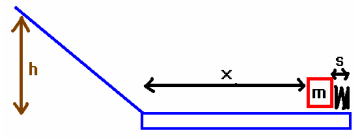
Instructions: You have a total of 55 minutes to complete this test.
Answer each of the following questions completely.
Time Start_____ Time finish_____ Pledged_____
You must supply all details that led to your answer.
You must provide correct SI units where required.
Do not discuss any aspect of this test with anyone until I return the test.
Although you may use additional sheets of paper which should be turned in with your test, please write (neatly) your answers on the pages where the problems are presented.

(1) A mass m (initially at rest) is placed on the end of a spring which has spring constant k and has been compressed through a distance s as shown. The spring is allowed to uncompress and the mass moves off of the spring. The flat surface indicated by the distance x has a coefficient of kinetic friction given by μ.



a: If μ=0, find the velocity of the mass right before it slides up the ramp in terms of k, s and m.

b: If μ=0, find the height that the mass slides (up the ramp) at the moment it stops in terms of k, m, g and s.

c: Suppose that the coefficient of friction is large enough so that the mass stops after having gone through the distance x. Find an expression for the value of the coefficient of friction that would cause this to happen.

d: If m=1.5kg, s=0.1m, x=1.0m and k=100N/m, provide numerical values for (a), (b) and (c) together with correct SI units.

(answer d:a):_____

(answer d:b):_____

(answer d:c):_____

(2) Consider the following situations and answer the following questions, showing all details.

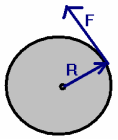
(a) Two masses m_1 which is traveling with a velocity $v_1 = 10\frac{m}{s}$ and mass $m_2 = 0.75kg$ which is initially at rest collide. After the collision (which is one dimensional) the masses stick together and move with a velocity of $v = 0.5\frac{m}{s}$. What is the value of mass m_1 with correct SI units.

(b) Two masses collide elastically in one dimension and $m_1 = 1.5kg$ is moving with a velocity of $v_1 = 10\frac{m}{s}$. After the collision, m_1 stops completely and m_2 moves off. How fast does m_2 move away from the collision and what is the value of mass m_2?

(c) Two masses collide elastically. Mass m_1 is much much larger than mass m_2 and is moving with an initial velocity of $v_1 = 10\frac{m}{s}$ before the collision. Approximately how fast is mass m_2 moving after the collision?

(d) Two equal masses collide elastically in a glancing collision. What is the angle between mass m_1 and mass m_2 after the collision?

(3) A wheel of radius R and mass M has a moment of inertia $I = \frac{2}{3}mR^2$ about its central axis is initially at rest. Suppose that a force is applied tangent to the surface (at right angles to R) so that the wheel starts rotating. The force varies as: $F = ht$ where h is a constant with SI units of N/s.



(a) What is the magnitude of the torque which is applied to the system at some later time t?

(b) What is the magnitude of the angular acceleration of the system at some later time t?

(c) If the torque is applied for a time t, what is the angular velocity at the end of this time interval t?

(d) What is the angle that the wheel turned through in this time t?

(e) Provide numerical answers for (a),(b),(c) and (d) together with correct SI units for the case h=1N/s, t=2 s, m=1 kg and R=1 m.

(answer e:a):_____

(answer e:b):_____

(answer e:c):_____

(answer e:d):_____

(4) A mass m is attached to a string of length R and then the mass is forced to undergo uniform circular motion. If it takes a total time of T for the mass to make one revolution, answer the following questions.
(a) What is the distance that the mass goes through in one revolution?

(b) What is the tangential velocity that the mass has?

(c) What is the centripetal acceleration of the mass?

(d) What is the angular velocity of the mass?

(e) What is the tension in the string?

(f) Provide numerical answers with correct SI units for (a),(b),(c),(d) and (e) for the case m=1kg, T=1s, R=1m.
(answer f:a):_____

(answer f:b):_____

(answer f:c):_____

(answer f:d):_____

(answer f:e):_____

(5) A meter stick (L=1m) with a mass of m=0.1 kg has a pivot located at x=0.4m. A mass m_1=1kg is placed on the meter stick at a position of 0.2 m. What is the value of a mass m_2 that must be placed at the position x=0.8 m in order for the system to balance? Hint: work the problem symbolically first and choose your axis carefully!