Name: Key

Linear Motion Test, Physics Spring 2013

Short Answer

1. What is the typical meaning of an algebraic sign (+ or -) in physics?

   Typically algebraic sign indicates direction.

2. What's the difference between speed and velocity?

   Speed is a scalar (magnitude only) and velocity is a vector (magnitude & direction).

3. How does one define acceleration? (Write a sentence using words—not an equation. Be specific!)

   Acceleration is the rate at which velocity changes.

4. Complete the table with either the words "increasing speed" or "decreasing speed:"

Velocity Direction	Acceleration Direction	Object is…
(+)	(+)	Increasing Speed
North	South	Decreasing Speed
Down	Down	Increasing Speed
(-)	(+)	Decreasing Speed

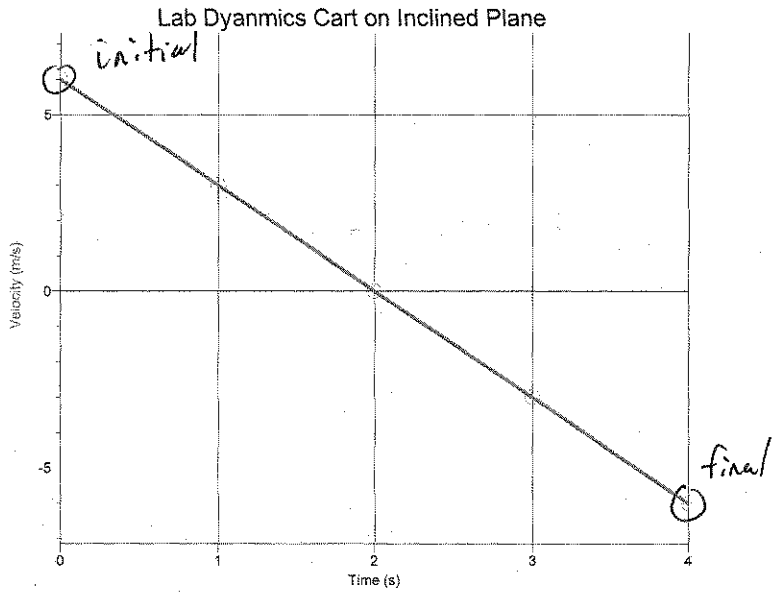
5. A ball is thrown upward with some speed. At the top of its path the velocity of the ball is 0

   At the top of its path, the acceleration of the ball is $-9.80 m/s^2$

   At the top of its path, the acceleration vector points down (what direction if any)

   On the way up and on the way down, the acceleration vector direction *changes* / (*remains the same*) (circle one)

6. Below is a velocity-time graph for a dynamics cart that is moving along an inclined plane (ramp).



$\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{\text{rise}}{\text{run}}$

$\frac{y_f - y_i}{x_f - x_i} = \frac{(-6\,m/s) - (+6\,m/s)}{4s - 0s}$

$= \frac{-12\,m/s}{4s}$

$= -3\,m/s^2$

a. At time = 0s, what is the cart's velocity? $+6\,m/s$

b. At time = 4s, what is the cart's velocity? $-6\,m/s$

c. Does the cart ever change direction? When? yes at 2s.

d. What is the cart's velocity at 1.0 second? $+3\,m/s$

e. What is the cart's *acceleration* at 2.0 seconds?

slope indicates acceleration on this type of graph... $\vec{a} = -3\,m/s^2$

f. Assuming it started from a position of zero, find the cart's displacement after 2.0 seconds.

$\vec{v}_{AVE} = \frac{\Delta \vec{x}}{t}$ or $\Delta \vec{x} = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

$\Delta x = (+6\,m/s)(2.0s) + \frac{1}{2}(-3\,m/s^2)(2s)^2$

$12 + -6 = +6m$

Puzzles

7. An automobile cruising at 10.0 m/s accelerates uniformly at 2.50 m/s^2. What is the final speed after 3.75 seconds?

G.U.

$v_0 = +10.0\,m/s$

$v_f = ?$

$v_{AVE} =$

$\Delta x =$

$a = +2.50\,m/s^2$

$t = 3.75s$

E.

$a = \frac{v_f - v_0}{t}$

$(3.75)\,2.5 = \frac{v_f - 10}{3.75}\,(3.75$

$(2.5)(3.75) = v_f - 10$

$9.375 = v_f - 10$

$+10 \quad +10$

19.4 m/s

Speed: 19.4 m/s

$v_0 = 0$

8. A radio blaring *Lady Gaga* is dropped from a balcony 32.5 meters above the sidewalk. How fast is the radio traveling when it hits the ground and how much time elapses before the *Lady* is silenced?

G.U.

$\vec{v}_0 = 0$

$\vec{v}_f = ?$

$\vec{v}_{AVE} =$

$\vec{a} = -9.80 m/s^2$

$\Delta\vec{x} = -32.5m$

$t = ?$

E.

$\vec{v}_f^2 = \vec{v}_0^2 + 2\vec{a}\Delta\vec{x}$

Sub.

$v_f^2 = 0 + 2(-9.8)(-32.5)$

Solve

$\sqrt{v_f^2} = \sqrt{637}$

$v_f = 25.23885\ldots$

$25.2 m/s$ (3 s.f.)

E.

$\Delta\vec{x} = \vec{v}_0 t + \frac{1}{2}\vec{a}t^2$

Sub

$-32.5 = 0t + \frac{1}{2}(-9.8)(t^2)$

$\frac{-32.5}{-4.9} = \frac{-4.9t^2}{-4.9}$

$\sqrt{6.632\ldots} = \sqrt{t^2}$

$t = 2.575393837\ldots s$

Speed at impact: 25.2 m/s

Time: 2.58 s

9. An airplane has a liftoff speed of 30.5 m/s. What minimum acceleration does this require if the airplane starts at rest and is airborne after a takeoff run of 250m?

G.U.

$v_0 = 0$

$v_f = +30.5 m/s$

$v_{AVE} =$

$a = ?$

$\Delta x = +250m$

$t =$

E.

$\vec{v}_f^2 = \vec{v}_0^2 + 2\vec{a}\Delta\vec{x}$

Sub

$(30.5)^2 = 0^2 + 2(a)(250)$

Solve

$\frac{930.25}{500} = \frac{500(a)}{500}$

$a = 1.8605 m/s^2$

(2 s.f.)

2 s.f.

Acceleration: $1.9 m/s^2$

10. A Piper Tomahawk two-seater plane lands at 64 m/s and accelerates uniformly as it comes to rest. If the plane takes 8.0 s to stop, what is the plane's average speed, and how far does it travel as it stops?

G.U.

$\vec{v}_0 = 64 m/s$

$\vec{v}_f = 0$

$\vec{v}_{AVE} = ?$

$\vec{a} =$

$\Delta\vec{x} = ?$

$t = 8.0 s$

E

$\vec{v}_{AVE} = \frac{\vec{v}_0 + \vec{v}_f}{2}$

Sub.

$v_{AVE} = \frac{0 + 64 m/s}{2}$

Solve

$v_{AVE} = 32 m/s$

E.

$\vec{v}_{AVE} = \frac{\Delta\vec{x}}{t}$

Sub.

$32 m/s = \frac{\Delta x}{8s}$

Solve

$(8s)\ 32 m/s = \frac{\Delta x}{8s}(8s)$

$256m = \Delta x$

(2 s.f.)

Average Speed: 32 m/s

Distance: 260m