Q1 - A girl pulls a box of mass **m = 6 kg** across a floor with a constant horizontal force **F = 35 N**. Initially the block is at rest. For the first **d_1 = 7 m**, there is no friction between the box and the floor. For the next **d_2 = 7 m** the coefficient of friction between the box and the floor is m **= 0.1**.

a) What is the work done on the box by the girl in moving the box over the distance **d_1 + d_2**?

The work done by a force F is given by $W = \vec{F}.\vec{s} = Fs\cos\theta$

Where s is the displacement and θ is the angle between the force and the displacement. Here θ = 0 hence the work done is the product of magnitude of the force and the displacement in the direction of force.

The total displacement of the box (point of application of force) is (d_1 +d_2) hence the work done by the girl is

$\quad$ W = F*(d_1 +d_2) = 35*(7 + 7) = **490 J**

b) What is work done on the box by friction in moving the box over the distance **d_1 + d_2**?

The frictional force is zero in the first part and in the second part is $\mu N = \mu mg$ and it is backward direction hence negative. Thus Work done by the friction force is given by

$\quad$ W_f = 0*d_1 - μmg*d_2 = = 0 – 0.1*6.00*9.8*7 = **- 41.16 J**

Negative sign shows that the work is done against the friction.

c) What is the final speed of the box (after being pushed to **d_1 + d_2**)?

According to work energy rule the work done is equal to the increase in the kinetic energy of body.

The net work done on the box is the work done by force F and that by the friction, hence
$\quad\quad$ KE = ½ mv^2 = W + W_f
or $\quad$ ½ * 6*v^2 = 490 – 41.16 = 448.84 = **12.23 m/s**

d) How high up will it go? (Measured vertically from the floor)

As the box moves up the frictionless incline its kinetic energy converts to potential and hence according to law of conservation of energy, gain in PE = loss in KE

Or $\quad$ mgh = ½ mv^2

Or $\quad$ h = v^2/(2g) = 149.6/19.6 = **7.633 m**