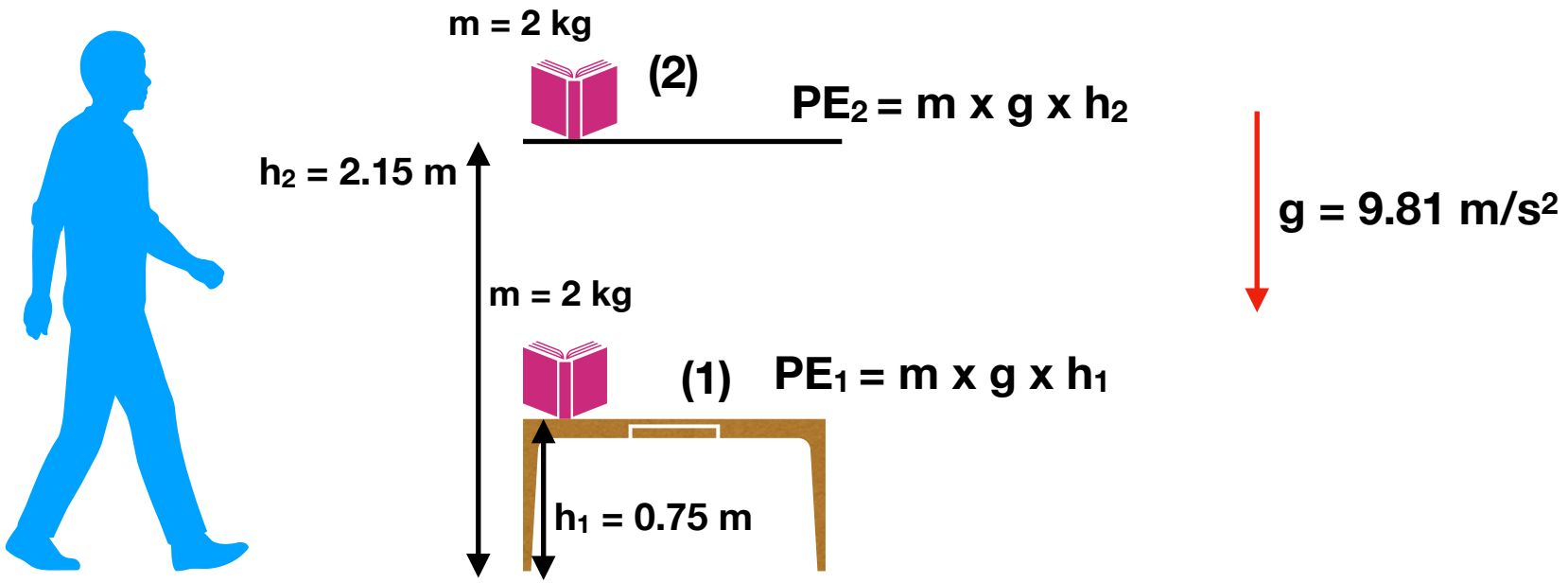
PE = m x g x h = 180 x 9.81 x 1.95 = 3,443.31 joules

Example 1: How much gravitational potential energy does a rock of mass m = 4.0 kg gain if it is lifted to the height h = 25 m?

PE = m x g x h = 4.0 x 9.81 x 25 = 9.8 x 10^2 J = 980 Joules



Antwan raised a 2 kg physics book (m = 2 kg) from a table 75 cm above the floor (h_1 = 0.75 m) to a shelf 2.15 m above the floor (h_2 = 2.15 m). What was the change in the potential energy of the system?



a) Position (1): $PE_1 = m \times g \times h_1 = 2 \times 9.81 \times 0.75 = 14.71$ joules.

b) Position (2): $PE_2 = m \times g \times h_2 = 2 \times 9.81 \times 2.15 = 42.183$ Joules

c) Change in potential energy between position (1) and (2)

$= PE_2 - PE_1 = 42.183 - 14.71 =$ 27.473 Joules = Work

or:

Change in potential energy = $\mathbf{m \times g (h_2 - h_1)}$

$= 2 \times 9.81 (2.15 - 0.75)$

= 27.468 Joules = Work

Work = The change in potential energy

Change in potential energy = $PE_2 - PE_1$

$= m \times g \times h_2 - m \times g \times h_1$

$= m \times g (h_2 - h_1) = \text{work}$

Change in potential energy = $m \times g (h_2 - h_1)$

$= 2 \times 9.81 (2.15 - 0.75)$

$= 27.468$ Joules

A 10.0 kg test rocket is fired vertically from Cape Canaveral. Its fuel gives it a potential energy of 1960 Joules by the time the rocket engine burns all the fuel. What additional height will the rocket rise?

m = 10.0 kg, PE = 1960 joules $g = 9.81\ m/s^2$
h = ?

$PE = m \times g \times h$

$1960 = 10 \times 9.81 \times h$
$1960 = 98.1 \times h$

$\frac{1960}{98.1} = \frac{98.1}{98.1} \times h$

$19.979\ m = h$

A hallway display of energy is constructed in which several people pull on a rope that lifts a block 1.00 m. The display indicates that 1.00 joules of work is done. What is the mass of the block?

h = 1 m , W = PE = 1 joules, g = 9.81 m/s^2

m = ?

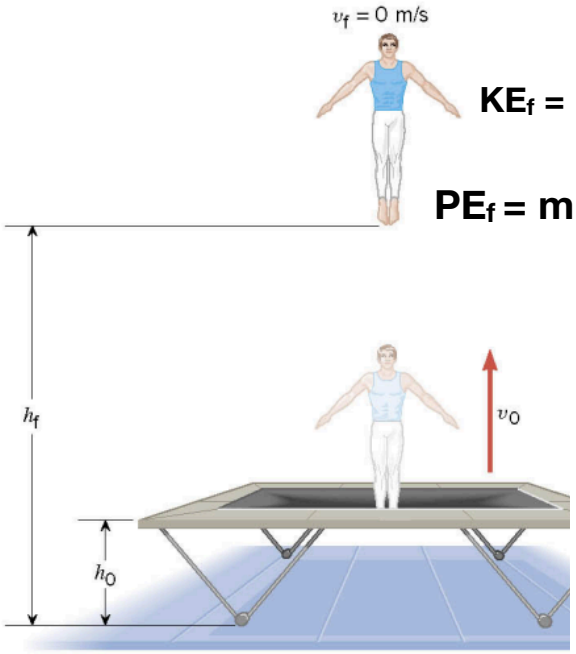
$$PE = m \times g \times h$$

$$1 = m \times 9.81 \times 1$$

$$1 = m \times 9.81$$

$$\frac{1}{9.81} = m \times \frac{9.81}{9.81}$$

$$0.1 \text{ kg} = m$$



$KE_f = 1/2\ m\ V_f^2 = 0$

$PE_f = m \times g \times h_f$

total $E_t = KE_f + PE_f$

$PE_o = m \times g \times h_o$

$KE_o = 1/2\ m\ V_o^2$

total $E_t = KE_o + PE_o$

The total mechanical energy of an object remains constant

Total energy in the initial position = Total energy in the final position

$$KE_o + PE_o = KE_f + PE_f$$

Change in potential energy = $PE_f - PE_o$

$= m \times g \times h_f - m \times g \times h_o$

$= m \times g (h_f - h_o) = \text{work} = -1/2\ m\ v_o^2$