MIDTERM 2

Physics 9A-02 **NAME:**

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General Instructions: This examination is closed book. Only a calculator is allowed. Please show all your work and box your answers. Credit will only be given for *complete* solutions. Answers must have correct units. There are seven problems on four pages. Note that not all the problems are worth the same number of points. The acceleration due to gravity is g=9.8 m/s^2.

[10 points] 1. A 4 kg textbook is forced against a horizontal spring with force constant $k = 8000$ N/m, compressing the spring a distance 0.15 m. When released, the textbook slides on a horizontal table top with coefficient of kinetic friction $\mu_k = 0.10$. How far does the textbook move from the compressed position before coming to rest?

[20 points] 2. A bomb of mass 8 kg is moving in the x direction with velocity $\vec{v}_i = 5\ \hat{i}$ m/s. It explodes into two fragments, of mass 2 kg and 6 kg. The 2 kg fragment moves off in the y direction with velocity $\vec{v}_{1f} = 7\ \hat{j}$. (a) Find the velocity of the 6 kg fragment. (b) Is the total kinetic energy of the two fragments the same as the initial kinetic energy of the bomb? If it is less, where did the energy go? If more, where did the energy come from?

[20 points] 3. An object of mass 9 kg is pulled by a rope with tension 110 N acting at an angle of 30 degrees from the horizontal. (See figure.) The coefficient of kinetic friction between the mass and the table on which it slides is 0.25. The object is pulled a distance 5 m.

a. What is the work done by the tension?

b. What is the work done by friction?

c. What is the work done by the normal force?

d. If the object starts at $v_0 = 7$ m/s, what is its final velocity?

[10 points] 4. A 50 kg woman stands up in a 80 kg canoe of length 6.0 m which is originally at rest. She walks from a point at the end of the canoe to the middle of the canoe. If resistance to motion of the canoe in the water can be neglected, how far does the canoe move during this process?

[10 points] 5. The figure below shows the potential energy $U(x)$ as a function of position x.

a. Mark the positions where the force is zero.

b. What is the direction of the force at $x = 2$?

c. If an object moving in this potential energy has a total energy of 5 Joules, where are the turning points of its motion?

d. What is this object's kinetic energy at point $x = 0$? What is the kinetic energy at point $x = 6$?

[20 points] 6. A force F is applied to a 3 kg block as it moves along a straight track. The component of the force along the track is shown in the figure. The block is moving with velocity $v = 5$ m/s at the origin $x = 0$.

a. What is the work done by the force in going from $x = 0$ to $x = 4$?

b. What is the velocity at $x = 4$?

[10 points] 7. Two masses $m_1 = 13$ kg and $m_2 = 9$ kg are hanging in an Atwood machine. The mass of the cord is negligible and the pulley is frictionless.

a. What are the tensions T_1 and T_2 in the cord?

b. What is the acceleration?

c. Now suppose the cord has mass $m_{\text{cord}} = 1$ kg. What is the acceleration?

d. What are the tensions T_1 and T_2 in the cord?