Kuwait University **Physics Department**

Physics 101

Spring Semester

1st Midterm Exam

Saturday, March 18, 2017

11:00 a. m. – 12:30 p.m.

Student's Name: ……..…….…….. Serial Number: ….……

Student's Number: ….…… Section: ……

Choose your Instructor's Name:

Prof. Yacoub Makdisi	Dr. Abdul Mohsen
Dr. Hasan Raafat	Dr. Tareq Al Refai
Dr. Hala Al-Jassar	Dr. Belal Salameh
Dr. Ahmed Al-Jassar	Dr. Nasser Demir
Dr. Fatema Al Dosari	Dr. Abdul Khaleq

For Instructors use only

Grades:

#	Q1	Q2	Q3	Q4	SP1	SP2	SP3	SP4	SP5	LP1	LP2	Total
Pts	1	1	1	1	2	2	2	2	2	3	3	20

Important:

1. No solution = no points.
2. No units = no points.
3. Assume g = 10 m/s^2.
4. **Please write down your final answer in the box shown in each problem**.
5. Mobiles are **strictly prohibited** during the exam.
6. Programmable calculators, which can store equations, are not allowed.
7. **Cheating accidents will be processed according to the university rules.**

GOOD LUCK

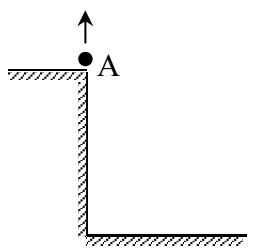
Part I: Questions (circle the * of the right answer) (1 point each)

Q1. One of the following quantities is always zero. Indicate which one

* $(\vec{A}+\vec{B})\cdot\vec{A}$ * $(\vec{A}+\vec{B})\times\vec{A}$ * $(\vec{A}\cdot\vec{A})\times\vec{B}$

(*) $(\vec{A}\times\vec{B})\cdot\vec{A}$ * $(\vec{A}\times\vec{B})\times\vec{A}$

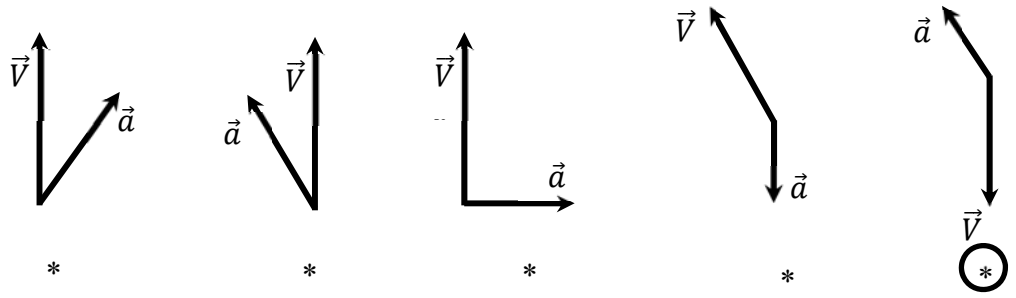
Q2. A ball is thrown upward with speed v_o, from the top of a cliff at point A. The velocity and the acceleration when the ball passes the point A in its way down will be



* (v_o, g) * $(v_o, -g)$ * $(-v_o, 0)$

(*) $(-v_o, -g)$ * $(o, -g)$

Q3. The velocity and the acceleration vectors for five moving particles, at one instant, are as shown. The particle which slows down and turns clockwise is

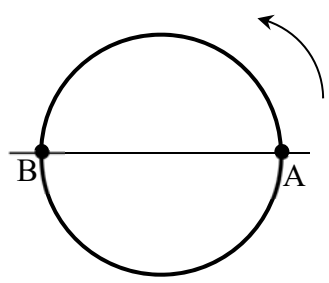


* * * * (*)

Q4. A particle moves in a circle of radius R with period T and constant speed V. The average speed of the particle as it moves from A to B is

* $\frac{1}{2}V$ (*) V * $2V$

* $\frac{\pi R}{T}$ * $\frac{4\pi R}{T}$



Part II: Short Problems (2 points each)

SP1. If $\vec{A} = 2\hat{\imath} + \hat{\jmath} + 2\hat{k}$, $\vec{B} = -2\hat{\imath} + 2\hat{\jmath} - \hat{k}$ and $\vec{C} = \vec{A} + \vec{B}$. Find the angle between $\vec{C}$ and the y-axis.

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

$\therefore\ \vec{C} = 3\hat{\jmath} + \hat{k}$

$\because C_y = C\ cos\ \theta_y$

$\because 3 = \sqrt{10}\ cos\ \theta_y$

$\theta_y = cos^{-1}\frac{3}{\sqrt{10}}$

$= 18.40$

Answer:	18.40

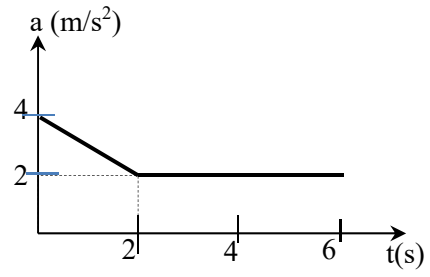
SP2. A boy runs from rest with constant acceleration of 3m/s^2. What is his average velocity during the first 2 sec?

$$\Delta x = V_o t + \frac{1}{2}at^2$$
$$= 0 + \frac{1}{2}(3)(2)^2 = 6m$$
$$\therefore V_{av} = \frac{\Delta x}{\Delta t} = \frac{6}{2} = 3m/s$$

Answer: $3m/s$

SP3. A particle moves in a straight line. Its acceleration as a function of time is shown in the figure. Find the particle velocity at t = 4s. If its velocity at t = 0 is 2 m/s.

$\because$ $\Delta V = Area$ under a vs t curve
$\therefore \Delta V = 4 + 2 + 4 = 10$
$\because V - V_o = 10$
$\therefore V = 2 + 10 = 12\ m/s$

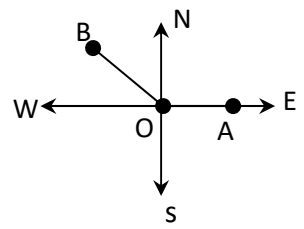


Answer: $12\ m/s$

SP4. Ossama stands at the center of a football field while Ali stands at 20 m east of Ossama. Bader stands at 30 m 36.9° west of north of Ossama. What is the distance between Ali and Bader?

$\because \vec{A} + \vec{R} = \vec{B}$
$\therefore 20\hat{\imath} + \vec{R} = (-30\sin 36.9)\hat{\imath} + (30\cos 36.9)\hat{\jmath}$
$= (-18\,\hat{\imath} + 24\,\hat{\jmath})\ m$
$\vec{R} = (-38\hat{\imath} + 24\hat{\jmath})\ m$
$R = \sqrt{38^2 + 24^2} = 45\ m$

or $AB = \sqrt{20^2 + 30^2 - 2(20)(30)\cos(126.9)}$
= 45 m



Answer: $45\ m$

SP5. A particle starts from the origin at t = 0 with a velocity of $(2\hat{\imath} - 3\hat{\jmath})$ and moves in the x-y plane with constant acceleration of $(\hat{\imath} + 3\hat{\jmath})\ m/s^2$. Find the speed of the particle at t = 2s.

$\vec{V} = \vec{V}_o + \vec{a}\,t$
$= (2\hat{\imath} - 3\hat{\jmath}) + 2(\hat{\imath} + 3\hat{\jmath})$
$= 4\hat{\imath} + 3\hat{\jmath}$
$\therefore V = 5m/s$

Answer: $5m/s$

Part III: Long Problems (3 points each)

LP1. The velocity V_x of a car at any time is given by the equation

$V_x = 60 - 0.4\,t^2$ where V_x in m/s and t in s.

a. What is the unit of the constant 0.4 in this equation?

m/s^3

Answer: m/s^3

b. Find the acceleration a_x at t = 0 and at t = 3s.

$a_x = -0.8t$

$$\begin{cases} a(o) = 0 \\ a(3) = -2.4\ m/s^2 \end{cases}$$

Answer: $a(o) = 0$
$a(3) = -2.4\ m/$

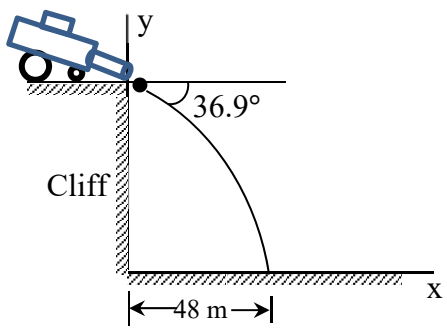
c. Find the average acceleration a_{avx} during the first 3 seconds.

$$\begin{cases} V(0) = 60\ m/s \\ V(3) = 60 - 3.6 = 56.4\ m/s \end{cases}$$

$$\alpha_{av} = \frac{V(3)-V(0)}{3} = \frac{-3.6}{3} = -1.2\ m/s^2$$

Answer: $-1.2\ m/s^2$

LP2. A cannon on the top of a cliff, fires a ball 36.9° below the horizontal direction as shown. The ball hits the ground after 2s at a distance 48 m from the cliff.



a) With what initial speed does the cannon fire the ball?

$$V_x = \frac{\Delta x}{\Delta t} = \frac{48}{2} = 24\ m/s$$

$$\because V_{ox} = V_o \cos 36.9$$

$$\therefore V_o = \frac{V_{ox}}{\cos 36.9} = \frac{24}{.8} = 30\ m/s$$

Answer: $30\ m/s$

b) With what velocity does the ball hit the ground in unit vector notation?

$$\begin{cases} V_y = V_{oy} - gt \\ \quad = -30 \sin 36.9 - 20 \\ \quad = -18 - 20 = -38\ \ m/s \end{cases}$$

$$\vec{V} = (24\,\hat{\imath} - 38\hat{\jmath})\ \ m/s$$

Answer: $(24\,\hat{\imath} - 38\hat{\jmath})\ m/s$

c) What is the height of the cliff?

$$\begin{cases} \Delta y = V_{oy}t - \frac{1}{2}\ g\ t^2 \\ \quad = (-18)(2) - 5\ (2)^2 \\ \quad = -36 - 20 = -56\ m \end{cases}$$

$$\therefore h = 56\ m$$

Answer: $56\ m$