Kuwait University
Physics Department

Physics 101

Second Midterm Exam
Autumn Semester
Thursday, December 11, 2003
1:00 p.m. – 3:00 p.m.

Student's Name: .... Solution

Student's Number: ....

Choose your Instructor's Name :

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

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

Grads:

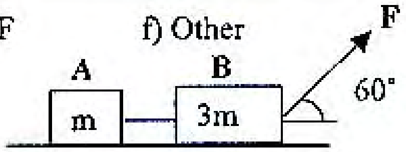
Problem	1	2	3	4	5	6	7	8	9	10	11	12	Total
Points													

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.

1. Two blocks A and B are connected by a rope. Assuming that the surface is frictionless and that a force **F** is applied on block B as shown, then the tension in the connected rope is:

[✓ a) F/8] b) F/4 c) F/2 d) F e) 2F f) Other



for $\underline{\underline{A}}$ $T = ma$ ①

for $\underline{\underline{B}}$ $F\cos 60^\circ - T = 3ma$ ②

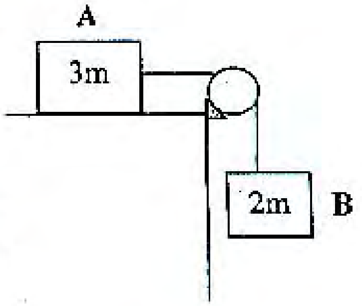
from ① & ②

$$\frac{F}{2} - T = 3T$$

$$T = \boxed{\frac{F}{8}}$$

2. In the figure shown, blocks A and B have masses of 3m and 2m respectively. Find the minimum coefficient of friction force that is needed to prevent any motion from occurring:

a) 1/4 b) 1/2 c) 1/3 [✓ d) 2/3] e) 1 f) Other



for $\underline{\underline{A}}$ $T - f_s = 0$

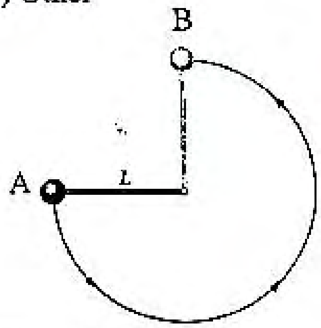
for $\underline{\underline{B}}$ $T - 2mg = 0$

$$2m\cancel{g} = f_s = \mu_s 3m\cancel{g}$$

$$\mu_s = \boxed{\frac{2}{3}}$$

3. The figure shows a ball with mass 19 g is attached to the end of a thin rod with length L = 80 cm and negligible mass. The initial speed (in m/s) that must be given to the ball so it moves from horizontal position A and reaches the upward position B with zero speed is:

a) 0.5 b) 1 c) 2 d) 3 [✓ e) 4] f) Other



$$E_i = E_f$$

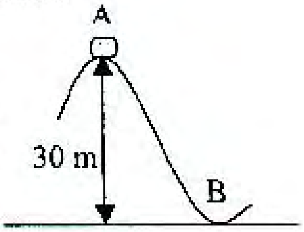
$$\frac{1}{2}mv_i^2 + 0 = +mgL$$

$$v_i = \sqrt{2gL}$$

$$= \sqrt{2(10)(0.8)} = \boxed{4 \text{ m/s}}$$

4. A block starts to move from rest at point A and travel to point B a distance of 50 m. If the average force of friction is equal to one fifth of its weight, then the speed (in m/s) of the roller coaster at point B is:.

a) zero b) 10 c) 14 [✓ d) 20] e) 40 f) Other



$$\Delta K + \Delta U = W_f$$

$$\left(\tfrac{1}{2} m v_B^2\right) + (-mgh) = -f_k d = -f_k d$$

$$\tfrac{1}{2} \cancel{m} v_B^2 - \cancel{m} g h = -\tfrac{1}{5}(\cancel{m} g)\, d$$

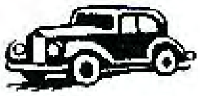
$$v_B^2 = 2g\left[h - \tfrac{d}{5}\right]$$

$$= 2(10)\left[30 - \tfrac{50}{5}\right] = 400 \ m^2/s^2$$

$$v_B = \boxed{20 \ m/s}$$

5. A 800 kg car moves at constant velocity. If the average force of air and road friction is 400 N, then the net force (in N) on the car is:

[✓ a) zero] b) 400 c) 1200 d) 1400 e) 1600 f) Other



as $\vec{v} \longrightarrow$ constant

$$a = 0$$

$$\therefore \quad \vec{F}_{net} = \sum \vec{F} = \boxed{0}$$

6. A force F = (2 N) i + (2 y N) j, with y in meters, acts on a particle with mass 200g and changes only its kinetic energy. If the particle starts from rest and from coordinates (3m, 1m), then the speed (in m/s) of the particle at coordinates (2m, 4m) is:

a) 2.4 b) 6.4 c) 8.4 [✓ d) 11.4] e) 18.4 f) Other

$$W = \Delta K$$

$$\int_3^2 2\,dx + \int_1^4 2y\,dy = K_2 - 0$$

$$[2x]_3^2 + [y^2]_1^4 = K_2$$

$$K_2 = [4-6] + [16-1] = -2 + 15 = 13 \ J$$

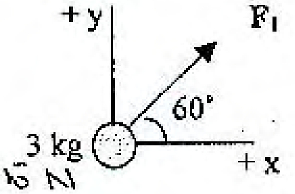
$$K_2 = \tfrac{1}{2} m v^2 \longrightarrow v = \sqrt{\frac{2K_2}{m}} = \sqrt{130}$$

$$= \boxed{11.4 \ m/s}$$

7. Two forces $\mathbf{F}_1$ and $\mathbf{F}_2$ are exerted on a 3 kg object that has an acceleration equal to $(5\mathbf{i} - 2\mathbf{j})\ m/s^2$. If $\mathbf{F}_1 = 10$ N as shown, then the magnitude of the other force $\mathbf{F}_2$ (in N), is approximately:

15

a) 0 b) 10 [✓ c) 18] d) 22 e) 33 f) Other



$$\vec{F}_1 + \vec{F}_2 = m\vec{a}$$

x =

$$10\cos 60 \qquad F = 3(5)$$

$$5 + F = 15 \Rightarrow F_{2x} = 10\ N$$

y

$$10\sin 60 + F_{2y} = (3)(-) \Rightarrow F_{2y} = -14.66\ N$$

$$F = \sqrt{10^2 + (-14.66)^2} = \sqrt{314.9} = 17.75 \simeq \boxed{18\ N}$$

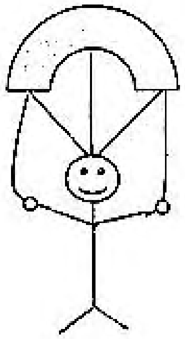
8. A parachutist is experiencing a downward acceleration that is 20 % of the gravitational acceleratior If the mass of the parachutist and his parachute is 60 kg. Then the upward force (in N) on th parachute from the air is.

a) zero b) 240 [✓ c) 480] d) 588 e) 720 f) Other

$$F_{up} - mg = -ma$$

$$F_{up} = m(g-a) = 60(10-2)$$

$$= \boxed{480\ N}$$



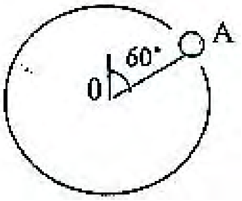
9. A ball of mass 0.5 kg is attached to the end of a cord of length L = 2m, that rotates in a vertical circl about point 0. If the speed of the ball at point A is 4 m/s, then the tension at this point is (in N):

a) 0.5 b) 1 [✓ c) 1.5] d) 2 e) 2.5 f) Other

$$mg\cos 60° + T = m\frac{v^2}{L}$$

$$(0.5)(10)(0.5) + T = (0.5)\frac{4^2}{2}$$

$$T = \boxed{1.5\ N}$$



Note: Some student might ignore mgx, but still get → $\boxed{14 \text{ m/s}}$

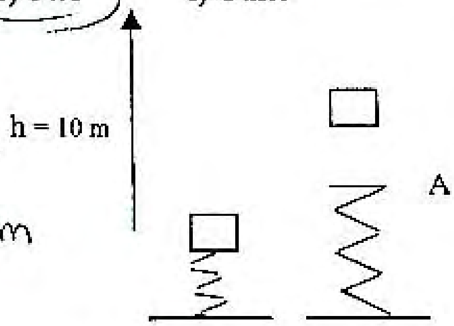
10. When a spring is compressed in a toy gun by 10 cm, it is able to launch a 50 g small block to a maximum height h = 10 meters. The speed (in m/s) of the block as it moves through the equilibrium position A of the spring is approximately:

a) zero b) 2.1 c) 6.1 d) 10.1 [✓ e) 14.1] f) Other

$$\frac{1}{2}kx^2 = mgh$$

$$k = \frac{2mgh}{x^2} = \frac{2(0.05)(10)(10)}{(0.1)^2}$$

$$= 1000 \text{ N/m}$$



$$mgx + \frac{1}{2}mv^2 = \frac{1}{2}kx^2$$

$$v = \sqrt{\frac{kx^2}{m} - 2gx} = \sqrt{\frac{(1000)(0.1)^2}{0.05} - 2(10)(0.1)}$$

$$= \sqrt{200 - 2} = \sqrt{198} = \boxed{14.1 \text{ m/s}}$$

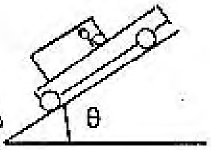
11. A 1500 kg car has a maximum power output of 186.5 kW. If the car climbs up a hill at a constant speed of 60 km/h and the friction force due to surface and air equals to 600 N, then the angle θ (in degrees) is approximately:

a) 15° b) 25° c) 35° [✓ d) 45°] e) 55° f) Other

$$F - mg\sin\theta - 600 = 0$$

$$\therefore F = mg\sin\theta + 600$$

$$P = \vec{F}\cdot\vec{v} = Fv = (mg\sin\theta + 600)\left(\frac{60 \times 1000}{3600}\right)$$



$$111900 = 250000\sin\theta + 10000$$

$$\sin\theta = 0.706$$

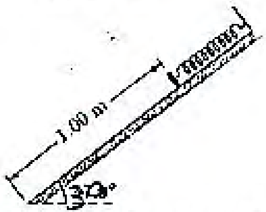
$$\therefore \theta = 44.9^\circ \Rightarrow \simeq \boxed{45^\circ}$$

12. The figure shows a spring with constant k = 50 N/m that is located at the top of a rough incline. A block of mass 2 kg compresses a spring by a distance of 0.5 m and then released. If it reaches the bottom of the incline with zero speed, then the coefficient of kinetic friction between the block and the surface is:

a) 0.12 b) 0.42 c) 0.62 [✓ d) 0.82] e) 1.2 f) Other

$$\Delta K + \Delta U_s + \Delta U_g = W_f$$

$$(0-0) + (0 - \tfrac{1}{2}kx^2) + (0 - mgh) = -\mu_k N d$$



$$-\tfrac{1}{2}(50)(0.5)^2 - (2)(10)(1+0.5)\sin\theta = -\mu_k(mg)(\cos 30)(1.5)$$

$$-6.25 - 15 = -\mu_k(25.98)$$

$$\mu_k = \boxed{0.82}$$