Kuwait University Physics Department

Physics 101
Final Examination

June 12, 2003

Name: ..... Student No. .....

Instructors: Drs. Abdulmuhsen Ali, A. Al-Jassar, A. Al-Yassin, A. Behbehani, F. El-Akkad, I. El-Sabbah, M. Fahmy, Y. Makdisi

For use by Instructors only

Prob.	1	2	3	4	5	6	7	8	9	10	11	12	Total
Marks													

1. Answer all the questions.
2. The solution should be given explicitly for each problem.
3. No solution = no grade.
4. Check the correct answer for each question.
5. Take g = 10 m/s^2.

NOTE: IT IS STRICTLY FORBIDDEN TO BRING ANY MOBILE COMMUNICATION DEVICES (MOBILE PHONES, PAGERS, ETC.), INTO THE EXAMINATION HALL.

Solution.

Answer The Following Questions

1-The position of a particle moving along the x-axis is given by

$x = 2t^2 - 8t$

Where x is in m and t is in seconds. Find the total distance traveled by the particle during the time interval from t = 0 to t = 5 s.

a. 22 m b. 24 m c. 26 m d. 28 m e.30 m f. other

$$v = \frac{dx}{dt} = 4t - 8 = 0$$

$t = 2\ s$

$x(0) = 0$

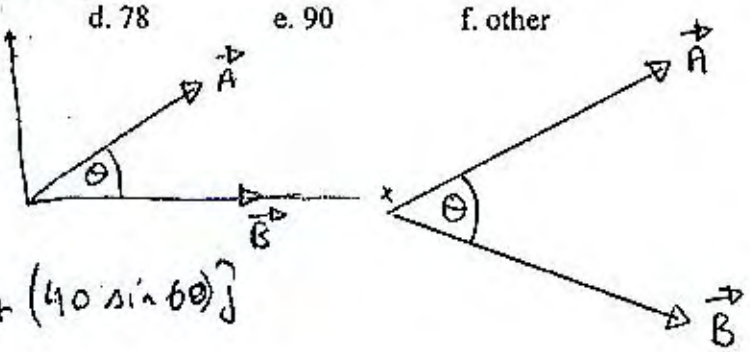
$x(2\ s) = 2(2)^2 - 8(2) = -8\ m$

$x(5\ s) = 2(5)^2 - 8(5) = 10\ m.$

$d = 2(8) + 10 = 26\ m$

2- Vectors $\vec{A}$ and $\vec{B}$ are shown below. If $A = 40$, $B = 50$ and $\theta = 60^\circ$, what is the magnitude of a vector $\vec{C}$, where $\vec{C} = \vec{A} - \vec{B}$

a. 46 b. 10 c. 30 d. 78 e. 90 f. other



$\vec{A} = (A\cos\theta)\hat{i} + (A\sin\theta)\hat{j}$

$\vec{B} = B\hat{i}$

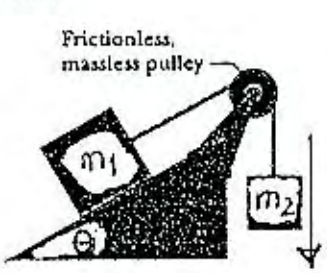
$\vec{C} = \vec{A} - \vec{B} = (40\cos 60 - 50)\hat{i} + (40\sin 60)\hat{j}$

$\vec{C} = -30\hat{i} + 34.6\hat{j}$

$C = \sqrt{(30)^2 + (34.6)^2} = 45.8 \simeq 46\ m$

3- In the figure, $m_1 = 2.0$ kg, $m_2 = 4.0$ kg, $\theta = 30^\circ$ and the incline is frictionless. The system is released from rest. Find the distance that m_1 will move in the first 2.0 seconds.

a. 12 m b. 20 m c. 16 m d. 10 m e.33 m f. other



$$a = \frac{m_2 g - m_1 g \sin\theta}{m_1 + m_2}$$

$$a = \frac{4(10) - 2(10)\sin 30}{2 + 4} = 5\ m/s^2$$

Known v_0, a, t

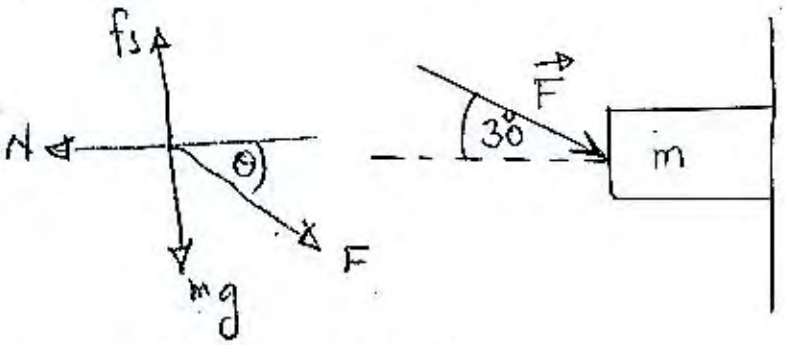
wanted Δx

$\Delta x = v_0 t + \frac{1}{2} a t^2$

$\Delta x = \frac{1}{2}(5)(2)^2 = 10\ m$

4-.In the figure shown, a block of mass 2 kg is held against a vertical wall by a force F and directed as show. If μ_s Between the wall and the block is 0.7, find the magnitude of F needed for the block to be just about to move.

a. 33 N b. 57 N (c. 188 N) d. 18 N e. 140 N f. other



$N = F\cos\theta$

$f_s = \mu_s N = mg + F\sin\theta$

$\mu_s F\cos\theta = mg + F\sin\theta$

$F(\mu_s\cos\theta - \sin\theta) = mg$

$F(0.7\cos 30 - \sin 30) = 2(10) \Rightarrow F = 188\ N$

5. Find the magnitude of the constant force F that should be applied to a 0.50-kg to raise its kinetic energy from zero to 30 J in 2 seconds.

a. 3.3 N b. 7.1 N c. 1.8 N d. 3.4 N (e. 2.7 N) f. Other

$K = \frac{1}{2}mv_f^2 \Rightarrow 30 = \frac{1}{2}(0.5)v_f^2$

$\therefore v_f = 10.95\ m/s$

$W = \Delta K \Rightarrow Fd = K_f - K_i$

to find d known v_0, v, t wanted Δx

$\Delta x = \left(\frac{v_0+v}{2}\right)t \Rightarrow \Delta x = \left(\frac{0+10.95}{2}\right)2$

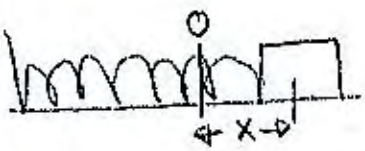
$\Delta x = d = 10.95\ m \Rightarrow F = \frac{30\ J}{10.95\ m}$

$F = 2.7\ N$

6- A 2.0 block sliding on a horizontal frictionless surface is attached to one end of a horizontal spring (k= 200N/m) which has its other end fixed. If the block has a speed of 4.0 m/s as it passes through the equilibrium position, what is its speed when it is 20 cm from the equilibrium position?

a. 2.6 m/s b.3.1 m/s (c. 3.5 m/s) d. 1.9 m/s e. 2.3 m/s f. other

$E_i = E_f$



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

$\frac{1}{2}(2)(4)^2 = \frac{1}{2}(200)(0.2)^2 + \frac{1}{2}(2)v_f^2$

$v_f = 3.46 \simeq 3.5\ m/s$

7- Three metallic rectangular pieces of identical mass are arranged as shown in the figure. If the pieces have identical length (L= 10m) and width (b=5 m), find the distance between the center of mass of the group and the origin O.

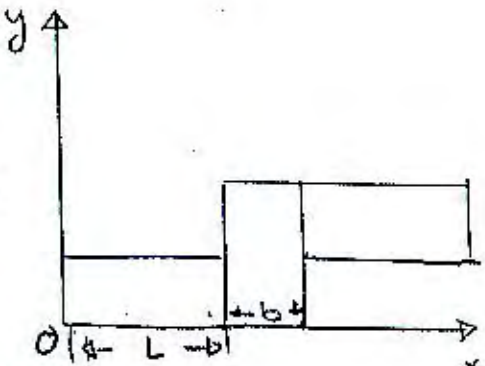
a. 13.5 m b 43.3 m c. 32.5 m d. 16.8 m e.30.5 m f. other

$3m\, x_{cM} = m(5) + m(12.5) + m(20)$

$x_{cM} = \frac{37.5}{3} = 12.5\ m$

$3m\, y_{cM} = m(2.5) + m(5) + m(7.5)$

$y_{cM} = \frac{15}{3} = 5$

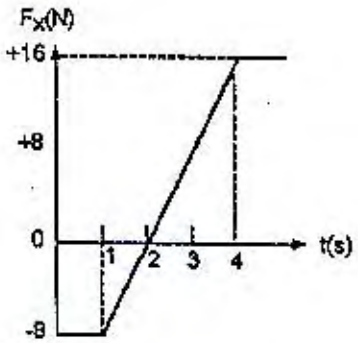


$r_{cM} = \sqrt{(12.5)^2 + (5)^2} = 13.46 \simeq 13.5\ m$

8. The only force acting on a 2.0-kg object moving along the x axis is show below. If the velocity v_x is + 2.0 m/s at t = 0, what is the velocity at t = 4.0 s ?

a. +4.0 m/s b. +5.0 m/s c. +6.0 m/s d. +7.0 m/s e. +2.0 m/s f. other

$J = \Delta p = \int_0^4 F\,dt$ = area under the curve.



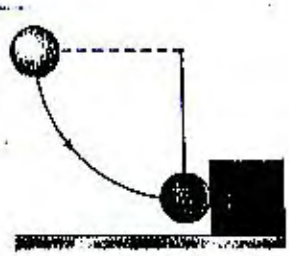
$m(v_f - v_i) =$ area

$2v_f - 2(2) = 1(-8) + \frac{1}{2}(1)(-8) + \frac{1}{2}(2)16$

$v_f = 4\ m/s$

9. A 1.0-kg ball is attached to the end of a 2.5-m string to form a pendulum. This pendulum is released from rest with the string horizontal. At the lowest point in its swings when it is moving horizontally, the ball collides elastically with a 2.0-kg block initially at rest on a horizontal frictionless surface. What is the speed of the block just after the collision?

a. 2.3 m/s b.4.7 m/s c. 3.5 m/s d. 3.0 m/s e. 7.0 m/s f. other



$E_i = E_f$

$mgh = \frac{1}{2}mv^2 \Rightarrow v = \sqrt{2gh}$

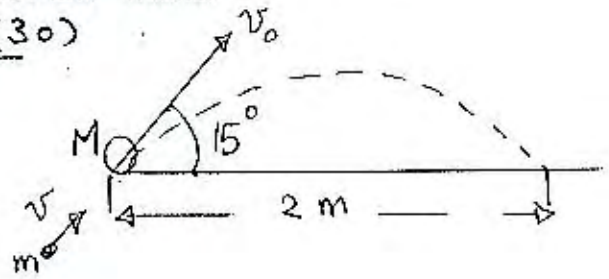
$v = \sqrt{2(10)(2.5)} = 7.07\ m/s$

$v_{2f} = \frac{2m_1}{m_1 + m_2} v$

$v_{2f} = \frac{2(1)}{1+2} 7.07 = 4.7\ m/s$

10. A 50 g bullet moving with a speed v hits a wooden ball mass 0.50 kg, initially at rest, as shown in the figure. The bullet passes through the ball and emerges with a speed of 80 m/s. As a result, the ball is projected into the air in a direction making an angle of 15° above the horizontal. The ball lands after moving a horizontal distance of 2.0 m. find the initial speed ~~v of the~~ bullet.

a. 122 m/s (b. 143 m/s) c. 213 m/s d. 512 m/s e 98 m/s f. other



$$R = \frac{v_0^2 \sin 2\theta}{g} \Rightarrow 2 = \frac{v_0^2 \sin(30)}{10}$$

$$\therefore v_0 = 6.32 \text{ m/s}$$

$$mv = mv' + Mv_0$$

$$0.05v = 0.05(80) + 0.5(6.32)$$

$$v = 143 \text{ m/s}$$

11. A 6.0-kg object moving 5.0 m/s collides with and sticks to a 2.0-kg object moving with speed v. After the collision the composite object is moving 2.0 m/s in a direction opposite to the initial direction of motion of the 6.0-kg object. Determine the speed v of the 2.0-kg object before the collision.

a. 15 m/s b.7.0 m/s c. 8.0 m/s (d. 23 m/s) e. 11 m/s f. other

$$m_1 v_1 + m_2 v_2 = (m_1 + m_2) V$$

$$6(5) + 2v_2 = (6+2)(-2)$$

$$v_2 = -23 \text{ m/s}.$$

$$\text{speed} = |\vec{v}_2| = 23 \text{ m/s}$$

12. A wheel rotating with a constant angular acceleration turns through 10 revolutions during a 5.0 s time interval. Its angular velocity at the end of this interval is equal to 2.5 rev/s. Find the tangential acceleration a_t of a point located 2.0 m from the axis of rotation

a. 2.2 m/ s^2 b.0.40 m/ s^2 c. 1.4 m/ s^2 (d. 2.5 m/ s^2) e. 1.1 m/s^2

a_t

$$\Delta\theta = 10 \text{ rev}, \quad t = 5 \text{ s}, \quad \omega = 2.5 \text{ rev/s}$$

$$\Delta\theta = \omega t - \frac{1}{2}\alpha t^2$$

$$10 = 2.5(5) - \frac{1}{2}\alpha(5)^2$$

$$\alpha = 0.2 \text{ rev/s}^2 = 0.2(2\pi) \text{ rad/s}^2$$

$$a_t = \alpha r = 0.2(2\pi)(2) = 2.5 \text{ m/s}^2$$