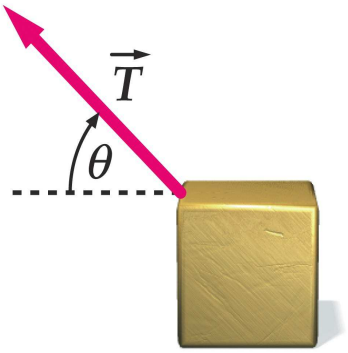
PHYSICS 10310 **Exam II** **March 7, 2006**

INSTRUCTIONS:

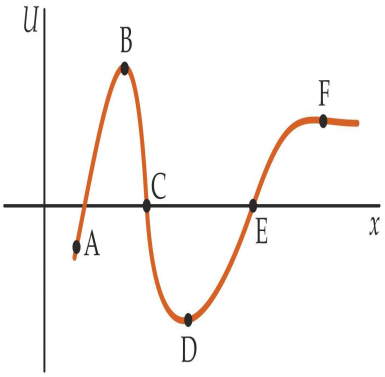
- Write your NAME and SECTION (1=8:30/Eskildsen, 3=3:00/Goussiou) on the cover page of the blue exam book.
- The exam is closed book. You may have only pens/pencils and a calculator (no stored equations or programs and no graphics).
- For the multiple choice questions, write the answers in the table on the first page of the exam book. (Not on the cover page!)
- For problems II-V, write the complete solution in your blue book. **No credit (full or partial) will be given for an answer with no supporting work.** Draw a diagram when possible. Circle or box your final answers, and cross out any parts you do not want us to consider.

I: Multiple Choice Questions

1. A block of mass m is pulled at a constant velocity across a horizontal surface by a string, as shown in the following figure. What is the magnitude of the frictional force?
   (A) $\mu_k mg$
   (B) $T\cos\theta$
   (C) $\mu_k(T - mg)$
   (D) $\mu_k T\sin\theta$
   (E) $\mu_k(mg - T\sin\theta)$



2. The following figure shows the plot of a potential energy-function U versus x. At which point does the force F_x has the greatest positive value?
(A) A (B) B (C) C (D) D (E) E (F) F



3. Two objects of unequal mass are connected by a massless cord passing through a frictionless peg. After the objects are released from rest, which of the following statements is true? (U = gravitational potential energy, K = kinetic energy of the system.)
(A) $\Delta U < 0$ and $\Delta K > 0$
(B) $\Delta U = 0$ and $\Delta K > 0$
(C) $\Delta U < 0$ and $\Delta K = 0$
(D) $\Delta U = 0$ and $\Delta K = 0$
(E) $\Delta U > 0$ and $\Delta K < 0$

4. Two stones are thrown with the same initial speed at the same instant from the roof of a building. One stone is thrown at an angle of 30° above the horizontal, the other is thrown horizontally. Neglect air resistance. Which statement below is true?
(A) The stones strike the ground at the same time and with equal speeds.
(B) The stones strike the ground at the same time with different speeds.
(C) The stones strike the ground at different times with equal speeds.
(D) The stones strike the ground at different times with different speeds.

5. A free neutron at rest decays into a proton plus an electron: $n \rightarrow p + e$
The rest energies of the neutron is 939.565 MeV, of the proton 938.272 MeV, and of the electron 0.511 MeV. What is the energy released in this reaction?
(A) 0.511 MeV
(B) 0.782 MeV
(C) 1.804 MeV
(D) 938.783 MeV
(E) 1878.348 MeV

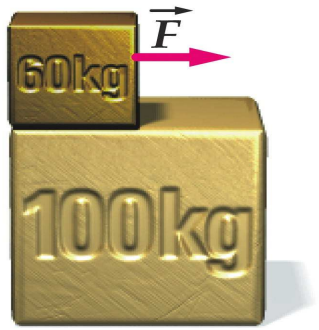
Problem II

A block of mass $m_1 = 60$ kg slides along the top of a block of mass $m_2 = 100$ kg. The m_2 block rests of a horizontal frictionless surface, but there is friction between the two blocks. When a horizontal force $\vec{F}$ of 320 N is applied on the m_1 block (see figure), the block acquires an acceleration $a_1 = 3$ m/s^2.

(a) Find the magnitude of the kinetic friction force between the two blocks.

(b) Find the coefficient of kinetic friction between the blocks.

(c) Find the acceleration a_2 of the $m_2 = 100$ kg block during the time that the $m_1 = 60$ kg block remains in contact.



Problem III

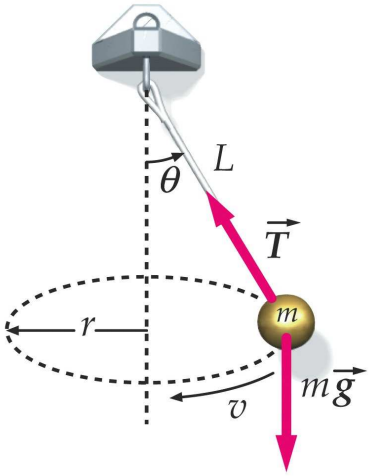
A ball of mass m is suspended from a rope of length L and travels at constant speed v in a horizontal circle of radius r, as shown in the figure. The rope makes an angle θ with the vertical. Find:

(a) The direction of the acceleration. (Draw a diagram and/or describe with words.)

Using θ, m, g and r find expressions for:

(b) The tension in the rope.

(c) The speed of the ball.



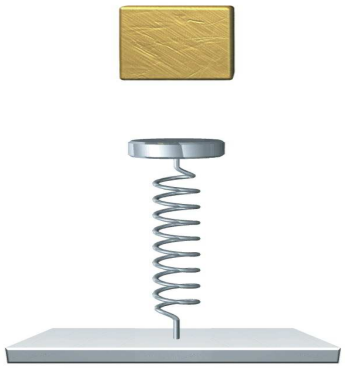
Problem IV

A block of mass $m = 2.4$ kg is dropped from a height of $h = 5.0$ m above an uncompressed spring. The spring constant is $k = 3955$ N/m. Find:

(a) The kinetic energy of the block at the moment it comes in contact with the spring.

(b) The speed of the block when the compression of the spring is $x = 15$ cm.

(c) The maximum compression of the spring, x_{max}, when the block is momentarily at rest.



Problem V

A block of mass $m_1 = 4$ kg is connected to a block of mass $m_2 = 2$ kg by a taut, non-stretching string that passes through a massless, frictionless pulley (see figure). The coefficient of kinetic friction between the m_1 block and the table is $\mu_k = 0.35$.

(a) Find the energy dissipated by friction when the m_2 block falls a distance $y = 2$ m.

(b) Find the total mechanical energy E_{mech} of the two-block-earth system after the m_2 block falls a distance $y = 2$ m, assuming that $E_{mech} = 0$ initially.

(c) Use your result for (b) to find the speed of either block after the m_2 block falls 2 m.