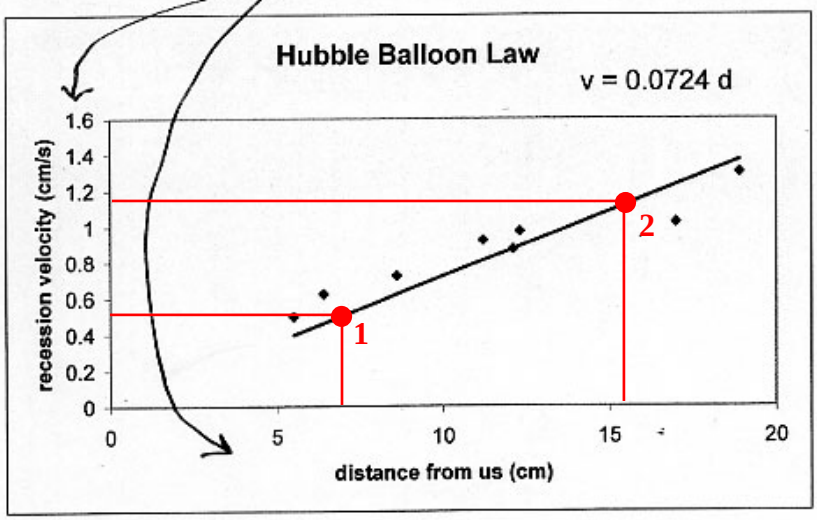
Hubble Law Lab — Answers

Hubble Balloon Lab

galaxy	initial distance	final distance	difference	velocity
-	[cm]	[cm]	[cm]	[cm/s]
1	13.7	18.9	5.2	1.3
2	11	15.5	4.5	1.125
3	8.4	12.3	3.9	0.975
4	5.7	8.6	2.9	0.725
5	3.9	6.4	2.5	0.625
7	3.5	5.5	2	0.5
8	8.6	12.1	3.5	0.875
9	12.9	17	4.1	1.025
10	7.5	11.2	3.7	0.925

time (s) 4



Slope = rise over run, so

$$H_o = \frac{v_2 - v_1}{d_2 - d_1} = 0.0724$$

1. What are the units of your Hubble Balloon Constant? Can you simplify them?

$$\frac{rise}{run} = \frac{(cm/s)}{cm} = \frac{cm}{s} \times \frac{1}{cm} = \frac{1}{s}$$

2. Calculate the age of your balloon universe. What assumptions must you make?
   age = $1/H_o$ = 1/.0724 = 13.8 seconds… assuming the expansion rate was constant the whole time.

3. You made a measurement on your balloon that is not possible for us to make in the real universe. What was it? How do we get around this problem in the real universe?

   We can't actually go back in time and measure the distances to galaxies in a younger universe, so "initial distance" is not a thing we can measure. But we only used that measurement to calculate the recession velocity for the galaxy, and that is a quantity we can measure *directly* in the real universe by looking for Doppler shift, so we don't need "initial distance"!