

(Typical format exam)

# PHYSICS 211

## Exam #1

NAME \_\_\_\_\_

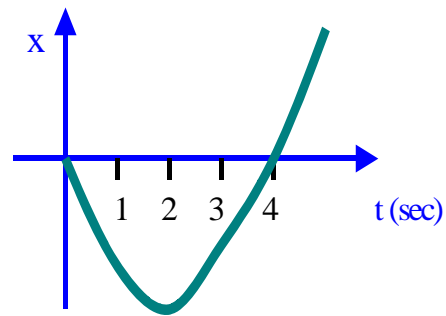
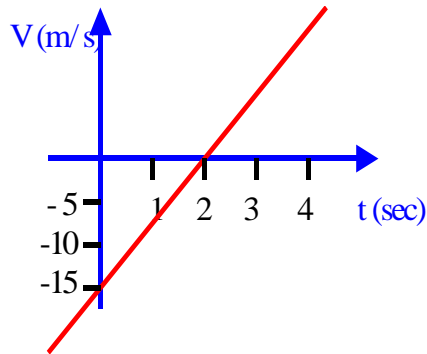
**Note:** To simplify calculation, use  $g = 10 \text{ m/s}^2$  in this exam.

1. A particle undergoes one-dimensional motion along the  $x$ -axis. The left-side figure below gives the velocity of such particle as a function of time. At  $t=0$  the particle is at  $x=0$ .

1A Circle the expression below that is correct:

- a) The particle is moving all the time toward the positive  $X$  direction
- b) The acceleration of the particle is negative for  $t < 2$  sec but positive for  $t > 2$  sec.
- c) From  $t=0$ , the particle starts moving to the left (direction of the negative  $X$ -axis) but later on it moves to the right (direction of the positive  $x$ -axis.)
- d) The particle is moving all the time toward the negative  $X$  direction
- e) All the statements above are false

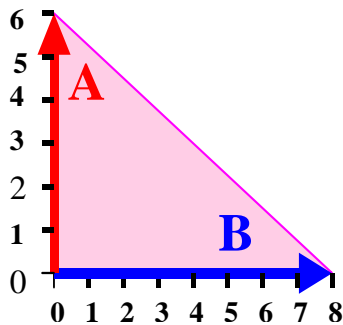
1B Use the right-side graph below to sketch the position of the particle as a function of time



(Graph for question 1-B)

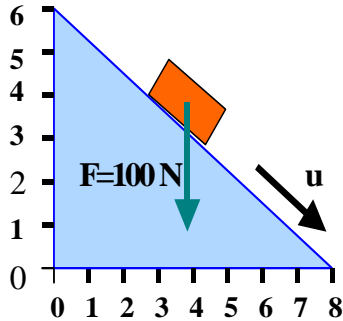
2. The left-side figure below shows the vectors **A** and **B**,

2A. Indicate graphically the vectors  $\mathbf{A+B}$ ,  $\mathbf{A-B}$  and  $\mathbf{B-A}$ . (On each arrow put the corresponding label)



Use this space to provide your answer) to question 2A)

- 2B. Indicate both the unit vector  $\mathbf{u}$  whose direction is parallel to the ramp and the scalar product between the vectors  $\mathbf{F}$  and  $\mathbf{u}$ . ( $\mathbf{F}$  is a vector force whose magnitude is 100 Newtons;  $\mathbf{i}$  and  $\mathbf{j}$  are unit vectors along the horizontal and vertical Y axis respectively.)



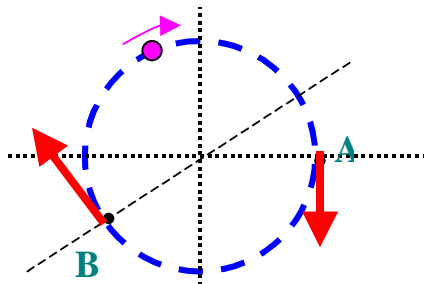
Answer:

$$\mathbf{u} = \underline{0.8} \mathbf{i} + \underline{-0.6} \mathbf{j}$$

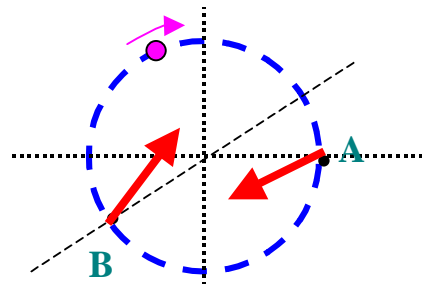
Answer:

$$\mathbf{F} \cdot \mathbf{u} = \underline{+60 \text{ N}}$$

3. 3A A particle moves along a circular path of radius “R” in the clockwise direction, as indicated in the graph below. If we know that the speed of the particle is continuously increasing, draw the corresponding velocity and acceleration vectors when the particle passes by the positions “A” and “B”.

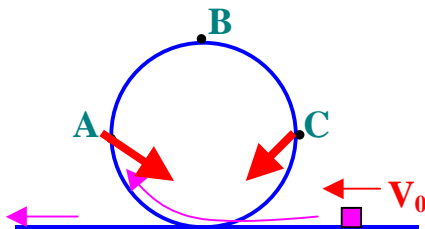


Use this graph to draw the **velocity** vectors

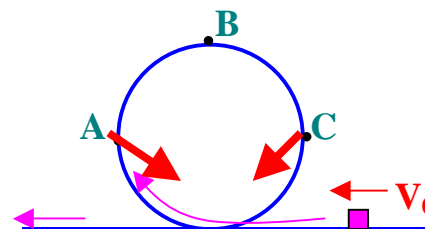


Use this graph to draw the **acceleration** vectors

- 3B. A block of mass “M” travels through a frictionless circular loop. Assuming that the mass remains attached to the surface throughout the motion, indicate the total force acting on the block when the mass passes by the positions A, B and C. Draw also the corresponding acceleration vectors.



Use this graph to draw the **force** vectors



Use this graph to draw the **acceleration** vectors

4. A dart is thrown horizontally with an initial speed of 10 m/s toward point “P”, the bull’s-eye on a dart board. It hits at point “Q” on the rim, vertically below P, 0.2 seconds later. To simplify calculations, use  $g = 10 \text{ m/s}^2$ .

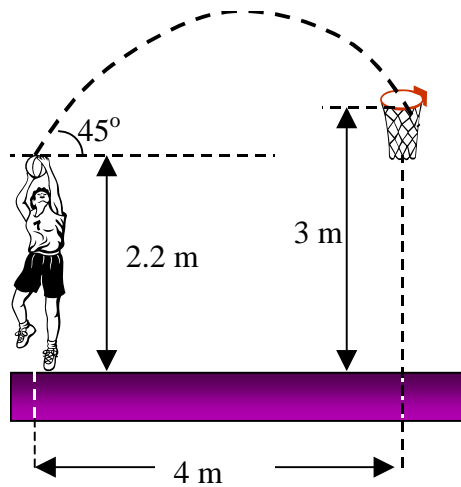
4A The distance PQ is equal to:

- a) 0.2 m      b) 2m      c) 1.8 m      d) 2.2 m      e) NA

4B Just before the dart hits the board, its speed is equal to:

- a) 12 m/s      b) 9.8 m/s      c) 8 m/s      d) 10.2 m/s      e) NA

5. 5A At what initial speed must the basketball player throw the ball, at  $45^\circ$  above the horizontal, to make a 2 points shot? (To simplify calculations, use  $g = 10 \text{ m/s}^2$ .)

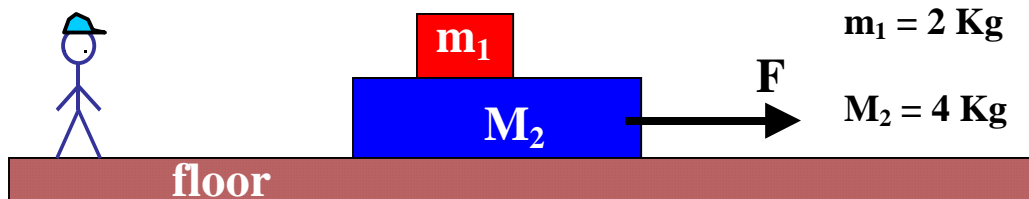


- a) 19 m/s  
b) 1.5 m/s  
c) 23 m/s  
d) 7 m/s  
e) NA

5B Circle the statement that is correct:

- a) The vertical component of the ball’s velocity remains constant during the motion  
b) The acceleration of the ball is constant while the ball travels through the air (assuming no friction effects)  
c) When the ball reaches the basket it has a higher speed than its initial speed.  
d) Since the angle is  $45^\circ$ , the ball will never reach the basket, no matter what its initial speed.  
e) All the expressions above are incorrect.

6. A 2-Kg block sits on a 4 Kg block that is on a frictionless table. The coefficient of friction between the blocks are  $\mu_s = 0.3$  and  $\mu_k = 0.2$



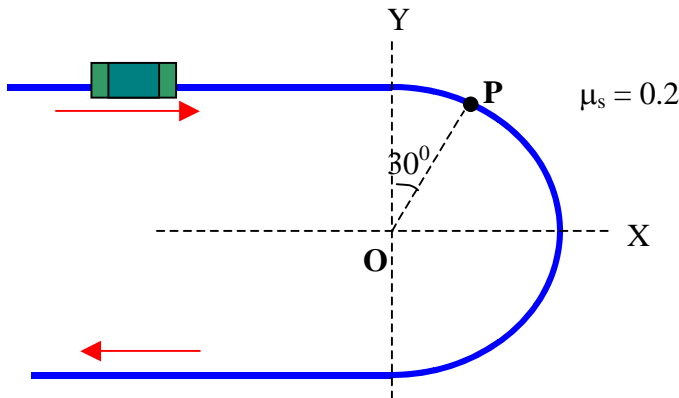
**6A** According to the observer (with its reference attached to the floor): if a strong-enough force  $F$  is applied to the mass  $M_2$ , the maximum acceleration that block  $m_1$  can possibly have is

- a)  $3 \text{ m/s}^2$     b)  $1.5 \text{ m/s}^2$     c)  $1 \text{ m/s}^2$     d)  $18 \text{ m/s}^2$     e) NA

**6B** If  $F$  is strong enough to cause the masses to slide against each other, the acceleration of block  $m_1$  will be (according to a reference attached to the floor):

- a)  $1 \text{ m/s}^2$     b)  $1.5 \text{ m/s}^2$     c)  $2 \text{ m/s}^2$     d)  $18 \text{ m/s}^2$     e) NA

7. A car of mass  $1500 \text{ Kg}$  travels at a constant speed  $v = 36 \text{ Km/h}$  around a flat road. The figure below show a top view of the road that has straight line sections and a circular track of radius  $R = 200 \text{ m}$ . Consider that  $\mu_s = 0.2$ . The speed of the car is the same evrywhere. (Use  $g = 10 \text{ m/s}^2$  to simplify calculations.)



**7A** Indicate which expression is correct:

- a) When the car enters the circular track the friction force that makes the car turn around has a magnitude of  $3,000 \text{ Newtons}$ .
- b) Since the car moves at constant speed, the total force acting on the car is zero throughout all its motion
- c) When the car passes by the position "P", the friction force is much bigger than needed to make the car turn around the track. Therefore the car will start moving toward the center position "O".
- d) When the car passes by the position "P", the friction force is zero, otherwise the car would increase its speed.
- e) All the expressions above are incorrect.

**7B** The x-component of the friction force acting on the car when it passes by the position "P" is:

- a)  $-1500 \text{ N}$     b)  $-375 \text{ N}$     c)  $0$     d)  $-750 \text{ N}$     e) NA

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## Helpful formulas

$$\text{Average velocity} = \Delta \mathbf{x} / \Delta t$$

$$\text{instantaneous velocity } \mathbf{v} = d \mathbf{x} / dt$$

$$\text{Average acceleration} = \Delta \mathbf{v} / \Delta t$$

$$\text{instantaneous acceleration } \mathbf{a} = d \mathbf{v} / dt$$

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## Motion under constant acceleration "a"

$$v = v_o + a t$$

$$x - x_o = v_o t + (1/2) a t^2$$

$$v^2 = v_o^2 + 2 a (x - x_o)$$

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## Free fall

$$v_y = v_{oy} - g t$$

$$g = 9.8 \text{ m/s}^2$$

$$y - y_o = v_{oy} t - (1/2) g t^2$$

$$x - x_o = v_{ox} t$$

$$g = 32 \text{ ft/s}^2$$

$$v_y^2 = v_{oy}^2 - 2 g (y - y_o)$$

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## UNIFORM CIRCULAR MOTION

$$\text{Centripetal acceleration: } a = v^2/R$$