Kuwait University Physics Department

Physics 101

Fall Semester
First Midterm Exam
Saturday, October 21, 2017
12:00 pm – 01:30 pm

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

Student's Number: ….…… Section: ……

Choose your Instructor's Name:

Dr. Ahmed Al-Jassar	Dr. Abdul Mohsen
Dr. Hala Al-Jassar	Dr. Tareq Al Refai
Dr. Fatema Al Dosari	Dr. Abdul Khaleq
Dr. Nasser Demir	Dr. Belal Salameh

For Instructors use only

Grade:

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

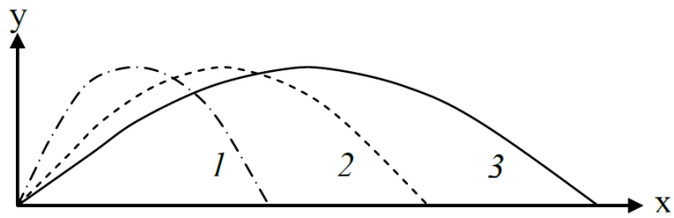
Important:

1. Answer all questions and problems.
2. Full mark = 20 points as arranged in the above table.
   i) 4 **Q**uestions
   ii) 5 **S**hort **P**roblems
   iii) 2 **L**ong **P**roblems.
3. No solution = no points.
4. **Use SI units.**
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.**

GOOD LUCK

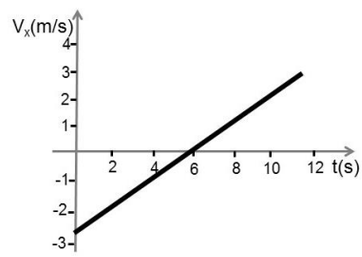
Part I: Questions (Choose the correct answer, one point each)

Q1. The figure shows the trajectories of three projectiles. **Which trajectory has the greatest initial vertical component of velocity (V_{yi}).**



* 1
* 2
* 3
* All the same

Q2. The velocity of a particle moving along the x axis as a function of time is shown in the figure. The **speed** of this particle is:



* Always increasing.
* Always decreasing.
* Decreasing then increasing.
* Increasing then decreasing.

Q3. If $\vec{A}$ and $\vec{B}$ are nonzero vectors and $\vec{A} \cdot \vec{B} = 0$, then which of the following is always true.

* $|\vec{A} \times \vec{B}| = 0$
* $\vec{A}$ is parallel to $\vec{B}$
* $|\vec{A} \times \vec{B}| = AB$
* $|\vec{A} \times \vec{B}| = 1$

Q4. A pilot drops a package from a plane **flying horizontally at a constant speed**. Neglecting air resistance, when the package hits the ground the horizontal location of the plane will be

* behind the package.
* directly above the package.
* in front of the package.
* undetermined.

Part II: Short Problems (2 points each)

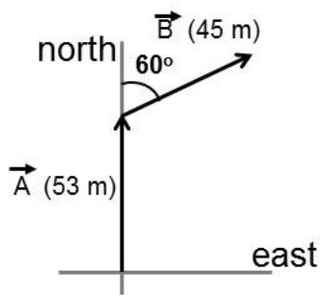
SP1. You walk 53 m to the north, then 45 m in a direction 60° east of north as shown in the figure. **Determine the magnitude and direction of your resultant displacement relative to the positive x-axis.**

$\vec{A} = 53\hat{j}\ m,\ \vec{B} = 45\cos(30)\,\hat{\imath} + 45\sin(30)\ \hat{j} = (39\,\hat{\imath} + 22.5\,\hat{j})\ m$

$\vec{R} = \vec{A} + \vec{B} = (39\,\hat{\imath} + 75.5\,\hat{j})\ m$

$|\vec{R}| = \sqrt{39^2 + 75.5^2} = 85\ m$

$\theta = tan^{-1}\left(\frac{75.5}{39}\right) = 62.7^o$



Answer: $|\vec{R}| = 85\ m\ ,\ \ \theta = 62.7^o$

SP2. A car is moving along the positive x axis. If it starts from point A with a speed of $10\ m/s$ and accelerates at a rate of $3\ m/s^2$ to reach point B at a speed of $20\ m/s$. **What is the distance (in m) between point A and point B?**

$V_{xf}^2 = V_{xi}^2 + 2a_x\Delta x$

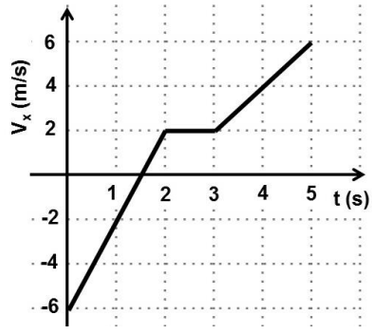
$(20)^2 = (10)^2 + 2(3)\Delta x$

$\Delta x = 50$ m

Answer: $\Delta x = 50$ m

SP3. The figure shows the velocity of a particle moving along the x axis as a function of time. **Find the average acceleration (in m/s^2) of the particle in the time interval from t=1 s to t=5 s.**

$$a_{av-x} = \frac{V_{xf} - V_{xi}}{t_f - t_i} = \frac{6-(-2)}{5-1} = +2\ m/s^2$$



Answer: $a_{av-x} = +2\ m/s^2$

SP4. The vectors $\vec{A}$ and $\vec{B}$ are shown in the figure. **Find $\vec{A} \times \vec{B}$** .

$|\vec{A} \times \vec{B}| = |\vec{A}|\,|\vec{B}| \sin\theta = (16)(7)\sin(79^o) = 110\ m^2$

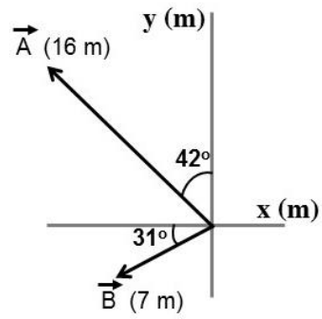
$\vec{A} \times \vec{B} = +110\ m^2\ \hat{k}$

OR

$\vec{A} = -16\sin(42^o)\,\hat{\imath} + 16\cos(42^o)\hat{\jmath} = (-10.7\hat{\imath} + 11.9\hat{\jmath})\ m$

$\vec{B} = -7\cos(31^o)\,\hat{\imath} - 7\sin(31^o)\hat{\jmath} = (-6\hat{\imath} - 3.6\hat{\jmath})\ m$

$$\vec{A} \times \vec{B} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ -10.7 & 11.9 & 0 \\ -6 & -3.6 & 0 \end{vmatrix} = 0\hat{\imath} + 0\hat{\jmath} + 110\hat{k} = +110\ m^2\hat{k}$$



Answer: $+110\ m^2\ \hat{k}$

SP5. An object has a position given by $\vec{r} = [(2+3t)\hat{\imath} + (3-2t^2)\hat{\jmath}]m$, where t is measured in seconds. **What is the magnitude of the acceleration (in m/s^2) of the object at time $t = 2\ s$?**

$\vec{a} = \frac{d^2\vec{r}}{dt^2} =$

$a_x = 0$ m/s^2

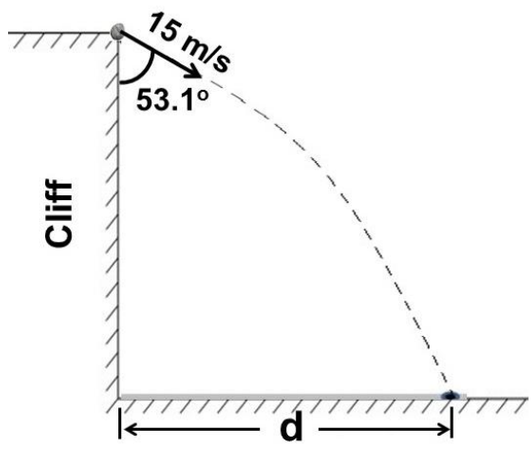
$a_y = -4$ m/s^2

$\vec{a} = -4$ m/s$^2\ \hat{\jmath}$ $\quad Then \quad$ $a = 4\ m/s^2$

Answer: $a = 4\ m/s^2$

Part III: Long Problems (3 points each)

LP1. A stone is thrown from the upper edge of a vertical cliff. **The stone's initial velocity is 15 m/s directed at 53.1° with respect to the vertical**, as shown in the figure. The stone hits the ground 2 s after being thrown and feels no air resistance.



a) What is the height (in m) of the cliff?

$V_{xi} = V_i \sin(53.1^o) = 12\ m/s$

$V_{yi} = -V_i \cos(53.1^o) = -9\ m/s$

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

$= -9(2) - 5(2)^2$

$\Delta y = -38$ m

h=38 m

Answer: h=38 m

b) Find the horizontal distance (d) (in m) between the edge of the cliff and the point where the stone strikes the ground.

$\Delta x = V_{xi} t = 12\ (2)$

$\Delta x = 24$ m

Answer: $\Delta x = 24$ m

LP2. A duck swims with a constant speed of 2 m/s toward a bridge. The bridge is 45 m above the water. A stone is **released from rest** from the bridge and hits the duck.

a) How far was the duck when the stone was released?

$$\Delta y = V_{yi}t - \frac{1}{2}gt^2$$

$$-45 = 0 \quad -5t^2$$

$$\Rightarrow t = 3\ s$$

$$\Delta x = V_{xi}t = 2(3) = 6\ m$$

Answer: $\Delta x = 6\ m$

b) Calculate the speed of the stone just before it touches the duck.

$$V_{yf} = V_{yi} - gt = 0 - 10(3) = -30\frac{m}{s}$$

$$final\ speed = 30 m/s$$

Answer: $final\ speed = 30 m/s$