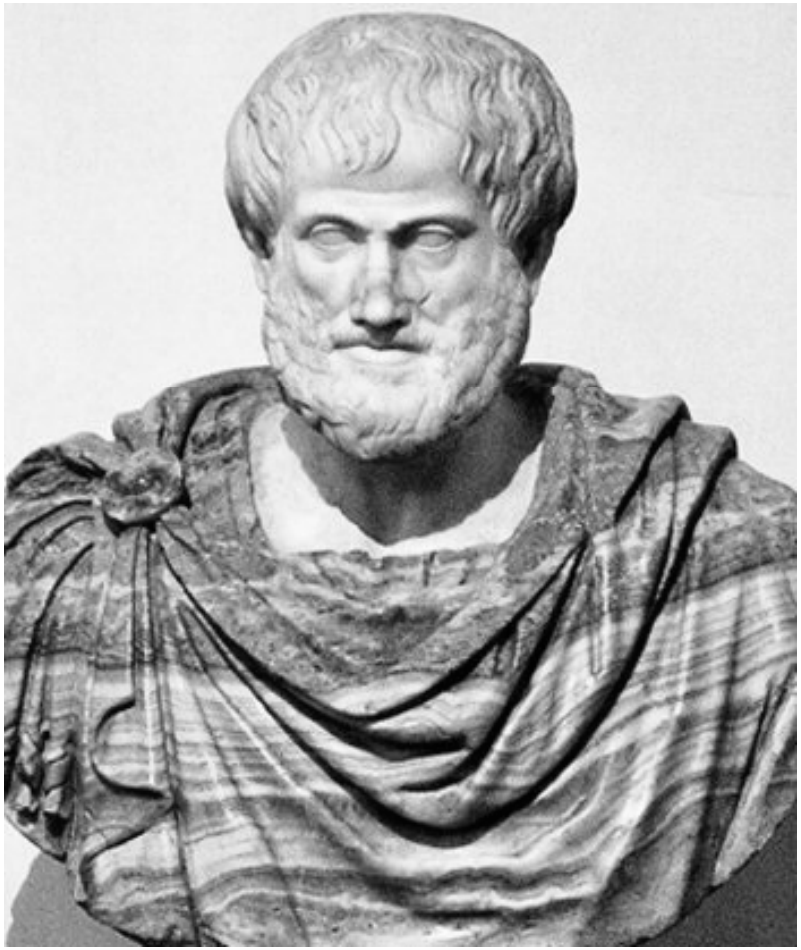
Free Falling…

Bodies in Free Fall

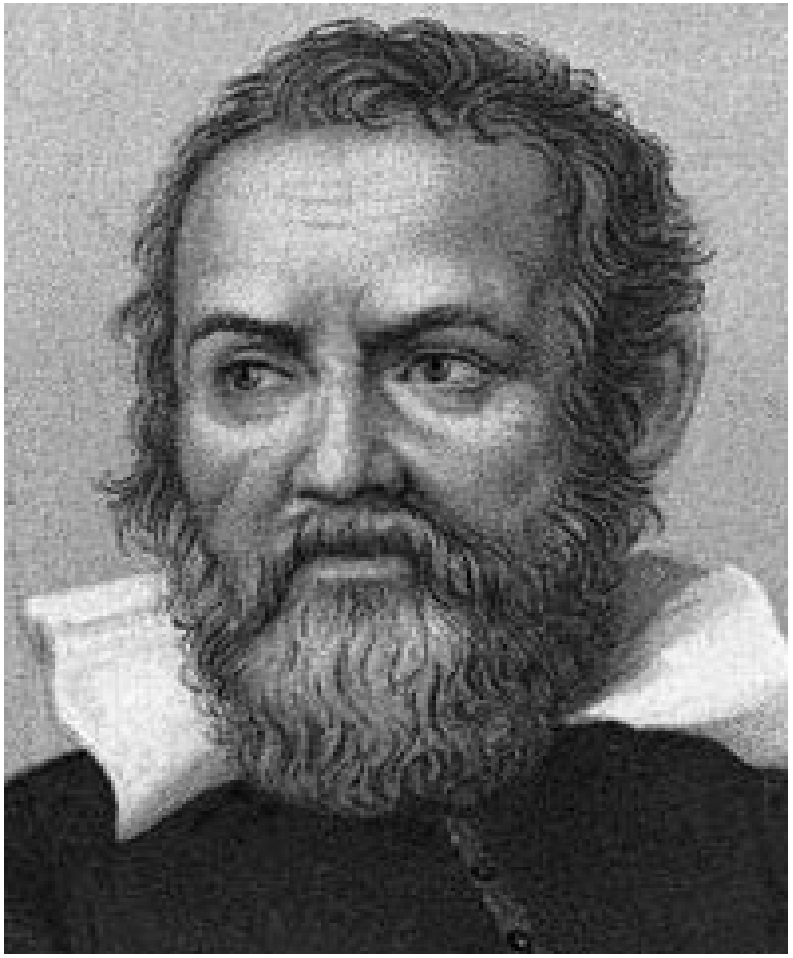
Two Different Ideas

- Aristotle (384 – 322 BC)
- Unchallenged for 2000 yrs, his theory says that **the speed of a falling object depends only on its mass and is constant.**
- Example: a 2 kg object falls faster that a 1 kg object.



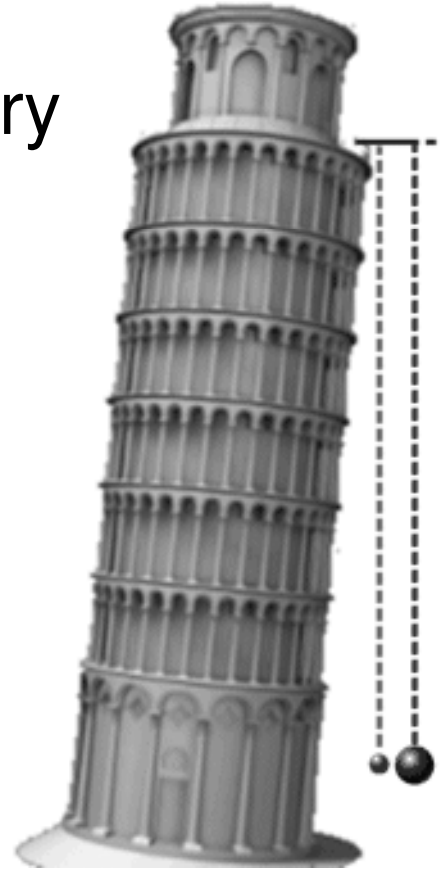
Galileo
“Father of Modern Science”

- Galileo (1564 -1642)
- Challenges Aristotle and says that objects do not fall at a constant rate but accelerate and the acceleration is independent of mass.
- Example a 2 kg object falls at the same rate as a 1 kg object.



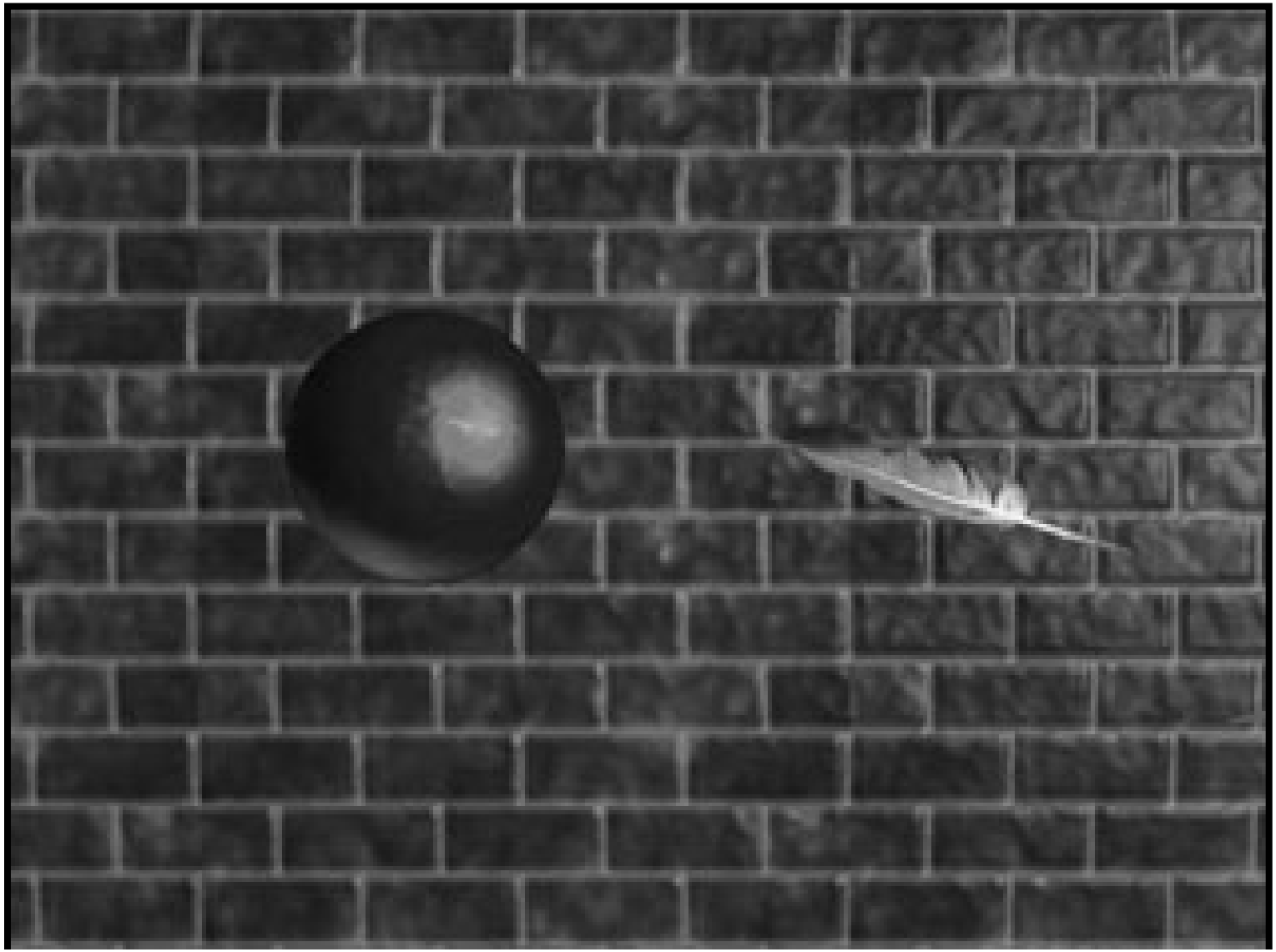
Who is Right and How do we know?

- Galileo did experiments to test his ideas. This was the first time anyone had proven an idea this way.
- He also disproved Aristotle's theory



We know that a feather cannot fall as fast as a rock.

So what is the problem here?

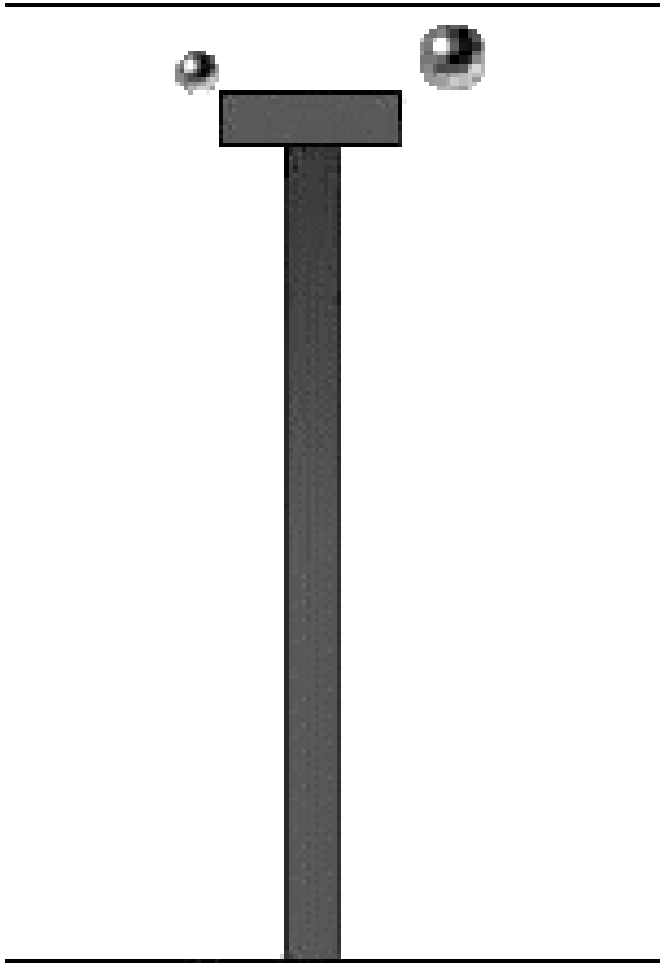


Demo Time

Dr. David Scott (an Apollo Astronaut) showed that a feather and hammer head could fall at the same rate on the moon on July 31 1972.

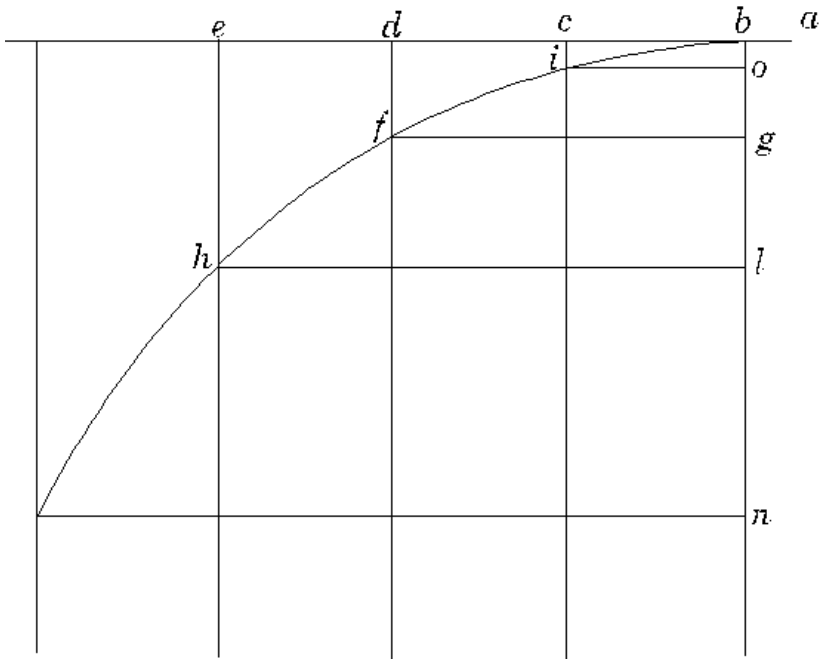
How come it works up there?

Dr. David Scott – Apollo 15.



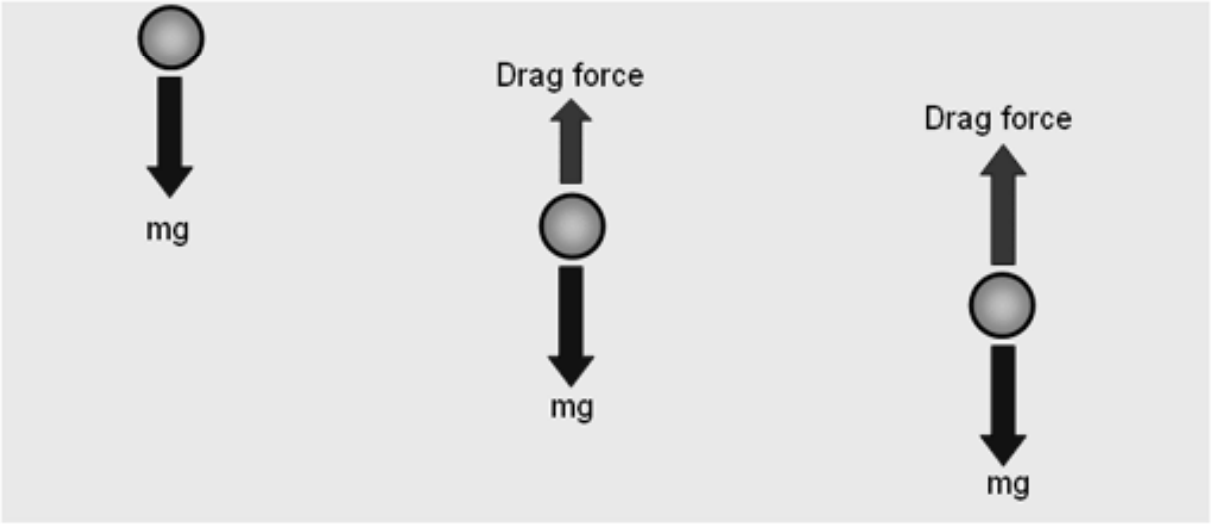
Ratios

- Galileo showed successfully that the distance a free falling body falls in successive time intervals is in the ratio of 1: 3: 5: 7: 9 …



Terminal Velocity

- What is terminal velocity and what effect does it have on a falling body?
- Can you think of a good example of terminal velocity?



Acceleration due to Gravity

- So what is the acceleration due to Gravity?
- Commonly accepted as (9.80 m/s^2)
- We will commonly use these equations to solve problems involving gravity

$$\Delta d = v_1 t + \frac{1}{2} a (\Delta t)^2$$

since $v_1 = 0$

$$\Delta d = \frac{1}{2} a (\Delta t)^2$$

or $$\Delta t = \sqrt{\frac{2\Delta d}{a_g}}$$

How far will an object have dropped?

- After 1 second?

$$\Delta d = (0.5)(9.80)(1)^2$$
$$\Delta d = 4.9m$$

- After 2 seconds?

$$\Delta d = (0.5)(9.80)(2)^2$$
$$\Delta d = 19.6m$$

- After 3 seconds?

$$\Delta d = (0.5)(9.80)(3)^2$$
$$\Delta d = 44.1m$$

- How long would it take a VW beetle to fall from a height of 5.26m to the ground floor?

  (which is the height of the purple railing outside)

Before calculating, estimate based on previous answers…

$$\Delta t = \sqrt{\frac{2\Delta d}{g}}$$

$$\Delta t = \sqrt{2(5.26)/9.80}$$

$$\Delta t = 1.036\text{s}$$

$$\text{t} = 1.04\text{s}$$

Black board examples

1. If it takes you 1.4 s to reach the the water from a 10 m platform, how fast will you go just before you enter the water

2. How far will you fall during a 5-second free fall?

What if…?

- What if an object has an initial velocity?
- Directions matter, so read carefully!
- If gravity is down then if the object is thrown down it must have the same sign as gravity.

Going Up…

Q1: If we throw a ball up with an initial velocity of 29.4 m/s how high will it go?

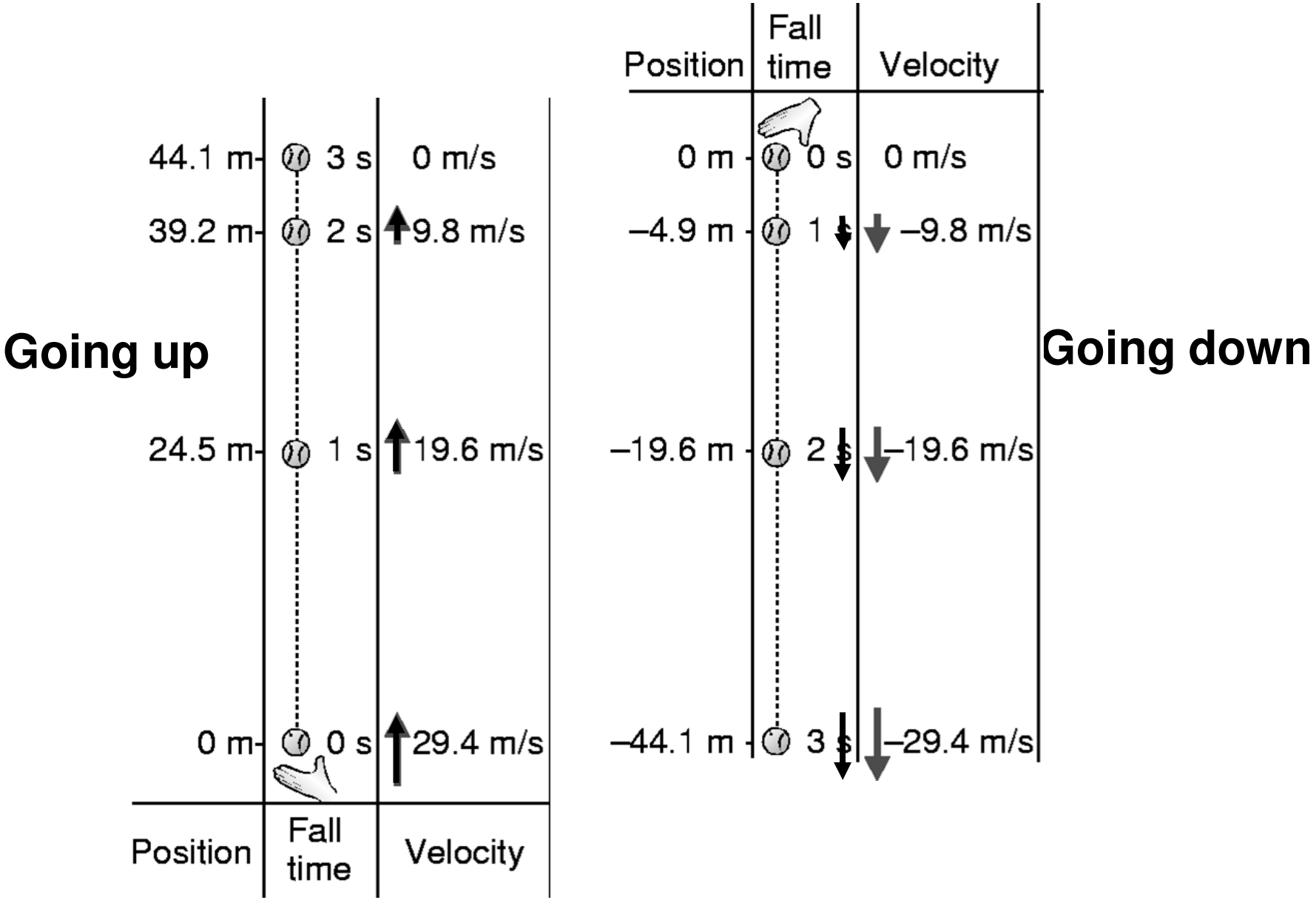
Q2: What will its velocity be at the to of its flight?

Q3: What is its acceleration be at the top of its flight?

Q4: What will its velocity be just before we catch again?

(assume we catch it at the same height)

Throwing a ball straight up and down



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- Do #9,11-15
- Mark them for next day, come prepared to ask questions.