REVIEW FOR EXAM 1

Note: This is not comprehensive. To be prepared for the exam, you must study ALL the required materials. This is meant for you to get an overview of some main topics to help jog your memories about those topics and ask any questions you have.

1. Draw free body diagrams for the following:
    a. An object in projectile motion that was thrown at an angle and is halfway to the apex of its trajectory. Neglect air resistance.

    b. A person in an elevator that is ascending at a decreasing speed.

    c. A block being pushed down an incline by a force F that acts parallel to the incline. The incline has friction.

2. Consider a cart of mass m that is going around a loop-the-loop of radius R. Ignore friction. Assume it is a constant speed v. When it is at the very bottom of the loop, describe the acceleration and velocity vectors by drawing a diagram. Also state the magnitude of the acceleration.

3. An object has no net force acting on it. Is it moving? Explain your answer.

4. How many different types of energies do we use in our conservation of energy problems? List the types by name and symbol

5. Is the change in internal energy ever included in the initial energy?

6. How does the change in internal energy relate to the work done by non-conservative forces?

7. What makes a force non-conservative? Give an example.

8. Does the absolute gravitational potential energy ever matter? If not, what does matter?

9. How do you get force from a potential energy?

10.

a) What *is* work? Explain in words.

b) What is the unit for work?

c) What is the general equation for finding work from a force?

d) How does this simplify if you have a constant force?

e) How does this simplify if the force is always perpendicular to the displacement/velocity?

f) How does this simplify if you have a non-constant but 1D force?

g) If you have a non-constant 1D force, how can you get work from a graph? What graph do you need?

11. What is power, in words, what is the unit of power?

12. What is the Work-Kinetic Energy theorem?

13. You are given a graph of Force versus position. What information can you obtain from this graph?

14. Say an object has:

$$v(t) = (-20 + 5.0\ t^2, 2.0t^4)\ m/s$$

and starts at r = (3, 0) meters at t = 0.

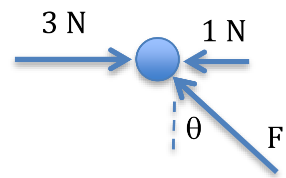
a. Find the acceleration at t = 2 seconds.

b. Find the time when the speed along the x direction is zero.

c. Find the position at t = 2 seconds.

15. A ball is thrown vertically upwards near the surface of the Earth. It has an initial speed v_o at t = 0. At what **time<u>s</u>** does it have a speed equal to $v_o/2$?

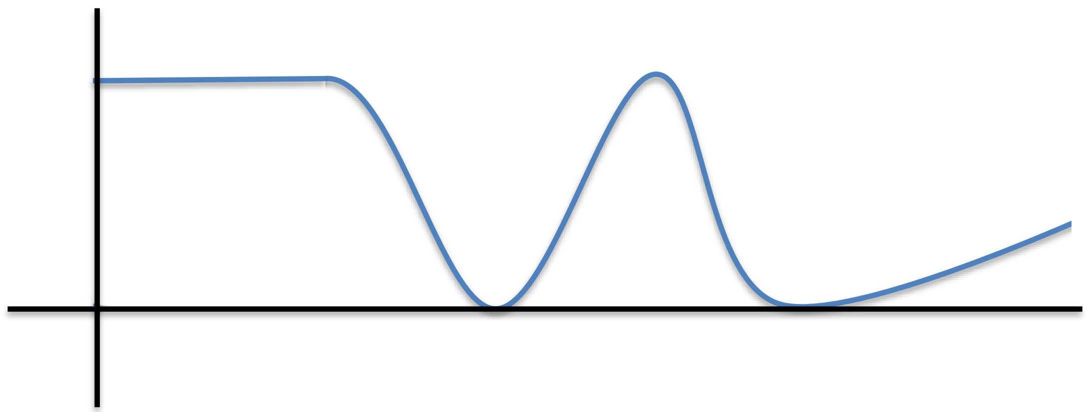
16. The object shown has a mass m = 1 kg and is being suspended in the air (near the surface of the Earth) by three people pushing on it as shown. No net force acts on it. Find the value of F and the angle θ. (HINT: This is NOT the complete free body diagram. **What force is missing?**)



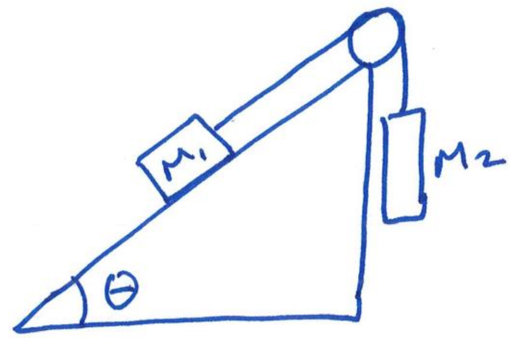
17. A plane flies at a level trajectory at a height h above the ground, which is also level. It has a constant speed v when it releases a package. What horizontal distance does the package travel relative to the release point before it strikes the ground below? Show all work, and put your answer in terms of h, v, and g, where g is positive (as it always is!).

18. A pail of water is spun in a vertical circle of radius R. If spun too slowly, the water will fall out at the top. What minimum speed must the pail and water have at the top in order for the water to stay in the pail? The water's mass is m. How can you use this to find the minimum required speed of the pail at any give point in the revolution? Explain in words

19. Consider the graph shown. In words, describe the motion, and draw the corresponding velocity versus time and acceleration versus time graphs below using the same time scale. **Assume all curved portions shown on the x(t) graph are parabolic**.



20. Assume the ramp has a coefficient of kinetic friction μ_k. You are told that block m_1 is originally headed down the ramp (because someone pushed it) but slowing down. Write the two equations that you would use to solve for the <u>magnitudes</u> of *T* and *a* **after the push** given μ_k, m_1, m_2, g, and θ. Show all work, including clear free body diagrams. *Do not solve for T and a… just know that you can.*



21. A block of mass m approaches the foot of a hill with a speed of v_o. It heads up the frictionless hill of height h and reaches the top. The top is rough with coefficient of kinetic friction μ_k over a distance d. After the rough patch, there is a spring of spring constant k. Ignore air resistance.

   a. Assume that the block does not make it through the rough patch. Determine the length L that it travels through the rough patch before coming to rest.

   b. For the situation in (a), what is the work done by non-conservative forces?

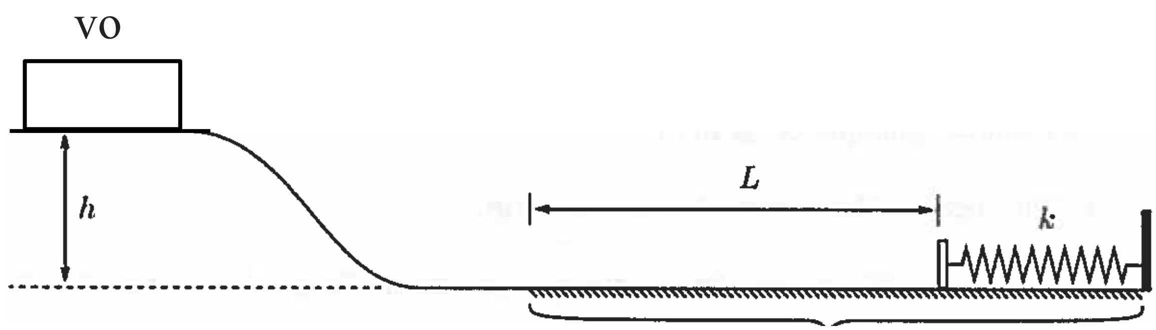
   c. Now assume that the block does make it through the rough patch. Determine the maximum compression of the spring.

22. A mass *m* is pushed against a spring with spring constant *k* and held in place with a catch. The spring compresses an unknown distance *x.* When the catch is removed, the mass leaves the spring and slides along a frictionless circular loop of radius *r.* When the mass reaches the top of the loop, the force of the loop on the mass (the normal force) is equal to twice the weight of the mass.

a) Using conservation of energy, find the kinetic energy at the top of the loop. Express your answer as a function of k, m, x, g, and R.

b) How far was the spring compressed?

23. A block of mass m=8.00 kg moves with initial speed vo=6.00 m/s along a track, as shown. The upper part of the track is a height h=10.0 m above the lower part of the track. There is no friction between the block and the track until the block reaches the rough patch on the lower part of the track, at which point the coefficients of kinetic and static friction are μk=0.250 and **μs=**0.350 respectively. After traveling a distance L=16.0 mover the rough patch, the block collides with a very long, ideal spring with spring constant k. The block compresses the spring by a maximum distance d = 4.00 m, *with friction still acting upon the block.* Calculate the spring constant.



GOOD LUCK!!! **STUDY HARD!!!** **YOU CAN DO IT!!!**