Kuwait University
Physics Department

I

Physics 101

Final Exam
Spring Semester
Thursday, June-2, 2005
11:00 a.m. – 1:00 p.m.

Student's Name: ....

Student's Number: ....

Choose your Instructor's Name :

Prof. Fekri El-Akkad,
Dr. Ahmed Ali Al-Jassar
Dr. Adnan Al-Yaseen
Dr. Abdel Muhsen Habib
Dr. Hala Khalid Al-Jassar

Dr. Afifa Bahbehani
Yaseen Dr. Ismail Sabbah
Dr. Yaccob Makdisi
Dr. Majed Ali Fehmi
Dr. Tariq Ramadan

Grades	Q1	Q2	Q3	Q4	Q5	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Total
Points																

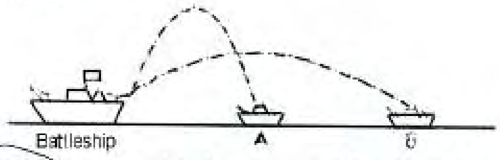
Important Notes:

1. Answer all questions and problems.
2. Each question will be assigned 1 points.
3. Each problem will be assigned 2 points.
4. No solution for problems = no points.
5. Check the correct answer for each question and problem.
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.

GOOD LUCK

Part I - Choose the Correct Answer:

1. If the shells have the same initial speed and were fired at the same time, which ship gets hit first?



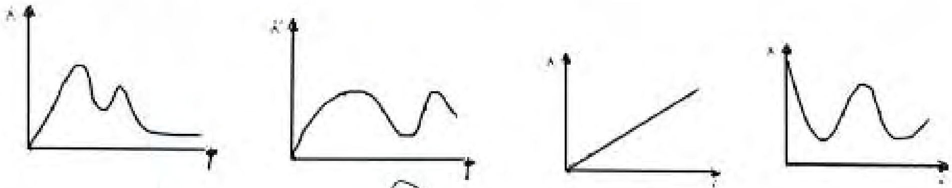
a) B b) A c) both at the same time d) need more information

2. Consider a person of weight W standing in an elevator that is accelerating downward. An upward force N is exerted by the elevator floor on the person. The relationship between N and W is:

(a) N = W (b) 0 (c) N > W (d) N < W

3. A ball, starting at rest, slides down and loops up and around on the "loop-the-loop" track shown below.

The track has negligible friction. Which of the following diagrams best represents the kinetic energy of the ball versus time?



a) b) c) d)

4. Two forces F1 and F2 are applied to a rod that can pivot about the point indicated. Only F1 is shown. Force F2 is perpendicular to the rod and is applied to the right end of the stick. If the rod is not to turn, then the force F2 should be:

a) down and less than F1
b) down and more than F1
c) up and less than F1
d) up and more than F1

5. What impulse will give a 2 kg object a momentum change of + 50 kg.m/s ?

a) +25 N.s b) -25 N.s c) +50 N.s d) -50 N.s

Part II - Solve the Following Problems:
(Solutions should be given explicitly for each problem)

1. You are asked to do an experiment to measure g. You set up a device which drops a metal ball from rest and at a height of 1.650 m. If you measure the time of the falling ball to be 0.585 s, then the value of g (in m/s^2) is:

(a) 9.64) b) 9.80 c) 9.43 d) 8.80 e) 10 f) Other

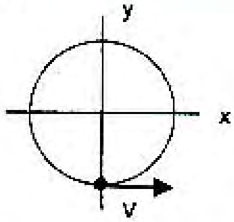
$$\Delta y = v_0 t - \frac{1}{2} g t^2$$

$$-1.65 = -\frac{1}{2}(g)(0.585)^2$$

$$g = \frac{3.3}{(0.585)^2} = \boxed{9.64} \ m/s^2$$

2. A particle moves counterclockwise in a circle in the x y plane. At a certain instant the velocity and acceleration of the particle are 6.0i (m/s) and 3i + 4j (m/s^2). The radius of the circle (in m) is:

a) 3 b) 5 c) 7.2 (d) 9.0) e) 12 f) Other

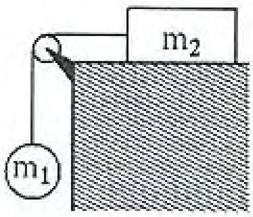


$$a_r = \frac{v^2}{r}$$

$$r = \frac{v^2}{a_r} = \frac{6^2}{4} = \boxed{9 \ m}$$

3. The following device in the figure is called a Tibometer. It is used to measure the coefficient of static friction μs between the block on the table and the table's surface. The hanging mass m_1 is varied to a point where the mass on the table m_2 is just about to move. If m_1=3 kg, m_2 =4 kg ,then μs is:

a) 0.25 b) 1.25 (c) 0.75) d) 0.34 e) 0.10 f) Other



$$\because a = 0$$

$$T = m_1 g$$

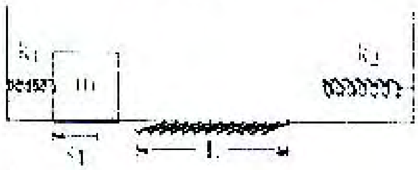
$$T = \mu_s m_2 g$$

$$m_1 g = \mu_s m_2 g$$

$$\mu_s = \frac{m_1}{m_2} = \frac{3}{4} = \boxed{0.75}$$

4. A spring of constant 16 N/cm is compressed a distance 7 cm by 0.5 kg mass, then released. It skids over a frictional surface of length L = 2.4 m with coefficient of kinetic friction 0.17, then compresses the second spring of constant 2 N/cm. How far (in cm) will the second spring compress in order to bring the mass to a stop?

a) 20.3   b) 28.5   c) 8.2   d) 10.2   (e) 13.7)   f) Other



$$\Delta E = E_f - E_i = W_f$$

$$\frac{1}{2} k_2 x_2^2 - \frac{1}{2} k_1 x_1^2 = -\mu_s m g L$$

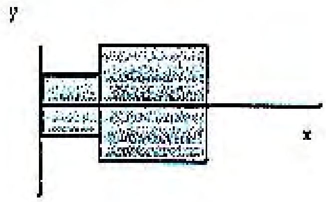
$$\frac{1}{2}(2)\, x_2^2 - \frac{1}{2}(16)(7)^2 = -(0.17)(0.5)(100)(240\,\text{cm})$$

$$x_2^2 - 392 = -204$$

$$x_2^2 = 188\,\text{cm}^2 \Rightarrow x_2 = \boxed{13.7\,\text{cm}}$$

5. Two thin uniform sheet squares that are made from the same material have sides L and 2L. They are placed next to each other (in contact) with their centers along a straight line (see the figure). The position of the center of mass of the system along the x-axis is:

a) 1.2 L   b) 1.2 L   (c) 1.7 L)   d) 3.5 L   e) 5 L   f) Other



$$\{A_1 + A_2\}\, x_{cm} = A_1 x_1 + A_2 x_2$$

$$\left[L^2 + (2L)^2\right] x_{cm} = L^2\left(\frac{L}{2}\right) + (2L)^2(2L)$$

$$[1 + 4]\, L^2\, x_{cm} = L^3\left[\frac{1}{2} + 8\right]$$

$$x_{cm} = \frac{8.5}{5} L = \boxed{1.7\,L}$$

6. A tennis ball with a speed of 12 m/s is moving perpendicular to a wall. After striking the wall, the ball rebounds in the opposite direction with a speed of 10.0 m/s. If the ball is in contact with the wall for 0.05 s, the magnitude of the average acceleration (in units of m/s^2) of the ball while it is in contact with the wall is:

a) 40   b) 100   (c) 440)   d) 920   e) 0   f) Other

$$\bar{F} = \frac{\Delta P}{\Delta t} \Rightarrow \Delta p = \bar{F}\Delta t$$

$$m(v_f - v_i) = m\bar{a}\,\Delta t$$

$$\bar{a} = \frac{10 + 12}{0.05} = \boxed{440\ m/s^2}$$

7. A 1000 kg car, heading north and moving at 100 km/h collides in a perfectly inelastic collision with a 4000 kg truck going East at 80 km/h. The speed of the wrecked vehicles (in km/h) just after collision is:

a) 18 b) 24 c) 35 d) 56 (e) 67) f) Other

$(m_1+m_2)\vec{v} = m_1\vec{v}_1 + m_2\vec{v}_2$

$(1000+4000)\vec{v} = 1000(100\hat{j}) + 4000(80\hat{i})$

$\vec{v} = \frac{(320000)\hat{i} + (100000)\hat{j}}{5000} = 64\hat{i} + 20\hat{j}$

$v = \sqrt{64^2+20^2} = \sqrt{4496} = \boxed{67\ m/s}$

8. A car motor rotates at 800 revolutions per minute. When shut off, it decelerates at a rate of 20 rad/s2. Then the time (in s) it will take the motor to completely stop is:

(a) 4.2) b) 5.2 c) 6.2 d) 8.4 e) 10.4 f) Other

$\omega = \omega_0 + \alpha t$

$0 = \frac{800(2\pi)}{60} - 20t$

$t = \frac{-83.78}{-20} = 4.188 \simeq \boxed{4.2\ (s)}$

9. A 10.0 kg dog is attached to a massless cord which is wrapped around a uniform pulley of mass M = 5.0 kg. If the inertia for the pully that rotates around its center of mass is (I_{cm} = (1/2) MR^2), then the dog's acceleration (in m/s^2) as it drops down is:

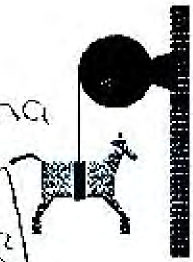
a) 2 b) 5 c) 6 d) 7 (e) 8) f) Other

$\tau = I\alpha \longrightarrow TR = \frac{1}{2} M R^2 \frac{a}{R}$

$\therefore T = \frac{1}{2} M a$

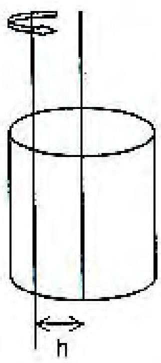
$mg - T = ma \Rightarrow mg - \frac{1}{2} M a = ma$

$\Rightarrow a = \frac{mg}{m + \frac{1}{2}M} = \frac{(10)(10)}{10+2.5} = \boxed{8\ m/s^2}$



10. A uniform solid cylinder with mass M = 3 kg and I_{cm} = 13.5 kg.m^2 can rotates about an axis that is parallel to the axis that goes through the center of mass as shown in the figure. If h = 1 m, then the work (in joules) that is needed to start the cylinder to rotate from rest to an angular speed of 10 rad/s is:

a) 445 b) 675 (c) 825) d) 1255 e) 2250 f) Other



$I = I_{cm} + Mh^2 = 13.5 + (3)(1)^2 = 16.5\ kg\cdot m^2$

$W = \Delta K = \frac{1}{2} I \omega^2 - 0 = \frac{1}{2}(16.5)(10)^2 = \boxed{825\ J}$