ABRHS PHYSICS (CP)

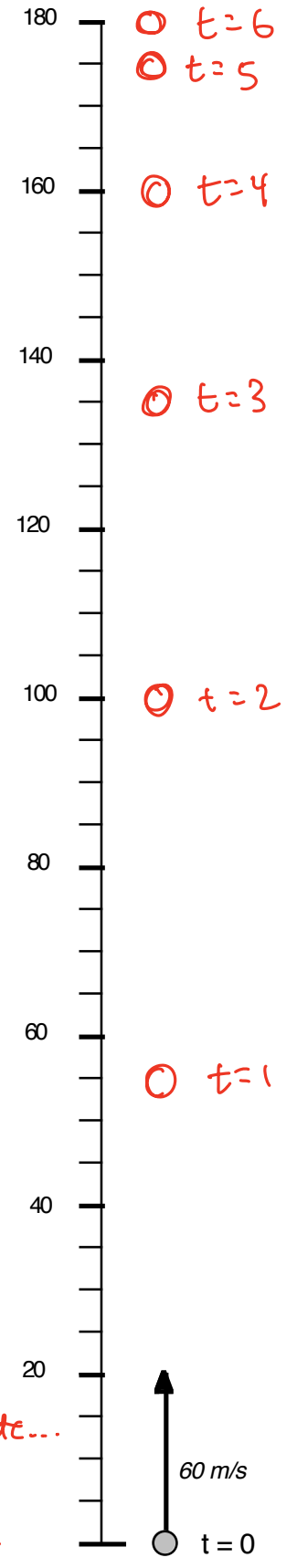
NAME: KEY

Ball Toss Concept Sheet

On the surface of the earth, the acceleration due to gravity is about 10 m/s^2. Ignoring air resistance, this means that the velocity of a falling object changes by about 10 m/s every second. On this sheet, you will calculate and draw the position of a ball that is tossed up in the air with an initial velocity of 60 m/s.

1. Calculate the velocity of the ball object for each second of its flight for the first 6 seconds. Record your answers in the column marked "Velocity." (Show your work below the chart.)
2. Calculate the height of the ball for each second. Record the answers in the "Height" column of the chart below. (Show your work below the chart.)
3. For each of the calculated values, draw a ball next to the appropriate height in the diagram. Label it with the appropriate time and speed. (The initial position is already done.)
4. Draw in arrows that could represent the velocity of the ball at each moment.
5. Answer the questions on the back of this sheet.

Time (s)	*Velocity (m/s)*	*Height (m)*
0	60	0
1	50	55
2	40	100
3	30	135
4	20	160
5	10	175
6	0	180



Velocities $V_f = at + V_i$

$V_i = 60\ m/s$

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

$t=1)\ V_f = (-10)(1) + 60 = 50$

$t=2)\ V_f = (-10)(2) + 60 = 40$

$t=3\ \ V_f = (-10)(3) + 60 = 30$

etc...

Distances (Height) $d = \frac{1}{2}at^2 + V_i t$

$t=1)\ d = \frac{1}{2}(-10)(1)^2 + (60)(1) = -5 + 60 = 55$

$t=2)\ d = \frac{1}{2}(-10)(2)^2 + (60)(2) = -20 + 120 = 100$

$t=3)\ d = \frac{1}{2}(-10)(3)^2 + (60)(3) = -45 + 180 = 135$

side 1

Ball Toss Concept Sheet

Questions:

1. What happened to the spacing between the balls as it got higher in the air? Explain why this happened.

   Got closer, because it was slowing down.

2. What do you think would have happened to the ball after the 6 seconds shown?

   It would have fallen back down

3. What will always be true about the speed of a tossed object when it is at its maximum height?

   $v = 0$ m/s @ maximum height.

4. For a ball tossed up with an initial speed of 60 m/s, how fast would it be going after 1.5 seconds?

   $v_f = at + v_i$ $\quad v_f = (-10)(1.5) + 60 = -15 + 60 =$ **45 m/s**

5. If the ball was thrown up with an initial speed of only 30 m/s, how high would it have gone?

   SEE BELOW!

   From the chart: $180 - 135 = 45$m [See below for calculation]

To answer the rest of these questions, you will also need your "Free Fall Concept Sheet." Compare the speeds and positions of the ball in the two diagrams.

6. When putting the two pictures next to each other, what do you notice about the positions of the ball?

   They are the same!

7. What do you notice about the speeds of the ball at each height?

   The same!

8. What would be true about the <u>velocities</u> of the ball at each height?

   Opposite! One is a positive velocity, the other is negative.

9. Why do you think I chose to start the ball toss with an initial speed of 60 m/s? (Hint: how do you think the two concept sheets are connected?)

   Because that was the <u>final</u> speed of the "Free Fall Concept" sheet.

10. Imagine you throw a ball up with some initial speed and then catch when it gets back to your hand
    a. How does the time it takes the ball to go up compare to the time it takes to fall back down?

       time up = time down

    b. What is true about the speed of the ball at its maximum height?

       $v = 0$ @ max height.

    c. What is true about the speed of the ball when it gets back to your hand?

       it will be the same as the initial speed – but opposite velocity!

Q5) If the ball had an initial velocity of +30 m/s, how high would it go?

$V_i = +30$ m/s

$a = -10$ m/s^2

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

$d = \frac{1}{2}(-10)t^2 + (30)t$??

Woops! Don't have time to max height.

So let's figure that out...

To find the time to get to the max height, we need another equation that has time in it. Our only choice is

$$V_f = at + V_i$$

But we seemingly don't know V_f .... until you realize that $V = 0$ @ Max height, so

$V_i = 30$ m/s

$a = -10$ m/s^2

$V_f = 0$ m/s

$$0 = (-10)t + 30$$

$$10t = 30$$

$$\boxed{t = 3 \text{ sec.}}$$

Now back to 1st equation:

$$d = \frac{1}{2}(-10)(3)^2 + (30)(3)$$

$$= -45 + 90$$

$$\boxed{d = 45 \text{ m}}$$