Homework Problems

1. A person with a mass $m = 70$ kg stands on the ground. What is the value of the compression force generated by each foot as it acts on the ground? What is the compression force the earth applies back to each foot?

   A <u>unit mass</u> (shown on the right) made with a thin mass, m, attached to a massless spring, (31 cm normal length and a spring constant, $k = 15$ N/cm). When a stack of six <u>unit masses</u> is assembled on the ground, one on top of the other.
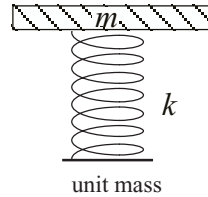
2. In the box to the right, draw a picture of the stack showing the bottom spring compressed by 30 cm (almost fully compressed), leaving it only 1 cm long, and the top mass near the top of the box.

3. What is the weight and mass m, of each unit mass?

   (show work here) $W =$ _____,

                                                 $m =$ _____

4. What is the compression force acting on the top and bottom surfaces of the masses, from the top (1) to the bottom (6) in the stack?

4. mass1: force on top _____ ; bottom _____

   mass2: force on top _____ ; bottom _____

   mass3: force on top _____ ; bottom _____

   mass4: force on top _____ ; bottom _____

   mass5: force on top _____ ; bottom _____

   mass6: force on top _____ ; bottom _____

(show work here)

_m._

k

unit mass

The Ground

Fig. for problems 2-4

In a stack of identical springs and masses placed on the ground, the second mass from the top, shown at the right, has three forces acting **on** it: the spring compression forces, C_1 and C_2, and the gravitational force, W. (note: the gravitational force acts on the whole mass)
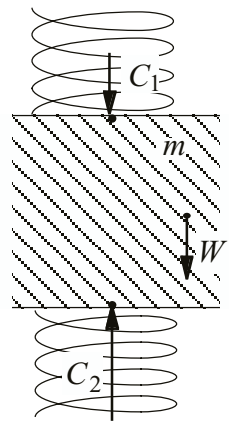
5. What is the weight of the mass? $W =$ _____

6. Are the forces acting on this piece of mass balanced? _____

7. If this mass instead was massless, what would be the value of C_2?

_____

8. What is the relationship between the compressions C_1, C_2, and the weight, W?

_____

9. Draw the compression force vector within the mass acting upward on the top spring. What is its magnitude compared to C_1? _____

Fig. for problem 5-10

10. Draw the compression force vector within the mass acting on the lower spring. What is its magnitude compared to C_2? _____

11. Three equal masses hang from the ceiling by strings as shown at the right. If the tension in the top string is T, what is the magnitude of the tension in the lowest string?

   a) $T/3$ b) $-T/3$ c) $-mg/3$ d) T e) $3mg$
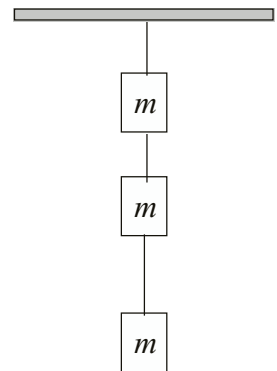
Three masses, m, $2m$, and $3m$, hang from the ceiling by strings as shown at the right.
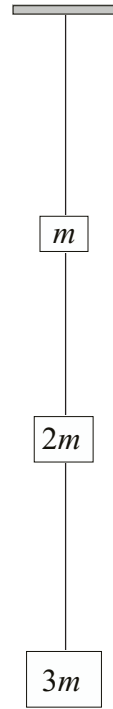
12.   Draw on the figure to the right the tension vectors generated at the ends of the three strings and the weight vectors acting on each mass. Label the tensions from the top as T_1, T_2, and T_3. Label each weight vector with its magnitude in units of mg.

13. What is the magnitude of T_3, the tension in the lowest string?

    a) 2 mg b) 3 mg c) 4 mg d) 5 mg e) 6 mg

14. What is the magnitude of T_2, the tension in the middle string?

    a) 2 mg b) 3 mg c) 4 mg d) 5 mg e) 6 mg

15. From these masses, what is the magnitude of the vector sum gravitational (not electromagnetic) forces acting on earth?

    a) zero   b) 3 mg c) 4 mg d) 5 mg e) 6 mg Fig. for Prob. 12-15

16. A mass, $m = 15$ kg, in a stationary stack of masses, has a spring with compression force $C_1 = 300$ N acting on its top face. What is the compression force, C_2, in the spring acting on the bottom face of the mass?

    a) 50 N   b) 150 N   c) 250 N   d) 350 N   e) 450 N

17. A mass weighs 10,000 N on the planet Mongo ($g_{\text{Mongo}} = 25$ N/kg). What is its weight on the Earth?

    a) 250,000 N   b) 400 N   c) 2.5 N   d) 4000 N   e) 2500 N