Kuwait University
Physics Department

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Physics 101

Second Midterm Exam
Autumn Semester
Thursday, December 9, 2004
11:15 a.m. – 1:15 p.m.

Student's Name: .... اول

Student's Number: ....

Choose your Instructor's Name :

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

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

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

Important Notes:

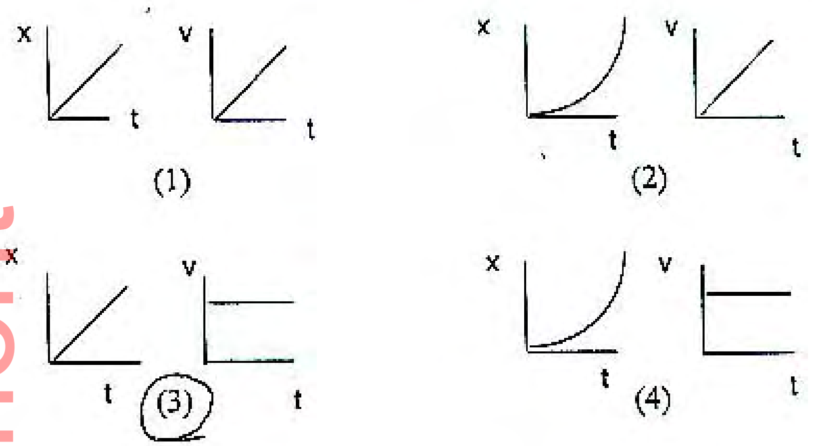
1. Answer all questions and problems.
2. Each question will be assigned 1 points.
3. Each problem will be assigned 2 points.
4. No solution for problems = no points.
5. Check the correct answer for each question and problem.
6. Take $g = 10\ m/s^2$
7. Mobiles and Pagers are not allowed during the exam.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

GOOD LUCK

Part I Choose the Correct Answer:

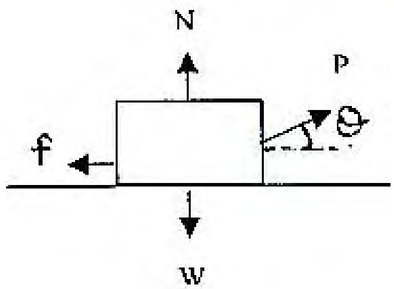
1. Which one of these two graphs represents the motion of an object with the net force is zero?

a) 2 and 3   b) 3 and 4   c) 3   d) 4



2. A box is pulled by a force P at constant speed as shown. Which of the following must be true (f is the force of friction, N is the normal force, and W is the weight):

a) P = f and N = W   b) P = f and N > W   c) P > f and N < W   d) P > f and N = W



3. An object moves in a circle at constant speed. The work done by the centripetal force is zero because:

a) the displacement for each revolution is zero
b) the average force for each revolution is zero
c) the magnitude of the acceleration is zero
d) the centripetal force is perpendicular to the velocity

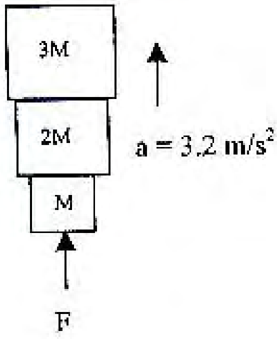
4. The potential energy of a body of mass m is given by $U = -mgx + \frac{1}{2}kx^2$. The corresponding force is

a) $mgx^2/2 - kx^3/6$
b) $-mg + kx/2$
c) $-mg + kx$
d) $mg - kx$

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

1. Three blocks M, 2M, 3M are being accelerated upward with acceleration of 3.2 m/s^2 by a force F applied to the bottom block as shown in the diagram. If M = 7 kg, then the force F (in N) is:

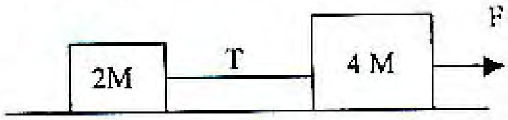
a) 554 N b) 206 N c) 134 N
d) 67.2 N e) 22.4 N f) Other



$$F - 6Mg = 6Ma$$
$$F = 6M(g+a)$$
$$= (6\times7)(10+3.2) = 554.4$$
$$\simeq 554\ \text{N}$$

2. The horizontal surface on which the object slides is frictionless. If M = 1.0 kg and the tension T of the connecting string on the smaller block is 3.0 N, then F (in N) is:

a) 3 b) 6 c) 9
d) 12 e) 15 f) Other

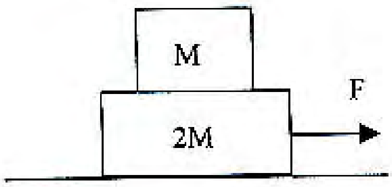


$$F = (2M + 4M)a = 6Ma$$
$$T = 2Ma$$
$$3 = 2(1)(a) \rightarrow a = 1.5\ \text{m/s}^2$$
$$\therefore F = 6(1)(1.5) = 9\ \text{N}$$

3. Two blocks are accelerated across a horizontal frictionless surface as shown. Frictional force between the surfaces of the two blocks keeps them from sliding, so the two blocks move with the same acceleration. If F = 1.2 N and M = 1.0 kg, then the frictional force (in N) between the blocks is:

a) 0.20 b) 0.40 c) 0.60
d) 0.80 e) 1.0 f) Other

Consider the 2 blocks as one block $\rightarrow$ 3M

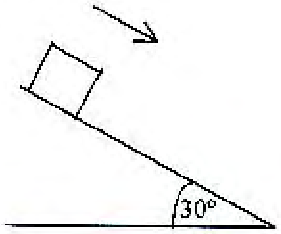


$$\therefore F = 3M\,a$$
$$\therefore a = \frac{F}{3M} = \frac{1.2}{3(1)} = 0.4\ \text{m/s}^2$$
$$\therefore f_s = Ma = (1)(0.4) = 0.4\ \text{N}$$

4. If a 100 kg box is sliding down a rough incline with an acceleration of 2 m/s^2 then the kinetic friction coefficient between the box and the incline is:

a) 1.74 b) 0.80 c) 0.34 d) 0.30 e) 0.12 f) Other

$\sum F_x = mg\sin\theta - f_k = ma$



$f_k = mg\sin\theta - ma$

$f_k = (100)[10(0.5) - 2]$

$= 300$ N

$\cos 30$

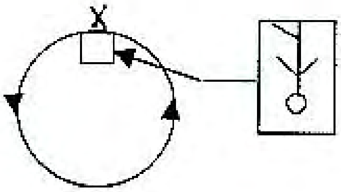
$f_k = \mu_k N = \mu_k mg\cos\theta \Rightarrow 300 = \mu_k (100)(10)$

$\mu_k = 0.346$

5. A giant wheel, 20 m in radius, is fitted with a cage and platform on which a man can stand. The wheel rotates at such a speed that when the cage is at X (as shown) the force exerted by the man on the platform is equal to his weight. The speed of the man (in m/s) is:

a) 14 b) 20 c) 28 d) 80 e) 120 f) Other

$mg + N = m\frac{v^2}{r}$



$2mg = m\frac{v^2}{r}$

$v = \sqrt{2gr} = \sqrt{(2)(10)(20)}$

$= 20$ m/s

6. Starting from rest at t = 0, a 5 kg block is pulled across a horizontal surface having a magnitude of 12 N. If the coefficient of friction between the block and the surface is 0.2, then the power of the force F (in W) at t = 5 s is:

a) 0.13 b) 0.14 c) 0.12 d) 24 e) 28 f) Other

$F - f_k = ma$

$12 - (0.2)(5)(10) = 5a$

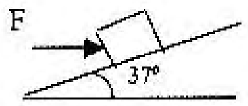
$a = \frac{12 - 10}{5} = \frac{2}{5} = 0.4$ m/s^2

$v = v_0 + at = (0.4)(5) = 2$ m/s

$P = Fv = (12)(2) = 24$ watt

7. A 2 kg block is pushed up a frictionless 37° incline by a horizontal force **F** as shown in the figure. If the block starts from rest and the work done by F to move it a distance 0.5 m is 22 J, the speed (in m/s) of the block then will be:

a) 3.1 b) 3.5 c) 4.0 d) 4.5 e) 5.3 f) Other



$\Delta K = W_F + W_g$

$\frac{1}{2}mv^2 - 0 = W_F - mgd\sin\theta$

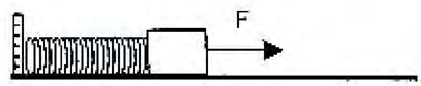
$v^2 = \frac{2W_F}{m} - 2gd\sin\theta$

$v^2 = 22 - (2)(10)(0.5)\sin 37° = 15.98$

$\therefore v = \sqrt{15.98} \simeq 4\ m/s$

8. A 10 kg block on a horizontal frictionless surface is attached to a spring with constant = 1.2 kN/m. The block is initially at rest at its equilibrium position when a horizontal force F is applied to the block, as shown below. When the block is 8.0 cm from the equilibrium position, it has a speed of 0.80 m/s. Then the work done (in J) on the block by the force **F** as the block moves the 8.0 cm is:

a) 8.3 b) 6.4 c) 7.0 d) 7.7 e) 3.8 f) Other



$W_F = \Delta E = E_f - E_i$

$= (U_f + K_f) - (U_i + K_i)$

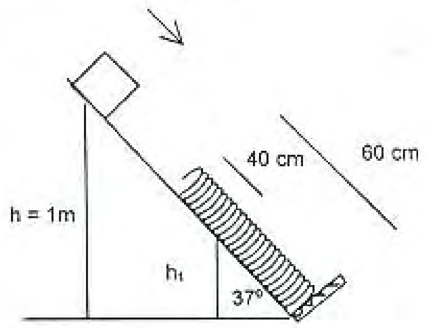
$W_F = (\frac{1}{2}kx^2 + \frac{1}{2}mv_f^2) - (0 - 0)$

$W_F = \frac{1}{2}(1200)(0.08)^2 + \frac{1}{2}(10)(0.8)^2$

$= 3.84 + 3.2 = 7.04 \simeq 7\ J$

9. A 20 kg block slides from rest head on into a spring of length 60 cm. When the block stops completely the spring is compressed by 40 cm. If the work done by the friction is - 64 J, then the spring constant k (in N/m) is:

a) 1300 b) 1400 c) 1500 d) 1600 e) 1700 f) Other



$h_1 = (60 - 40)\sin 37$

$= 12\ cm = 0.12\ m$

$\Delta E_{mec} = W_f$

$\frac{1}{2}kx^2 - mg(h - h_1) = -64$

$\frac{1}{2}k(0.4)^2 - (20)(10)(0.88) = -64$

$0.08\,k = 176 - 64 \Rightarrow k = \frac{112}{0.08} = 1400\ N/m$