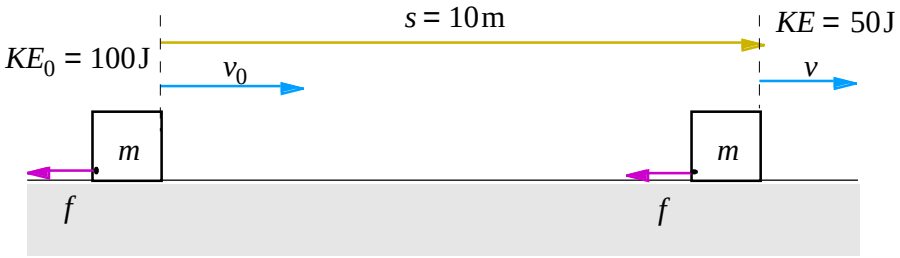
ISP209 Fall 2000 **Homework 9** Name: _____
Due: Tues., Mar. 27, 2:40 pm, in Rm 118PA. ID:_____

1. The work done on a mass as it moves is negative. Does the kinetic energy of the mass increase or decrease during this motion? decreases
2. When a mass is slowly raised from the floor to a table by a human being what are the two forces acting on the mass during the motion? the hand force and gravity. Are the signs of the work done by the two forces the same or opposite? opposite
3. What is stored in a spring that is stretched or compressed, force or energy? energy

4. What happens to the kinetic energy of a mass that comes to rest by compressing a spring? it is transferred to potential energy stored by the spring



A mass sliding on a table with an initial kinetic energy, $KE_0 = 100$ J is observed to have a kinetic energy, $KE = 50$ J at a later time.

5. The kinetic energy of the mass changes by, $\Delta KE = KE - KE_0 = (50-100)\text{J} = -50\text{J}$
6. If no potenial energy is stored, what happened to the missing energy? appears as heat energy in the table and mass.
7. What is the name of the non-conservative force that has affected the speed? friction.
8. How much heat energy is "generated" (kinetic energy removed from mass) during this motion? 50 J
9. What was the average force acting on the mass if it traveled 10m during this time?

$\mathbf{s} = +10\,\text{m}$, $\mathbf{F} = -f$ (opposite directions)

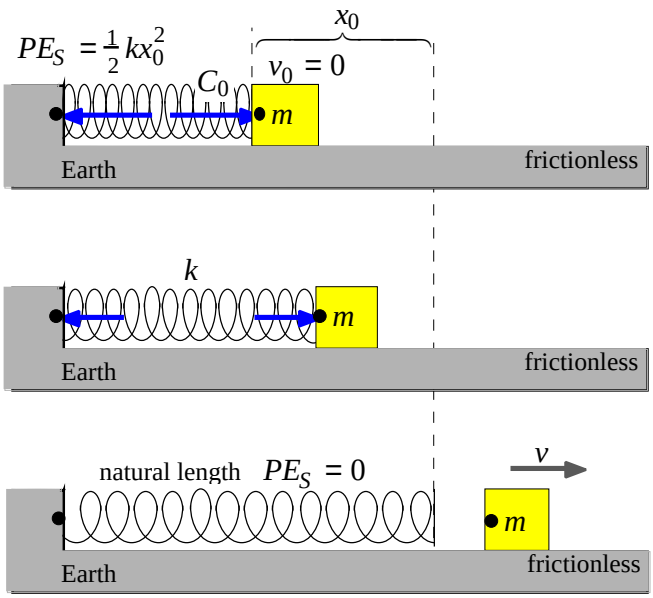
$w = \mathbf{F}\ \mathbf{s} = -f\ s = -50$ J

$$f = \frac{50\text{ J}}{s} = \frac{50\text{ Nm}}{10\text{ m}} = 5\text{ N}.$$

10. The force(s), electromagnetic(E), gravitational(G), weak nuclear(WN) or strong nuclear(SN), is(are) primarily responsible for the following:

color of a green leaf. E
scatter of neutrons off a nucleus. SN
period of Haley's comet (76 years). G
beta decay producing a 3.5 MeV electron WN
boiling of water E
shape of a salt crystal. E
screech of a tire on a road. E
hardness of a diamond. E
smell of brie cheese. E
sound of a beating heart. E
decay of the Roman Empire. E
fall of a thrown baseball. G

Show work for all questions. **Attach extra sheets if necessary.**



A spring, with spring constant *k*, is attached to a wall and compressed by a distance *x*. It then expands horizontally against a small mass, *m*, that slides on a frictionless table (as shown in figure 9.1) Answer questions, 11-14 , based on these conditions.

11. What is the initial force acting on the small mass in the horizontal direction?

Initial compression force (blue vector) $C_0 = kx_0$

12. What is the *net* force (in the vertical direction) acting on the mass, *m*? zero

13. What is the initial potential energy in the spring $PE_0 = \frac{1}{2}kx_0^2$

14. What is the speed of the mass when it leaves the spring?

$$PE_0 = \frac{1}{2}kx_0^2 \; ; \quad KE = \frac{1}{2}mv^2$$

$$KE = PE_0$$

$$\frac{1}{2}mv^2 = \frac{1}{2}kx_0^2$$

$$v^2 = \frac{k}{m}x_0^2 \; ; \qquad v = \sqrt{\frac{k}{m}}x_0$$

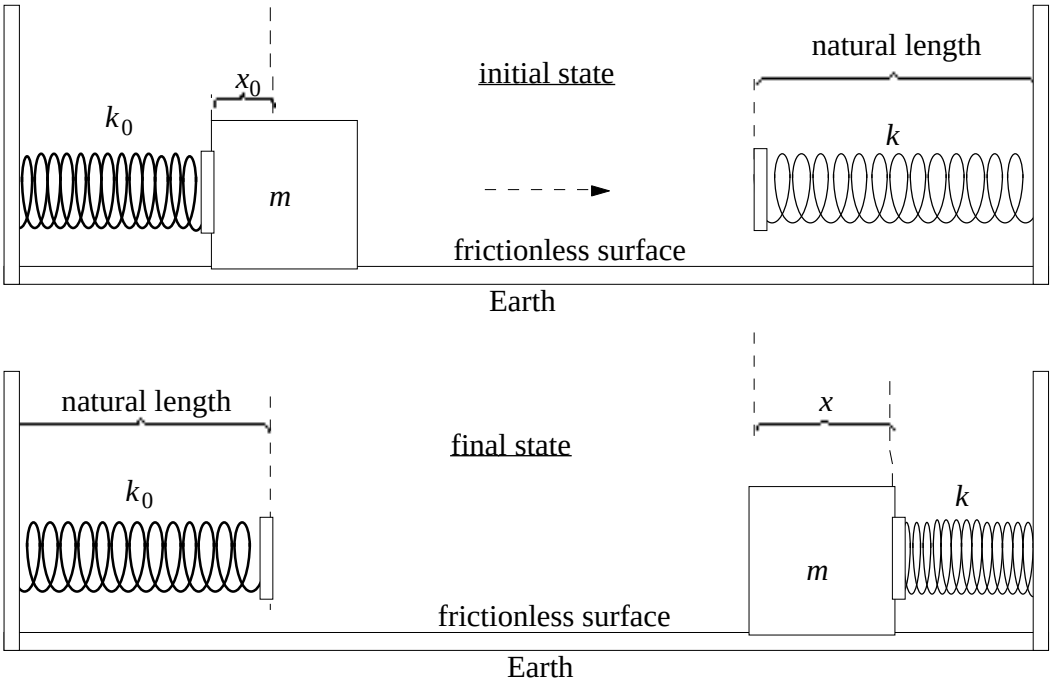


Figure for problem 15

15. A compressed spring with spring constant, k_0, transfers all of its stored energy to a mass that slides on a frictionless table attached to the earth, as shown above. The mass then hits and compresses a second spring with spring constant, k, (k_0 has a different value) and storing all the kinetic energy. What is the ratio of the compression, x, of the second spring to the compression, x_0, of the first spring, i.e., what is the ratio of the compressions x/x_0 = ?

$$PE_0 = \tfrac{1}{2}k_0x_0^2; \quad PE = \tfrac{1}{2}kx^2$$

$$PE = PE_0$$
$$\tfrac{1}{2}kx^2 = \tfrac{1}{2}k_0x_0^2$$
$$\frac{x^2}{x_0^2} = \frac{k_0}{k}; \qquad \frac{x}{x_0} = \sqrt{\frac{k_0}{k}}$$

Problems 16 -18True or False (ignoring air friction):

16. The work done to raise a mass sitting on the floor to one sitting on a table without changing direction does not depend on how fast it is done. True: (work by human) = – (work by gravity). Work by gravity depends only on starting and ending height

17. Work is a vector because it can be either positive or negative. False: (work is a scalar that can have positive or negative values, like temperature)

18. A mass thrown upward has no forces acting on it at the highest point. False: (Gravity acts on the mass)

19. Which pair, below, are both considered non-conservative forces?

(a) gravitational and ideal spring forces
(b) gravitational and human forces
(c) ideal spring and human forces
(d) frictional and human forces
(e) elastic and frictional force