Kuwait University
Physics Department

Physics 101

First Midterm
Summer Semester
Thursday, July 17, 2003
8 AM – 10:00 AM

Student's Name: ..... الحل النموذجي .....

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. An object starts from rest at x = 0 and moves along the x-axis with constant acceleration of 4 m/s^2. Its average velocity (in m/s) as it goes from x = 2 m to x = 8 m is:

a) 1 b)2 c) 3 d) 5 (e) 6 f) Other

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

$2 = \frac{1}{2}(4) t^2 \Rightarrow t_1 = 1\,s$

also $8 = \frac{1}{2}(4) t^2 \Rightarrow t_2 = 2\,s$

$v_{avg} = \frac{8-2}{2-1} = 6\ m/s$

2. A particle starts from rest at x = 0 and moves for 10 s with an acceleration of + 2.0 cm/s^2. For the next 20s, the acceleration of the particle is –1.0 cm/s^2. The position (in meters) of the particle at the end of this motion is:

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

$\Delta x_1 = v_0 t + \frac{1}{2} a t^2 \Rightarrow \frac{1}{2}(2)(10)^2 = 100\ cm$

$v_f = v_0 + a t \Rightarrow 2(10) = 20\ cm/s$

$\Delta x_2 = 20(20) + \frac{1}{2}(-1)(20)^2 = 200\ cm$

$\therefore$ total distance $= 100 + 200 = 300\ cm = 3\ m$

3. A ball falls freely, starting from rest. It travels a distance of 25 m between the second and the third second of time. Then the distance (in meters) it travels between the third and the fourth second is:

a) 25 (b) 35 c) 5 d) 30 e) 40 f) Other

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

$\therefore y_1 = -\frac{1}{2}(10)(3)^2 \Rightarrow -45\ m$

$y_2 = -\frac{1}{2}(10)(4)^2 \Rightarrow -80\ m$

$\therefore |\Delta y| = |-80 - (-45)| = 35\ m$

4. If $\vec{C}$ = (2.5 cm , 80°), $\vec{D}$ = (3.5 cm, 120°), and $\vec{E} = \vec{D} - 2\vec{C}$, then the direction of $\vec{E}$ relative to the x-axis (to the nearest degree) is:

a) 247° b) 235° c) 243° (d) 216° e) 144° f) Other

$\vec{C} = .434\,\hat{i} + 2.462\,\hat{j}$ $\quad \vec{D} = -1.75\,\hat{i} + 3\,\hat{j}$

$\vec{E} = -2.618\,\hat{i} - 1.924\,\hat{j}$

$|\vec{E}| = 3.25$ cm

$\theta = \tan^{-1}\frac{1.924}{2.618} = 36.3°$ $\quad \therefore \theta = 180 + 36.3 \simeq 216$ ✗

5. Two vectors $\vec{A}$ and $\vec{B}$ are given by $\vec{A} = 4\hat{i} + 8\hat{j}$ and $B = 6\hat{i} - 2\hat{j}$. The scalar product of $\vec{A}$ and a third vector $\vec{C}$ is −16. The scalar product of $\vec{B}$ and $\vec{C}$ is 18. The z component of $\vec{C}$ is zero. The magnitude of $\vec{C}$ is:

a) 7.8 b) 6.4 (c) 3.6 d) 5.0 e) 4.8 f) Other

$\vec{A}\cdot\vec{C} = 4C_x + 8C_y = -16$ ——— (1)

$\vec{B}\cdot\vec{C} = 6C_x - 2C_y = 18$ ——— (2)

$4C_x + 8C_y = -16$

$2C_x - 8C_y = 72$ $\Longrightarrow$ $C_x = 2$

$\therefore C_y = -3$

$|\vec{C}| = \sqrt{(2)^2 + (-3)^2} = \sqrt{13} \simeq 3.6$ ✓

6. A projectile is launched with an initial speed of 30 m/s at an angle of 60° above the horizontal. Its velocity after 3 seconds in vector notation is:

a) $-4\hat{i} + 15\hat{j}$ (b) $15\hat{i} - 4\hat{j}$ c) $-15\hat{i} - 4\hat{j}$ d) $15\hat{i} - 14\hat{j}$ e) $-4\hat{i} - 15\hat{j}$ f) Other

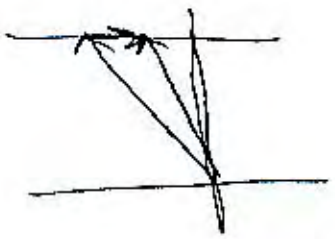
$v_{fx} = v_{ox}\cos\theta \Longrightarrow 15\,\hat{i}$ m/s

$v_{fy} = v_{oy} - gt \Longrightarrow -4\,\hat{j}$ m/s

$v_f = +15\,\hat{i} - 4\,\hat{j}$ ✓

7. A 80 meter wide river flows due east at a uniform speed of 4 m/s. A boat with a speed of 10 m/s relative to the water leaves the south bank pointed in a direction of 37° west of north. The velocity of the boat relative to ground and its direction from east is:

a) (5.4,104°) b) (10.2,76°) c) (9.17,90°) d) (8.25,76°) e) (8.25,104°) f) Other



$\vec{v}_{bg} = \vec{v}_{br} + \vec{v}_{rg}$

$\therefore \vec{v}_{bg} = 10\cos 127\,\hat{i} + 10\sin 127\,\hat{j} + 4\hat{i}$

$v_{bg} = -2\hat{i} + 8\hat{j}$

$|v_{bg}| = \sqrt{68} = 8.25 \text{ m/s}$

$\theta = \tan^{-1}\frac{8}{2} = 76 \Rightarrow \theta = 180 - 76 = 104°$

8. A 12 cm radius fan rotates 1500 Rev/min. The centripetal acceleration (in km/s^2) on the tip of the blades is:

a) 2.96 b) 296 c) 0.209 d) 0.526 e) 33.5 f) Other

$v = \frac{2\pi r}{T} = 2\pi r f = 18.85 \text{ m/s}$

$a = \frac{v^2}{r} = 2.96 \text{ Km/s}$

9. A particle starts moving from origin with initial speed $\vec{v}_o = 3\hat{i} + 4\hat{j}$ m/s and a constant acceleration $\vec{a} = 2\hat{i} - 4\hat{j}$ m/s. The speed of the particle (in m/s) when it reaches its maximum y-coordinates is:

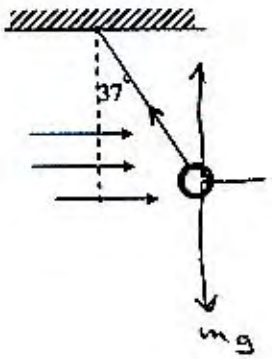
a) 12 b) 3 c) 5 d) 9 e) 15 f) Other

when $v_{fy} = 0 \Rightarrow 0 = 4 + (-4)t \Rightarrow t = 1 \text{ sec}$

$\therefore v_{fx} = 3 + 2(1) \Rightarrow 5 \text{ m/s}$

10. A 0.5kg object is hanging by a string from the ceiling. A constant wind is pushing it to make an angle of 37° with the vertical. The force F (in N) of the wind is:

a) 2.35 b) 6.25 c) 4.75 d) 5.35 **e) 3.75** f) Other



x-axis $F - T\sin 37^\circ = 0$

$F = .6T$

y-axis $T\cos 37^\circ - mg = 0$

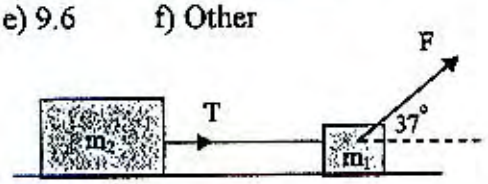
$.8T = (.5)(10)$

$\therefore T = 6.25N$

$\therefore F = (.6)(6.25) = 3.75\ N$

11. Two blocks m_1 and m_2 are connected by a light cord and pulled along a frictionless surface by a 60N force F making an angle 37° with the surface as shown in the figure. If m_1 = 5kg, and m_2 = 20kg. The tension (in N) in the connected cord is:

a) 38.4 b) 24.6 c) 48.3 d) 20 e) 9.6 f) Other



$F\cos 37^\circ - T + T = (m_1 + m_2)a$

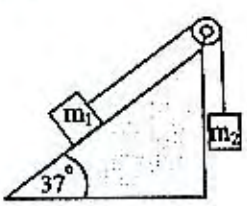
$60(.8) = 25a$

$a = 1.92\ m/s^2$

$T = m_2 a = 38.4\ N$

12. A 4 kg block (m_1) on a fritionless incline is attached by a cord to a suspended (m_2) as shown. Find the mass of (m_2) so that the system is not moving (i.e. m_1 and m_2 will be at rest).

a) 2.4 b) 4.0 c) 3.1 d) 1.0 e) 5.5 f) Other



$-m_1 g\sin 37^\circ + T - T + m_2 g = 0$

$10m_2 = m_1(10)\sin 37^\circ$

$10m_2 = 24.07$

$m_2 = 2.4\ kg$