ABRHS PHYSICS (CP) NAME: KEY

Linear Motion II Exam Review (CP)

1. A car traveling at 6 m/s is uniformly accelerated at a rate of 3 m/s² for 15 seconds.
   a. What is the car's final velocity?

$v_i = 6$ m/s, $a = 3$ m/s², $t = 15$ s

$v_f = at + v_i$

$v_f = (3)(15) + 6$

$v_f = 45 + 6$

$v_f = 51$ m/s

   b. How far does the car travel during this time?

$d = \frac{1}{2}at^2 + v_i t$

$d = \frac{1}{2}(3)(15)^2 + (6)(15)$

$d = 337.5 + 90$

$d = 427.5$ m

   c. After the car reaches its final speed (part a.) it begins to slow down and comes to rest in 1 minute. What is the car's acceleration as it comes to rest?

Now: $v_i = 51$ m/s, $v_f = 0$ m/s, $t = 1$ min $= 60$ s

$a = \frac{v_f - v_i}{t} = \frac{0 - 51}{60}$

$a = -0.85$ m/s²

2. What acceleration is necessary for a boat to increase its speed from 13 m/s to 26 m/s over a distance of 1.25 km? Is this acceleration positive or negative? Explain.

$v_i = 13$ m/s, $v_f = 26$ m/s, $d = 1.25$ km $= 1250$ m

① $\bar{v} = \frac{v_i + v_f}{2} = \frac{13 + 26}{2}$

$\bar{v} = 19.5$ m/s

② $\bar{v} = \frac{d}{t}$

$19.5 = \frac{1250}{t}$

$t = 64.1$ s

③ $a = \frac{v_f - v_i}{t}$

$= \frac{26 - 13}{64.1}$

$a = 0.2$ m/s²

its + (it sped up going forwards)

3. A car traveling at 8 m/s slows to a stop in 5 seconds. How far does the car travel over this time interval? What was the car's acceleration?

$v_i = 8$ m/s, $v_f = 0$ m/s, $t = 5$ s

① $a = \frac{v_f - v_i}{t}$

$a = \frac{0 - 8}{5} = -1.6$ m/s²

② $d = \frac{1}{2}at^2 + v_i t$

$= \frac{1}{2}(-1.6)(5)^2 + (8)(5)$

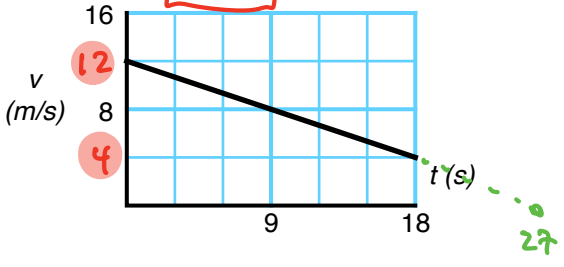
$= -20 + 40 = 20$ m

② OR $\bar{v} = \frac{v_i + v_f}{2} = \frac{8 + 0}{2} = 4$ m/s

$d = \bar{v}t = (4)(5)$

$d = 20$ m

4. The velocity graph for a truck is shown in the graph to the right.



   a. Describe the motion in words.

An object has an initial velocity of 12 m/s, and slows to a final velocity of 4 m/s in a time of 18 s.

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b. What was the acceleration of the truck?

$a = \frac{v_f - v_i}{t} = \frac{4-12}{18} = -0.44\ m/s^2$

Notice it is the SLOPE of the line!

c. How far did the truck travel in the time shown?

$d = \frac{1}{2}at^2 + v_i t$

$= \frac{1}{2}(-.44)(18)^2 + (12)(18)$

$= -72 + 216 = 144\ m$

OR $\bar{v} = \frac{v_i + v_f}{2} = \frac{12+4}{2} = 8\ m/s$

$d = \bar{v}t = (8)(18) = 144\ m$

d. At what time would the truck finally stop (assuming it maintained the acceleration.)

So now $v_i = 12\ m/s$, $v_f = 0\ m/s$, $a = -0.44\ m/s^2$

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

$-0.44 = \frac{0-12}{t}$

$(-0.44)t = -12$

$t = \frac{-12}{-0.44}$

$t = 27.3\ s$

OR From Graph - look @ pattern! It will take 9 more seconds to reach 0 m/s.

5. A pebble is dropped from the top of a 12 m high bridge. How fast is the pebble moving when it hits the ground? How long does it take the pebble to hit the ground?

So $t = 27s$

$d = -12\ m$, $v_i = 0\ m/s$, $a = -10\ m/s^2$

① $d = \frac{1}{2}at^2 + v_i t$

$-12 = \frac{1}{2}(-10)t^2 + (0)t$

$-12 = -5t^2$

$t^2 = 2.4$

$t = 1.55\ s$

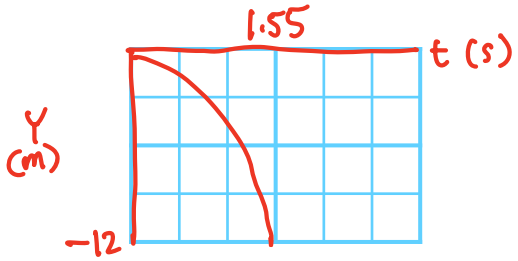
② $v_f = at + v_i$

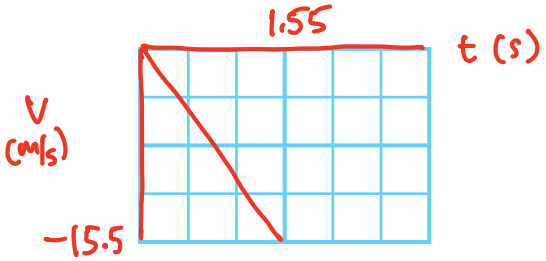
$v_f = (-10)(1.55) + 0$

$v_f = -15.5\ m/s$

This is actually the correct answer - the equation gave 27.3 because the acceleration was rounded!

6. Make the height and velocity graphs that correspond to the motion in question 5.





7. Akansha jumps into the air with a speed of 2.3 m/s. How high does she jump? How long is she in the air?

$v_i = 2.3\ m/s$, $a = -10\ m/s^2$

① @ Max Height $v = 0$!

So $v = at + v_i$

$0 = (-10)t + 2.3$

$10t = 2.3$

$t = 0.23\ s$

$d = \frac{1}{2}at^2 + v_i t$

$= \frac{1}{2}(-10)(.23)^2 + (2.3)(.23)$

$= -0.265 + 0.529$

$d = 0.265\ m$

OR $\bar{v} = \frac{v_i + v_f}{2} = \frac{2.3+0}{2} = 1.15\ m/s$

$d = \bar{v}t = (1.15)(.23) = 0.265m$

② Since time up = time down

total time is 0.23 + 0.23 = 0.46 s

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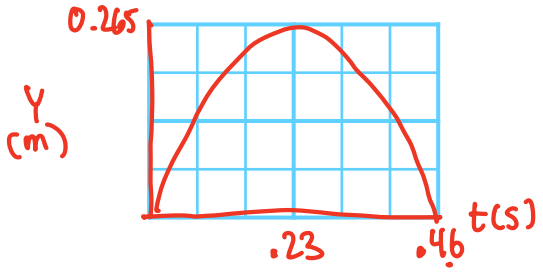
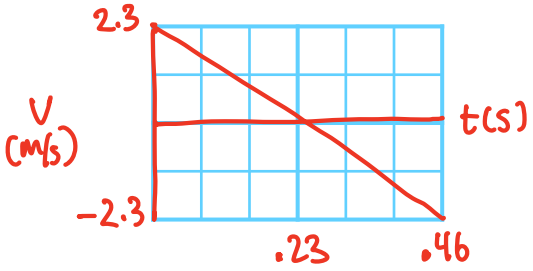
8. Make the height and velocity graphs that correspond to the motion in question 7.





9. Is it possible to have a constant acceleration and also have a velocity of 0? Explain.

Sure! If that were the case, you would be reversing your direction. Like a ball tossed - at its Max. Height its velocity is 0 m/s, but it is still accelerating because of gravity.

10. A pumpkin is thrown straight down from a height of 25 meters. It hits the ground in only 1.7 seconds.
    a. What was the initial velocity of the pumpkin?

$d = -25$ m
$t = 1.7$ s
$a = -10$ m/s^2

$d = \frac{1}{2}at^2 + v_i t$

$-25 = \frac{1}{2}(-10)(1.7)^2 + v_i(1.7)$

$-25 = -14.45 + (1.7)v_i$

$(1.7)v_i = -10.55$

$v_i = \frac{-10.55}{1.7}$

$v_i = -6.2$ m/s

    b. What was the velocity of the pumpkin just as it hits the ground?

$v_f = at + v_i$

$= (-10)(1.7) + (-6.2)$

$= -17 - 6.2$

$v_f = -23.2$ m/s

11. Imagine you throw a ball straight up in the air and catch it at the same height from which it was thrown.
    a. Compare the time it takes the ball to go up to the time it takes the ball to come down.

time up = time down

    b. Because the ball goes up and down, it will be at a particular height twice. Compare the speeds of the ball at those two different times.

Speeds would be the same

    c. Compare the velocities of the ball when it is at the same height.

But the velocities would be opposite (up = + and down = −)

    d. What is the speed of the ball at its maximum height?

0 m/s

    e. What is the velocity of the ball at its maximum height?

0 m/s

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f. What is the acceleration of the ball while going up?

$-10\ m/s^2$

g. What is the acceleration of the ball while coming down?

$-10\ m/s^2$

It's CONSTANT acceleration, which means the acceleration is ALWAYS $-10\ m/s^2$

h. What is the acceleration of the ball at its maximum height?

$-10\ m/s^2$

i. Was the velocity of the ball constant?

Nope!

j. Was the acceleration of the ball constant?

Yes - of course!

12. A ball is launched straight up and is in the air for a total of 3 seconds. How high does it go and with what speed was it launched?

$a = -10\ m/s^2$

$t_{(total)} = 3\ s$

① Since total time was 3 seconds, it took $\frac{1}{2}$ that time to reach the max. height.

So $t_{(up)} = 1.5\ s$

② $v = 0$ @ max height.

$v = at + v_i$

$0 = -10(1.5) + v_i$

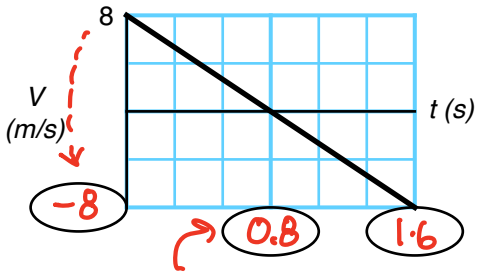
$v_i = 15\ m/s$

③ $d = \frac{1}{2}at^2 + v_i t = \frac{1}{2}(-10)(1.5)^2 + (15)(1.5) = 11.25m$ OR $\bar{v} = \frac{15+0}{2} = 7.5\ m/s$

$d = \bar{v}t = (7.5)(1.5)$

$d = 11.25m$

13. An object is tossed straight up in the air. Fill in the missing numbers on the graphs.



$v_i = 8\ m/s$

$a = -10\ m/s^2$

$v = 0\ m/s$ @ Max Height,

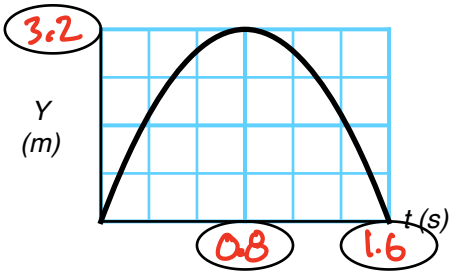
$v = at + v_i$

$0 = -10t + 8$

$t = 0.8\ s$

So total time =

$0.8 + 0.8 = 1.6\ s$



$d = \frac{1}{2}at^2 + v_i t$

$= \frac{1}{2}(-10)(.8)^2 + (8)(.8)$

$= -3.2 + 6.4$

$d = 3.2m$

or $\bar{v} = \frac{v_i + v_f}{2} = \frac{8+0}{2} = 4\ m/s$

$d = \bar{v}t = (4)(0.8) = 3.2\ m$

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14. An arrow is fired with an initial velocity of -30 m/s. It hits the ground in 0.7 seconds.
    a. What is the velocity of the arrow jst as it hits the ground?

$v_i = -30$ m/s
$a = -10$ m/s^2
$t = 0.7$ s

$v_f = at + v_i$

$v_f = (-10)(.7) + (-30) = -7 - 30$

$v_f = -37$ m/s

    b. From what height was the arrow fired?

$d = \frac{1}{2}at^2 + v_i t$

$= \frac{1}{2}(-10)(.7)^2 + (-30)(.7) = -2.45 - 21 = -23.45$ m

So the initial height was 23.5m

    c. What does the negative sign mean in the initial velocity?

It was going down.

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Answers:

1. a) 51 m/s b) 428 m c) -0.85 m/s^2
2) a = -.20 m/s^2; its positive because it is going forwards and speeding up
3) a = -1.6 m/s^2 & d = 20 m
4) t = 1.55 s & v = -15.5 m/s (so actually, its speed is 15.5 m/s)
5)
6) t = 0.46 s & d = 0.26 m
7)
8) Of course! But not a constant velocity of 0 – only at one point in time. This happens when something has been tossed up in the air – at its maximum height is velocity is 0, but it is still constantly accelerating because of gravity.
9. a) $t_{up} = t_{down}$ b) speeds the same (but opposite velocities) c) opposite
   d) 0 m/s e) 0 m/s f) -10 m/s^2 g) -10 m/s^2 h) -10 m/s^2 i) no j) yes
10) v_i = 15 m/s & d = 11.25 m