Name	Section	Date	Score
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Phys 20.01 Long exam 1

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2025 W36

Instructions: For comprehension and conceptual questions, choose the best answer. For problem-solving questions, choose the best answer and show your solution and reasoning. Comprehension is 1 pt each, conceptual is 2 pt each, and problem-solving is 3 pt each.

1. Comprehension

1. What is the study of motion that doesn't consider the causes that affect that motion?
   a. kinematics
   b. dynamics
   c. mechanics
   d. graphical analysis

2. As you read this in your chair, how fast are you moving relative to the chair? Relative to the sun? (~ means approximately)
   a. 0 km/hr, 0 kph
   b. 0 km/hr, ~107,000 km/hr
   c. 0.01 km/hr, ~107,000 km/hr
   d. 0 km/hr, it depends on the time of day and year

3. Which of the following quantity is not a scalar?
   a. temperature
   b. instantaneous speed
   c. displacement
   d. distance

4. The 3 fundamental physical quantities are mass, length, and time. Their corresponding SI units are
   a. gram, centimeter, second
   b. gram, meter, second
   c. kilogram, meter, second
   d. kilogram, foot, second

5. Recall that slope is the difference in the vertical (rise) divided by the difference in the horizontal (run). What is the slope of a graph of velocity v vs time t?
   a. velocity v
   b. acceleration a
   c. displacement x
   d. position x

6. Which of these best describes the relationship between instantaneous velocity and instantaneous speed?
   a. Both instantaneous speed and instantaneous velocity are same, even when there is change in direction
   b. Instantaneous speed and instantaneous velocity cannot be same, even if there is no change in direction of motion
   c. Magnitude of instantaneous velocity is equal to instantaneous speed
   d. Magnitude of instantaneous velocity is always greater than instantaneous speed

7. Which kinematic equation would you use to find the velocity of a skydiver 2.0 s after she jumps from a plane and before she opens her parachute? Assume the positive direction is downward.
   a. $v = v_0 + at$
   b. $v = v_0 - at$
   c. $v^2 = v_0^2 + at$
   d. $v^2 = v_0^2 - at$

8. Something is a perspective from which you're making observations and is composed of an origin, a set of axes, and a clock. Often, we take another stationary object in said something eg. rocket launch relative to earth. What is this something?
   a. reference frame
   b. point of view
   c. observation point
   d. coordinate system

9. What quantity is the total length of the path traveled between two positions within a timeframe?
   a. displacement
   b. distance traveled
   c. average velocity
   d. average speed

10. Which of these explains a racecar going around a curve is accelerating, even if speed is constant?
    a. Because the magnitude as well as the direction of velocity is changing
    b. Because the magnitude of velocity is changing
    c. Because the direction of velocity is changing
    d. Because neither the magnitude nor the direction of velocity is changing

11. What can you infer from "An object's velocity is zero?"
    a. Object is moving at a constant speed
    b. Object is in linear motion with constant velocity
    c. Object is either at rest or it returns to initial point
    d. Object is moving in a straight line without changing its direction

12. Which of these is not a valid unit for acceleration?
    a. m/s^2
    b. km/h/s
    c. cm/min
    d. miles/hour/second

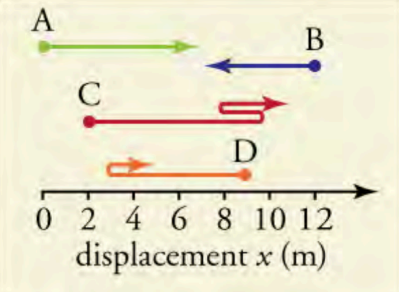
13. Which of these best describes the interval in which events occur, and provides a framework for quantifying change?
    a. time
    b. space
    c. inertia
    d. velocity

14. Is it possible to determine a car's instantaneous velocity from just the speedometer reading?
    a. No, it reflects speed but not the direction
    b. No, it reflects the average speed of the car
    c. Yes, it sometimes reflects the instantaneous velocity
    d. Yes, it always reflects the instantaneous velocity

15. On earth, all free-falling objects have an acceleration due to gravity, which averages at
    a. 0 m/s^2
    b. 0 m/s^2, which then increases to 9.8 m/s^2 as the object falls
    c. 9.8 m/s^2, which also decreases as the object falls
    d. 9.8 m/s^2, regardless of their shape or mass

2. Conceptual

1. You can find the distance traveled from the starting point for each path. But which path has the maximum displacement magnitude?
    a. A
    b. B
    c. C
    d. D



2. Free fall is the state of motion resulting from
    a. any object being dropped
    b. an object falling at a constant speed
    c. only the force of gravity acting on an object
    d. the absence of any forces acting on an object

3. Suppose a train is moving along a track. Is there a single, correct frame of reference from which to describe the train's motion?
    a. Yes, there is a single correct frame because motion is a relative term
    b. Yes, there is a single correct frame which is in terms of earth's position
    c. No, there is not a single correct frame because motion is a relative term
    d. No, there is not a single correct frame because motion is independent of frame of reference

4. A car is slowing down as it approaches a red light. Which of the following is always true?
    a. The car has a negative acceleration
    b. The car is not accelerating
    c. The car is decelerating, and its acceleration is in the same direction as its velocity
    d. The car is decelerating, and its acceleration is in the opposite direction to its velocity

5. A student calculates the final velocity of a bicycle that decelerates from an initial velocity of 15.0 m/s. The student obtains a final velocity of 22.5 m/s. Which of these most likely indicates a mistake in the calculation?
    a. The final velocity is positive, which always means the bicycle is speeding up
    b. The magnitude of final velocity is larger than initial velocity, which is not possible in deceleration
    c. The final velocity should have more significant figures than the initial velocity
    d. The units of final velocity should be m/s^2, not m/s

6. A student is asked to solve a problem: An object falls from a height for 2.0 s, at which point it is still 60 m above the ground. What will be the velocity of the object when it hits the ground? Which of the following provides the correct order of kinematic equations that can be used to solve the problem?
    a. Use $v^2 = v_0^2 + 2a(x - x_0)$, then use $v = v_0 + at$
    b. Use $v = v_0 + at$, then use $v^2 = v_0^2 + 2a(x - x_0)$
    c. Use $x = x_0 + v_0t + \frac{1}{2}at^2$, then use $v = v_0 + at$
    d. Use $v = v_0 + at$, then use $x = x_0 + v_0t + \frac{1}{2}at^2$

7. Four bicyclists travel different distances and times along a straight path. Which cyclist traveled with the greatest average speed?
    a. Cyclist 1 travels 95 m in 27 s
    b. Cyclist 2 travels 87 m in 22 s
    c. Cyclist 3 travels 106 m in 26 s
    d. Cyclist 4 travels 108 m in 24 s

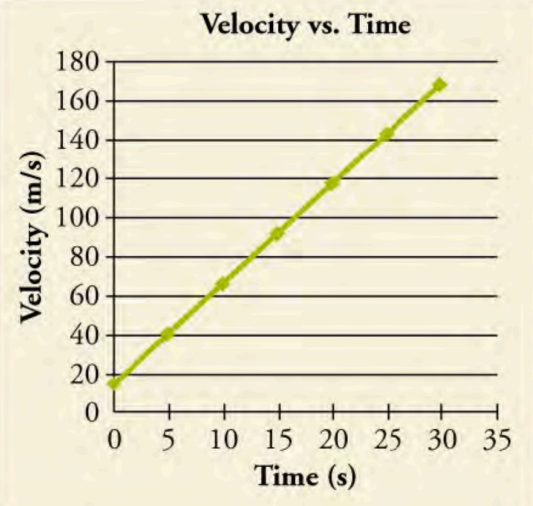
8. If a car decelerates from 20 m/s to 15 m/s in 5 s, what is Δv?
    a. −5 m/s
    b. −1 m/s
    c. 1 m/s
    d. 5 m/s

9. A circus clown is catapulted straight up in the air. The catapult is 1.5 m off the ground level. If his velocity as he leaves the catapult is 4 m/s, how high does he get, as measured from the ground?
    a. 0.4 m
    b. 0.8 m
    c. 1.9 m
    d. 2.3 m

10. Swimming one lap in a pool is defined as going across a pool and back again. If a swimmer swims 3 laps in 9 minutes, how can his average velocity be zero?
    a. Because his total distance is zero
    b. Because his total displacement is zero
    c. Because the number of laps is an odd number
    d. Because the velocity of each successive lap is equal and opposite

11. Maud sends her bowling ball straight down the center of the lane, getting a strike. The ball is brought back to the holder mechanically. What are the ball's net displacement and distance traveled?
    a. Displacement of the ball is twice the length of the lane, while the distance is zero
    b. Displacement of the ball is zero, while the distance is twice the length of the lane
    c. Both the displacement and distance for the ball are twice the length of the lane
    d. Both the displacement and distance for the ball are equal to zero

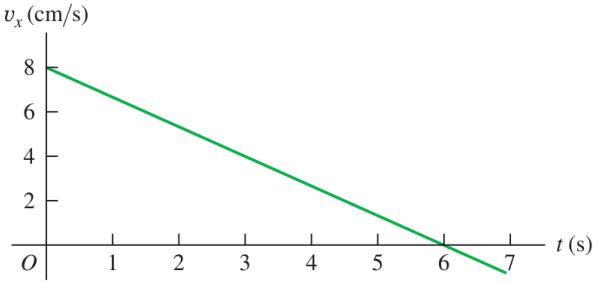
12. Given the velocity vs. time graph, which of these correctly describes the object's speed?
    a. The object is speeding up
    b. The object is not speeding up
    c. The object's speed is constant
    d. The object's speed is increasing then decreasing



13. Using the same graph, which of these best describes the appearance of an acceleration vs. time graph for this object?
    a. A horizontal line at some positive value
    b. A horizontal line at some negative value
    c. A diagonal line with a positive slope
    d. A diagonal line with a negative slope

14. Using the same graph, what is the object's average velocity?
    a. 18 m/s
    b. 84 m/s
    c. 93 m/s
    d. 168 m/s

15. A cat walks in a straight line, which we shall call the x-axis, with the positive direction to the right. As an observant physicist, you make measurements of this cat's motion and construct a graph of the feline's velocity as a function of time. What is the cat's acceleration at $t = 3.0$ s?
    a. 0 cm/s^2
    b. 8 cm/s^2
    c. 4/3 cm/s^2
    d. $-4/3$ cm/s^2

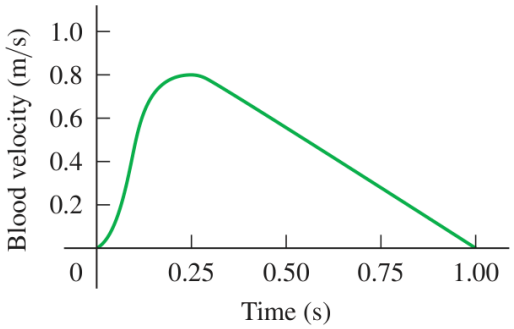


3. Problem solving

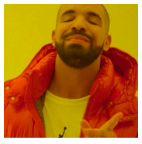
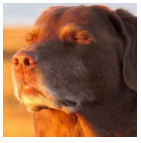
Blood flow in the heart. The human circulatory system is closed—that is, the blood pumped out of the left ventricle of the heart into the arteries is constrained to a series of continuous, branching vessels as it passes through the capillaries and then into the veins as it returns to the heart. The blood in each of heart's four chambers comes briefly to rest before it is ejected by contraction of heart muscle.

1. If the contraction of the left ventricle lasts 250 ms and the speed of blood flow in the aorta (the large artery leaving the heart) is 0.80 m/s at the end of the contraction, what is the average acceleration of a red blood cell as it leaves the heart?
    a. 310 m/s^2
    b. 31 m/s^2
    c. 3.2 m/s^2
    d. 0.32 m/s^2

2. The velocity of blood in the aorta can be measured directly with ultrasound techniques. A typical graph of blood velocity versus time during a single heartbeat is shown in the figure. Which statement is the best interpretation of this graph?
    a. The blood flow changes direction at about 0.25 s
    b. The speed of the blood flow begins to decrease at about 0.10 s
    c. The acceleration of the blood is greatest in magnitude at about 0.25 s
    d. The acceleration of the blood is greatest in magnitude at about 0.10 s



3. **Vibe check**. How was the exam?

a. 
b. 
c. 
d.(draw here)