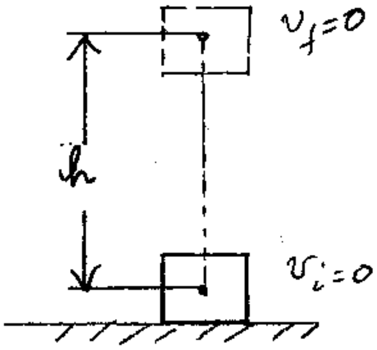
Solution.

PHYSICS 161, Spring 2003

Discussion Quiz , Tuesday, April 8

Q1). A box of mass m is lying at rest on the ground. Suppose you lift the box straight up to load it onto a truckbed a vertical height h above the ground. If the final speed of the box is also zero, find:



a). the work done by gravity on the box in this process.

$W_g = -mgh$

b). the net work done on the box in this process.

$W_{net} = \Delta K.E \Rightarrow W_{net} = 0$ since $\Delta K.E = 0$.

c). the work done by you in this process.

$W_{net} = 0$

$W_g + W_{you} = 0 \Rightarrow W_{you} = -W_g = +mgh$. fig Q1.

Q2). Now suppose instead of lifting it straight up you use a **frictionless** ramp inclined at an angle θ. You start it from rest applying a force parallel to the ramp. Let the final speed of the box to be zero. (See fig Q2).

d). What now is the wrok done by gravity?

$W_g = \vec{F_g} \cdot \Delta\vec{Y} = -F_g h = -mgL\sin\theta$

e). What now is the total work done on the box?

$W_{net} = \Delta K.E$ since $\Delta K.E = 0$

$\boxed{W_{net} = 0}$

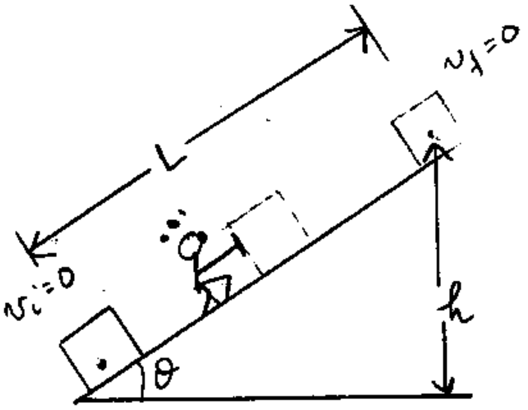
f). What now is the total work done by you work done by you? Is its magnitude larger smaller or the same as the work done by gravity?

$W_{net} = \Delta K.E$

$W_g + W_{you} = 0$

$\Rightarrow W_{you} = -W_g$

$\boxed{W_{you} = +mgL\sin\theta}$



Note that the force you apply on the box is actually NOT constant. Think about why that's the case. Think of N2.

Solution.

PHYSICS 161, Spring 2003

Discussion Quiz, Thursday, April 10

Q1). A spring is used to project a block of mass m with some initial speed v_0 up along a **frictionless** ramp as shown in Fig 1. It comes momentarily to rest after traveling a distance L.

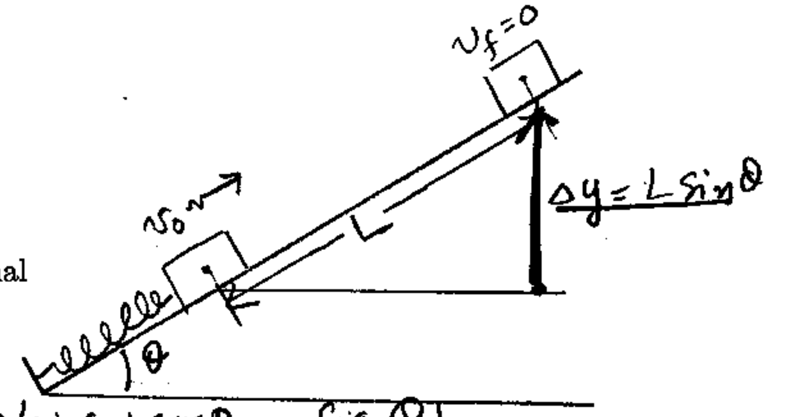


fig Q1

a). Find the work done by gravity over the distance L.

$W_g = \vec{F}_g \cdot \vec{d} = -(mg)(L\sin\theta)$

b). What is the work done by the normal over this distance?

$W_N = 0$ since F_N is $\perp$ to displacement along ramp.

c). If the mass of the block is 1 kg, the distance L is 2m, and the angle of the ramp $\theta = 30^0$, use the work-kinetic energy theorem to calculate the value of the initial speed of the block.

$W_{net} = \Delta K.E$

$W_g = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$ ($v_f = 0$)

$\Rightarrow + mgL\sin\theta = +\frac{1}{2} m v_0^2$

$v_0^2 = 2gL\sin\theta$

$v_0^2 \cong (2)(10\,m/s^2)(1m)(\frac{1}{2})$

$\Rightarrow$ $v_0 = \sqrt{10}\ m/s$

Q2). Starting from rest, the block then travels down the ramp, compressing the spring by an amount d and coming momentarily to rest.

d). If the spring constant is k, write down the work done by the spring.

$W_s = -\int_{-d}^{0} kx\,dx = +\int_{0}^{-d} kx\,dx = +\frac{1}{2} k d^2$

e). Now write down the work done by gravity on the block.

$W_g = -mg(L+d)\sin\theta$

f). What is the numerical value of the **total work** done on the block.

$W_{total} = \Delta K.E$

$\Rightarrow$ $W_{total} = 0$

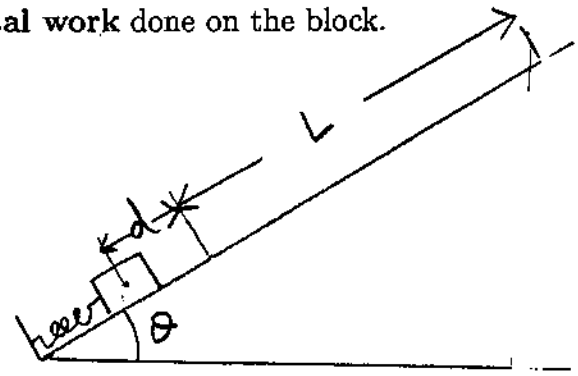


fig Q2.

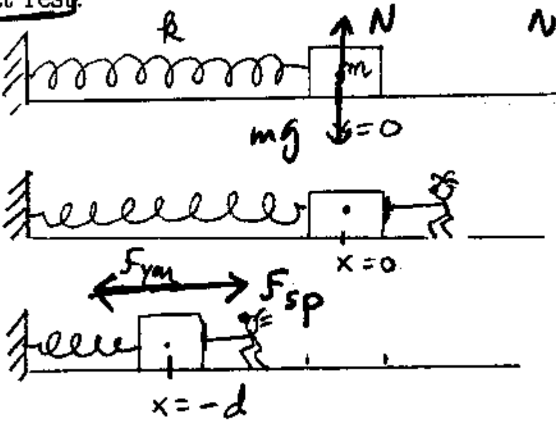
Solution :

PHYSICS 161, Spring 2003

Discussion Quiz, Friday, April 11

$\Rightarrow \Delta K.E = 0$

Q1). A block of mass m is attached to a spring of spring constant k. The block is initially at rest. Suppose you push the block against the spring, compressing it by an amount d. The block is again at rest.



Note: N & mg don't do any work.

a). What is the work done by the spring on the block?

$$W_s = -\int_0^{-d} kx\,dx = -\frac{1}{2}kd^2$$

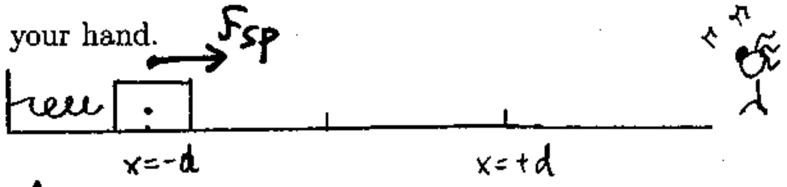
b). What is the **total work** done on the block?

$$W_{net} = \Delta K.E \quad (\Delta K.E = 0)$$
$$\Rightarrow W_{net} = 0$$

c). What is the work done **by you** on the block? Compare it to the work done by the spring.

$$W_{net} = 0$$
$$W_{sp} + W_{you} = 0 \Rightarrow W_{you} = -W_{sp} = +\frac{1}{2}kd^2.$$

Q2). Suppose that you now remove your hand.



d). Now what is the **total** work done on the block as it moves from $x = -d$ to $x = 0$?

$$W_s = -\int_{-d}^{0} kx\,dx + \int_0^{-d} kx\,dx = +\frac{1}{2}kd^2.$$

e). If $k = 1000N/m$, $m = 10kg$ and $d = 10cm = 0.1m$, find the speed of the block at $x = 0$.

$$W_{net} = \Delta K.E \Rightarrow \frac{1}{2}kd^2 = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2 \quad (v_i = 0) \Rightarrow v_f^2 = \frac{kd^2}{m}$$

$$\Rightarrow v_f^2 = \frac{(1000\,N/m)(0.1\,m)^2}{10\,kg}$$

$$v_f^2 = 10\ m/s$$

$$\Rightarrow \boxed{v_f = 3.16\ m/s}.$$

f). What is **total work** done on the block as it moves from $x = 0$ to $x = +d$?

$$W_{net} = W_s = -\int_0^{+d} kx\,dx$$

$$\boxed{W_s = -\frac{1}{2}kd^2}$$