Kuwait University

Physics Department
Physics 101

First midterm
Second Semester 2012-2013

Saturday, March16, 2013
01:30 p.m. – 03:00 p.m.

Student's Name: ……..…….…….……..……

Student's Number: …. … …… .. …… …. …. Section: ……

Choose your Instructor's Name:

Prof. Fikry El-Akkad	Dr. YacoubMakdesi
Dr. Ahmed Al-Jassar	Dr. Adnan Al-Yaseen
Dr. Hassan Ra'fat	Dr. Hala Al- Jassar
Dr. Abdul-Mohsen Ali	Dr. TareqAlrefai
Dr. Hassan Manaa	Dr. Fatema Al-Dousari
Dr. Ashraf Zaher	Dr. Nasser Demir
Dr. Tarek Ramadan	

Grades:

#	Q1	Q2	Q3	Q4	Q5	SP1	SP2	SP3	SP4	SP5	LP1	LP2	LP3	LP4	Total
Pts	1	1	1		1	1	1	1	1	1	2.5	2.5	2.5	2.5	20

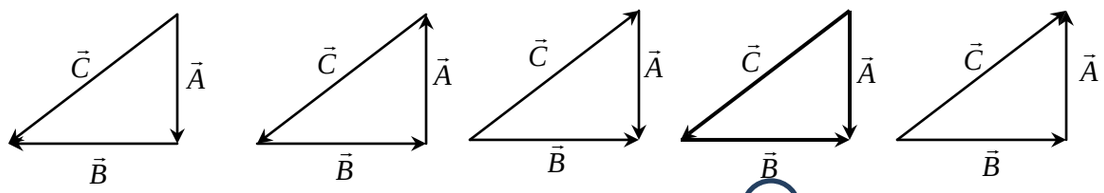
Important:

1. Answer all questions and problems.
2. Full mark = 20 points, arranged as follows:
   i. 5**Q**uestions (1 mark each),
   ii. 5**S**hort **P**roblems(1 mark each), and
   iii. 4**L**ong **P**roblems (2.5 marks each)..
3. No solution = no points.
4. Check the correct answer for each question.
5. Assume g = 10 m/s^2.
6. Mobiles and pagers are not allowed during the exam.
7. Programmable calculators, which can store equations, are not allowed.

GOOD LUCK

Part I : Answer the following questions(Tick the correct answer – **one mark each**)

Q1. Which of the following represents $\vec{C} = \vec{A} - \vec{B}$



(a) (b) (c) **(d)** (e)

Q2. $\vec{A}$ and $\vec{B}$ are two vectors, if $\vec{A} \times \vec{B} = \vec{C}$ then $2\vec{A} \cdot \vec{C}$ is equal to

(a) 2 (b) -2 (c) $2A^2B$ (d) -2AC (e) **Zero**

Q3. A particle is moving along a straight line. Its position as a function of time is as shown in the figure.

The acceleration of the motion is negative during the interval of time:

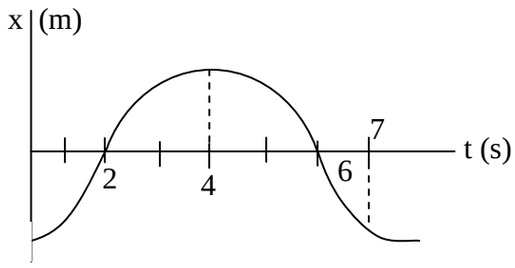
(a) t = 0 to t = 2s

(b) t = 0 to t = 4s

(c) t = 2s to t =6s

(d) t = 4s to t= 7s

(e) t > 7s



Q4. H is the maximum height that a ball will reach if it is thrown upward with speed v_o.

If the ball is thrown with speed $2v_o$, then **the maximum height is**

(a) 1.25 H (b)1.5 H (c) 2H (d) **4H** (e) 8 H

Q5. A projectile is thrown with an initial speed v_o at an angle θ above the horizontal.

At its maximum height, **the velocity vector is**

(a) $v_o \hat{i}$ (b) **$v_o \cos\theta \, \hat{i}$** (c) $v_o \sin\theta \, \hat{j}$ (d) $v_o \cos\theta \, \hat{i} + v_o \sin\theta \, \hat{j}$ (e) zero

Part II : Solve the following problems(one mark each)

SP1. Two vectors are given by

$\vec{A} = 4\hat{i} - 3\hat{j}$ $\vec{B} = 2\hat{i} + \hat{j}$

If $\vec{A} - \vec{B} + \vec{C} = 0$, **find the angle that $\vec{C}$ makes with the positive x-axis**.

$$\vec{C} = \vec{B} - \vec{A} = (2\vec{i} + \vec{j}) - (4\vec{i} - 3\vec{j}) = -2\vec{i} + 4\vec{j}$$

$$\theta = \tan^{-1}\left(\frac{4}{-2}\right) = -63.4^\circ \quad (\textit{in the second quadrant})$$

$$= 180 - 63.4 = 116.6^\circ$$

SP2. A particle is moving along the x-axis.Its position with time is given by $x = \frac{1}{3}t^3 - t^2 - 8t$ (where x in meter and t is in second). Find the **<u>average acceleration</u>**(in m/s^2) for the time interval t = 0 to t = 3s.

$$v = 3\left(\frac{1}{3}\right)t^2 - 2t - 8$$

$v(o) = \mathbf{-8\ m/s}$ $\qquad$ $v(3) = (3)^2 - 2(3) - 8 = \mathbf{-5\ m/s}$

$$\bar{a} = \frac{v_2 - v_1}{\Delta t} = \frac{-5-(-8)}{3} = \mathbf{1\ m/s^2}$$

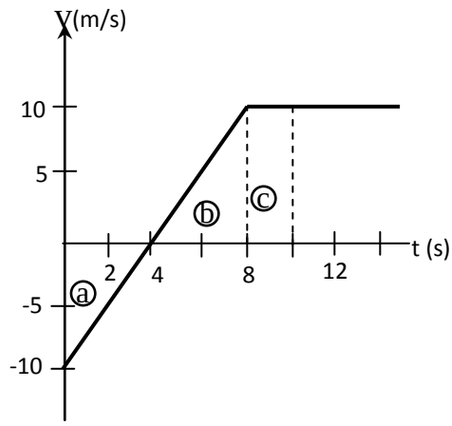
SP3. A cat moves along a straight line. Its velocity-time graph is as shown in the figure. Calculate the cat's **<u>average speed</u>**(in m/s) from t = 0 to t = 10 sec.

Total distance = $|area\ ⓐ| + area\ ⓑ + area\ ⓒ$

$\Delta x = \frac{1}{2}(4)(10) + \frac{1}{2}(4)(10) + 2 \times 10$

$= 20 + 20 + 20 = \mathbf{60m}$

$\bar{v} = \frac{60}{10} = \mathbf{6\ m/s}$



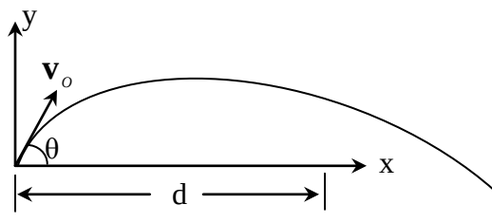
SP4. A projectile was projected from the ground level with initial speed $\mathbf{v}_o$ at an angle $\boldsymbol{\theta}$. After 10s its velocity was $20\hat{i}$ (in m/s), **<u>find the horizontal distance d (in m) when it hits the ground</u>.**

$v_y = 0$ means maximum height. Total time = time of max. height × 2

$v_{xo} = \mathbf{20\ m/s}$ $\qquad$ $t = 2(10) = \mathbf{20s}$

$d = v_{xo}\ (t)$

$d = 20(20) = \mathbf{400m}$



SP5. A particle moves with constant speedv in a circle of radius 1.5m. It makes 120 rpm.

<u>Find its speed v(in m/s)</u>.

$$v = \frac{distance}{time} = \frac{n(2\pi r)}{t}$$

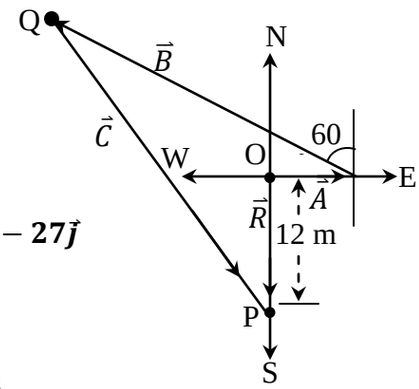
$$v = \frac{120(2\pi)(1.5)}{60} = \mathbf{18.8\ m/s}$$

$$f = \frac{120}{60} \qquad T = \frac{60}{120} = \mathbf{0.5}$$

$$V = \frac{2\pi r}{T} = \frac{2\pi(1.5)}{0.5} = \mathbf{18.8\ m/s}$$

Part III – Solve the following problems (show your work in details – 2.5 marks each)

LP1. A man starts to walk from point (O). He walks 16 m east and then 30 m in a direction 60° west of north and stops at point Q.**In what direction and how far (in m) must he then walk from point Q to end up at point p 12 m south of point O.**



$\vec{A} = 16\vec{\imath},\ \vec{B} = (-30\sin 60\vec{\imath} + 30\cos 60\,\vec{\jmath}),\ \vec{R} = -12\vec{\jmath}$

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

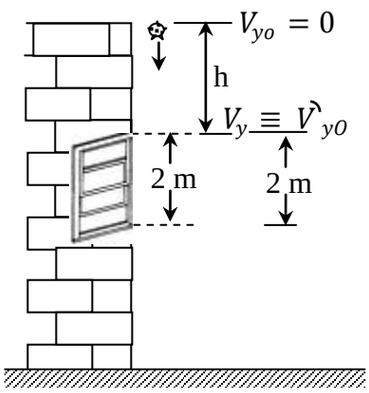
$\vec{C} = -12\vec{\jmath} - 16\vec{\imath} - (-2.5.98\,\vec{\imath} + 15\vec{\jmath})$

$$\vec{C} = -12\vec{\jmath} - 16\vec{\imath} + 25.98\vec{\imath} - 15\vec{\jmath} = \mathbf{9.98\vec{\imath} - 27\vec{\jmath}}$$

$$\theta = tan^{-1}\left(\frac{-27}{9.98}\right) = \mathbf{69.7°\ S\ of\ E}$$

$$\left|\vec{C}\right| = \sqrt{(9.98)^2 + (27)^2} = \mathbf{28.8\ m}$$

LP2. A falling stone takes 0.2s to travel past a window 2 m tall (see the fig.). **From what height (h) (in m) above the top of the windowdid the stone fall** if it fell from rest?



$\Delta y = -2\ m \quad t = 0.2\ s \quad g = 10\ m/s^2$

$\Delta y = V`_{yo}\,t - \frac{1}{2}gt^2$

$-2 = V`_{yo}\,(0.2) - \frac{1}{2}(10)(0.2)^2$

$V`_{yo} = \frac{-1.8}{0.2} = \mathbf{-9\ m/s}\ (\equiv V_y\ for\ the\ upper\ part)$

$V_y^2 = V_{yo}^2 - 2g\Delta y$

$(-9)^2 = 0 - 2(10)h$

$|h| = \frac{9^2}{2(10)} = \mathbf{4.05\ m}$

LP3. A particle starts from the origin at t = 0 with a velocity of $\left(4\hat{i} - 3\hat{j}\right)$ m/s and moves in the x-y plane with a constant acceleration of $\left(2\hat{i} - 3\hat{j}\right)$ m/s^2. **What is the speed (in m/s) of the particle at t = 2s?**

$\vec{V}_o = 4\vec{\imath} - 3\vec{\jmath}\, m/s\ \vec{a} = 2\vec{\imath} - 3\vec{\jmath}\, m/s$ t = 2s

$\vec{V} = \vec{V}_o + \vec{a}t$

$= (4\vec{\imath} - 3\vec{\jmath}) + (2\vec{\imath} - 3\vec{\jmath})(2)$

$= \mathbf{8}\vec{\boldsymbol{\imath}} - \mathbf{9}\vec{\boldsymbol{\jmath}}$

$V = \sqrt{(8)^2 + (9)^2} = \mathbf{12.0}\, \boldsymbol{m/s}$

$V_x = V_{xo} + a_x t$

$= 4 + 2(2)$

$= \mathbf{8}\ \boldsymbol{m/s}$

$|\vec{V}| = \sqrt{(8)^2 + (9)^2} = \mathbf{12.0}\, \boldsymbol{m/s}$

$V_y = V_{yo} + a_x t$

$= -3 + (-3)(2)$

$= \mathbf{-9}\ \boldsymbol{m/s}$

LP4. A light plane is flying at 120 km/h relative to the air, but there is a 40 km/h wind blowing due east.

a. **What direction should the pilot take for the plane to travel north relative to the ground?**

b. **How long (in hour) it takes the plane to travel north a distance of 1000 km?**

$V_{PW} = 120\, km/h\, V_{wg} = 40\ km/h\, (east)$

$\vec{V}_{pg} = \vec{V}_{pw} + \vec{V}_{wg}$

$\theta = sin^{-1}\left(\frac{V_{wg}}{V_{pw}}\right) = sin^{-1}\left(\frac{40}{120}\right) = \mathbf{19.5°}\ \ \boldsymbol{Wof\ N}$

$V_{pg} = \sqrt{V_{pw}^2 - V_{wg}^2} = \sqrt{(120)^2 - (40)^2}$ = **113.1** $\boldsymbol{km/h}$

$t = \frac{distance}{velocity} = \frac{1000}{113} = \mathbf{8.85}\ \boldsymbol{h}$