Kuwait University
Physics Department

Physics 101

Second Midterm Exam
Spring 2007-2008
Saturday, May 10, 2008
9:00 a.m. – 11:00 a.m.

Student's Name: ……………………………………………………………………………

Student's Number: ……………………………………………………………………………

Choose your Instructor's Name :

Prof. Fekri El-Akkad.
Dr. Ahmed Ali Al-Jassar
Dr. Hala K. Al-Jassar
Dr. Abdel Mohsen Habib
Dr. Tarek Al Refaey
Dr. Hasan Rafaat
Dr. Adnan Al-Yaseen
Dr. Ismail Sabbah
Dr. Ashraf Zaher
Dr. Tarek Ramadan

Grades:

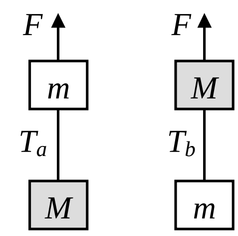
Problems	Q1	Q2	Q3	Q4	P1	P2	P3	P4	P5	P6	P7	P8	Total
Points													

Important Notes:

1. The exam contains **4 questions** and **8 problems** in **3 pages** plus the front page.
2. Answer all questions and problems.
3. Each question will be assigned 1 point.
4. Each problem will be assigned 2 points.
5. **No solution for problems = no points**.
6. Check the correct answer for each question.
7. **Take g = 10 m/s^2**
8. Mobiles and Pagers are not allowed during the exam.
9. Programmable calculators which can store equations are not allowed.

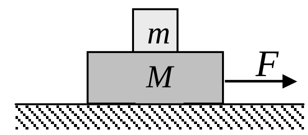
GOOD LUCK

Part I: Questions ***Choose the correct answer***



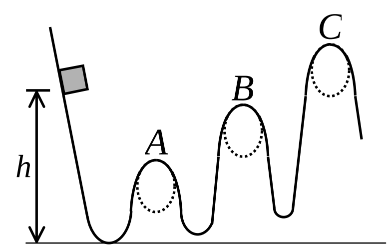
1. Two masses *M* and *m* (<*M*) are connected by a string. We would like to raise them up **at constant speed** by a force *F*. Then, the tension in the string between the two masses will be

(a) $T_a = T_b = 0$ (b) $T_a < T_b$ (c) $T_a = T_b$ (d) $T_a > T_b$



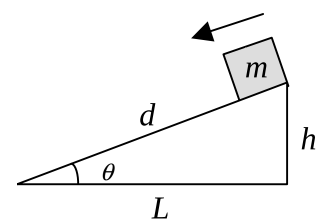
2. A mass *m* is placed on top of a mass *M* and the system accelerates on a rough horizontal surface under the action of a force *F* acting on *M* as shown in the figure. If **the mass *m* is on the verge of slipping**, then the **frictional force** exerted on it equals

(a) $\mu_s\, mg$ (b) $\mu_k\, mg$ (c) $\mu_s\,(m+M)g$ (d) $\mu_k\,(m+M)g$



3. A block initially released from rest at a height *h* above the ground moves along a **frictionless** surface. If the hills have **identical circular tops** with different heights, as shown, then on which hill top will the **normal force** exerted on the block be **maximum**

(a) A (b) B (c) C (d) A and B



4. An object moves a distance *d* along the **rough incline** shown. the magnitude of the **work done by the frictional force** is

(a) $\mu_k mgh$ (b) $\mu_k mgd$ (c) $\mu_k mgL$ (d) 0

Part II: Problems ***Solve the following problems***

1. A 5-kg block is moving in the positive *x*-direction while a net horizontal force *F* of 30 N is acting on it in the negative *x*-direction. If the initial velocity of the block is 8 m/s calculate its **velocity** (in m/s) after 4.0 s.

$$a = \frac{F}{m} = \frac{-30}{5} = -6 m/s^2$$

$$v = v_0 + at = 8 + (-6)(4) = 8 - 24 = -16 m/s$$

2. An elevator moves with a **constant speed** vertically upward a distance of 8 m in 5 seconds. It is driven by a motor that provides a maximum power of 40 hp. Find the **maximum overall weight** (in N) of the elevator with the passengers. (Hint: 1 hp = 746 W)

Since the motion is in a straight line at constant speed thus, $F_{motor} - W = 0$

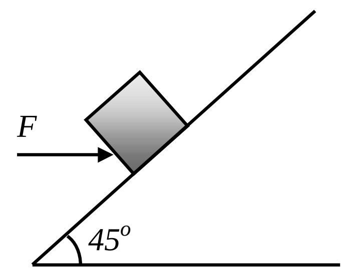
$$F_{motor} = W$$

$$v = 8/5 = 1.6 m/s$$

$$P_{motor} = F_{motor} v$$

$$W = \frac{P_{motor}}{v} = \frac{(40)(746)}{1.6} = 18650\, N$$

3. A block of mass 2.0 kg rests on a rough 45° incline with coefficient of kinetic friction μ_k=0.5. **What force *F*** (in N) must be exerted in the horizontal direction, to move the block with a constant speed in the upward direction along the incline?



$$F\cos\theta - f_k - mg\sin\theta = 0$$

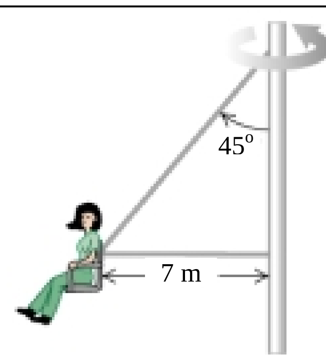
$$f_k = \mu_k N$$

$$N = F\sin\theta + mg\cos\theta$$

$$F\cos\theta - \mu_k(F\sin\theta + mg\cos\theta) - mg\sin\theta = 0$$

$$F = \frac{(\mu_k + \tan\theta)}{(1-\mu_k\tan\theta)}mg = (3)(20) = 60N$$

4. The seat of a swing is connected to two cables as shown in the figure, one of which is horizontal. It rotates with a person sitting on it in a horizontal circle at a speed of 10 m/s. If the overall mass of the seat and the person is 70 kg, find **the tension (in N) in the horizontal cable.**



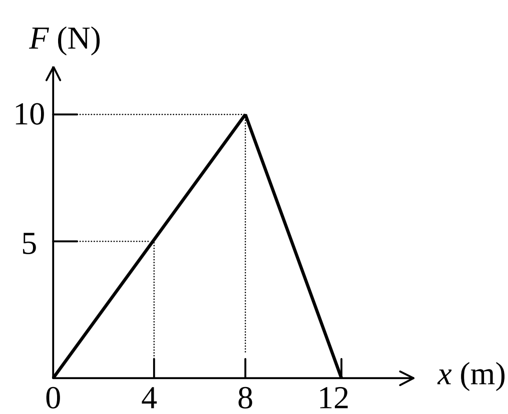
$$T_1 + T_2\sin\theta = m\frac{V^2}{R}$$

$$T_2\cos\theta = mg$$

$$T_1 = m\frac{V^2}{R} - mg\tan\theta$$

$$T_1 = (70)\left(\frac{100}{7}\right) - (70)(10)(1) = 300N$$

5. A single variable force *F* acts on a 0.1-kg mass as it moves along the *x*-axis. The force varies with position as shown in the figure. The speed of the mass at *x*=4 m is 5 m/s. What is its **speed** (in m/s) at *x*=8 m?



$$W_F = \frac{1}{2}(8)(10) - \frac{1}{2}(4)(5) = 30J$$

$$W_F = \frac{1}{2}m(v^2 - v_0^2)$$

$$v^2 = \frac{2W_F}{m} + v_0^2 = \left(\frac{60}{0.1}\right) + (25) = 625$$

$$v = \sqrt{625} = 25m/s$$

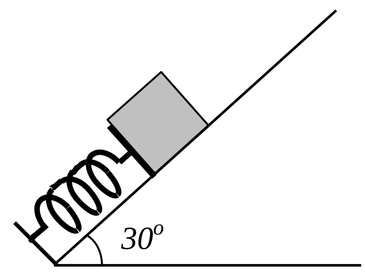
6. A 2.0-kg block is pushed against a spring with a spring constant k = 500 N/m, compressing it 0.30 m. When the block is released, it moves along a **frictionless** 30.0° incline. **How far** (in m) does the block travel up the incline before starting to slide back down?

$$E_i = E_f$$

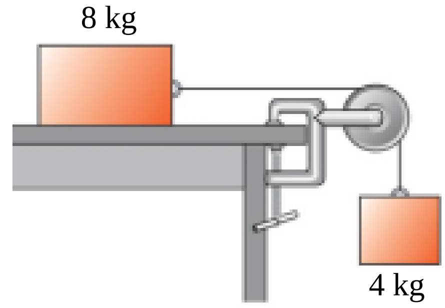
$$\frac{1}{2}kx^2 = mgh$$

$$h = \frac{kx^2}{2mg} = \frac{(500)(0.09)}{2(2)(10)} = 1.125m$$

$$d = \frac{h}{\sin\theta} = 2.25m$$



7. Consider the system shown in the figure. The coefficient of kinetic friction between the 8.00-kg block and the tabletop is μ_k=0.3. The blocks are released from rest. Calculate **the kinetic energy** (in J) of the 4.00-kg block after it has descended 1.5 m.



$$E_f = E_i + W_f$$

$$\frac{1}{2}(m+M)v^2 = mgh + W_f$$

$$W_f = -\mu_k Mgh$$

$$v = \sqrt{\frac{2(mgh + W_f)}{(m+M)}} = 2m/s$$

$$K = \frac{1}{2}mv^2 = \frac{(4)(4)}{2} = 8J$$

8. A particle is moving along the x-axis under the action of a variable conservative force. The potential energy (in Joules) associated with this force is given by $U(x) = 2x^2 - 4x + 6$, where x is in meters. When the force acting on the particle is zero its kinetic energy is 32 J. Find **the mechanical energy** (in J) of the particle.

$$F = -\frac{dU}{dx} = -4x + 4$$

$$F = 0 \longrightarrow x = 1m$$

$$U(1m) = 2 - 4 + 6 = 4J$$

$$E = U(1m) + K(1m) = 4 + 32 = 36J$$