



# Physics Department

## Physics 101

I

First Midterm Exam  
Summer 2009  
Thursday, July 16<sup>th</sup>, 2009  
6:00 p.m. – 7:30 p.m.

Student's Name: .....

# MODEL ANSWER

Student's Number: .....

Choose your Instructor's Name:

Dr. Hala Al-Jassar  
Dr. Adnan Al-Yaseen  
Dr. Ashraf Zaher

Dr. Fatma Al-Dossari  
Dr. Tareq Alrefae

Grades:

#	Q1	Q2	Q3	Q4	P1	P2	P3	P4	P5	P6	Total / 16	Total / 20
Points												

**Important:**

1. Answer all questions and problems.
2. Each question will be assigned 1 point.
3. Each problem will be assigned 2 points.
4. No solution = no points.
5. Check the correct answer for each question.
6. Assume  $g = 10 \text{ m/s}^2$ .
7. Mobiles and Pagers are not allowed during the exam.
8. Programmable calculators, which can store equations, are not allowed.

GOOD LUCK

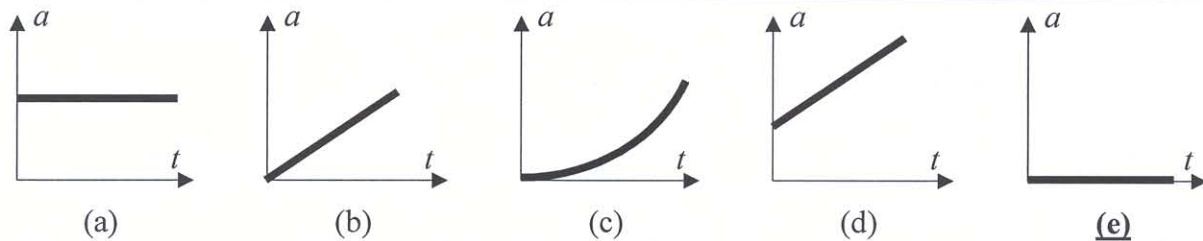
## Part I: Questions (Choose the correct answer)

1. A vector of magnitude 20 is added to another vector of magnitude 25. Which of the following can be a valid answer for their sum?

- (a) Zero.
- (b) 3.
- (c) **12.**
- (d) 47.
- (e) 500.

$$\longrightarrow \boxed{\left| |\vec{A}| - |\vec{B}| \right| \leq |\vec{A} + \vec{B}| \leq |\vec{A}| + |\vec{B}|}$$

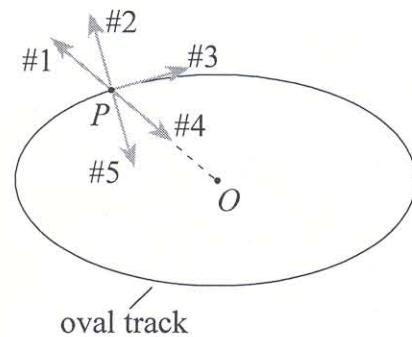
2. A particle is moving in a straight line, at a constant velocity of 20 m/s. Which of the following figures represents its motion?



Answer (e) as  $a = 0$

3. An object moves at a constant speed in a clockwise direction around an oval track. The geometrical center of the track is at point  $O$ . When the object is at point  $P$ , which arrow shows the direction of the object's acceleration vector?

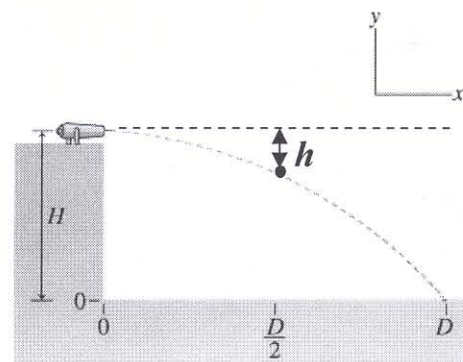
- (a) arrow #1 (directly away from point  $O$ )
- (b) arrow #2 (perpendicular to the track)
- (c) arrow #3 (in the direction of motion)
- (d) arrow #4 (directly toward point  $O$ )
- (e) **arrow #5 (perpendicular to the track)**



Answer (e) as  $a$  must be perpendicular to  $v$

4. A canon ball is fired horizontally from the top of a cliff at a height  $H$  as shown in figure. When the ball has travelled a distance  $D/2$ , the value of  $h$  is:

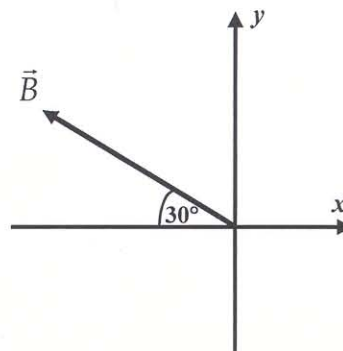
- (a)  $H/10$ .
- (b)  $H/5$ .
- (c)  **$H/4$ .**
- (d)  $H/3$ .
- (e)  $H/2$ .



Answer (c) as  $y$  is proportional to  $t^2$  while  $x$  is proportional to  $t$

## Part II: Problems (solve the following problems)

1. Vector  $\vec{B}$ , shown in figure, has a magnitude of five. If vector  $\vec{A} = 3\hat{i} + 6\hat{j}$ , find the angle that vector  $\vec{R} = \vec{B} - \vec{A}$  makes with the positive  $x$ -axis.



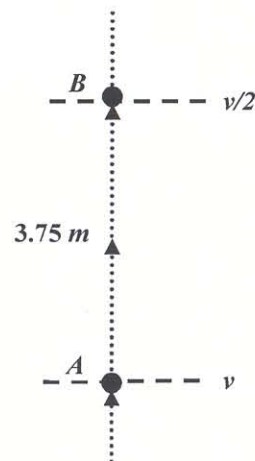
$$\vec{B} = -(5 \cos 30^\circ)\hat{i} + (5 \sin 30^\circ)\hat{j} = -4.33\hat{i} + 2.5\hat{j}$$

$$\vec{R} = \vec{B} - \vec{A} = (B_x - A_x)\hat{i} + (B_y - A_y)\hat{j}$$

$$= -7.33\hat{i} - 3.5\hat{j}$$

$$\theta = \tan^{-1} \frac{-3.5}{-7.33} = 180^\circ + \tan^{-1} \frac{3.5}{7.33} = 180^\circ + 25.5^\circ = 205.5^\circ$$

2. A stone is thrown vertically upward. On its way up, it passes point  $A$ , with speed  $v$ , and point  $B$ ,  $3.75$  m higher than  $A$ , with speed  $v/2$ . Calculate the value of the speed  $v$  in m/s.



$$v^2 = v_0^2 - 2g\Delta y$$

$$(0.5v)^2 = v^2 - 2 \times 10 \times 3.75$$

$$0.25v^2 = v^2 - 75$$

$$0.75v^2 = 75 \Rightarrow v^2 = 100 \Rightarrow v = 10 \text{ m/s}$$

3. A particle, moving along the  $x$ -axis, has a position given by  $x = 24t - 2t^3$ , where  $x$  is in m, and  $t$  in s. What is the magnitude of the acceleration when the particle is momentarily at rest?

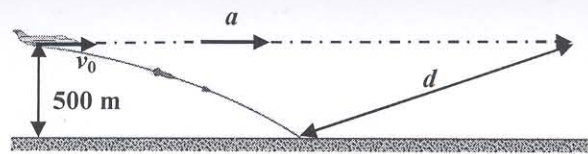
$$v = \frac{dx}{dt} = 24 - 6t^2$$

$$a = \frac{dv}{dt} = \frac{d^2x}{dt^2} = -12t$$

$$\text{No motion} \equiv (v = 0) \Rightarrow 24 - 6t^2 = 0 \Rightarrow t = 2 \text{ s}$$

$$a = -12 \times 2 = -24 \text{ m/s}^2 \Rightarrow |a| = 24 \text{ m/s}^2$$

4. A fighter jet, flying horizontally at an altitude of 500 m, as shown in figure, drops a shell when its velocity was  $v_0 = 100$  m/s and then accelerates away at a constant acceleration  $a$ . Find its minimum acceleration such that it will be at least at a distance  $d = 1300$  m away from the position at which the shell hits the ground.



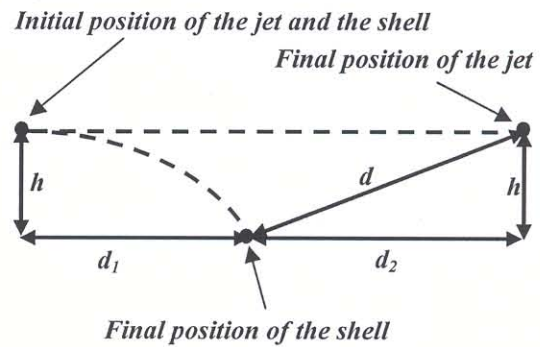
$$h = \frac{1}{2}gt^2 \Rightarrow 500 = 5t^2 \Rightarrow t = 10 \text{ s}$$

$$d_1 = v_0t = 100 \times 10 = 1000 \text{ m}$$

$$d_2 = \sqrt{d^2 - h^2} = \sqrt{1300^2 - 500^2} = 1200 \text{ m}$$

$$d_1 + d_2 = v_0t + \frac{1}{2}at^2 \Rightarrow 2200 = 1000 + 50a$$

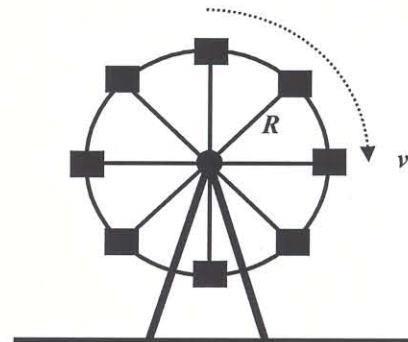
$$\Rightarrow a = 24 \text{ m/s}^2$$



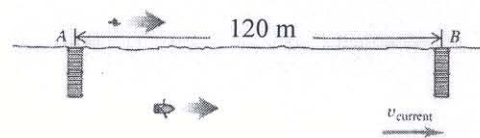
5. It is required to design a Ferris wheel, at an amusement park, such that it makes 6 revolutions per minute, while moving at a constant speed  $v = 3.14$  m/s. Find the radius,  $R$ , of the Ferris wheel.

$$T = \frac{60}{6} = 10 \text{ s}$$

$$v = \frac{2\pi R}{T} \Rightarrow R = \frac{vT}{2\pi} \Rightarrow R = \frac{3.14 \times 10}{2\pi} \cong 5 \text{ m}$$



6. A man rowing a boat, at a constant velocity of 5 m/s relative to the water, makes a round trip from point A to B in the water, as shown in figure. The time taken to finish his round trip in the water is 15 s more than the time taken to make the same round trip on land when running at a constant velocity of 4 m/s relative to earth. Find the speed of the water,  $v_{\text{current}}$ , relative to earth.



$$t_{\text{land}} = \frac{2 \times 120}{4} = \frac{240}{4} = 60 \text{ s}$$

$$t_{\text{water}} = t_{\text{land}} + 15 = 60 + 15 = 75 \text{ s}$$

$$t_{\text{land}} = 75 = \frac{120}{5 + v_{\text{current}}} + \frac{120}{5 - v_{\text{current}}} = \frac{1200}{25 - v_{\text{current}}^2}$$

$$25 - v_{\text{current}}^2 = 16 \Rightarrow v_{\text{current}} = 3 \text{ m/s}$$