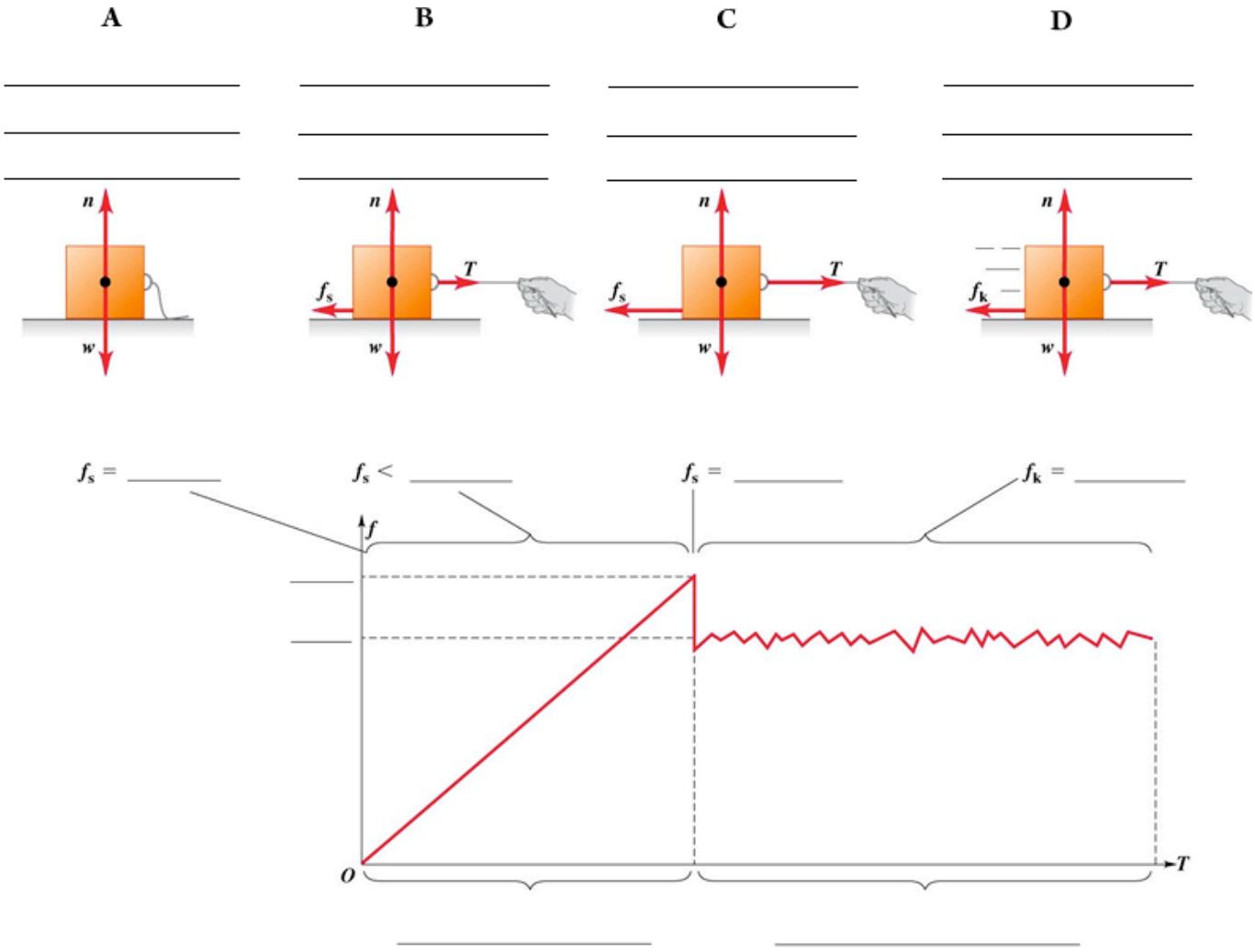
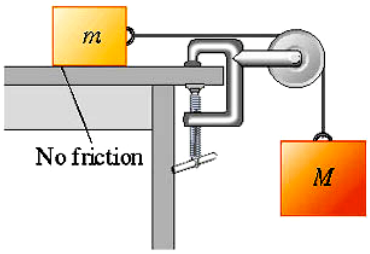
Physics 180A
Test 2 - 120 Points

Name _____

1) Describe each situation and fill in the blanks to the diagram below. There are 4 situations and 8 blanks. (12 pts)



2) In the system shown in the figure, M>m, the surface of the bench is horizontal and frictionless, and the connecting string pulls horizontally on m. As more and more weight is gradually added to m, which of the following statements best describes the behavior of the system after it is released? (5 pts)



a. The velocity becomes zero when m = M
b. None of the statements is correct.
c. The acceleration becomes zero when enough weight is added so that m = M.
d. The acceleration remains the same in all cases, since there is no friction and the pull of gravity on M is the same.

3) An unstretched spring is 15.00 cm long. When you hang an 725.0 g weight from it, it stretches to a length of 17.00 cm. What is the force constant (N/m) of this spring? What total mass must you hang from the spring to stretch it to a total length of 21.00 cm? (6 pts)

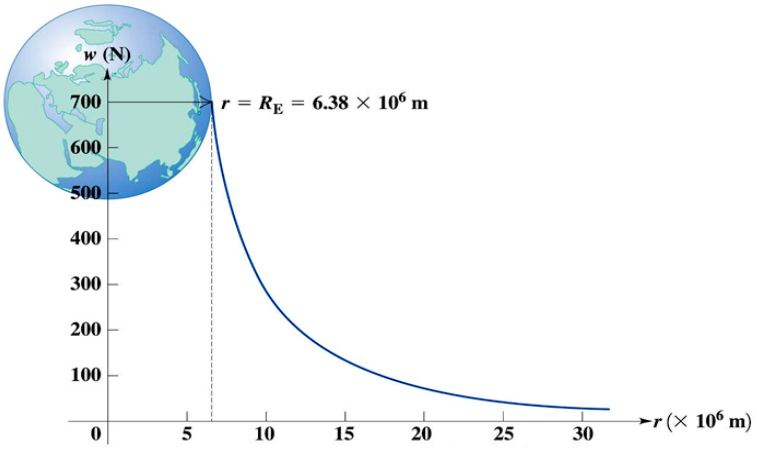
4) A toboggan approaches a snowy hill moving at 12 m/s. The coefficients of static and kinetic friction between the snow and the toboggan are 0.42 and 0.29, respectively, and the hill slopes upward at 42° above the horizontal. Find the acceleration of the toboggan as it is going up the hill. Find the acceleration of the toboggan after it has reached its highest point and is sliding down the hill. Draw a diagram, draw a freebody diagram, sum the forces, and solve the probem. (15 pts)

5) How did the Physicists find the density of the Earth using Newton's Universal Law of Gravitation? What is the density of the earth? (6 pts)

6) Derive Kepler's Third Law from Newton's Universal Law of Gravitation. (5 pts)

7) Using Kepler's Third Law, what is the mass of the Sun using the Mars's parameters. (7 pts)

8) Using the diagram, what is the mass of a person on the surface of the earth? Use the diagram to estimate the mass of a person twice the distance from the center of the earth? (5pts)



9) You tie a cord to a pail of water, and you swing the pail in a vertical circle of radius 1.8 m. What minimum speed must you give the pail at the highest point of the circle if no water is to spill from it? (6 pts)

10) A 73.0 kg stunt pilot who has been diving her airplane vertically pulls out of the dive by changing her course to a circle in a vertical plane. If the plane's speed at the **lowest point** of the circle is 107.0 m/s what should the minimum radius of the circle be in order for the acceleration at this point not to exceed 3.00 g? What is the apparent weight of the pilot at the **lowest point** of the pullout? Draw a freebody diagram, sum the forces and solve. (15 pts)

11) Two balls having different masses reach the same height when shot into the air from the ground. If there is no air drag, which of the following statements must be true? (More than one statement may be true.) (5 pts)

A. Both balls left the ground with the same speed.
B. Both balls left the ground with the same kinetic energy.
C. The heavier ball must have left the ground with a greater speed than the lighter ball.
D. Both balls will have the same gravitational potential energy at the highest point.
E. Both balls have no acceleration at their highest point.

12) A 86.0 kg skier approaches the foot of a hill with a speed of 22 m/s. The surface of this hill slopes up at 45.0° above the horizontal and has coefficients of static and kinetic friction of 0.750 and 0.250, respectively, with the skis. Use energy conservation to find the maximum height above the foot of the hill that the skier will reach. Will the skier remain at rest once she stops, or will she begin to slide down the hill? **Do not solve this problem.** Draw a diagram of this situation. Include the energy at important locations. (7 pts)

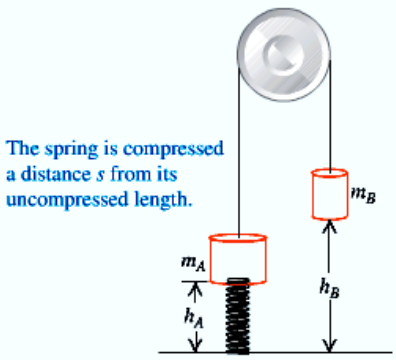
13) (5pts)

Quantitative Analysis 7.5

Total mechanical energy

In Figure 7.28, two blocks with masses m_A and m_B, where $m_A > m_B$, are attached to a thin string that passes over a frictionless pulley. The larger mass is resting on a spring that is compressed a distance s from its equilibrium position. The spring's compression is maintained by a trigger mechanism. What is the total mechanical energy for this system?

A. $m_A g h_A + m_B g h_B + \frac{1}{2} k h_A^2$
B. $m_A g h_A + m_B g h_B + \frac{1}{2} k s^2$
C. $m_A g h_A - m_B g h_B + \frac{1}{2} k s^2$



14) A 173.2 N carton is pulled up a frictionless baggage ramp inclined at 35° above the horizontal by a rope exerting a 72.10 N pull parallel to the ramp's surface. If the carton travels 5.820 m along the surface of the ramp, calculate the work done on it by the rope, gravity, and the normal force of the ramp. (6 pts)

15) A 4.20 kg piece of wood slides on the surface shown in the accompanying figure. All parts of the surface are frictionless, except for a 54.0 m long rough segment at the bottom, where the coefficient of kinetic friction with the wood is 0.250. The wood starts from rest 5.60 m above the bottom. Where will the wood eventually come to rest? How much work is done by friction by the time the wood stops? Use the diagram. Show the energy at each location. Use energy methods. (15 pts)