



# 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  
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 Dr. Nasser Demir

Dr. Abdul Mohsen  
 Dr. Tareq Al Refai  
 Dr. Abdul Khaleq  
 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

**Important:**

1. Answer all questions and problems.
2. Full mark = 20 points as arranged in the above table.
  - i) 4 Questions
  - ii) 5 Short Problems
  - iii) 2 Long Problems.
3. No solution = no points.
4. **Use SI units.**
5. Check the correct answer for each question.
6. Assume  $g = 10 \text{ m/s}^2$ .
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.**

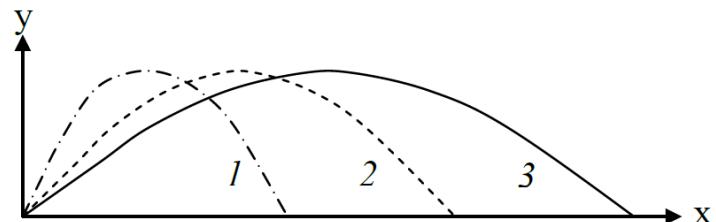
GOOD LUCK

**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 ( $V_{yi}$ ).

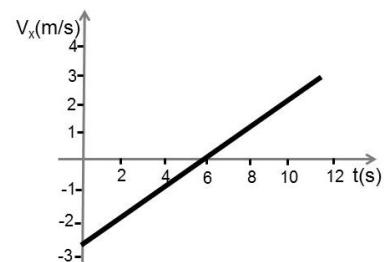
- \* 1
- \* 2
- \* 3

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)**

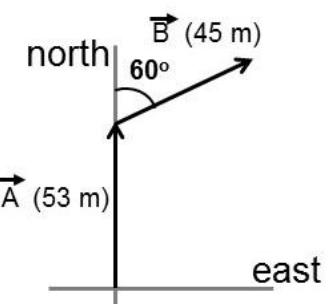
**SP1.** You walk 53 m to the north, then 45 m in a direction  $60^\circ$  east of north as shown in the figure. **Determine the magnitude and direction of your resultant displacement relative to the positive x-axis.**

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

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

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

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



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

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

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

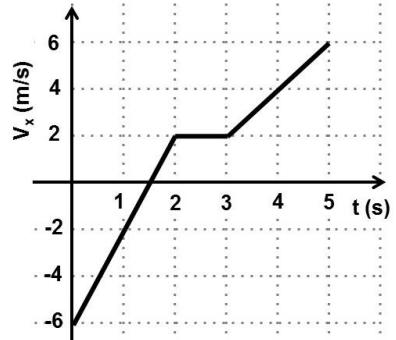
$$(20)^2 = (10)^2 + 2(3)\Delta x$$

$$\Delta x = 50 \text{ m}$$

Answer:  $\Delta x = 50 \text{ m}$ 

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

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

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

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

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

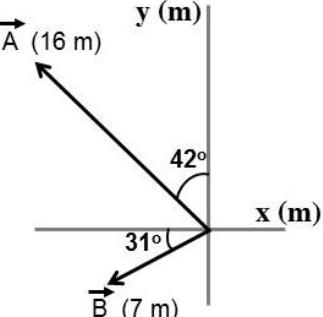
$$\vec{A} \times \vec{B} = +110 \text{ m}^2 \hat{k}$$

OR

$$\vec{A} = -16 \sin(42^\circ) \hat{i} + 16 \cos(42^\circ) \hat{j} = (-10.7 \hat{i} + 11.9 \hat{j}) \text{ m}$$

$$\vec{B} = -7 \cos(31^\circ) \hat{i} - 7 \sin(31^\circ) \hat{j} = (-6 \hat{i} - 3.6 \hat{j}) \text{ m}$$

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

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

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

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

$$a_x = 0 \text{ m/s}^2$$

$$a_y = -4 \text{ m/s}^2$$

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

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

**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?

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

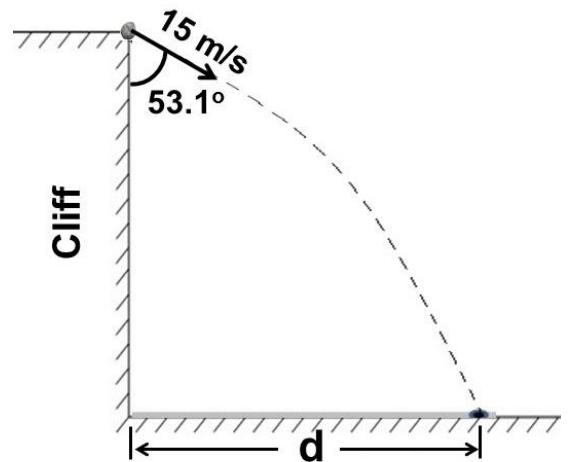
$$V_{yi} = -V_i \cos (53.1^\circ) = -9 \text{ m/s}$$

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

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

$$\Delta y = -38 \text{ m}$$

$$h=38 \text{ m}$$



Answer:  $h=38 \text{ m}$

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

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

$$\Delta x = 24 \text{ m}$$

Answer:  $\Delta x = 24 \text{ m}$

**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?

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

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

$$\Rightarrow t = 3 \text{ s}$$

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



Answer:  $\Delta x = 6 \text{ m}$

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

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

final speed = 30m/s

Answer: final speed = 30m/s