Kuwait University
Physics Department

Physics 101

Second Midterm Exam
Spring Semester
Thursday, May 13, 2005
11:30 p.m. – 1:30 p.m.

Student's Name: ..... اكل النمودجي .....

Student's Number: .....

Choose your Instructor's Name :

Prof. Fekri El-Akkad.
Dr. Ahmed Ali Al-Jassar
Dr. Ismail Sabbah
Dr. Abdel Muhsen Habib
Dr. Hala Khalid Al-Jassar

Dr. Afifa Bahbehani
Dr. Adnan Al-Yaseen
Dr. Yaccob Makdisi
Dr. Majed Ali Fehmi

Grads:

Problem	1	2	3	4	5	6	7	8	9	10	11	12	Total
Points													

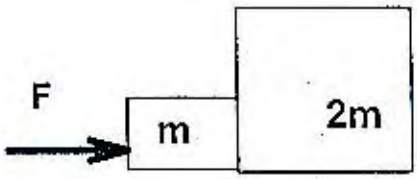
Important Notes:

1. Answer all questions.
2. Each question will be assigned 2 points.
3. The solution should be given explicitly for each problem.
4. No solution = no points.
5. Check the correct answer for each question.
6. Take $g = 10\ m/s^2$
7. Mobiles and Pagers are not allowed during the exam.
8. Programmable calculators which can store equations are not allowed.
9. Some Rotational Inertias

OBJECT (mass M)	AXIS	MOMENT OF INERTIA (I)
Thin rod of length L	Through center ⊥ rod	$1/12\ ML^2$
Solid sphere of radius R	Through center	$2/5\ MR^2$
Solid disk or cylinder of radius R	Through center	$1/2\ MR^2$

Part I: Circle the correct answer:

Two boxes of mass m and 2m are in contact with each other on a frictionless surface. What is the net force on the mass 2m?



(a) 2/3 F (b) F (c) 3/2 F (d) 2F

2. The force that keeps you from sliding on an icy sidewalk is:

(a) Weight (b) Kinetic friction (c) Static friction (d) Normal force

3. Does the centripetal force acting on an object do work on the object?

(a) Yes, since it takes energy to turn an object.
(b) Yes, since a force acts and the object moves, and work is force times distance.
(c) No, because the object has constant acceleration.
(d) No, because the force and the displacement of the object are perpendicular.

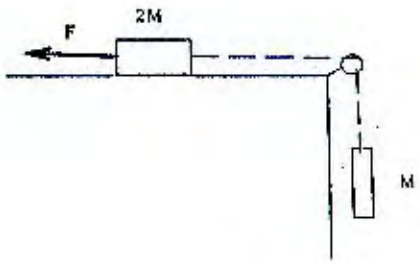
4. A ball drops some distance and loses 30 J of gravitational potential energy. Do not ignore air resistance. How much kinetic energy did the ball gain?

(a) More than 30 J (b) Exactly 30 J (c) Less than 30 J (d) Cannot be determined from the information given.

Part II: Solve the following and choose the correct answer:

1. In the Figure the block 2M is sliding to the left by the force $F = 30\,N$ along a horizontal surface at constant velocity. If M=2 kg, then the coefficient of kinetic friction μ_k between the block and the surface is:

(a) 0.25 (b) 1.25 (c) 0.7 (d) 0.35 (e)0.52 (f) other



$$T = Mg$$

$$F = T + f_K$$

$$30 = Mg + \mu_K (2M) g$$

$$\mu_K = \frac{30 - Mg}{2Mg} = \frac{30 - 20}{40} = 0.25$$

Part I: Circle the correct answer:

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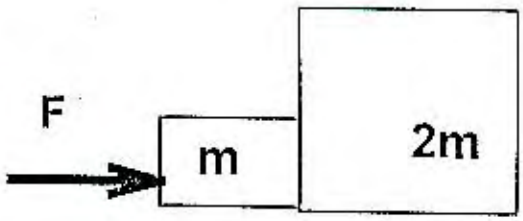

(a) 3/2 F (b) 2F (c) 2/3 F (d) F

2. The force that keeps you from sliding on an icy sidewalk is:

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1. In the Figure the block 2M is sliding to the left by the force $F = 30\,N$ along a horizontal surface at constant velocity. If M=2 kg, then the coefficient of kinetic friction μ_k between the block and the surface is:

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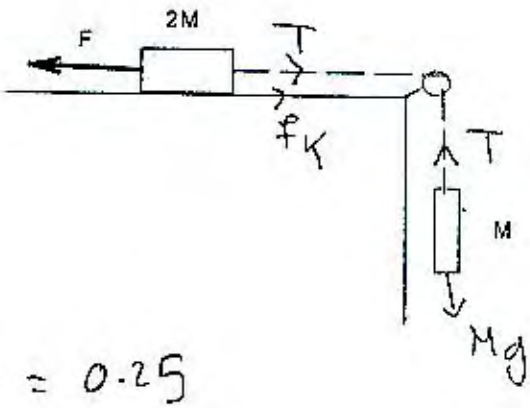
(f) other



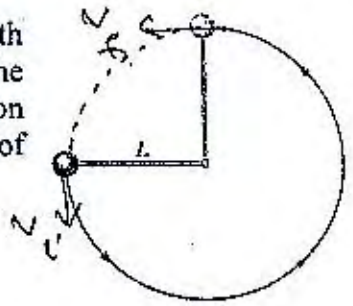
$T = Mg$

$F = T + f_K$

$30 = Mg + \mu_s (2M) g$

$\mu_s = \frac{30 - Mg}{2Mg} = \frac{30 - 20}{40} = 0.25$

2. The Figure shows a ball with mass 17 gm attached to the end of a thin rod with length 55 cm and negligible mass. The other end of the rod is pivoted so that the ball can move in a vertical circle. The rod is pushed from the horizontal position downward with a speed 6 m/s causing the ball to swing vertically. The speed of the ball at the highest position is:



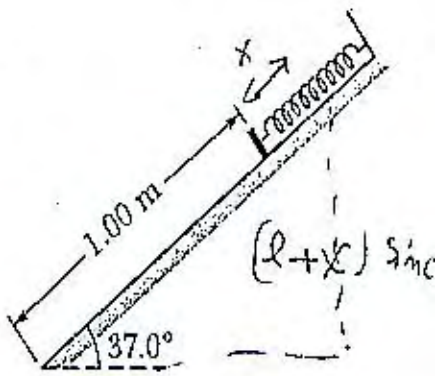
(a) 7 m/s (b)6 m/s (c) 5 m/s (d)3 m/s (e) 0 m/s (f) other

$$\frac{1}{2}mv_i^2 = \frac{1}{2}mv_f^2 + mgL$$

$$\frac{1}{2}6^2 = \frac{1}{2}v_f^2 + 10(0.55)$$

$$v_f = 5\ m/s$$

3. In the Figure a spring with constant k = 170 N/m is at the top of a 37° frictionless incline. A mass of 2 kg is pushed against the spring until it is compressed 0.2 m and released from rest in order to slide down. The speed of the mass (m/s) as soon as it leaves the incline is:



(a) 1.8 (b)3.9 (c) 4.2 (d)4.8 (e) 5.2 (f) other

$$mg(\ell+x)\sin\theta + \frac{1}{2}Kx^2 = \frac{1}{2}mv_f^2$$

$$2\times10(1+0.2)\sin37 + \frac{1}{2}\times170\times(0.2)^2 = \frac{1}{2}\times2\times v_f^2$$

$$v_f = 4.2\ m/s$$

4. A block of mass 10 kg is sliding along the +X direction with $a = 2\ m/s^2$ under the action of three forces: $\vec{F}_1 = 80i - 40j$, $\vec{F}_2 = -60i - 79j$ and $\vec{F}_3$. Find F_3.

(a) 0 N (b)119 N (c) 135 N (d)175 N (e) 77 N (f) other

x: $80 - 60 + F_{3x}i = ma_x$

$20 + F_{3x}i = 10(2)$

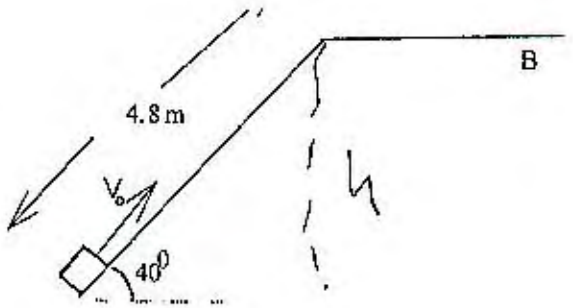
$F_{3x} = 0$

y: $-40 - 79 + F_{3y}j = 0$

$F_{3y}j = 119$

$F_3 = 119\ N$

5. In the Figure, a block of mass 13 kg is projected along the incline up with initial speed 15 m/s along a track, where it stops at B. The coefficient of kinetic friction between the block and the track is 0.7. The increase in the thermal energy of the block and track is:



(a) 1061 J (b)-1061 J (c) 1463 J (d)- 1463 J (e) 1306 J
(f) other

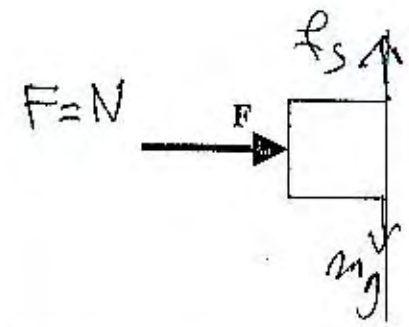
$$\frac{1}{2} m v_0^2 = mgh + \Delta E_{th}$$

$$\Delta E_{th} = \frac{1}{2} \times 13 \times 15^2 - 13 \times 10 \times 4.8 \sin 40$$

$$= 1061 \text{ J}$$

6. A block of mass 1.4 kg is pressed against a rough wall by a force $\vec{F}$ as shown in the Figure. The coefficients of friction between the block and the wall are $\mu_s = 0.5$ and $\mu_k = 0.3$ .What is the minimum value of F that prevents the block from falling down?

(a) 47 N (b)74 N (c) 28 N (d)21 N (e) 77 N (f) other



$$f_s = mg$$

$$\mu_s N = mg$$

$$\mu_s F = mg$$

$$F = \frac{mg}{\mu_s} = \frac{1.4 \times 10}{0.5} = 28 \text{ N}$$

7. A boy does work at the rate of 500 Watt while riding a bicycle. How much force do his feet push with when he is traveling at 5 m/s?

(a) 31 N (b) 100 N (c) 80 N (d) 4000 N (e) 2500 N (f) other

$$P = \frac{dw}{dt} = 500 = F v$$

$$= F 5$$

$$F = 100 \text{ N}$$

8. You know your mass is 60 Kg, but when you stand on a bathroom scale in an elevator, it reads your mass is 80 kg. The total work done on you when the elevator travel 12 m is: (if the acc. is const.)

(a) 240 J (b)2400 W (c) 2400 J (d)-240 W (e) -240 J (f) other

$W = (N - mg)\,12$

$= 800 - 600)12 = 2400\ J$

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9. Force $\vec{F}$ acts along the +x axis on a block of mass 10 kg, changing only the kinetic energy of the block. The position of the block at any time t is given by $x = t^2$. The work done on the block as it moves from $x = 4m$ to $x = 9m$ is:

(a) 80 J (b)100J (c) 180 J (d)250 J (e) 1300 J (f) other

$x = t^2$

$v = 2t$

$a = 2$

$\Rightarrow F = ma = 10 \times 2 = 20N$

$W = F\,d$

$= 20(9-4)$

$= 100\ J$

or $W = \frac{1}{2} m [v_f^2 - v_i^2]$

$v_i = 2t_i = 2\sqrt{x_i} = 4$; $x_i = 4\ m$

$v_f = 2t_f = 2\sqrt{x_f} = 6$; $x_f = 9\ m$

$W = \frac{1}{2} \times 10 [6^2 - 4^2]$

$= 100\ J$

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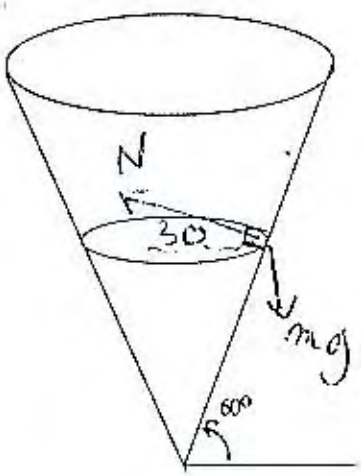
10. A block of mass m travels in a horizontal, circular path of radius 60 cm in the internal wall of a cone as shown. The coefficient of static friction between the block and the internal wall of the cone is 0.2. The minimum speed that must the block has to keep it from sliding down is:

(a) 2.7 m/s (b)4.7 m/s (c)7.5 m/s (d)11.5 m/s (e)15.7 m/s (f) other



$N \cos 30 = \frac{m v^2}{r}$

$N \sin 30 = mg$

$\frac{N \sin 30}{N \cos 30} = \frac{mgr}{mv^2}$

$\tan 30 = \frac{gr}{v^2} \Rightarrow v = \sqrt{\frac{gr}{\tan 30}}$

$v = \sqrt{\frac{10 \times 0.6}{0.58}} = 3.2\ m/s$