Homework Problems

1. Which force(s), electromagnetic(E), gravitational(G), weak nuclear(WN) or strong nuclear(SN), is(are) primarily responsible for the following (100% correct for credit):

photosynthesis in a plant. _____   friction. _____
emission of neutrons from a nucleus. _____   lubrication with oil. _____
orbiting of an earth satellite. _____   lightning . _____
decay of a neutron to a proton+e+ν. _____   thunder. _____

decay of tooth. _____   pain. _____
shape of a snowflake. _____   formation of diamonds in a mine ___ & ___

2. Which of the following forces acts on only one object?
   (a) the gravitational force, (b) the force of a spring, (c) the electric force , (d) the force of friction, (e) none of the previous

3. What happens to an object when two inward forces of magnitude, F, act on it from opposite sides? _____

4. Near the surface of the Earth the gravitational force F_G on a 1 kg mass is 10N. What is the magnitude of the gravitational force acting on the Earth? _____
   If the 1 kg is falling toward the earth, what gravitational force acts on each mass,
   Force on the 1 kg mass? _____ Force on the Earth? _____

5. On the earth, gravity acts on a small object with a force, F_G = 100N. What the mass of the small object? _____ What is its weight? _____

6. A mass, m, is thrown upward a maximum height of 100 m. At the given points in the motion, what gravitational force acts on the mass? Note: if the mass is unknown, use the symbols, m and g (do not use 10 N/kg), in your answers to this and later problems.

   In the hand of the thrower, _____   when moving upward, _____
   at the highest point, _____   on the way down, _____
   and when it hits the ground. _____
   Does the weight of the mass change anywhere during the motion? _____

7. Resting on the earth, a large mass, M, is comprised of 10 smaller masses, m_1. Using the symbol, m_1, in your answers, The gravitational force, F_G, acting on the large mass is, _____ , and acting on the earth is, _____.

8. Two objects with a mass m are supported by ropes.
   Draw the weight vectors acting on the masses.
   In a), what is the tension T in the rope? _____
   In b) what is the tension T in the rope? _____

9. Each rope has a spring constant k . What is the stretch x of each rope due to the hanging mass? (use symbols in your ans.)_____
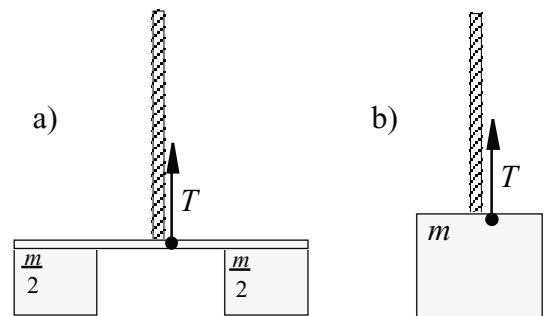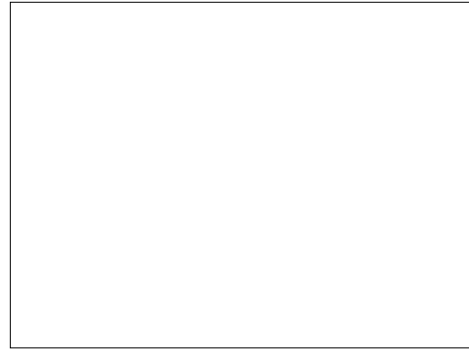
a)   b)

Figure for problems 8 and 9.

10. A person with a mass of 70 kg sits on a chair
    (assume massless) with 4 legs. Draw this situation,
    the gravitational forces acting on the person and
    the earth, and the compression forces acting at the
    ends of the chair legs. What compression force acts
    in each leg? _____
    (show work here)

11. The density ρ (rho) of iron, $\rho = 8 \, \text{gm}/\text{cm}^3$. What is the **weight** of an iron bar with
    dimensions: $l = 400$ cm, $w = 25$ cm, $h = 1.0$ cm? (volume $V = l \times w \times h$, $m = \rho V$)
    (remember 1 kg = 1000 gm, also, weight and mass are different quantities)
    (show work here)

A rope, pulleys on a pole, and a spring (all
massless) attached to the ground, support a mass
m at rest as shown. The spring has been stretched
a distance, x, by the hanging mass.

12. Draw the gravitational force vectors with
    magnitude, F_G, acting on the mass, m, and on the
    earth. Using symbols in your answers, what is F_G
    for this mass?_____

13. Draw the tension force vectors with magnitude,
    T_R, acting in each piece of the rope (including the
    top piece). What is the relationship between F_G
    and T_R? _____
    Between T_R and m? _____

14. Draw the tension force vectors generated by the
    spring with magnitude, T, acting on the rope and
    the earth. What is the relationship between T_R and
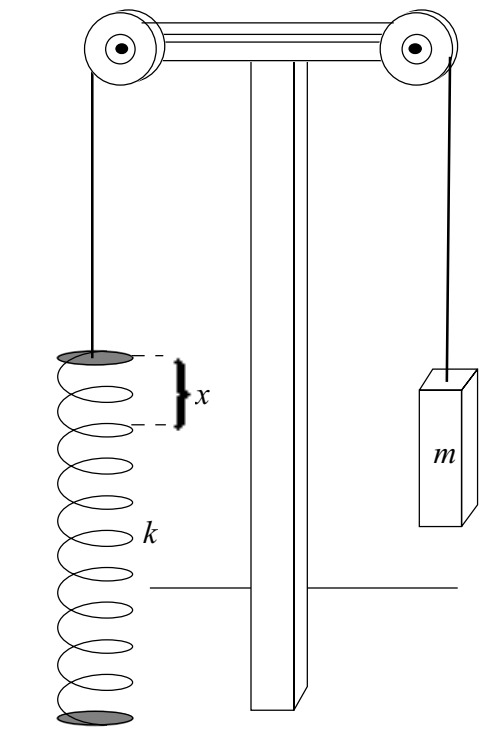 T? _____
    Between T and m? _____

Fig. for problems 12 to 17

15. Draw the compression forces, C, acting in the vertical pole.
    What is the relationship between C and T_R? _____
    What is the relationship between C and m? _____

16. What is the spring stretch, x, for this mass, m, and, spring constant, k? _____

17. The force **vectors** (+ is up), acting **on** the earth, are (use symbols in your ans.)
    T = _____ , **C** = _____ , and $\mathbf{F}_G$ = _____.
    What is their vector sum? _____
    Are the forces acting on the earth balanced? _____

Show work for all questions.   14   **Attach extra sheets if necessary.**

A mass, m (all other objects shown at the right are massless), is attached to one of two pulleys by a bar (dark line), the other pulley is attached to the roof. A rope runs through the two pulleys and is attached to ground on one end and the roof on the other (see chapter 2 for information about pulleys)
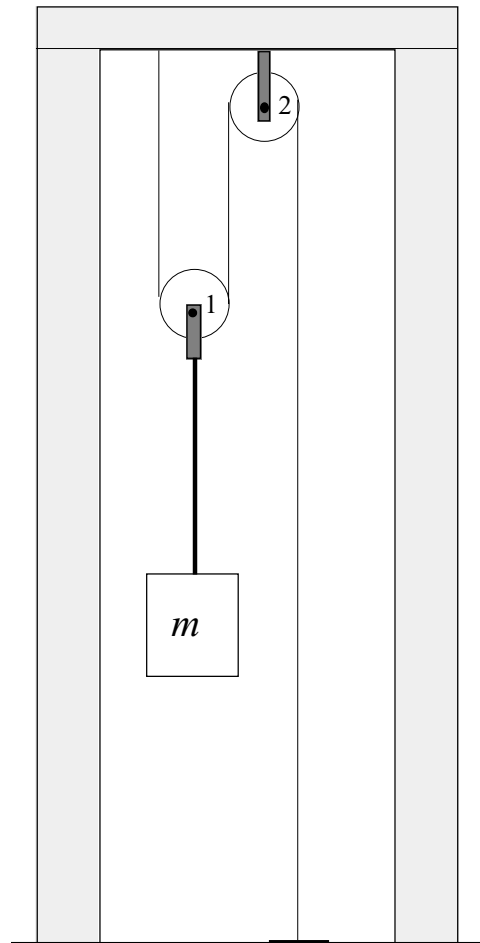
18. Draw the gravitational force vectors acting on the mass and the earth (F_G).

19. What is the weight of the mass?

F_G = a) m b) $2m$ c) mg d) $2\,mg$ e) $mg/2$

20. Draw the tension vectors, T_B, generated in the bar (dark line) that act on the mass and the pulley (#1) above it. What is the relationship between the tension in the bar, T_B, and the mass, m ?

T_B = a) m b) $2m$ c) mg d) $2\,mg$ e) $mg/2$

21. Draw the tension forces, T_R, generated <u>in each piece of the rope</u> that passes through the pulleys. What rope tension, T_R, balances the tension in the bar, T_B, acting on pulley (#1)? (hint: how many pieces of rope act on that pulley?)

T_R = a) mg b) $mg/2$ c) $2\,mg$ d) $3\,mg$ e) $mg/3$

Fig. for Problems 18-24

22. Three pieces of rope apply downward forces on the roof and on the pulley (#2) that is attached to the roof. What is the total force, F, pulling down on the roof?

F = a) mg b) $mg/2$ c) $2mg/3$ d) $3mg/2$ e) $mg/3$

23. Draw the compression forces, C, in each of the two posts that act on the roof and on the ground. What is the value of C?
C = a) mg b) $mg/4$ c) $4mg/3$ d) $3mg/4$ e) $mg/2$

24. True or false questions (all correct for credit) refer to the previous problems 18-23.

T F: The forces acting on the earth (from problems 19, 21 and 23) are in balance.
T F: The forces acting on the roof (from problems 22 and 23) are in balance.
T F: The forces acting on the mass (from problems 19 and 20) are in balance.
T F: The forces acting on pulley (#1) (from problems 20 and 21) are in balance.
T F: A rope tension (from problem 21) half the weight of the mass keeps it at rest.

Show work for all questions.   15   **Attach extra sheets if necessary.**