Physics 102 – Spring 2011 – Recitation module 2

What role does aesthetics play in science?

Should aesthetics play a role in science?

Why is it, do you think, that mathematical theories such as Newtonian mechanics describe our world so well?

When a moving bus comes to a rapid stop, why is it the standing riders lurch toward the front of the bus?

When a rifle fires, it accelerates a bullet along the barrel. Why does the rifle recoil?

Since the law of inertia states that no force is needed to keep an object moving in a straight line at an unchanging speed, why is a force needed to keep a car mving?

What is the difference between mass and weight?

Would you rather have a hunk of gold that weighs one newton on Earth or one that weighs one Newton on the moon – or would it make no difference?

Why did many people find the Copernican heliocentric view of the universe very disturbing? What was it that they found disquieting?

Was the Copernican heliocentric view of the universe hailed as a great step forward by scientists when it was first put forth?

In what ways was the heliocentric view of the universe at odds with the ideas of the Church?

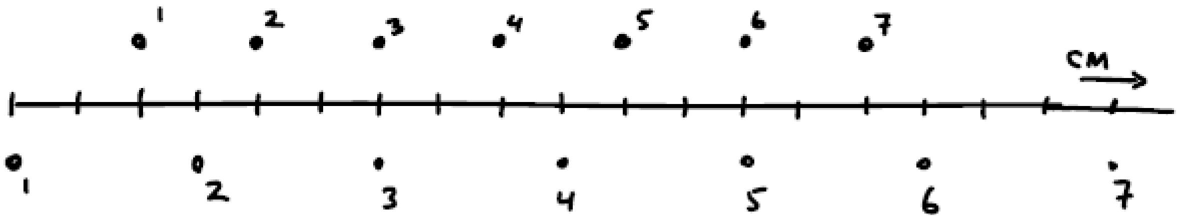
Consider two balls moving in one dimension along a ruler with marks every centimeter (cm) – not shown exactly to scale in the drawing. The position of each ball at the end of each of seven consecutive seconds is shown on the drawing below.

Are the balls accelerating?

How fast is the top ball moving?

How fast is the bottom ball moving?

At what time does the bottom ball pass the top ball?



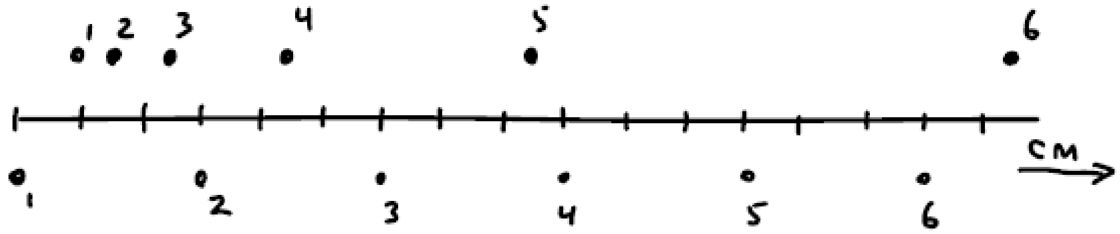
Consider two balls moving in one dimension along a ruler with marks every centimeter (cm) – not shown exactly to scale in the drawing. The position of each ball at the end of each of seven consecutive seconds is shown on the drawing below.

Are the balls accelerating?

How fast is the top ball moving?

How fast is the bottom ball moving?

Estimate the acceleration of the top ball.



The gravitational force of attraction between two objects with mass M and m, respectively, separated by distance r is

$$F = \frac{GMm}{r^2}$$

= Mass of M in kg (kilograms)

= Mass of m in kg

G = a constant that characterizes the strength of the gravitational force.

$$G = 6.67 \times 10^{-11} \frac{N\,m^2}{kg^2}$$

r = distance between centers of objects in m

If object $M = M_E$ is the earth and the other object is near earth's surface

This becomes $$F_{\text{on } m} = \frac{G M_E m}{R_E^2}$$

$M = M_E$ = Mass of Earth = 5.97×10^{24} kg

m = mass of object in kg

R_E = Radius of Earth = 6.38×10^{6} m

$$F = \frac{G M_E m}{R_E^2} = g m$$

CONSTANT called g, units of acceleration (m/s^2)

$$\underset{\text{Force}}{F} = \overset{\text{mass}}{m}\,\overset{\text{acceleration}}{a}$$ always ↳ from Newton's second law as we will see

g represents the acceleration of objects toward the center of the earth due to the gravitational force.

Your recitation leader will supply you with a photograph of a ball falling near the surface of the earth. In this photograph the flash emits light (strobes) every $1/30$ second. So images of the ball are recorded on the same frame every $1/30$ second as the ball falls.

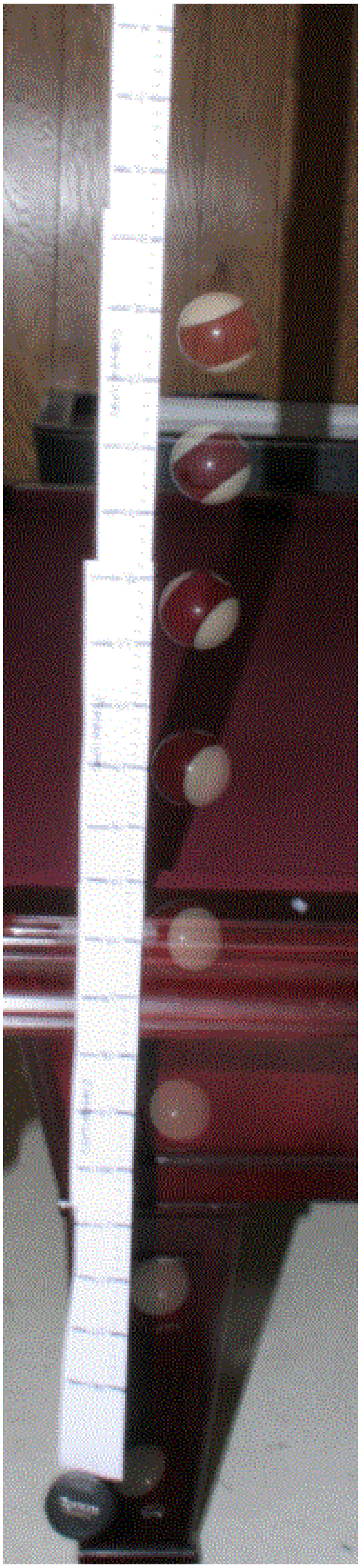
Discuss how you might use this photograph to measure g.

Measure g using the photograph

How "good" is your Measurement? That is

Estimate the uncertainty in your Measurement.

How does your value compare to the textbook value of $9.8\ m/s^2$?



Flash strobe
at 30 Hz

(1 flash every $\frac{1}{30}$ s)

5 cm spacing between
dark lines