Kuwait University
Physics Department

Physics 101

First Midterm Exam
Spring Semester
Tuesday, March 30, 2004
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 Ali Al-Jassar
Dr. Ismail Sabbah
Dr. Abdel Muhsen Habib
Dr. Hala Khalid Al-Jassar

Dr. Afifa Bahbehani
Dr. Adnan Al-Yaseen
Dr. Yaccob Makdisi
Dr. Majed Ali 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.
9. Some Rotational Inertias

GOOD LUCK

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1. If $\mathbf{A} = 2\mathbf{i} + 3\mathbf{j} + 4\mathbf{k}$, $\mathbf{B} = \mathbf{i} + 6\mathbf{k}$, $\mathbf{C} = 3\mathbf{i} + 2\mathbf{j} - 5\mathbf{k}$. Then $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})$ is:

a) 27 (b) 53 c) 163 d) 106 e) 114 f) Other

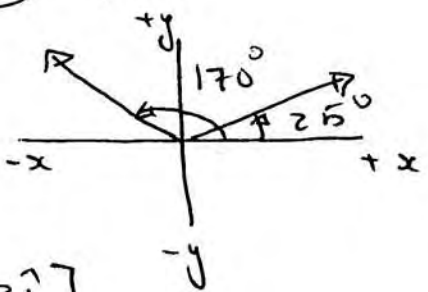
$$\vec{B} \times \vec{C} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 0 & 6 \\ 3 & 2 & -5 \end{vmatrix} = -12\hat{i} + 23\hat{j} + 2\hat{k}$$

$$\vec{A} \cdot (\vec{B} \times \vec{C}) = (2\hat{i} + 3\hat{j} + 4\hat{k}) \cdot (-12\hat{i} + 23\hat{j} + 2\hat{k})$$

$$= -24 + 69 + 8 = 53$$

2. Given two vectors: **A**: 20 at 25° and **B**: 10 at 170° (all angles with respect to the positive x-axis). If $\mathbf{C} = \mathbf{A} + \mathbf{B}$, find **C** in magnitude and direction with respect to the positive x-axis.

a) (5, 30°) b) (6, 40°) c) (10, 214°) d) (12, 250°) (e) (13, 51°) f) Other



$$\vec{C} = \vec{A} + \vec{B}$$

$$= (A\cos 25°)\hat{i} + (A\sin 25)\hat{j} + (B\cos 170°)\hat{i} + (B\sin 170)\hat{j}$$

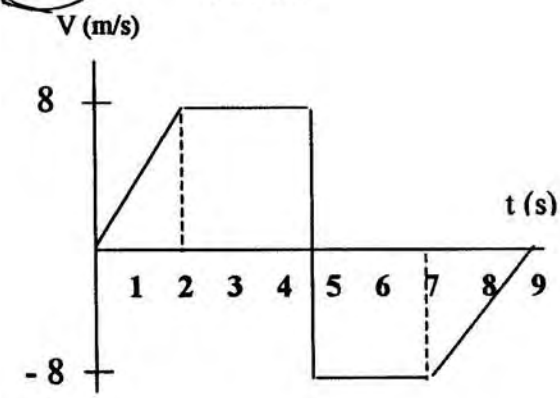
$$= (18\hat{i} + 8.45\hat{j}) + [(-9.84\hat{i}) + 1.73\hat{j}]$$

$$= 8.26\hat{i} + 10.18\hat{j} \Rightarrow C = \sqrt{(8.3)^2 + (10.2)^2} \simeq 13$$

$$\theta = \tan^{-1}\frac{10.18}{8.3} \simeq 51°$$

3. Find the average speed (in m/s) of a particle between t = 2 (s) and t = 7 (s) from the velocity-time graph shown below:

a) 0.8 b) 1.6 c) 3.2 d) 4 (e) 8 f) Other



$$\text{avr. speed} = \frac{\text{total distance}}{\text{time}}$$

$$\text{distance} = (3)(8) + (2)(8)$$

$$= 40$$

$$\text{avr. speed} = \frac{40}{5} = 8 \text{ m/s}$$

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4. A man is traveling upward by a balloon at a constant speed. The man drops a package when the balloon is at an altitude of 20 m above the ground. The package hits the ground after 4 seconds. At that instant the balloon will be at a height (in m) of:

a) 20 b) 40 c) 60 **d) 80** e) 100 f) Other

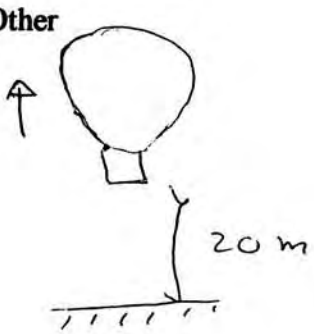
$\Delta y = v_0 t - \frac{1}{2} g t^2$

$-20 = 4 v_0 - 5(4)^2$

$v_0 = 15$ m/s

$h = 20 + v_0 t$

$= 20 + (15)(4) = 80$ m



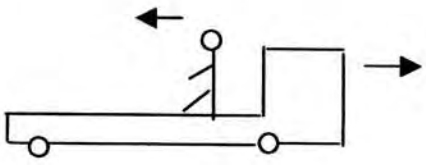
5. A flat car travels at 30 km/h. You run from the front of the car towards the rear at speed of 14 km/h relative to the car. Your speed (in km/h) relative to the ground will be:

a) 44 b) 33 c) 30 **d) 16** e) 14 f) Other

$\vec{v}_{yG} = \vec{v}_{yc} + \vec{v}_{cG}$

$= -14 + 30$

$= 16$ km/h



6. A 1 kg pendulum bob is held at an angle of θ from the vertical by a 3 N horizontal force F as shown. The tension (in N) in the string supporting the pendulum bob is:

a) 0.04 b) 1.4 c) 3.4 d) 5.4 **e) 10.4** f) Other

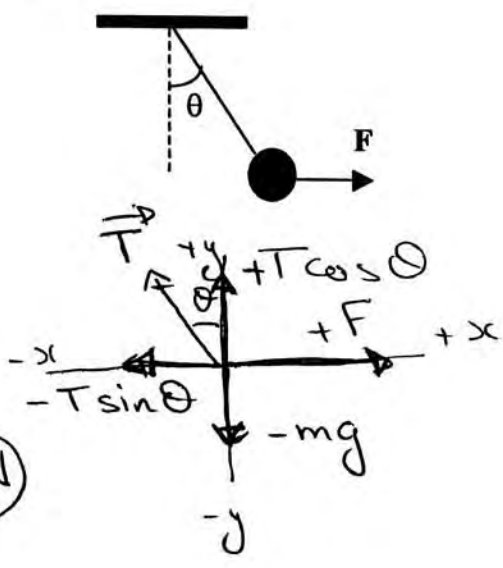
$F = T\sin\theta$ } divide

$mg = T\cos\theta$ }

$\tan\theta = \frac{F}{mg} = \frac{3}{10} = 0.3$

$\theta = 16.7°$

$T = \frac{F}{\sin\theta} = \frac{3}{\sin 16.7} = 10.4$ N



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7. A particle moves from the origin with the velocity $v_x = 3$ (m/s) and $v_y = 7$ (m/s) and acceleration $\mathbf{a} = -3\mathbf{j}$ (m/s^2). How far (in m) from the origin is the particle at t = 2 sec?

a) 6.0 b) 6.2 c) 7 d) 8 **e) 10** f) Other

$\Delta x = v_x t = (3)(2) = 6$ m as $v_x \to$ constant

$\Delta y = v_{y_0} t + \frac{1}{2} a_y t^2 = (7)(2) + \frac{1}{2}(-3)(2)^2 = 8$ m

$r = \sqrt{x^2 + y^2} = \sqrt{6^2 + 8^2} =$ **10 m**

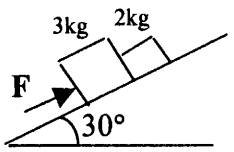
8. Two blocks having masses 2 kg and 3 kg are in contact on a fixed smooth inclined plane as shown in the figure. Calculate the force F (in N) that will accelerate the blocks up the incline with acceleration of 2 m/s^2.

a) 35 b) 25 c) 15 d) 10 e) 5 f) Other

$F - (m_1 + m_2) g \sin 30^\circ = (m_1 + m_2) a$

$F = 50 \sin 30 + 5(2)$

$F =$ **35 N**



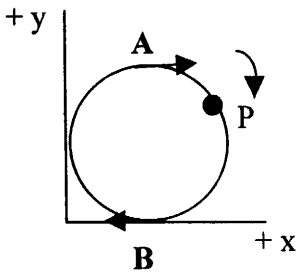
9. A particle P travels with constant speed on a circle of radius 2 m. The particle completes one revolution every 4 seconds. If the reference frame of the particle is as shown, then the average acceleration in (m/s^2) of the particle when it moves from point A to point B is:

a) $-\pi\,\mathbf{i}$ b) $(\pi^2/2)\,\mathbf{i}$ c) $\pi\,\mathbf{j}$ d) $-\pi\,\mathbf{j}$ e) $(\pi^2/2)\,\mathbf{j}$ f) Other

$v = \frac{2\pi r}{T} = \frac{2\pi(2)}{4} = \pi$

$\vec{a}_{avg} = \frac{\vec{v}_B - \vec{v}_A}{2}$

$= \frac{-\pi\hat{i} - \pi\hat{i}}{2} =$ **$-\pi\hat{i}$**



10. The minimum speed (in m/s) that you should run horizontally to jump from the roof of building A to the roof of building B (as shown in the figure) will be:

a) 3.0 b) 3.2 c) 4.0 d) 4.5 **e) 5** f) Other

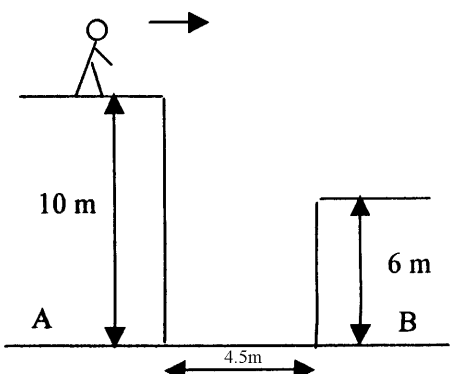
$\Delta y = 0 - \frac{1}{2} g t^2 = -5t^2$

$-4 = -5t^2 \Rightarrow t = 0.9$ (s)

$\Delta x = v_x t \Rightarrow$ as $v_{0x} = v_x$

$4.5 = v_x (0.9)$

$v_{0x} = v_x = \frac{4.5}{0.9} =$ **5 m/s**



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