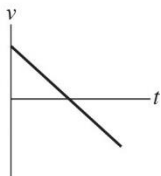


AP PHYSICS  
FALL SEMESTER REVIEW

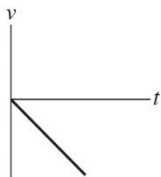
GRAPHING

1) A child standing on a bridge throws a rock straight down. The rock leaves the child's hand at time  $t = 0$  s. If we take upward as the positive direction, which of the graphs shown below best represents the velocity of the stone as a function of time?

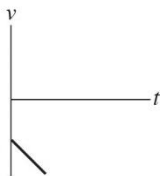
A)



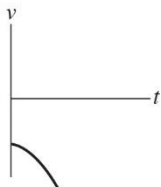
B)



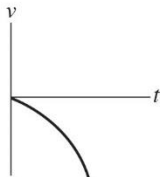
C)



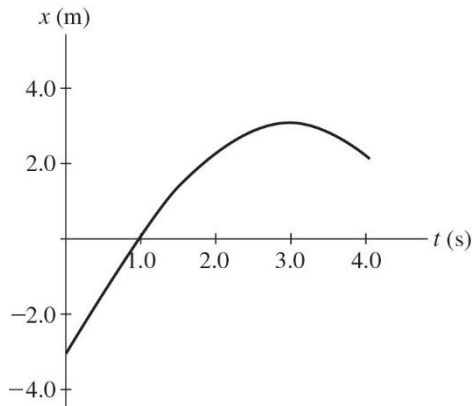
D)



E)



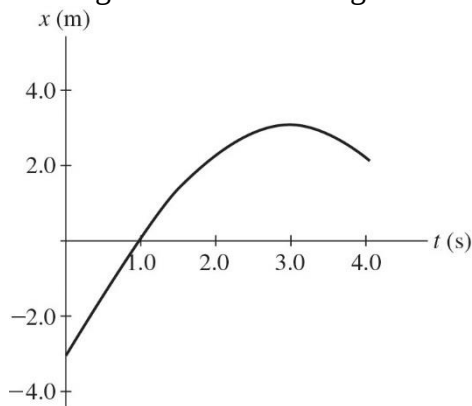
2) The graph in the figure shows the position of a particle as it travels along the  $x$ -axis.



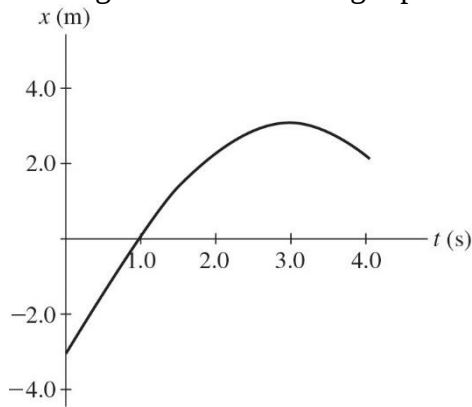
At what value of  $t$  is the speed of the particle equal to 0 m/s?

- A) 0 s
- B) 1 s
- C) 2 s
- D) 3 s
- E) 4 s

3) The graph in the figure shows the position of a particle as it travels along the  $x$ -axis. What is the magnitude of the average velocity of the particle between  $t = 1.0$  s and  $t = 4.0$  s?



4) The graph in the figure shows the position of a particle as it travels along the  $x$ -axis. What is the magnitude of the average speed of the particle between  $t = 1.0$  s and  $t = 4.0$  s?

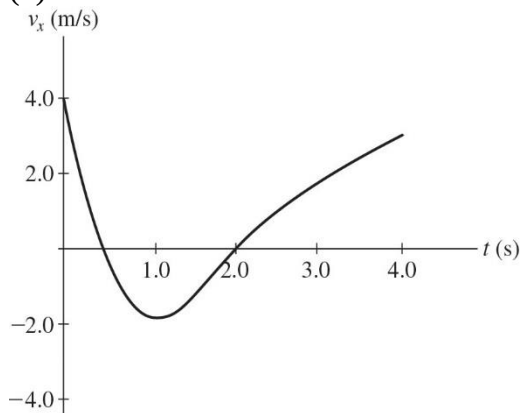


5) The graph in the figure shows the velocity of a particle as it travels along the  $x$ -axis. (a) In what direction ( $+x$  or  $-x$ ) is the acceleration at  $t = 0.5$  s?

(b) In what direction ( $+x$  or  $-x$ ) is the acceleration at  $t = 3.0$  s?

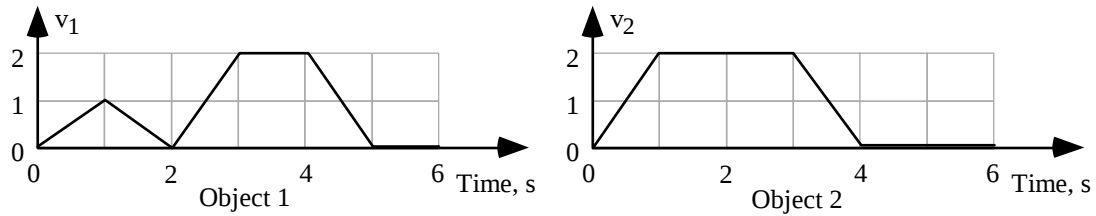
(c) What is the average acceleration of the particle between  $t = 2.0$  s and  $t = 4.0$  s?

(d) At what value of  $t$  is the instantaneous acceleration equal to  $0$  m/s<sup>2</sup>?



6) A flying fish swimming at an initial depth of 0.5 m breaches the surface at time 1 s where he reaches a maximum height of 2.5 meters. The fish maintains his height for the entire 3.0 s before diving back below the surface of the water to a depth of 2.0 meters. Sketch and label a graphical representation of the fish's flight.

7) The graphs below show the velocity of two objects during the same time interval.



Three students are discussing the displacements of these objects for this interval.

Amos: "I think Object 2 will have the greater displacement because it gets to a higher speed faster than Object 1."

Badu: "No, Object 1 will have the greater displacement because it travels for a longer time than Object 2."

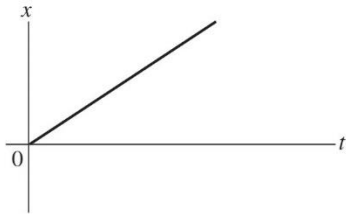
Candi: "I agree with Amos, but for a different reason. Object 2 has the larger displacement because the area under the graph is greater."

**With which, if any, of these three students do you agree?**

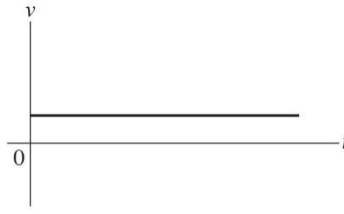
Amos \_\_\_\_\_ Badu \_\_\_\_\_ Candi \_\_\_\_\_ None of them \_\_\_\_\_ **Explain your reasoning.**

8) Which of the following graphs represent an object having zero acceleration?

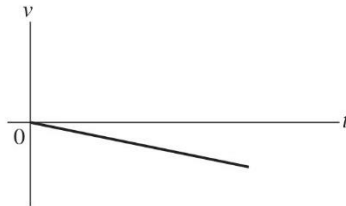
(a)



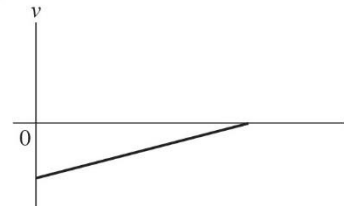
(b)



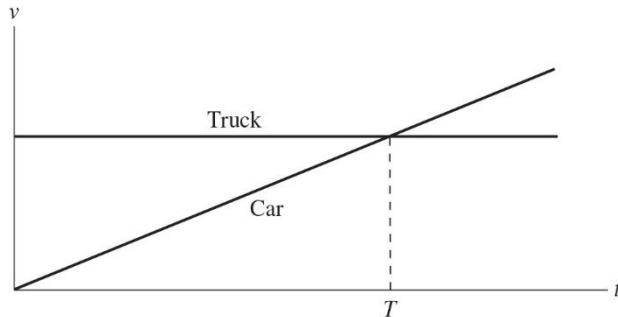
(c)



(d)



9. The motions of a car and a truck along a straight road are represented by the velocity-time graphs in the figure. The two vehicles are initially alongside each other at time  $t = 0$ .



At time  $T$ , what is true of the *distances* traveled by the vehicles since time  $t = 0$ ?

- A) They will have traveled the same distance.
- B) The truck will not have moved.
- C) The car will have travelled further than the truck.
- D) The truck will have travelled further than the car.

#### KINEMATICS:

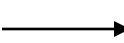
1. A Cessna aircraft accelerates down a run-way from rest at  $3.20 \text{ m/s}^2$  for 32.8 s until it achieves liftoff. How far did it travel on the runway before taking off?
2. A Ford Raptor starts from rest and accelerates uniformly over a time interval of 5.21 seconds for a resulting displacement of 110 m. What is the acceleration of the truck?
3. A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds. Determine the acceleration of the car. How far has it traveled?
4. Rocket-powered sleds are used to test the human response to acceleration. If a rocket-powered sled is accelerated to a speed of 444 m/s in 1.8 seconds, then what is the acceleration and what is the distance which the sled travels?
5. A horse accelerates uniformly from rest to a speed of 7.10 m/s over a distance of 35.4 m. Determine the acceleration the horse experiences.
6. An engineer is designing the run-way for an airport. Of the planes which will use the airport, the lowest acceleration rate is likely to be  $3 \text{ m/s}^2$ . The takeoff speed for this plane will be 65 m/s. Assuming this minimum acceleration, what is the minimum allowed length for the run-way?

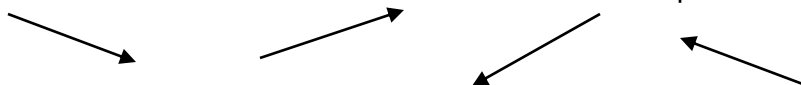
7. A student running late for school pulls into the parking lot driving at 22.4 m/s and skids to a stop in 2.55 s. Determine the skidding distance of the car (assume uniform acceleration).
8. A bullet is moving at a speed of 367 m/s when it embeds into a lump of moist clay. The bullet penetrates for a distance of 0.0621 m. Determine the acceleration of the bullet while moving into the clay. (Assume a uniform acceleration.)
9. It was once recorded that a Jaguar left skid marks which were 290 m in length. Assuming that the Jaguar skidded to a stop with a constant acceleration of  $-3.90 \text{ m/s}^2$ , determine the speed of the Jaguar before it began to skid.
10. A dragster accelerates to a speed of 112 m/s over a distance of 398 m. Determine the acceleration (assume uniform) of the dragster.

## VECTORS:

1. Write the equation for sine, cosine, and tangent.
2. Write the equation to determine the angle  $\theta$  using  $\sin^{-1}$ ,  $\cos^{-1}$  and  $\tan^{-1}$ .
3. Define:
  - A. vector
  - B. scalar
4. In order to solve vector problems, you must decide on a coordinate system. Which of the following would be the best system to analyze east-west motion on the ground?
  - A. x-axis is east-west; y- axis is north-south
  - B. x-axis is north-south; y- axis is east-west
  - C. x-axis is horizontal; y- axis is vertical
  - D. x-axis is vertical; y- axis is horizontal
5. Draw the resultant vector for the following. Graphically, determine the velocity. (Don't forget the angle!)  
Scale: 1 cm = 50.0 m/s



6. The vector sum of three vectors gives a resultant equal to zero. What can you say about the three vectors?
7. Can vectors be multiplied by vectors? If so, is the result a vector or a scalar?
8. Can vectors be multiplied by scalars? If so, is the result a vector or a scalar?
9. Which resultant would be drawn if  is added to  ?



10. Ann drives 200. km E, then 100. km N, then 150. km W, and finally 200. km S. What is her displacement? **Show work.**

11. A pilot sets his controls to fly at 225. km/h to the north. A 50.0 km/h wind is blowing directly east. What is the magnitude and direction of his resultant velocity?

## Projectile Motion

1. What is a projectile?
2. The horizontal motion of any projectile is \_\_\_\_\_, while its vertical motion is \_\_\_\_\_.
3. The value of the horizontal acceleration of a projectile is \_\_\_\_\_. The value of the vertical acceleration of a projectile is \_\_\_\_\_.
4. Is a ball thrown straight up an example of a projectile?
5. What happens to the maximum altitude and range of a projectile if its projection speed is increased, but the angle of projection stays the same?
6. What happens to the maximum altitude and range of a projectile if its projection angle is increased, but the speed of projection stays the same?
7. Ideally, the maximum range of a projectile occurs for a projection angle of \_\_\_\_\_°
9. What are the values of the initial vertical and horizontal velocities of a ball which rolls off of a table at 3 m/sec?

### Equations (don't forget to show your work):

$$v_{xi} = \cos\theta v_i \quad v_{yi} = \sin\theta v_i \quad \Delta x = v_{xi} t \quad t = \sqrt{\frac{2\Delta y}{g}}$$

$$v_{yf}^2 = v_{yi}^2 + 2g\Delta y \quad v_{yf} = v_{yi} + gt \quad \Delta y = v_{yi}t + \frac{1}{2}gt^2$$

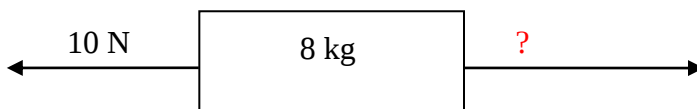
$$v_i = \sqrt{\frac{g\Delta x}{2\sin\theta\cos\theta}} \quad d = \frac{v^2}{g} \sin(2\theta)$$

1. A steel projectile is shot horizontally at 20. m/s from the top of a 40. m tower. How far from the base of the tower does the projectile hit the ground? **Ans: 57.14 m**

2. A projectile is fired from a cannon at a speed of 301 m/s and at an angle of  $3.00^\circ$ . How long does it take the projectile to reach its highest point? How far does it go horizontally? Ans: 1.61 sec; 964.89m
3. A bomber releases a bomb at a height of 50.0 m above the surface. The bomber is flying at a constant horizontal speed of 88.9 m/s. How long does it take the bomb to fall to the surface? How far away is the point of impact? Ans: 3.19 sec; 283.59 m
4. A golfer launches a ball with an initial speed of 30.0 m/s at an angle of  $34.0^\circ$  with respect to the ground. At what time does the golf ball reach its maximum height? What is this height? What is the total time in the air? Ans: 1.71 sec; 14.37m; 3.42 sec; 85.06 m

## FORCES AND NEWTON'S LAWS

1. Unbalanced Forces cause \_\_\_\_\_
2. Define inertia.
3. If the acceleration due to gravity is less on another planet, how does the mass of an object compare to the mass on Earth?
4. If an object is at rest, there is no force acting on it.
5. If an object is traveling at a constant speed in a straight line the net force is \_\_\_\_\_
6. If an object is moving to the right, friction acts to \_\_\_\_\_
7. Write the formula for weight. \_\_\_\_\_
8. Which direction does the weight vector point? \_\_\_\_\_
9. What is the difference between mass and weight? Which one changes according to location?
10. What are the units of mass? Kilograms What are the units of weight? \_\_\_\_\_
11. If an object is sliding along a surface at a constant velocity and the frictional force is 12.5 N to the right, what is the applied force \_\_\_\_\_
12. Acceleration is \_\_\_\_\_ proportional to mass and \_\_\_\_\_ proportional to the net force.
13. Give an example of an action-reaction pair. bug hits a windshield and the windshield hits the bug.
14. If  $a = 2 \text{ m/s}^2$  to the right, what is the missing force?



16. For an object to be in equilibrium, the net force must be equal to \_\_\_\_\_
17. Can an object be moving if there is no net force acting? \_\_\_\_\_
18. If an object is on an incline, how is normal force calculated? \_\_\_\_\_
19. State Newton's Laws. For Newton's 2<sup>nd</sup> Law, also write the formula that comes from that law.
20. For an action-reaction pair, how do the forces on each object compare?

**Free-body diagrams:**

Draw the following free-body diagrams showing all forces acting on the object on your own paper.

1. An object moving at a constant velocity on a horizontal surface with the applied force parallel to the surface.
  2. An object falling through the air and accelerating downward (consider air resistance).
  3. An object being pulled across a horizontal surface at a constant velocity with the applied force at an angle with the horizontal.
  4. An object being pushed across a horizontal surface at a constant velocity with the applied force.
- 
1. An object is acted upon by the following forces: 125 N to the right, 308 N to the left, 422 N upward, and 155 N downward.
    - A. Draw a free-body diagram.
    - B. Calculate the net force in the y-direction. (267 N; you state direction)
    - C. Calculate the net force in the x-direction. (183 N; you state direction)
    - D. Calculate the net force (include angle and direction). (324 N; you state direction)
  2. Suppose an empty grocery cart rolls downhill in a parking lot. The cart undergoes a constant increase in speed of 1.0 m/s over a 5.0 s time interval. If the downhill force acting on the cart is 18.0 N and the uphill force due to friction is 15.0 N, what is the cart's mass? (15 kg)
  3. A force of 5.00 N to the left causes a 1.35 kg book to have a net acceleration of  $0.76 \text{ m/s}^2$  to the left. What is the frictional force acting on the book? (3.97 N)
  4. What is the mass of a 754 N person? (76.9 kg)
  5. A four way tug-of-war has four ropes attached to a metal ring. The forces on the rings are as follows:  $F_1 = 4.00 \times 10^3 \text{ N}$  east,  $F_2 = 5.00 \times 10^3 \text{ N}$  north,  $F_3 = 7.00 \times 10^3 \text{ N}$  west, and  $9.00 \times 10^3 \text{ N}$  south. What is the magnitude and direction of the net force?
  6. Assume that a catcher in a professional baseball game exerts a force of -65.0 N to stop the ball. If the baseball has a mass of 0.145 kg, what is its net acceleration as being it is being caught?