Kuwait University
Physics Department

Physics 101

First Midterm Exam
Autumn Semester
Sunday, October 26, 2003
12:30 p.m. – 2:00 p.m.

Student's Name: .....

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

Grades:

Problem	1	2	3	4	5	6	7	8	9	10	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. A particle moves along the x-axis according to the equation $x = -2t^3$, then the average acceleration (in m/s^2) of the particle between $t_1 = 1$ s and $t_2 = 3$ s is:

a) - 30 b) -26 c) -24 d) 24 e) 30 f) Other

$x = -2t^3$ (m)

$v = -6t^2$ m/s

$v(1) = -6$ m/s , $v(3) = -54$ m/s

$\bar{a} = \dfrac{v(3) - v(1)}{3 - 1}$

$= \dfrac{-54 - (-6)}{2} = \boxed{-24}$ m/s^2

2. If $A = 3i - 2j$
$B = 5i + j$
$C = i + j - k$
Then $(A \times B) \cdot C$

a) 13k b) –13k c) 13 (i, j) d) 13 e) -13 f) Other

$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -2 & 0 \\ 5 & 1 & 0 \end{vmatrix} = [3 - (-10)]\hat{k} = 13\hat{k}$

$(\vec{A} \times \vec{B}) \cdot \vec{C} = (13\hat{k}) \cdot (\hat{i} + \hat{j} - \hat{k})$

$= \boxed{-13}$

3. You kicked a ball with speed v_o towards a wall, which is 18 meters from you (see the figure). The ball hits the wall after 2 seconds at a point 4 meters above the ground. Then the initial speed v_o (in m/s) is:

a) 9 b) 12 c) 15 d) 10.5 e) 18 f) Other

$\Delta x = v_{ox} t \Rightarrow 18 = 2v_{ox}$

$\therefore v_{ox} = 9$ m/s

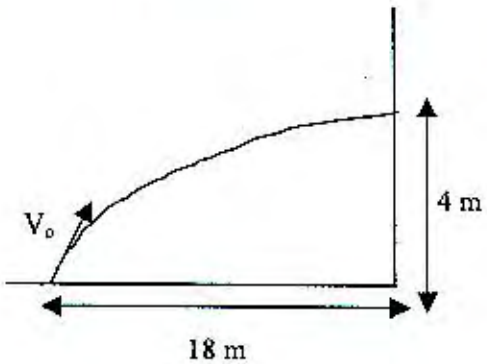
$\Delta y = v_{oy} t - \frac{1}{2} g t^2$

$4 = 2v_{oy} - 20$

$\therefore v_{oy} = 12$ m/s

$v_o = \sqrt{144 + 81}$

$= \boxed{15}$ m/s



4. A particle starts to move from rest with constant acceleration of $\mathbf{a} = (-\mathbf{i} + 4\mathbf{j})$ m/s^2 and from an initial point of coordinates (2,4) (in m). Then at the instant when its y coordinate is 8 m, its x coordinate (in m) is:

a) 0 (b) 1 c) 2 d) 3 e) 4 f) Other

$\Delta y = v_{oy} t + \frac{1}{2} a_y t^2$

$8 - 4 = 0 + \frac{1}{2}(4) t^2$

$4 = 2t^2$

$t^2 = 2 \text{ sec}^2$

$\Delta x = v_{ox} t + \frac{1}{2} a_x t^2$

$x - 2 = 0 + \frac{1}{2}(-1)(2)$

$x = \boxed{1}$ m

5. A girl on a merry-go-round is rotated horizontally in a circle of radius 5 m at constant speed. She is moved one fourth of a revolution, in 5 s. The magnitude of the acceleration (in m/s^2) acting on her is:

a) 8 b) 5 c) 3 d) 1 (e) 0.5 f) Other

$T = \frac{2\pi r}{v}$

$20 = \frac{10\pi}{v}$

$v = \frac{\pi}{2}$ m/s

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

$a = \frac{(\pi/2)^2}{5}$

$= \frac{\pi^2}{20} \simeq \boxed{0.5}$ m/s^2

6. An airplane has a velocity of 300 km/h due east relative to the air. At the same time the air blows northward with a speed of 70 km/h relative to the ground. Then the airplane velocity (in m/s) relative to the ground is:

a) 300i – 70j b) -300i + 70j (c) 300i + 70j d) 70i + 300 j

e) 70i – 300j f) Other

$\vec{v}_{PA} = 300\hat{i}$, $\vec{v}_{AG} = 70\hat{j}$

$\vec{v}_{PG} = \vec{v}_{PA} + \vec{v}_{AG}$

$\vec{v}_{PG} = \boxed{300\hat{i} + 70\hat{j}}$

7. A ball is thrown vertically upward with a speed of 40 m/s. The distance (in m) covered by the ball after 5 seconds is:

a) - 85 b) -75 c) 75 (d) 85 e) 95 f) Other

Ascending Δy_1

$v^2 = v_0^2 + 2g\Delta y_1$

$0 = (40)^2 - 20\Delta y_1$

$\Delta y_1 = 80$ m

Ascending t

$v = v_0 - gt_1$

$0 = 40 - 10t_1$

$t_1 = 4$ s

Descending Δy_2

$t_2 = 5 - t_1 = 1$ s

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

$\Delta y_2 = 0 - 5t^2$

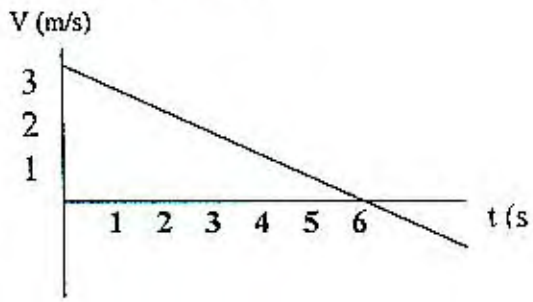
$\Delta y_2 = -5$ m

∴ The distance covered by the ball is:

$d = |\Delta y_1| + |\Delta y_2| = \boxed{85}$ m

8. The figure shown gives the velocity of a particle moving on an x-axis. If the initial position of the particle at $t_1 = 0$ is 40 m then its position (in m) at $t_2 = 20$ seconds is:

a) 0 b) -320 c) -40 d) 40 e) 60 f) Other



$\because a = \frac{dv}{dt}$ = slope of the curve

$a = -\frac{1}{2}\ m/s^2$

$\because a \rightarrow$ is constant

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

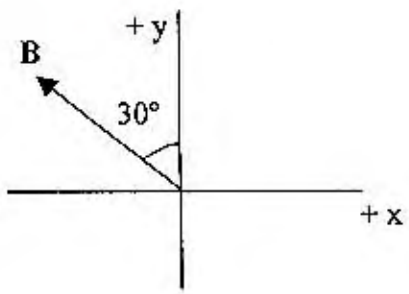
$x - x_0 = (3)(20) + \frac{1}{2}(-\frac{1}{2})(20)^2$

$x - 40 = 60 - 100$

$x = \boxed{0}$

9. A and B are two vectors of equal magnitudes. Vector $\mathbf{A} = 4\mathbf{i} - 3\mathbf{j}$ and B is as shown in the figure. If vector $\mathbf{C} = \mathbf{A} - 2\mathbf{B}$, then the direction of the vector C with respect to the positive x-axis is:

a) 108° b) 158° c) 208° d) 258° e) 308° f) Other



$|\vec{A}| = |\vec{B}| = \sqrt{4^2+3^2} = 5$

$\vec{B} = -5\cos 60\,\hat{i} + 5\sin 60\,\hat{j}$

$= -2.5\,\hat{i} + 4.3\,\hat{j}$

$\therefore \vec{C} = \vec{A} - 2\vec{B} = 9\hat{i} - 11.6\,\hat{j}$

$\therefore \theta = \tan^{-1}\left(\frac{-11.6}{9}\right) = -52^\circ$

$\therefore \theta = 360^\circ - 52$

$= \boxed{308^\circ}$

10. A Ferris wheel with a radius of 8 m makes 1 revolution every 10 s. A ball is released from the top point of the wheel. How far horizontally (in m) does the ball land?

a) 8 b) 9 c) 10 d) 12 e) 16 f) Other

$T = \frac{2\pi r}{v} \Rightarrow v = \frac{2\pi r}{T} = \frac{16\pi}{10}$

$\simeq 5\ m/s$

$\Delta y = v_{oy} t - \frac{1}{2} g t^2 \Rightarrow 16 = 0 - 5t^2$

$t^2 = 3.2\ s^2 \Rightarrow t = 1.8\ s$

$\Delta x = v_{ox} t = 5(1.8) = \boxed{9\ m}$