Name: _____ **Date:** _____ **Period:** _____

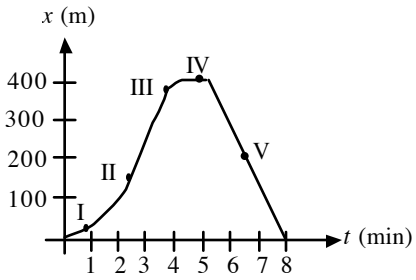
AP Physics C
Linear Motion HO1

1.) Starting from a pillar, you run 200 m east (the +*x*-direction) at an average speed of 4.0 m/s, then run 280 m west at an average speed of 7.0 m/s to a post. Calculate your (2-6)

a.) average speed from pillar to post

b.) average velocity from pillar to post

2.) Rat leaves her house and walks along the sidewalk toward campus. After 5 minutes it starts to rain, and she returns home. Her distance from her house as a function of time is shown below. At which of the labeled points is her velocity (2-8)



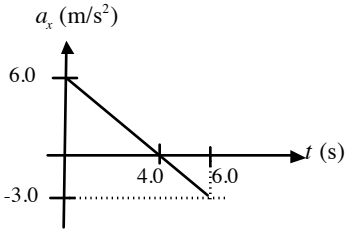
a.) zero?

b.) constant and positive?

c.) constant and negative?

d.) increasing in magnitude?

e.) decreasing in magnitude?

3.) 

At $t = 0$, a particle is located at $x = 25$ m and has a velocity of 12 m/s in the positive x direction. The acceleration of the particle varies with time as shown in the diagram to the left. What is the velocity of the particle at $t = 6.0$ s?

4.) An antelope moving with constant acceleration covers the distance between two points that are 80 m apart in 7.00 s. Its speed as it passes the second point is 15.0 m/s. (2-19)

a.) What is its speed at the first point?

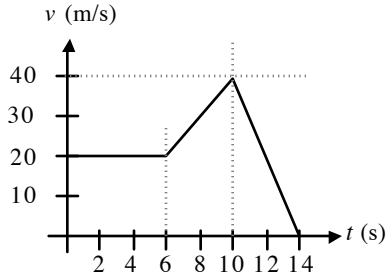
b.) What is the acceleration?

5.) An airplane travels 420 m down the runway before taking off. It starts from rest, moves with constant acceleration, and becomes airborne in 16.0 seconds. What is it speed when it takes off? (2-22)

6.) A hot-air balloonist, rising vertically with a constant velocity of 5.00 m/s, releases a sandbag at an instant when the balloon is 40 m above the ground. After it is released, the sandbag is in free fall. (UP 2-42)

a.) Find the position and velocity of the sandbag at 0.500 s and 2.00 s after it is released.

b.) What is the velocity of the sandbag when it strikes the ground?

7.) 

The graphs to the left shows the velocity of a car as a function of time. (UP 2-23)

a.) Find the instantaneous acceleration at $t = 3$ s, 7s, and t = 11 s.

b.) How far does the car travel in the first 5 s? The first 10 s? The first 14 s?

8.) At $t = 0$ a car is stopped at a traffic light. When the light turns green, the car starts to speed up and gains speed at a constant rate until it reaches a speed of 20 m/s eight seconds after the light turns green. The car continues at a constant speed for 40 m. Then the driver sees a red light and starts slowing down at a constant rate. The car stops at the red light, 180 m from where it was at $t = 0$. Draw accurate *x-t*, *v-t*, and *a-t* graphs for the motion of the car. (2-26)

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AP Physics C
1-D Motion HO2

1.) A train starts from rest and accelerates uniformly, until it has traveled 3.0 km and reached a velocity of 24 m/s. The train then moves at a constant velocity of 24 m/s for 430 s. The train then decelerates uniformly at 0.065 m/s^2, until it is brought to a stop.

a.) Find the acceleration of the train during the first 3.0 km of travel.

b.) Find the distance traveled by the train during deceleration.

c.) Find the velocity of the train, when it has decelerated for 160 s.

d.) Find the average velocity for the entire motion of the train.

2.) A car moving at a velocity 20 m/s is behind a truck moving at a constant velocity of 18 m/s. When the car is 50 m behind the front of the truck, the car accelerates uniformly at 1.8 m/s^2. The car continues at the same acceleration until it reaches a velocity of 25 m/s and continues at this velocity until it passes the front of the truck.

a.) Find the distance the car travels while accelerating.

b.) Find the time interval from the point that the car reaches 25 m/s until it passes the truck.

3.) A ball is projected upward at time $t = 0.0$ s, from a point on a roof 30 m above the ground. The initial velocity of the ball is 24.5 m/s.

a.) At time $t = 2.50$ s, what is the acceleration of the ball?

b.) At time $t = 2.50$ s, what is the velocity of the ball?

c.) Find the average velocity of the ball during the first 4.0 s.

d.) Find the velocity of the ball when it is 24 m above the ground.

e.) Find the time that the ball strikes the ground.

4.) A toy rocket is launched vertically from the ground. The rocket engine provides constant upward acceleration during the burn phase. At the instant of engine burnout, the rocket has risen to 68 m and acquired a velocity of 30 m/s. The rocket continues to rise in nonpowered flight, reaches maximum height, and falls back to the ground.

a.) Find the upward acceleration of the rocket during the burn phase.

b.) Find the maximum height reached by the rocket.

c.) Find the time interval during which the rocket is in nonpowered flight.

d.) Find the speed of the rocket just before it strikes the ground.

5.) A typical world-class sprinter accelerates to his maximum speed in 4.0 s. If such a runner finishes a 100 m race in 9.1 s, what is the runner's average acceleration during the first 4.0 s? (UP 2-51)

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AP Physics C
Linear Motion HO3

1.) A car's velocity as a function of time is given by $v(t) = a + bt^2$, where $a = 3.00$ m/s and $b = 0.200$ m/s^3. (2-14)

a.) Calculate the average acceleration for the time interval $t = 0$ to $t = 5.00$ s.

b.) Calculate the instantaneous acceleration at $t = 8$ s, 13s, and 15 s.

2.) The position of a car is given by $x = 3.42$ m + (0.600 m/s^2)t^2 – (0.100 m/s^6)t^6. Find its position and acceleration at the instants when the car has zero velocity. (2-16)

3.) The position of a particle moving along the x-axis is given by $x = (21 + 22t - 6.0t^2)$ m, where t is in seconds. What is the average velocity during the time interval $t = 1.0$ s to $t = 3.0$ s?

4.) The position of a particle moving along the x-axis is given by $x = (2.0t^3 - 6.0t^2 + 4.0)$ m, where t is in seconds. What is the average acceleration during the time interval $t = 1.0$ s to $t = 3.0$ s?

5.) A particle moving along the x-axis has a position given by $x = (24t - 2.0t^3)$ m, where t is measured in seconds. What is the magnitude of the acceleration of the particle when the particle is not moving?

6.) A particle confined to motion on the x-axis moves with constant acceleration from $x = 2.0$ m to $x = 8.0$ m during a 2.5 s time interval. The velocity of the particle at $x = 8.0$ m is 2.8 m/s. What is the acceleration during this time interval?

7.) The acceleration of a bus is given by $a = \alpha t$, where $\alpha = 1.5$ m/s^3. (UP 2-46)

a.) If the bus's velocity at time $t = 1.0$ s is 5.0 m/s, what is its velocity at time $t = 2.0$ s?

b.) If the bus's position at time $t = 1.0$ s is 6.0 m, what is its position at time $t = 2.0$ s?

8.) The acceleration of a motorcycle is given by $a = At - Bt^2$, where $A = 1.20$ m/s^3 and $B = 0.120$ m/s^4. It is at rest at the origin at time $t = 0$. (UP 2-47)

a.) Find its position and velocity as functions of time.

b.) Calculate the maximum velocity it attains.

9.) An object's velocity is measured to be $v(t) = \alpha - \beta t^2$, where $\alpha = 5.00$ m/s and $\beta = 2.00$ m/s^3. At $t = 0$ the object is at $x = 0$. (UP 2-64)

a.) Calculate the object's position and acceleration as functions of time.

b.) What is the object's maximum *positive* displacement from the origin?

10.) a.) If a flea can jump straight up to a height of 0.520 m, what is its initial speed as it leaves the ground?

b.) For how much time is it in the air? (UP 2-35)