Kuwait University
Physics Department

Physics 101

Final Exam

Summer Semester
Thursday, August 7, 2003
2 p.m. – 4 p.m.

Student's Name: ..... الحل الفوزجي .....

Student's Number: .....

Choose your Instructor's Name :

- ○ Dr. Adnan Al-Yaseen
- ○ Dr. Hala Al Jassar
- ○ Dr. Abdulnasser Burezq
- ○ Dr. Abdulmuhsen Habeeb
- ○ Dr. Yaccob Makdisi

Grads:

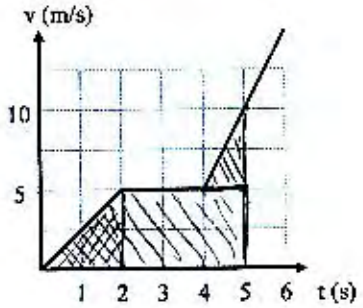
Problem	1	2	3	4	5	6	7	8	9	10	11	12	Total
Points													

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 $g = 10\ m/s^2$, $\sin 37^\circ = 0.6$ and $\cos 37^\circ = 0.8$.
7. Mobiles and Pagers are not allowed during the exam.
8. Programmable calculators which can store equations are not allowed.

1. A particle moves in one dimension and its motion is described by the speed versus time graph as shown. If x = 2m at t = 0s, find the position of the particle (in m) at t = 5s.

a) 24.5 b) 20.5 c) 27.0 d) 18.3 e) 7.8 f) Other



Three areas added together to give Δx

$\Delta x = \frac{1}{2}(2)5 + 3(5) + \frac{1}{2}(5)$

$= 5 + 15 + 2.5 = 22.5$

$x_f - x_0 = 22.5$ where $x_0 = 2$

$\therefore x_f = 22.5 + 2 = 24.5$ m

2. If $\vec{A} = 2\hat{i} - 3\hat{j} - \hat{k}$, and $\vec{B} = \hat{i} + 2\hat{j}$, then find the angle (in degrees) between $\vec{A} \times \vec{B}$ and the y-axis.

a) 54.7° b) -26.6° c) 7.8° d) 82.2° **e) 97.8°** f) Other

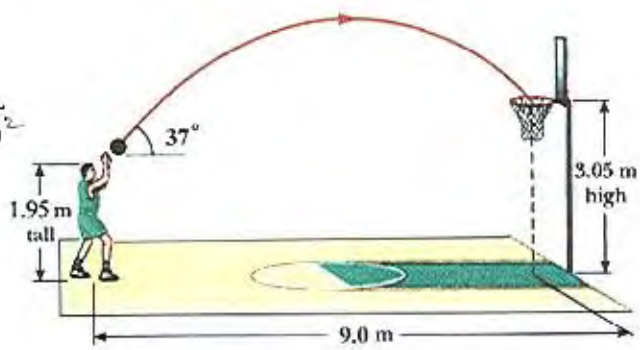
$$\vec{C} = \vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -3 & -1 \\ 1 & 2 & 0 \end{vmatrix} = 2\hat{i} - \hat{j} - 7\hat{k}$$

$$|\vec{C}| = \sqrt{2^2 + 1^2 + 7^2} = \sqrt{54} = 7.348$$

$$\theta = \cos^{-1}\frac{-1}{7.348} = 97.8^\circ$$

3. A 195 cm tall basketball player throws the ball to the basket, as shown. At what initial speed (in m/s) must he throw, so that the ball goes through the hoop?

a) 44.1 **b) 10.6** c) 60.6 d) 13.1 e) 19.2 f) Other



$$y = [\tan\theta_0]x - \frac{gx^2}{2(v_0\cos\theta_0)^2}$$

$$3.05 - 1.95 = \tan 37^\circ(9) - \frac{(10)(9)^2}{2v_0^2(\cos 37^\circ)^2}$$

$$1.1 = .7535(9) - \frac{810}{2v_0^2(.6378)}$$

$$-5.682 = -\frac{810}{2v_0^2(.6378)}$$

$$v_0^2 = \frac{810}{2(5.682)(.6378)} = 111.76 \Rightarrow v_0 = 10.57 \text{ m/s}$$

4. Two blocks m_1 and m_2 weighing 1 kg and 3 kg respectively and connected by a string that passes over a massless pulley as shown. Find out the time (in seconds) when the block m_2 reaches the ground. (h = 5 m)

a) 4 **b) 1.4** c) 2.6 d) 3.2 e) 6.0 f) Other

free axis +

$-m_1 g + T - T + m_2 g = (m_1 + m_2)a$

$(m_2 - m_1)g = (m_1 + m_2)a$

$a = \frac{m_2 - m_1}{m_1 + m_2} g = \frac{3-1}{4}(10) = 5\ m/s^2$

$\because \Delta y = v_i t - \frac{1}{2} a t^2 \Rightarrow -5 = 0 - \frac{1}{2}(5)t^2$

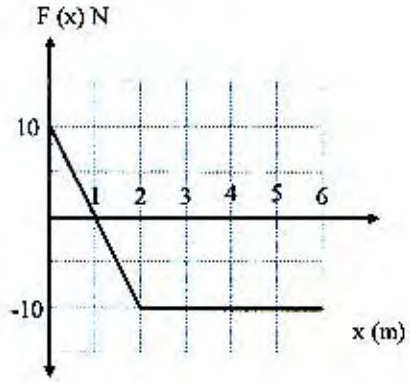
$\Rightarrow t^2 = \frac{5}{2.5} = 2 \Rightarrow t = 1.4\ s$ #

5. The only force acting on an object as it moves along the x-axis is given in the figure. If the object moves from x_1= 1m to x_2 = 5m during an interval of time Δt = 5s, then the average power (in W) is:

a) -10 b) -35 c) 7 **d) -7** e) 35 f) Other

$W = -\frac{1}{2}(1)10 - 3(10) = -35\ J$

$P = \frac{W}{\Delta t} = \frac{-35}{5} = -7\ W$



6. A force acting in one dimension on a 3 kg particle varies with time as shown in the figure. Find the final velocity (in m/s) at t_2 = 7s if the initial velocity v_1 = - 2.5 m/s. at t_1 = 0s.

a) 50 b) 37.5 c) 55.5 **d) 22.5** e) 32.5 f) Other

$J = \Delta P$

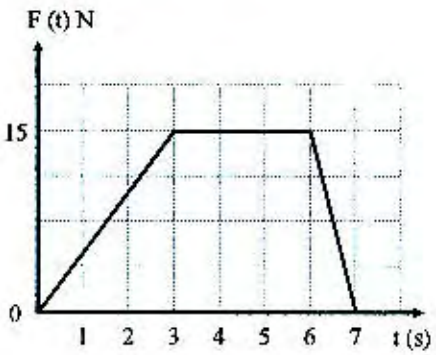
$J = \frac{1}{2}(3)15 + 3(15) + \frac{1}{2}(15)$

$= 22.5 + 45 + 7.5 = 75$

$\therefore 75 = m_1 v_2 - m v_1$

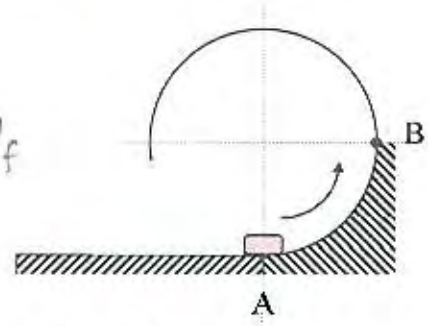
$75 = 3v_2 + 7.5$

$v_2 = \frac{67.5}{3} = 22.5\ m/s$



7. A 1.5 kg mass is projected up a rough track with radius r = 0.5m as shown. The speed of the mass at A is 12 m/s and at point B is 8.5 m/s. Find the magnitude of the average force of friction between the mass and the track (in N).

a) 85 b) 93 c) 101 d) 78 **e) 59** f) Other



$\Delta E_{mec} = W_f$

$(mgh - 0) + \left(\frac{1}{2}mv_B^2 - \frac{1}{2}mv_A^2\right) = W_f$

$(1.5)(10)(.5) + \left[\frac{1}{2}(1.5)(8.5)^2 - \frac{1}{2}(1.5)(12)^2\right] = W_f$

$7.5 + 54.1875 - 108 =$

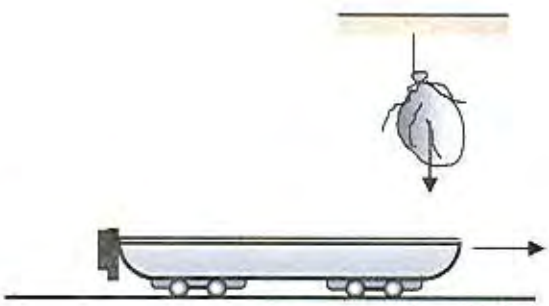
$-46.3125 = -f_k d$

$f_k = \frac{-46.3125}{-d} = \frac{-46.3125}{-\frac{1}{4}(2\pi R)} = \frac{-46.3125}{-.785} = 58.9$

$\simeq 59 N$

8. A bag of coal of mass m is dropped on a 4500 kg train carriage which was initially moving at 6 m/s as shown. After the bag rests on the carriage, the speed of both masses is 5 m/s. The mass of the bag (in kg) is:

a) 900 b) 1600 c) 1500 d) 100 e) 500 f) Other



$P_i = P_f$

(x) $m v_i = (m_1 + m_2) V$

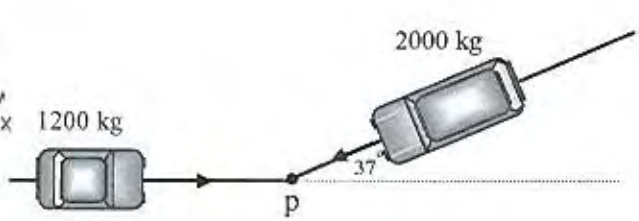
$(4500)(6) = [(4500) + m](5)$

$27000 = 22500 + 5m$

$m = \frac{4500}{5} = 900$ kg

9. A 1200 kg car with a speed of 80 km/h collides with a 2000 kg car at point p with a speed of 120 km/h as shown. If both cars stick together after collision, find the direction of the velocity of the wreckage after collision (in degrees) with respect to the +x-axis.

a) 315.5° b) 126° c) 36.3° d) 236.5° e) 215.6° f) Other



$P_i = P_f$

(x) $m_1 v_1 + m_2 v_2 = (m_1 + m_2) V_x$

$(1200)(80) - (2000)(120)\cos 37° = (3200) V_x$

$V_x = \frac{-96000}{3200} = -30$

(y) $-(2000)(120)\sin 37° = (m_1 + m_2) V_y$

$V_y = \frac{-144000}{3200} = -45$

$\theta = \tan^{-1}\frac{-45}{-30} = 56.31$ But θ in the third quarter

$56.31 + 180 = 236.3°$ //

10. Two objects A and B are moving toward each other along the x-axis. A has a mass of 2 kg and a velocity of 198 km/h, while B has a mass of 4 kg and a velocity of −54 km/h. They suffer a head-on elastic collision and move off along the x-axis. Find the total kinetic energy (in KJ) after collision.

a) 47.2 b) 22.3 c) 7.2 d) 60.3 e) 3.5 f) Other

$\frac{198 \times 1000}{3600} = 55$

$\frac{54 \times 1000}{3600} = 15$

$K_A = \frac{1}{2}(2)(55)^2 = 3025\ J$

$K_B = \frac{1}{2}(4)(15)^2 = 450\ J$

$K_{total} = 3025 + 450 = 3475\ J$

$= 3.5\ J$

11. A wheel starts from rest and reaches an angular speed of 6 rad/s while turning through 2 revolutions. What is the average angular acceleration of the wheel (in rad/s^2)?

a) 0.24 b) 1.43 c) 3 d) 9 e) 6 f) Other

$\alpha_{avg} = \frac{\omega_2 - \omega_1}{t_2 - t_1}$

$\Delta\theta = \frac{1}{2}(\omega_0 + \omega)t$

$4\pi = \frac{1}{2}(6)t$

$\Delta t = 4.189$

$\therefore \alpha_{avg} = \frac{6-0}{4.189} = 1.43\ rad/s^2$

12. A car is rotating on a circular path of radius 20m with a constant speed of 70 km/h. What is the constant angular acceleration (in rad/s^2) needed for this car to stop after rotating 2.5 revolutions.

a) -0.5 b) -0.6 c) −2.5 d) -0.03 e) -0.31 f) Other

$v_t = \omega r \Rightarrow \omega = \frac{19.44}{20} = .972\ rad/s^2$

$\omega^2 = \omega_0^2 + 2\alpha\Delta\theta$

$0 = (.972)^2 + 2\alpha(2.5)(2\pi)$

$\alpha = .03\ rad/s^2$