Kuwait University Physics Department

Physics 101

First Semester 2018 - 2019
1st Midterm Exam
Saturday, October 6, 2018
11:00 – 12:30

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

Student's Number: ….…… Section: ……

Choose your Instructor's Name:

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

For Instructors use only

Grades:

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

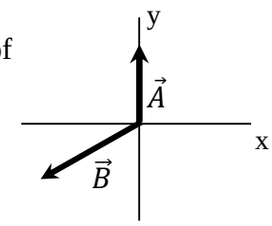
Important:

1. Answer all questions and problems.
2. Full mark = 20 points as arranged in the above table.
3. No solution = no points.
4. **Give your final answer in the correct unit.**
5. Check the correct answer for each question.
6. Assume g = 10 m/s^2.
7. Mobiles are **strictly prohibited** during the exam.
8. Programmable calculators, which can store equations, are not allowed.
9. **Cheating incidents will be processed according to the university rules.**
10. Mobiles are **strictly prohibited** during the exam.

GOOD LUCK

Part I: Choose the correct Answer (circle the * of the correct answer) (1 point each)

Q1. The figure shows two vectors $\vec{A}$ and $\vec{B}$. If vector $\vec{C} = \vec{A} - \vec{B}$, then the signs of the components c_x and c_y are respectively



(*) (+, +) * (–, +) * (+, –) * (–, –)

Q2. A, B, C, and D are 4 particles moving along the x-axis. The table shows the initial and final position for each particle.

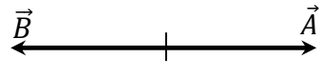
The particle which has the most negative displacement is

* A (*) B * C * D

	A	B	C	D
x_i	-4	4	-4	-8
x_f	8	-8	-8	8

Q3. $\vec{A}$ and $\vec{B}$ vectors, of equal magnitudes, are shown in the figure. If $\vec{C} = \vec{A} - \vec{B}$, then $\vec{C}$ equals

* zero * $-2\vec{A}$ (*) $2\vec{A}$ * $2\vec{B}$



Q4. A cat runs from rest in a straight line with a constant acceleration. If the distance covered by the cat from (t = 0 to t = 1s) is d, then the distance covered (from t = 1s to t = 2s) is

* d * 2 d (*) 3 d * 4 d

Part II: Short Problems (2 points each)

SP1. Given the three vectors: $\vec{A} = -\hat{\imath} - 4\hat{\jmath} + 2\hat{k}$, $\vec{B} = 3\hat{\imath} + 2\hat{\jmath}$ *and* $\vec{C} = \hat{k}$

Calculate $\vec{A} \cdot (\vec{B} \times \vec{C})$

$$\vec{B} \times \vec{C} = (3\hat{\imath} + 2\hat{\jmath}) \times \hat{k}$$
$$= 2\hat{\imath} - 3\hat{\jmath}$$
$$\vec{A} \cdot (\vec{B} \times \vec{C}) = (-\hat{\imath} - 4\hat{\jmath} + 2\hat{k}) \cdot (2\hat{\imath} - 3\hat{\jmath})$$
$$= -2 + 12 = 10$$

Answer: $\vec{A} \cdot (\vec{B} \times \vec{C}) = 10$

SP2. A stone is thrown vertically upward from the ground. After 4 s, the stone strikes the ground. With what speed was the stone thrown?

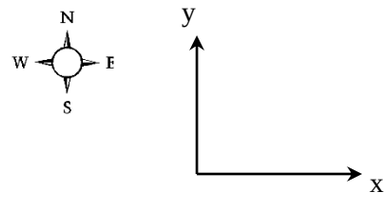
$$\Delta y = V_o t - \frac{1}{2} g\, t^2$$
$$0 = 4V_o - 5\,(4)^2$$
$$V_o = 20 \ \ m/s$$

Answer: $V_o = 20\ m/s$

SP3. A dog runs in a park, its position vector (in m) as a function of time is

$\vec{r} = (6 + 3t)\hat{\imath} + t^2\hat{\jmath}$, where t is measured in seconds

with what initial speed and in which direction does the dog run?



$\vec{V} = \frac{d\vec{r}}{dt} = 3\hat{\imath} + 2t\hat{\jmath}$

$\overrightarrow{V_o} = 3\hat{\imath}\ m/s$

$V_o = 3\ m/s$ toward east

Answer: $V_o = 3\ m/s$ toward east

SP4. The dog (in **SP3**) runs with constant acceleration. What is the magnitude and the direction of the acceleration?

[1] $\vec{a} = \frac{d\vec{v}}{dt} = 2\hat{\jmath}\ \text{m/s}^2$

$a = 2\ m/s^2$ toward north

Answer: $2\ m/s^2$ toward north

SP5. Car A is moving along a straight road with a constant speed of 20 m/s toward car B. When the distance between the two cars becomes 800 m, car B starts to move from rest toward car A with a constant acceleration of 2 m/s^2. How long will take the two cars to pass each other?

$800 = \Delta x_A + \Delta x_B$ $V_A = 20\ m/s$

$= V_A t + \frac{1}{2} a_B\, t^2$ $a_B = 2\ m/s^2$

$800 = 20t + t^2$ $V_{OB} = 0$

$t^2 + 20t - 800 = 0$

$t = \frac{-20 \pm \sqrt{400 - 4(-800)}}{2} = 20\ s$

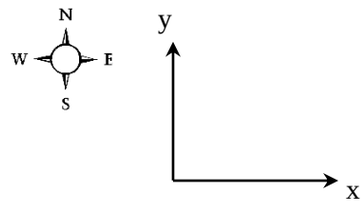
Answer: $t = 20\ s$

Part III: Long Problems (3 points each)

LP1. You walk from your house to Kuwait University taking the following path:

(500 m east), then (400 m, 36.9˚ north of east), then (300 m north)

a. What is the length and the direction of the vector displacement that points from your house directly to the university?



$\vec{A} = 500\ \hat{\imath}$ $\vec{B} = [(400\cos 36.9°)\hat{\imath} + (400\sin 36.9°)\,\hat{\jmath}]\ m$

$= (320\ \hat{\imath} + 240\ \hat{\jmath})$ m

$\vec{C} = 300\ \hat{\jmath}$ m

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

$\vec{R} = (820\ \hat{\imath} + 540\ \hat{\jmath})$ m

$R = \sqrt{(820)^2 + (540)^2} = 981.8\ m$

$\theta = tan^{-1}\left(\frac{540}{820}\right) = 33.4°$ north of east

Answer: $R = 981.8\ m$
$\theta = 33.4^o$ north of east

b. If you are taking 12 min to reach the university, what is the magnitude of your average velocity and average speed?

$$V_{av} = \frac{R}{\Delta t} = \frac{982}{12 \times 60} = 1.36\ m/s$$

$$S_{av} = \frac{d}{\Delta t} = \frac{1200}{12 \times 60} = 1.67\ m/s$$

Answer: $V_{av} = 1.36\ m/s$

Answer: $S_{av} = 1.67\ m/s$

LP2. A particle moves along the x-axis, its velocity as a function of time is given by

$V_x = b - ct$ where $b = 6$ m/s and $c = 2$ m/s^2

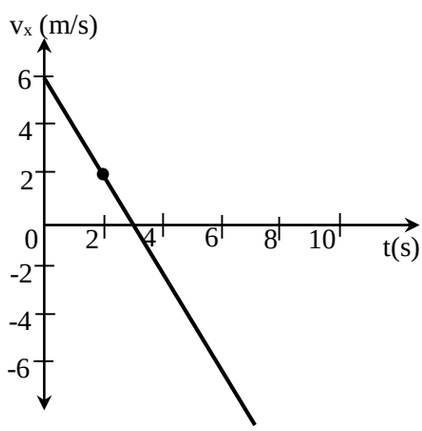
a) Calculate the acceleration of the particle.

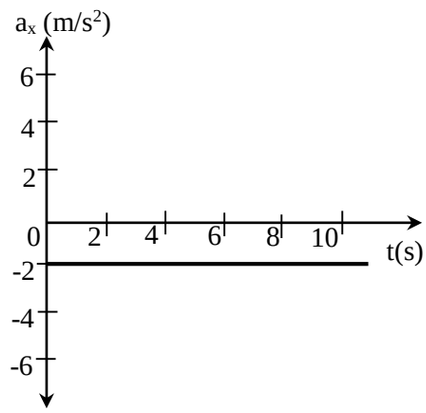
$$V_x = 6 - 2t$$

$$a_x = \frac{dV_x}{dt} = -2\ m/s^2$$

Answer: $a_x = -2\ m/s$

b) Plot (v_x –t) and (a_x –t) in the given diagram.





c) What is the distance covered by the particle during the first 6 sec?

$$d = |\Delta X_+| + |\Delta X_-| = 9 + 9 = 18\ m$$

Answer: $d = 18\ m$

d) What is the position of the particle at t = 10 s if its initial position is 4 m?

$\because\ a = -2m/s \qquad V_{ox} = 6\ m/s \qquad t = 10$

$$x - x_o = V_o t + \frac{1}{2}\ a_x t^2$$

$$x - 4 = 6(10) + \frac{1}{2}(-2)(10)^2 = -40\ m$$

$$x = -40 + 4 = -36m$$

Answer: $x = -36m$