Sample Test 3
PHYS 111 Fall 2012

Name: ________________________

By writing my name above, I affirm that this test represents my work only, without aid from outside sources. In all aspects of this course I perform with honor and integrity.

SHOW YOUR WORK ON ALL OF THE PROBLEMS – YOUR APPROACH TO THE PROBLEM IS AS IMPORTANT AS (IF NOT MORE) IMPORTANT THAN) YOUR FINAL ANSWER.

1) Starting with the definition of work, derive the **Work Energy Theorem**.

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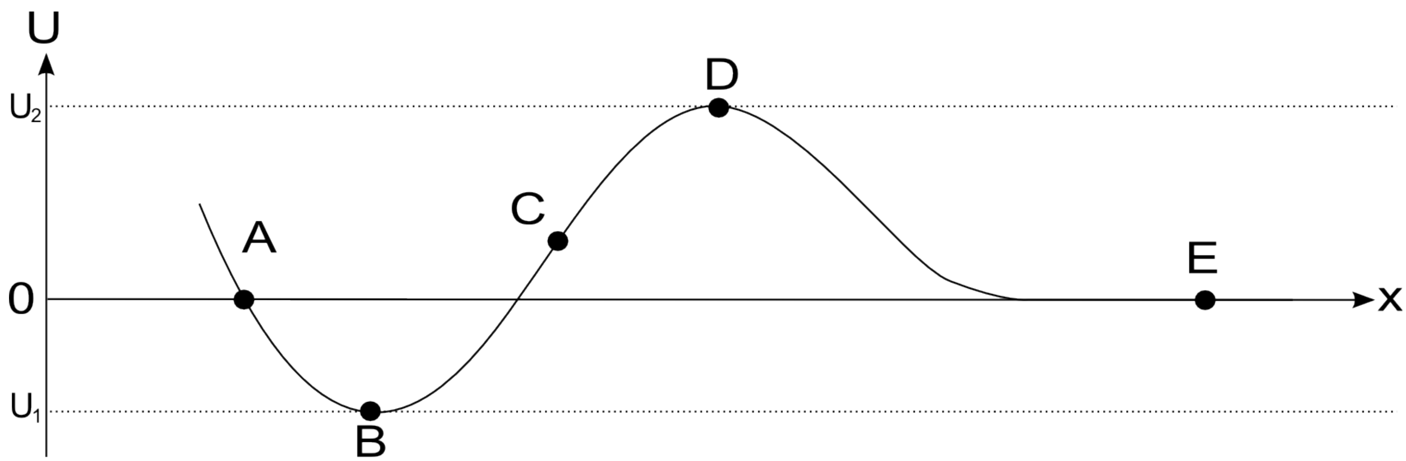
2) Conceptual Questions, 6 points each.



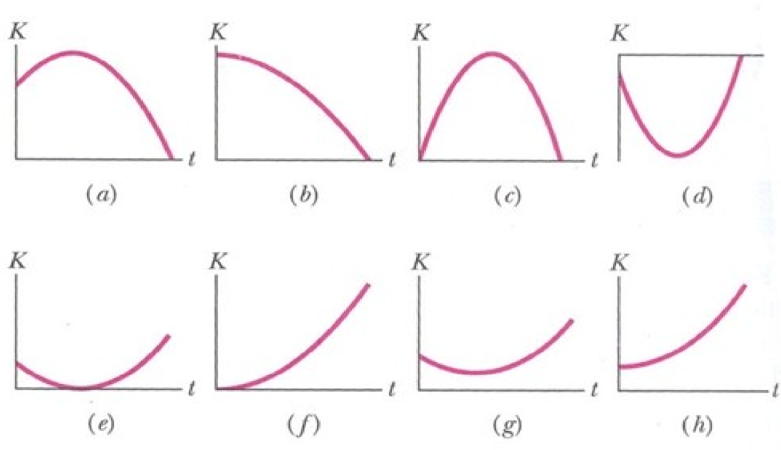
2.1) Refer to the potential energy curve above. At which point(s) does the Force go to zero?
a) A, C
b) B, D
c) B, D, E
d) B

2.2) Your car travels at a *constant velocity* up a hill that makes an angle θ with the horizontal. After traveling a distance d, the **net work** done on the car is:
a) $W_{net} = mgd\sin(\theta)$
b) $W_{net} = -mgd\sin(\theta)$
c) $W_{net} = 0$
d) $W_{net} = mgd\sin(\theta) - N\mu_k d$

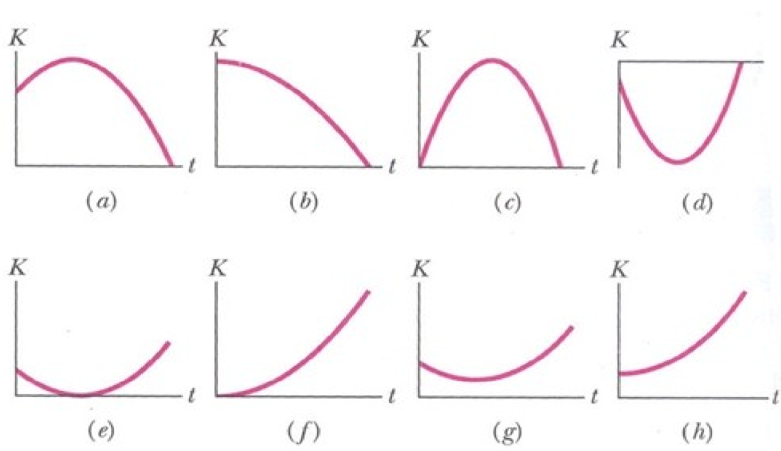
2.3) Two objects, one of mass m and the other of mass 2m, are dropped from the top of a building. When they hit the ground:

a) both will have the same kinetic energy.
b) the heavier one will have twice the kinetic energy of the lighter one.
c) the heavier one will have half the kinetic energy of the lighter one.
d) the lighter one will be moving at half the speed of the heavier one.

2.4) A glob of slime is dropped from rest from the edge of a cliff. Which graph(s) below could show how the kinetic energy changes as a function of time?



2.5) A glob of slime is launched with an initial velocity from the top of a cliff. Which graph(s) below could show how the kinetic energy changes as a function of time?
(The direction of the initial velocity is intentionally left undefined.)

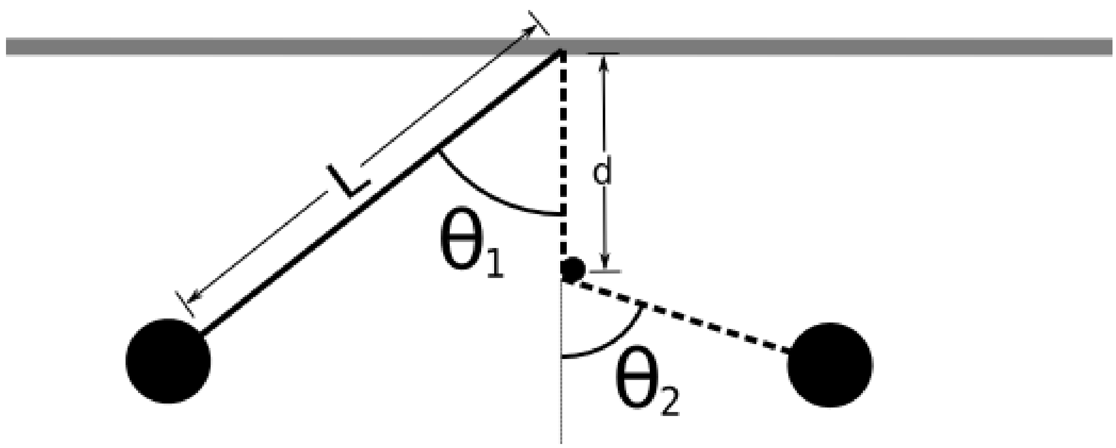


3. *Use work-energy techniques to solve the following problem.*

A pendulum consisting of a string of length L and a sphere of mass m starts from rest at an angle θ_1 from the vertical. The string hits a peg a distance d below the suspension point, as shown in the picture below.

a. Use work/energy to find θ_2 in terms of θ_1, L, and d.

b. If $\theta_1 = 90^{\circ}$, what is the minimum value of d (in terms of L) so that the pendulum will make a full circle around the peg without the string going slack?



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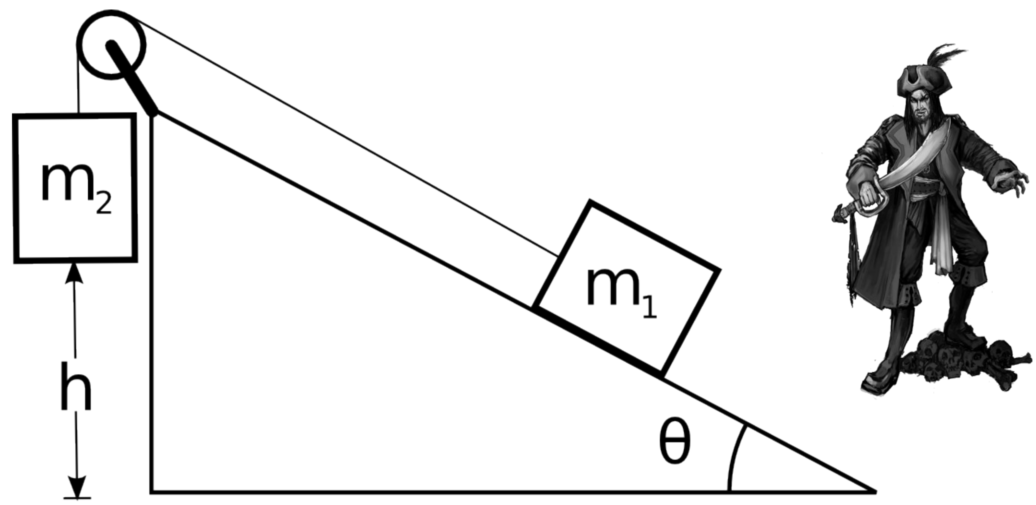
3) (36pts) ***Use Work-Energy techniques to solve the following problem***

In the system below, m_2 hangs from a rope that passes over a pulley (massless and frictionless) and is attached to m_1. Assuming that $m_2 > m_1$, the system starts from rest, and that an annoying evil pirate has added friction to the ramp, find an expression for the velocity of m_2 after it falls through a distance h.



5) (36pts) ***Use Work-Energy techniques to solve the following problem***

After getting your physics degree, you end up on the planning committee for the 2040 Olympic games. You are considering a new sport: Asteroid Jumping. You need to pick an asteroid that the high jumpers will not accidentally escape from after their jump (the initial velocity of their jump must be below the escape velocity of the asteroid).

a) On Earth, the absolute highest a high jumper could go is 3.0m. On the Earth's surface, what initial velocity is required to reach a height of 3.0m?

b) Asteroids are made out of rock that has a density of 2500 kg/m^3. Assuming spherical asteroids, find the radius of an asteroid with an escape velocity equal to the velocity from part a.

(HINT: The volume of a sphere is , where r is the radius of the sphere.)