Kuwait University

Department of Physics

A

PHYS 101 **Second Midterm Examination** **General Physics**

Date: Saturday 15 May, 2010 **Time: 9:00–11:00 AM**

Student's Name:_____**KU ID**:_____**Section**:___

Instructor's Name:_____

INSTRUCTIONS:

- Do not start until you are told to do so.
- Solve all problems, show all work and circle your final answer.
- Show all work neatly in this booklet.
- Books and notes are not permitted.
- Make sure that exam booklet includes 4 conceptual questions and 8 problems, in 5 pages including the cover page.
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- Take g = 10 m/s^2

For Instructors only:

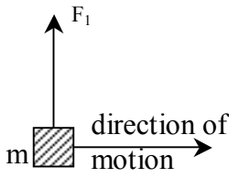
Prob.	1	2	3	4	5	6	7	8	Subtotal
Score									

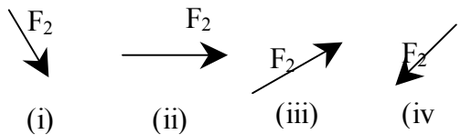
MCQ	1	2	3	4	Subtotal
Score					

Part I: Questions (Choose the correct answer)

1. In a spaceship (zero gravity) a block moves while two forces F_1 and F_2 are acting on it. If F_1 is directed upward , which one of the following forces insures that the block moves in the positive x- direction?.

(a.) (i)
b. (ii)
c. (iii)
d. (iv)





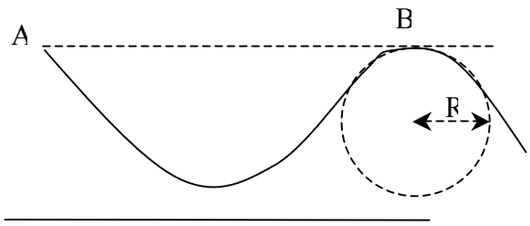
2. A skier slides on a frictionless ice track from point **A** to point **B** that have the same height (see figure). At **B,** the track is circular with radius ***R***. What must be the maximum speed at **A** if the skier is to round the curve at **B** without leaving the track ? Hint: At **B** the normal force =**0**

a. $mg\,(h+R)$

(b.) $\sqrt{Rg}$

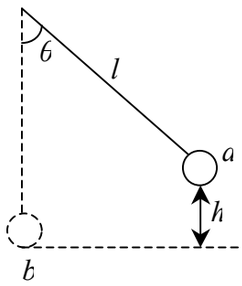
c. $m\,V^2/R$

d. mgh



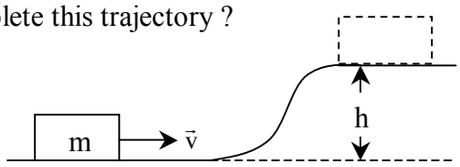
3. A pendulum of length l and mass ***m*** swings from point ***a*** to point ***b***. How much work is done by the tension in the string?

a. mgh
b. mg l cos θ
(c.) Zero
d. mgh sinθ



4. A block of mass ***m*** slides with speed ***v*** without friction on a horizontal surface and then rises up a hill of height ***h***. What must be its minimum speed to complete this trajectory ?

a. $1/2\sqrt{gh}$
b. $\sqrt{gh/2}$
c. $2\sqrt{2gh}$
(d.) $\sqrt{2gh}$



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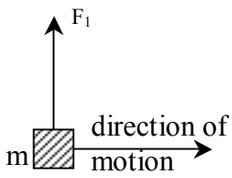

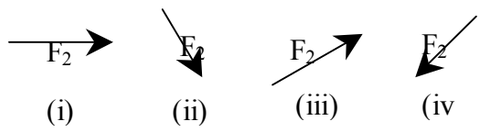

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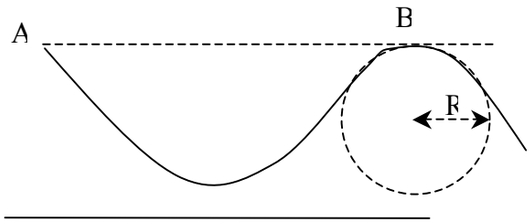

3. A pendulum of length l and mass ***m*** swings from point ***a*** to point ***b***. How much work is done by the tension in the string?

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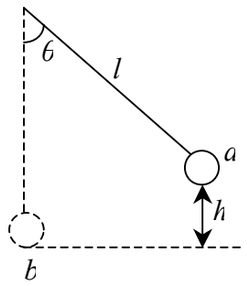

4. A block of mass ***m*** slides with speed ***v*** without friction on a horizontal surface and then rises up a hill of height ***h***. What must be its minimum speed to complete this trajectory?

(a.) $\sqrt{2gh}$
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c. $1/2\sqrt{gh}$
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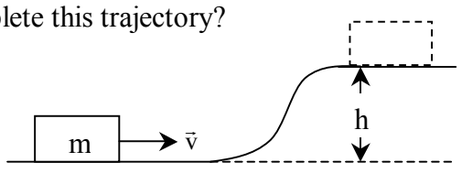
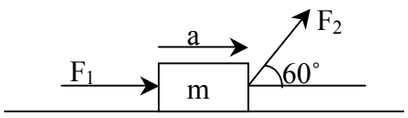


Part II – Problems: Solve the following problems

1. Let $F_1 = F_2 = 4$ N and m = 2 kg . What is the magnitude of the acceleration (in m/s^2) if the surface is frictionless?

1 $$a = \frac{F_1 + F_2 \cos\theta}{m}$$

1 $$a = \frac{4 + 4\cos 60}{2} = 3\, m/s^2$$



2. If the system is in equilibrium, and m = 2 kg. What is the tension (in N) in string 1?

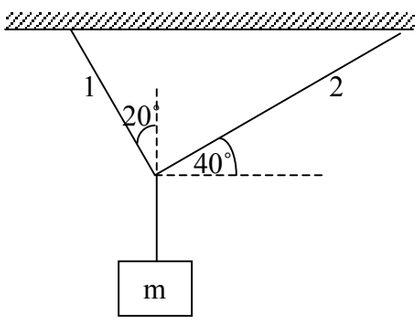
½ $$T_1 \sin 20 = T_2 \cos 40$$

1 $$\therefore T_2 = \frac{\sin 20}{\cos 40} T_1 = 0.446 T_1$$

$$T_1 \cos 20 + T_2 \sin 40 = mg$$

$$T_1(\cos 20 + 0.446 \sin 40) = 2(10)$$

½ $$T_1 = 16.3\ N$$



3. A 2000 kg car starts from rest and accelerates on a horizontal surface reaching a speed of 12 m/s in 4s. It then moves with constant speed up a 30° frictionless incline. What is the speed (in m/s) on the incline, knowing that the power (of the motor force) on the incline is equal to the average power on the horizontal surface?

On the horizontal surface

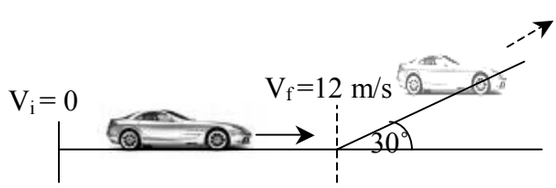
1 $$\overline{P} = \frac{\Delta K}{\Delta t} = \frac{\frac{1}{2} m v_f^2}{\Delta t} = \frac{\frac{1}{2}(2000)(12)^2}{4} = 36 \times 10^3\ W$$

on the incline

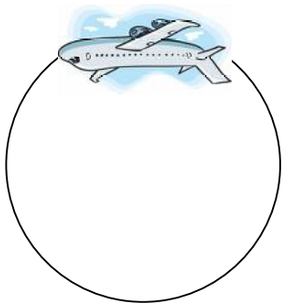
$$P = Fv = (mg \sin\theta) v$$

1 $$36 \times 10^3 = 2000(10)(\sin 30) v$$

$$v = 3.6\ m/s$$



4. A pilot of mass 80 kg makes a vertical loop where the plane is upside down at the top of the trajectory. If the speed of the plane is 40 m/s at the top, and the radius of the loop is 140 m, find the apparent weight (in N) of the pilot.



1 $N + mg = \frac{mv^2}{r}$

$N = m\left(\frac{v^2}{r} - g\right)$

$N = 80\left(\frac{(40)^2}{140} - 10\right)$

½ $N = 114\,N$

½ $Apparent\ weight = 114\,N$

5. Two forces are the **only** forces acting on a 3 kg object which moves with an acceleration of 3 m/s^2 in the positive ***y*** direction and travels a distance 4 m. If one of the forces act in the positive ***x*** direction and has a magnitude of 8 N. What is the total work (in J) done on the object?

½ $W_{tot} = W_{F1} + W_{F2}$

1 $= 0 + mad$

½ $W_{tot} = 3(3)(4) = 36\ J$

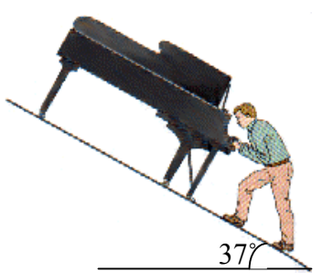
6. A 350 kg piano slides 5.0 m down a rough 37° incline while a man is pushing upward on it parallel to the incline. The piano moves downward with constant speed. If the coefficient of kinetic friction is μ_k=0.40, calculate the work done (in J) by the man on the piano.

1 $F = mg\sin\theta - \mu_k mg\cos\theta$

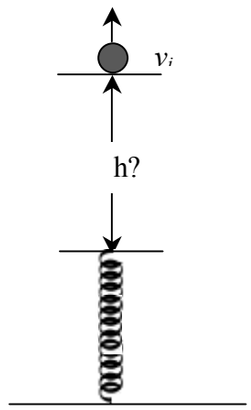
$F = 350(10)(\sin 37 - 0.4\cos 37) = 988\,N$

1 $W_F = -Fd = -988(5) = -4.94\times10^3\ J$

$\approx -5\,kJ$



7. A 2-kg stone is thrown vertically upward with speed 8 m/s from a height h above a vertical spring (k= $6.14\text{x}10^3$ N/m) as shown in the figure. On its way down the stone compresses the spring a maximum compression of 0.22 m . Find the value of ***h***.



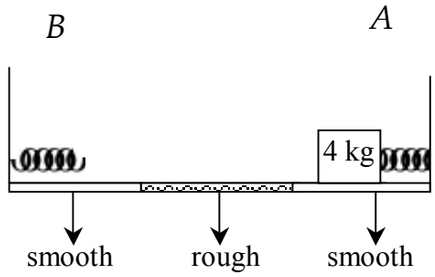
½ $E_i = E_f$

1 $mg(h+x)+\frac{1}{2}mv_i^2 = \frac{1}{2}kx^2$

$2(10)(h+0.22)+\frac{1}{2}(2)(8)^2 = \frac{1}{2}(6.14\times10^3)(0.22)^2$

½ $h = 4\,m$

8. Two similar springs ***A*** and ***B***, each of force constant 8×10^3 N/m, are a distance of 6 m apart on a horizontal surface (see figure). The surface is frictionless except for 2 m of rough portion having a coefficient of kinetic friction μ_k. Spring ***A*** is compressed by 0.12 m against a block of mass 4 kg. When released, the block moves toward spring ***B*** and compresses it, bounces back and comes to a complete stop at the middle of the rough part. Find the coefficient of friction μ_k.



$W_f = \Delta E = E_f - E_i$

1 $-\mu_k mgd = -\frac{1}{2}kx^2$

½ $\mu_k(4)(10)(3) = \frac{1}{2}(8\times10^2)(0.12)^2$

½ $\mu_k = 0.48$