Kuwait University
Physics Department

I

2nd Midterm

Summer Course
Saturday, July 23, 2005
5:00 p.m. – 6:30 p.m.

Student's Name: ..... Answers .....

Student's Number: .....

Choose your Instructor's Name :

- ○ Dr. Hassan Raafat
- ○ Dr. Adnan Al-Yaseen
- ○ Dr. Abdulnasser Burezq
- ○ Dr. Yaccob Makdisi
- ○ Dr. Hala Al Jassar

Grads:

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

Important Notes:

1. Answer all questions and problems.
2. Each question will be assigned 1 point and each problem 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, sin 37° = 0.6 and cos 37° = 0.8.
7. Mobiles and Pagers are not allowed during the exam.
8. Programmable calculators which can store equations are not allowed.

PART I – QUESTIONS - Choose the correct answer

Q1. An object moving in a circle has a centripetal force F. If the radius is doubled keeping the speed and mass the same then the centripetal force F' must be:

A) 2 F
C) 4 F
E) the same
(B) ½ F
D) ¼ F

$F = m\frac{v^2}{R}$

$F' = m\frac{v^2}{2R} = \frac{1}{2}F$

Q2. Which of the following bodies has the largest kinetic energy?

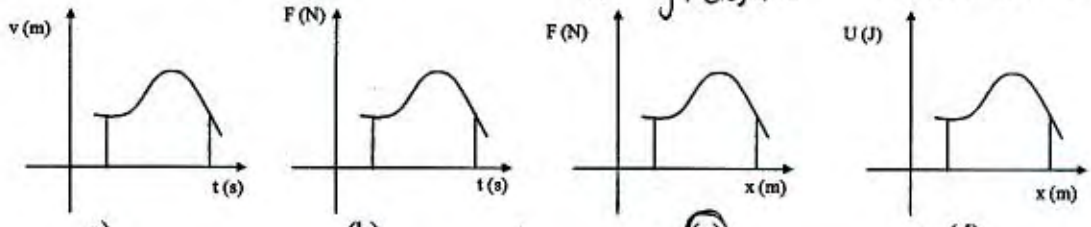
1) Mass 3 M and speed V
2) Mass 3 M and speed 2 V
(3) Mass 2 M and speed 3 V
4) Mass M and speed 4 V
5) All four of the above have the same kinetic energy.

⇒ ① $K = \frac{1}{2}(3)(1)^2 = 1.5$
⇒ ② $K = \frac{1}{2}(3)(2)^2 = 6$
⇒ ③ $K = \frac{1}{2}(2)(3)^2 = 9$
⇒ ④ $K = \frac{1}{2}(1)(4)^2 = 8$

assuming that M = 1 and V = 1 then

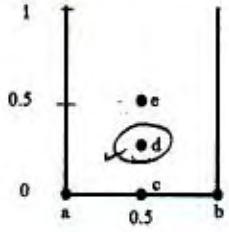
Q3. Which of the following curves represents work?

$W = \int F(x)\,dx$ area under curve.



a) (b) (c) (d)

Q4. A thick uniform wire is bent into the shape of U as shown. Which point indicates the location of the center of mass of the U-shaped wire? (put a circle on the correct position)



PART II – PROBLEMS - Solve the following problem

P1. A 0.2 kg stone is attached to a string and made to rotate in a circle of radius 0.6 m on a horizontal and frictionless surface. If the stone makes 2.5 revolutions per second, then the tension force (in N) of the string is:

a) 148 b) 9.4 c) 29.6 d) 88.8 e) Other

Time period for one revolution is $= \frac{1}{2.5} = 0.4$ S

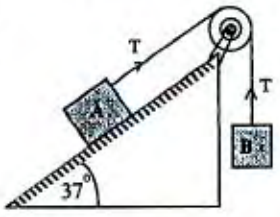
$\therefore v = \frac{2\pi R}{T} = 9.42$ m/s

$\therefore$ Tension $= m\frac{v^2}{R} = (.2)\frac{(9.42)^2}{.6}$

$= 29.6$ N #

P2. In the figure shown, m_A=10 kg on a slope of $\theta = 37^\circ$ and $\mu_s = 0.4$, find the largest mass m_B (in kg) for which m_A will remain at rest and not slide upward (pulley is massless and frictionless).

a) 2.5 b) 3.5 c) 5.9 **d) 9.2** e) other



friction force f_s must be downward to stop m_A from moving up the slope.

$\Sigma \quad m_B g - T = 0 \Rightarrow m_B g = T$

$\oplus \quad N - m_A g \cos\theta = 0 \Rightarrow N = m_A g \cos 37^\circ$

$\otimes \quad T - f_s - m_A g \sin 37^\circ = 0 \quad$ where $T = m_B g$

$\therefore m_B g - \mu_s N - m_A g (.6) = 0$

$$m_B = \frac{\mu_s m_A g \cos 37^\circ + (.6)(m_A g)}{g} = (.4)(10)(.8) + 6$$

$$= \boxed{9.2 \text{ Kg}}$$

P3. The speed of a 4 kg object is given by $v = 2t$ m/s, where t is in seconds. At what rate is the resultant force (in Watt) doing work on this object at t = 1s.

a) 48 **b) 16** c) 32 d) 56 e) other

$$\text{Power} = \frac{dW}{dt} = \vec{F} \cdot \vec{v}$$

$$a = \frac{dv}{dt} = 2 \text{ m/s}^2$$

$\therefore F = ma = (4)(2) = 8N$

& $v = 2t = 2(1) = 2 \text{ m/s}$

$\therefore \text{Power} = F \cdot v = (8)2 = \boxed{16 \text{ W}}$

P4. A man pushes a box weighing 80 N at a constant speed for a distance of 5 m upwards along a rough slope ($\mu_k = 0.4$) that makes an angle of 30° with the horizontal. The work done (in J) by the force of gravity is:

a) -200 b) -400 c) -69 4) 400 e) other

$$W_g = \vec{F}_g \cdot \vec{d}$$

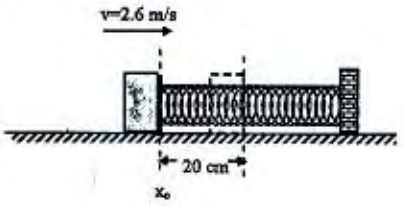
$$= (mg)(d)\cos\phi \quad \text{where } \phi = 120^\circ$$

$\therefore W_g = (80)(5)\cos 120^\circ$

$$= \boxed{-200 \text{ J}}$$

P5. A 2 kg block sliding over a rough horizontal surface hits a spring (k = 250N/m) which has its other end fixed. The block passes the equilibrium with a speed of 2.6 m/s and then stops momentarily at a distance of 20 cm from the equilibrium, find μ_k.

a) 0.32 **b) 0.44** c) 0.58 4) 0.19 e) other



$\Delta E_{mec} = W_f$

$(U_2 + K_2) - (U_1 + K_1) = -\mu_k mg x$

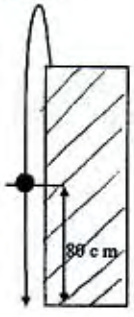
$\frac{1}{2}Kx^2 - \frac{1}{2}mv^2 = -\mu_k (2)(10)(.2)$

$-\mu_k = \frac{.5(250)(.2)^2 - (.5)(2)(2.6)^2}{2(10)(.2)}$

$= 0.44$ #

P6. A 1 kg ball is falling from a high building towards the floor. When it is 0.8 m above the floor its potential energy equals its kinetic energy. How fast (in m/s) is it moving at this height?

a) 4 b) 64 c) 16 4) 8 e) other



at height (.8): $\Rightarrow U = K$

$\therefore mgh = \frac{1}{2}mv^2$

$v^2 = 2gh$

$v = \sqrt{2(10)(.8)}$

$= 4\ m/s$ #

P7. A 2 kg mass sliding on a frictionless surface explodes into two 1 kg masses. After the explosion the velocity of the first mass is 3 m/s North and the second 5 m/s, 30° North of East. What was the magnitude of the original velocity (in m/s) of the 2 kg mass?

a) $-3.16\hat{i} + 2.95\hat{j}$ b) $2.6\hat{i} + 5.5\hat{j}$ c) $4.33\hat{i} + 5.5\hat{j}$ **4) $2.16\hat{i} + 2.75\hat{j}$** e) other

$p_i = p_f \Rightarrow m_T v_i = m_1 v_1 + m_2 v_2$

$\therefore 2\vec{v} = (1)(3\hat{j}) + (1)(5)\cos 30^\circ \hat{i} + (1)(5)\sin 30^\circ \hat{j}$

$\vec{v} = \frac{4.33\hat{i} + 5.5\hat{j}}{2}$

$\vec{v} = 2.16\hat{i} + 2.75\hat{j}$ #

P8. The center of mass of a two particle system is at the origin. One particle is located at (3,0) and has a mass of 2kg. What is the location of the second mass of 3 kg?

a) (-3,0) **b) (-2,0)** c) (2,0) 4) (3,0) e) other

$x_{cm} = \frac{m_1 x_1 + m_2 x_2}{m_1 + m_2} \Rightarrow 0 = \frac{2(3) + 3x_2}{2+3}$

$3x_2 = -6 \Rightarrow x_2 = -2$

& $y = 0$