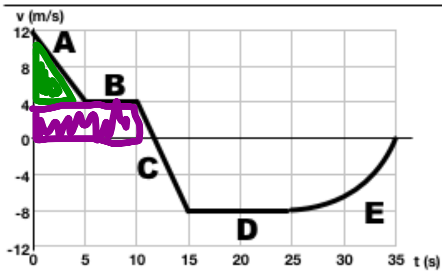
Cycle 15 Motion Assessment

Review - Basics



1. a) Region(s) with positive accel: E

b) Region(s) with negative accel: A C

c) Region(s) with zero accel: B D

d) Region(s) with non-constant accel: E

e) Region(s) where the object moves leftward: A B & part of C

f) Regions(s) where the object moves rightward: D E & part of C

g) Calculate the acceleration of region A.

accel = slope; For A: rise = -8 m/s; run = 5 s

accel = rise/run = -8/5 = $\boxed{-1.6 \text{ m/s/s}}$

h) Calculate the total change in position from t = 0 to t = 10 s.

Δx = area

green triangle = 1/2 bh = 1/2 (5s)(8m/s) = 20 m

purple rectangle = bh = (10s)(4m/s) = 40 m

total = 20 m + 40 m = $\boxed{60 \text{ m}}$

2. The vehicle starts at 2 m/s and accelerates at 8 m/s/s for 5 seconds.

a) Calculate the change in position.

vi = 2 m/s; a = 8 m/s/s; t = 5 s; Δx = ?

$\Delta x = (vi)t + 1/2\ a\ t^2$

$= (2)(5) + 1/2(8)(5^2) = \boxed{110 \text{ m}}$

b) Calculate the final velocity.

vi = 2 m/s; a = 8 m/s/s; t = 5 s; vf = ?

vf = vi + at

$= (2) + (8)(5) = \boxed{42 \text{ m/s}}$

3. A ball is thrown straight upward. Assume that gravity is the only force acting.

Which regions have positive velocity?
- ✔ On the way up.
- ☐ At the top.
- ☐ On the way down.

Which regions have positive accel?
- ☐ On the way up.
- ☐ At the top.
- ☐ On the way down.

none!

Which regions have negative velocity?
- ☐ On the way up.
- ☐ At the top.
- ✔ On the way down.

Which regions have negative accel?
- ✔ On the way up.
- ✔ At the top.
- ✔ On the way down.

Which regions have zero velocity?
- ☐ On the way up.
- ✔ At the top.
- ☐ On the way down.

Which regions have zero accel?
- ☐ On the way up.
- ☐ At the top.
- ☐ On the way down.

none!

Review - Deeper

4. Vehicle 1 is moving at a constant velocity of 27 m/s. At a moment when the two cars are 60 m apart, Vehicle 2 begins accelerating at 6 m/s/s from rest.

a) When does Vehicle 1 pass Vehicle 2?

1	2
xi = 0 m	xi = 60 m
vi = 27 m/s	vi = 0
a = 0	a = 6 m/s^2

$x = x_i + (v_i)t + 1/2\ a\ t^2$

$x = 0 + 27t + 0$ $\quad x = 60 + 0 + 1/2\ (6)t^2$

$27t = 60 + 3t^2$

$0 = 3t^2 - 27t + 60$ Quad. form. > t = $\boxed{4s}$ or 5 s

b) At what position does Vehicle 1 pass Vehicle 2?

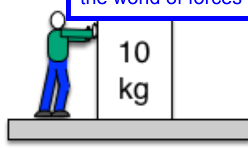
Plug the time into either position equation.

$x = 27t$

$x = 27(4)$

$x = \boxed{108\ m}$

You need acceleration - that is the connection between the world of forces and the world of motion.



accel = slope = 1 m/s/s

5. The person pushes the 10 kg box against friction. The box's velocity graph is shown above.

Make up applied a... with the graph and y-direction as well. ...ld be compatible ...orces acting in the

Remember that on... with labels.

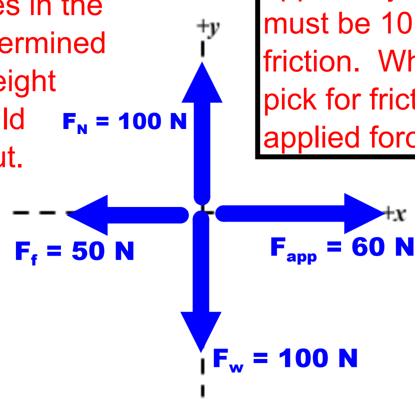
accel = Fnet/mass

1 m/s/s = Fnet/(10 kg)

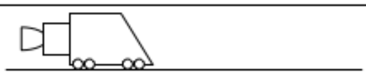
Fnet = 10 N

That means that the force applied by the person must be 10 N bigger than friction. Whatever you pick for friction, make the applied force 10 N bigger!

The forces in the y-are determined by the weight and should cancel out.



Review - Deeper



6. A rocket car has been designed to produce an acceleration of 15 m/s/s. Your lab has been contracted to verify that the car actually produces that acceleration.

a) What quantities would you measure?

Pick an equation of kinematics that includes accel. The other variables will tell you what to measure.

b) What measuring devices would you use to measure each of those quantities? (No accelerometers are available.)

Velocities could be measured using a radar gun (commonly used by the police).

Distances could be measured with a metric measuring tape.

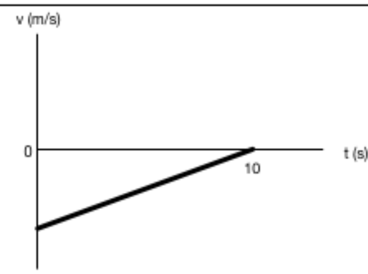
Times could be measured with a hand-timer.

c) How would you minimize error?

Doing multiple trials and taking an average is what we usually do.

c) How would you calculate the acceleration from those quantities? (Show how with sample data.)

Make up numbers and put them in the equation of kinematics you chose and solve.



7. A toy's velocity vs time graph for the x-direction is shown above, ending at t = 10 s.

a) If you were watching this toy, how would you describe its motion?

Moving to the left (velocity is negative), but slowing down to a stop (velocity is moving toward zero).

b) If you knew that the toy moved 1 meter during the 10 seconds, what quantity or quantities could you calculate? Calculate it/them.

First of all it was moving to the left, so $\Delta x = -1$ m.

Since $\Delta x =$ area, the area of the triangle must be -1.

That means we can get vi (the y-intercept).

1/2 bh = Δx

1/2 (10)(vi) = -1

vi = -0.2 m/s

Now we can get the accel (slope) since we have the start and end velocities and time:

accel = slope = rise/run = (10 m/s)/(10 s)

accel = +0.02 m/s/s

(note that it is positive: an up-slope.)