AP Physics I Summer Work

2017

(20 points)

Please complete the following set of questions and word problems.

Answers will be reviewed in depth during the first week of class followed by an assessment based on the content.

There are many useful resources online including Khan Academy, www.njctl.org and www.physicsclassroom.com.

Kinematics Chapter Questions

1. When you drive a car and take a quick look on the speedometer, what do you see velocity or speed?

2. A ball is thrown vertically up and is caught at the starting point; compare the traveled distance and displacement of the ball.

3. Can an object with a constant acceleration reverse it's direction of travel? Explain.

4. Can an object have a varying speed when its velocity is constant? Explain.

5. Is it possible for an object to have average velocity equal to its instantaneous velocity?

6. What quantity describes how quickly you change your speed?

7. Can an object have a southward velocity and a northward acceleration?

8. Is it possible for an object to have average speed equal to the magnitude of its average velocity?

9. If you take a quick look at the car's speedometer, what do you read?

10. What does the area under the curve on a velocity-versus-time graph represent?

11. What does the slope of the curve on a displacement-versus-time graph represent?

12. What does the slope of the curve on a velocity-versus-time-time graph represent?

Dynamics Chapter Questions

1. What is Newton's First Law? Second Law? Third law?

2. Can an object with zero net force acting on it be moving? Explain.

3. Discuss how an object's acceleration relate to the direction of its movement.

4. A box is placed on a table. Describe the action-reaction forces between the box and the table, the box and the earth's gravitational field, and the table and the earth's gravitational field.

5. You are on a train. A baseball that is initially at rest in the aisle suddenly starts moving backwards without an applied force. Apply the definition of an inertial reference frame to explain what is happening.

6. Compare/contrast the physically measured quantities of mass and weight.

7. What is the normal force?

8. Explain the differences between kinetic and static friction without using equations.

9. What is a free body diagram and how is it used to solve for the motion of an object?

10. Draw the free body diagram for a physics student fast asleep at her desk.

11. Draw a free body diagram for a box being pushed across the floor at a constant velocity.

12. Draw a free body diagram for a box being accelerated across the floor.

13. When there is friction between a moving object and the surface it rests on in the x axis, why is it necessary to first apply Newton's Second Law to the free body diagram in the y direction?

14. What assumption is made about moving objects on a surface oriented in the x axis that results in $F_N = mg$?

15. A 250 N force acts at an angle of 35° above the horizontal. Resolve this force into its x and y components.

16. You are pulling a wagon with a handle that is at an angle θ with respect to the horizontal x axis with a force F.

    a) Explain how you would find how much of F results in acceleration of the wagon in the x axis.

    b) Assume there is friction between the wagon and the ground. How do you determine the value of the frictional force, using the y component of the applied force F?

    c) Instead of pulling the wagon, you push it with the handle oriented at the same angle with respect to the horizontal. Compare the frictional force to when the wagon was being pulled.

17. An object is moving with constant velocity downwards on a frictionless inclined plane that makes an angle of θ with the horizontal.

    a) Which direction does the force of gravity act on the object?

    b) Which direction does the normal force act on the object?

    c) Which force is responsible for the object moving down the incline?

18. Give two reasons why the x-y coordinate axes are rotated to align with the inclined plane.

19. For an object to remain at rest, it is necessary for it to be in translational equilibrium. What can you say about the net force on the object for this to be true?

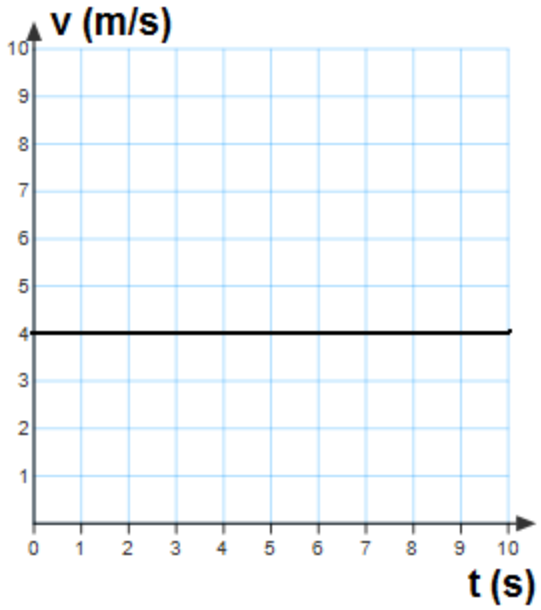
20. A box of mass m is suspended by two ropes from a ceiling.

    a) If the ropes make the same angle with the vertical, what is the tension in each rope?

    b) The ropes make different angles with the vertical, one being more vertical than the other. Which rope has the greatest tension?

c) Why can the ropes that support the box never be perfectly horizontal?

1. An object moves at a constant speed of 6 m/s. This means that the object:
   A. Increases its speed by 6 m/s every second
   B. Decreases its speed by 6 m/s every second
   C. Doesn't move
   D. Has a positive acceleration
   E. Moves 6 meters every second



2. The graph above represents the relationship between velocity and time for an object moving in a straight line. What is the traveled distance of the object at 9 s?
   A. 10 m B. 24 m C. 36 m D. 48 m E. 56 m

3. Which of the following statements is true?
   A. The object speeds up
   B. The object slows down
   C. The object moves with a constant velocity
   D. The object stays at rest
   E. The object is in free fall

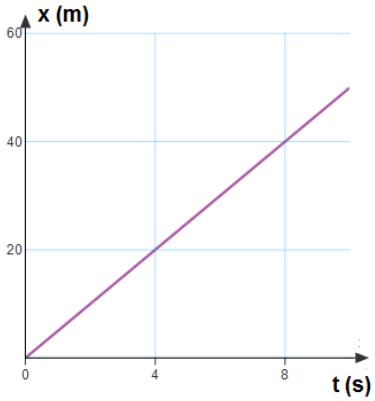
4. What is the velocity of the object at 5 s?
   A. 1 m/s B. 2 m/s C. 3 m/s D. 4 m/s E. 5 m/s

5. A motorbike travels east and begins to slow down before a traffic light. Which of the following is the correct direction of the motorbike's acceleration?

A. B.  C. 

D.  E. 

The following graph represents the position as a function of time for a moving object. Use this graph to answer questions 6 and 7.

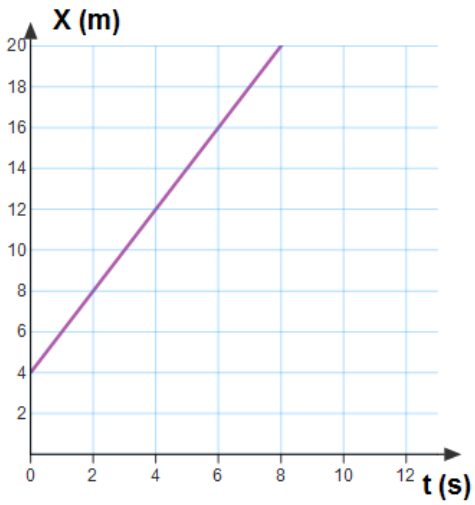


6. Which of the following is true?
   A. The object increases its velocity
   B. The object decreases its velocity
   C. The object's velocity stays unchanged
   D. The object stays at rest
   E. More information is required

7. What is the velocity of the object?
   A. 4 m/s B. 20 m/s C. 8 m/s D. 40 m/s E. 5 m/s

8. A car and a delivery truck both start from rest and accelerate at the same rate. However, the car accelerates for twice the amount of time as the truck. What is the traveled distance of the car compared to the truck?
   A. Half as much
   B. The same
   C. Twice as much
   D. Four times as much
   E. One quarter as much

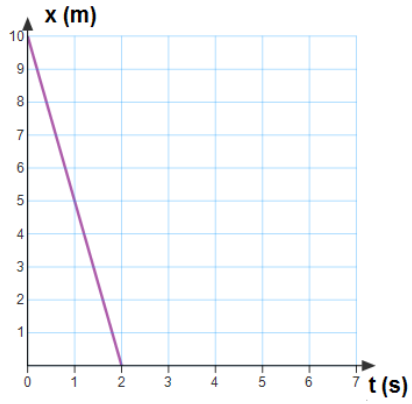
The following graph represents the position as a function of time of a moving object. **Use this graph to answer questions 9 and 10.**



9. What is the initial position of the object?
   A. 2 m B. 4 m C. 6 m D. 8 m E. 10 m

10. What is the velocity of the object?
    A. 2 m/s B. 2.5 m/s C. 4 m/s D. 8 m/s E. 10 m/s

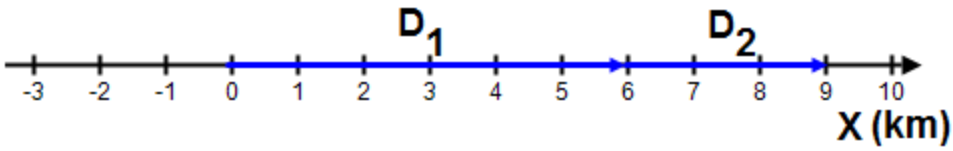
The following graph represents the position as a function of time of a moving object. **Use this graph for questions 11 and 12.**



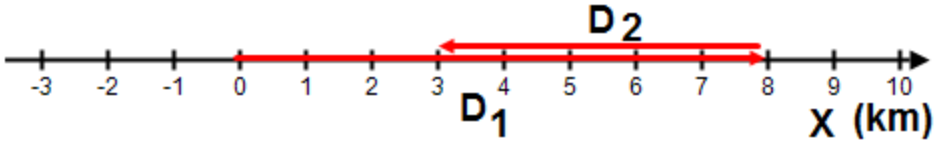
11. What is the initial position of the object?
    A. 2 m B. 4 m C. 6 m D. 8 m E. 10 m

12. What is the velocity of the object?
    A. 5 m/s B. -5 m/s C. 10 m/s D. -10 m/s E. 0 m/s

13. Which of the following is a vector quantity?
    A. Speed B. Time C. Traveled distance D. Velocity E. Area



14. Starting from the origin, a person walks 6 km east during first day, and 3 km east the next day. What is the net displacement of the person from the initial point in two days?
    A. 6 km, west B. 3 km, east C. 10 km, east D. 5 km, west E. 9 km, east

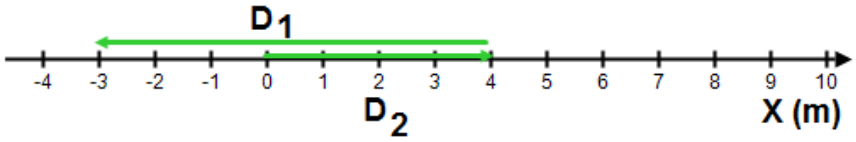


The diagram above illustrates a person who, starting from the origin, walks 8 km east during first day, and 5 km west the next day. Use it to answer questions 18 and 19.

15. What is the net displacement of the person from the initial point in two days?
    A. 6 km, east B. 3 km, east C. 10 km, west D. 5 km, west E. 9 km, east

16. What is the traveled distance of the person from the initial point in two days?

A. 13 km B. 3 km C. 10 km D. 5 km E. 9 km



The diagram above illustrates a car that, starting from the origin, travels 4 km east and then 7 km west. Use it to answer questions 17 and 18.

17. What is the net displacement of the car from the initial point?
    A. 3 km, west B. 3 km, east C. 4 km, east D. 7 km, west E. 7 km east

18. Starting from the origin, a car travels 4 km east and then 7 km west. What is the traveled distance of the car from the initial point?
    A. 3 km B. 3 km C. 4 km D. 7 km E. 11 km

19. When a platypus sleeps on a table, the net force on it is
    A. zero
    B. directed upward
    C. directed downward
    D. directed in the horizontal direction
    E. more information is required

20. When the engines on a rocket ship in deep space, far from any other objects, are turned off, it will
    F. slow down and eventually stop
    G. stop immediately
    H. turn right
    I. move with constant velocity
    J. turn left

21. In order for a rocket ship in deep space, far from any other objects, to move in a straight line with constant speed it must exert a net force that is
    a. proportional to its mass
    b. proportional to its weight
    c. proportional to its velocity
    d. zero
    e. proportional to its displacement

22. If a book on the dashboard of your car suddenly flies towards you, the forward velocity of the car must have
    a. decreased
    b. increased
    c. changed direction to the right
    d. become zero
    e. changed direction to the left

23. Which Newton's law can explain the following statement that we often see on the highway display: "Buckle up –it's the State Law"?
    A. First Newton's Law
    B. Second Newton's Law
    C. Third Newton's Law
    D. Gravitational Law
    E. None from the above

24. A spacecraft travels at a constant velocity in empty space far away from any center of gravity. Which of the following about the force applied on the spacecraft is true?

    A. The applied force is equal to its weight
    B. The applied force is slightly greater than its weight
    C. The applied force is slightly less that its weight
    D. The applied force must perpendicular to its velocity
    E. No applied force is required to maintain a constant velocity

25. A boy rides a bicycle at a constant velocity. Which of the following about the net force is true?

    A. There is a net force acting in the velocity direction
    B. There is a net force acting opposite to the velocity direction
    C. The net force is zero
    D. There is a net force acting perpendicularly to the velocity direction
    E. None from the above

26. When a baseball is struck by a bat, the force of the bat on the ball is equal and opposite to the force of the ball on the bat. This is an example of
    a. Newton's first law
    b. Newton's second law
    c. Newton's third law
    d. Newton's law of gravitation
    e. None from the above

27. If you exert a force F on an object which has a much greater mass than you do, the force which the object exerts on you will
    a. be of magnitude F and in the same direction
    b. be of magnitude F and in the opposite direction
    c. be of much less magnitude than F
    d. be of much greater magnitude than F
    e. be zero

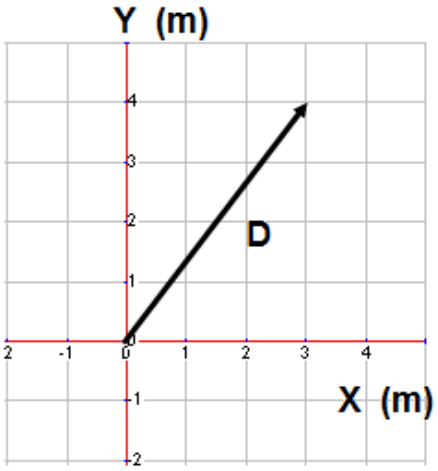
28. Newton's third law refers to "action-reaction forces". These forces always occur in pairs and
    a. sometimes act on the same object
    b. always act on the same object
    c. may be at right angles
    d. never act on the same object
    e. always act at right angles

29. Action-reaction forces are
    a. equal in magnitude and point in the same direction
    b. equal in magnitude and point in opposite directions
    c. unequal in magnitude but point in the same direction
    d. unequal in magnitude and point in opposite directions
    e. cancel each other

30. Mass and weight
    a. Both have the same measuring units
    b. Both have different measuring units
    c. Both represent force of gravity
    d. Both represent measure of inertia
    e. None from the above

31. The acceleration due to gravity is higher on Jupiter than on Earth. The mass and weight of a rock on Jupiter compared to that on Earth would be
    a. same, more
    b. same, less
    c. more, more
    d. more, less
    e. same, same

A vector of displacement D is placed in X-Y coordinate system shown in the diagram to the right. Use this diagram to answer questions 32 through 34.



32. What is the x-component of vector D?
    A. 2 m B. 3 m C. 4 m D. 5 m

33. What is the y-component of vector D?
    A. 2 m B. 3 m C. 4 m D. 5 m

34. What is the magnitude of vector D?
    A. 2 m B. 3 m C. 4 m D. 5 m

Vector Resolution:

1. Find the magnitude and the direction of vector C for the following cases.
   a. A = 10 N at 0°, B = 20 N at 0°, C = A + B
   b. A = 10 N at 0°, B = 20 N at 180°, C = A + B
   c. A = 10 N at 180°, B = 20 N at 180°, C = A + B
   d. A = 10 N at 0°, B = 20 N at 90°, C = A + B
   e. A = 10 N at 90°, B = 20 N at 0°, C = A + B

2. Find the magnitude and the direction of vector G as a sum of two vectors D and E by going through the following steps.
   a. D = 10 N at 37°. Find D_x and D_y.
   b. E = 20 N at 25°. Find E_x and E_y.
   c. Find $G_x = D_x + E_x$
   d. Find $G_y = D_y + E_y$
   e. Find the magnitude of G from its components
   f. Find the direction of G.

3. Find the magnitude and the direction of vector C for the following cases.
   a. A = 40 N at 0°, B = 10 N at 0°, C = A + B
   b. A = 40 N at 0°, B = 10 N at 180°, C = A + B
   c. A = 40 N at 180°, B = 10 N at 180°, C = A + B
   d. A = 40 N at 0°, B = 10 N at 90°, C = A + B
   e. A = 40 N at 90°, B = 10 N at 0°, C = A + B

Kinematics in 1-D:

1. An object is moving with an initial velocity of 19 m/s. It is then subject to a constant acceleration of 2.5 m/s^2 for 15 s. How far will it have traveled during the time of its acceleration?

2. An object accelerates from rest, with a constant acceleration of 8.4 m/s^2, what will its velocity be after 11s?

3. An arrow is projected by a bow vertically up with a velocity of 40 m/s, and reaches a target in 3 s. What is the velocity of the arrow just before it hits the target? How high is the target located?

4. An object is traveling with a constant velocity of 3.0 m/s. How far will it have gone after 4.0 s?

5. An object accelerates from rest to a velocity of 34 m/s over a distance of 70 m. What was its acceleration?
6. An object falls from a height of 490 m. How much time does it take for the object to reach the ground?

Problems using Newton's 2nd Law:

1. A physics student pushed a 50 kg load across the floor, accelerating it at a rate of 1.5 m/s^2. How much force did she apply?

2. A 10,000 N net force is accelerating a car at a rate of 5.5 m/s^2. What is the car's mass?

3. A boy pedals his bicycle with a net horizontal force of 227 N. If the total mass of the boy and the bike is 40 kg, how much are they accelerating?

4. A 20 kg box on a frictionless surface is subject to two forces: F1 is 100N and acts towards the right, F2 is 20N and acts towards the left. What is the magnitude and direction of the acceleration of the box?

5. A boy weighs 285 N. What is his mass?

6. Find the weight of a 63 kg table.

7. A Martian weighs 17 N on the surface of Mars. Calculate his weight on Earth and on the Earth's moon. Does his mass change along the flight from Mars to the Moon to the Earth? The acceleration due to gravity on Mars is 3.8 m/s^2 and the acceleration due to gravity on the Moon is 1.6 m/s^2.

8. A stationary 250 kg object is located on a table near the surface of the earth. The coefficient of static friction between the surfaces is 0.30 and the coefficient of kinetic friction is 0.15.

    a. A horizontal force of 300 N is applied to the object.
        a. Draw a free body diagram with the forces to scale.
        b. Determine the force of friction.
        c. Determine the acceleration of the object.

    b. A horizontal force of 500 N is applied to the object.
        a. Draw a free body diagram with the forces to scale.
        b. Determine the force of friction.

c. Determine the acceleration of the object.

c. A horizontal force of 750 N is applied to the object.
    a. Draw a free body diagram with the forces to scale.
    b. Determine the force of friction.
    c. Determine the acceleration of the object.

d. A horizontal force of 1500 N is applied to the object.
    a. Draw a free body diagram with the forces to scale.
    b. Determine the force of friction.
    c. Determine the acceleration of the object.