Welcome back to **PHY101: Major Concepts in Physics I**

Photo: Greg Rothman

Announcements

Course Website:
jmschwarztheorygroup.org/phy101/

No labs until the week of September 10th.

You can purchase an ebook or a hard copy of the course textbook. Go to :http://connect.mheducation.com/class/j-schwarz-schwarz-fall-2017 to purchase the ebook and/or the hard copy from the publisher.

HW 1 on Chapter 1 has now been assigned. Please go to the course website to access it. HW 1 is due on Wednesday, September 6, at the beginning of lecture.

Three **Big** Questions

- What is science?
- What is physics?
- What tools do you need to learn physics?

See Chapter 1 of textbook!

What tools do you need to learn physics?

- A little bit of math
- Units and converting units
- Reading graphs
- Problem-solving skills

What does it take to learn physics?

Since math is a concise way of stating scientific ideas, it will be useful to know a little math.

$$V = \frac{4}{3}\pi r^3$$

What does it take to learn physics?

It will be useful to know base quantities, or dimensions, and their respective units and be able to *convert* units.

"Base" quantities	Unit
length (l)	meter
mass (m)	kilogram
time (t)	second
electric current (I)	ampere
temperature ("thermodynamic") (T)	kelvin
amount of substance (n)	mole
luminous intensity (Iv)	candela

What does it take to learn physics?

Some of the standard SI unit prefixes and their respective powers of 10.

Prefix	Power of 10	Prefix	Power of 10
tera (T)	10^{12}	centi (c)	10^{-2}
giga (G)	10^{9}	milli (m)	10^{-3}
mega (M)	10^{6}	micro (μ)	10^{-6}
kilo (k)	10^{3}	nano (n)	10^{-9}

What does it take to learn physics?

Problem-solving skills!

Our first problem: How many cells are there in the human body? Let's make an estimate.

Physics Problem Solving

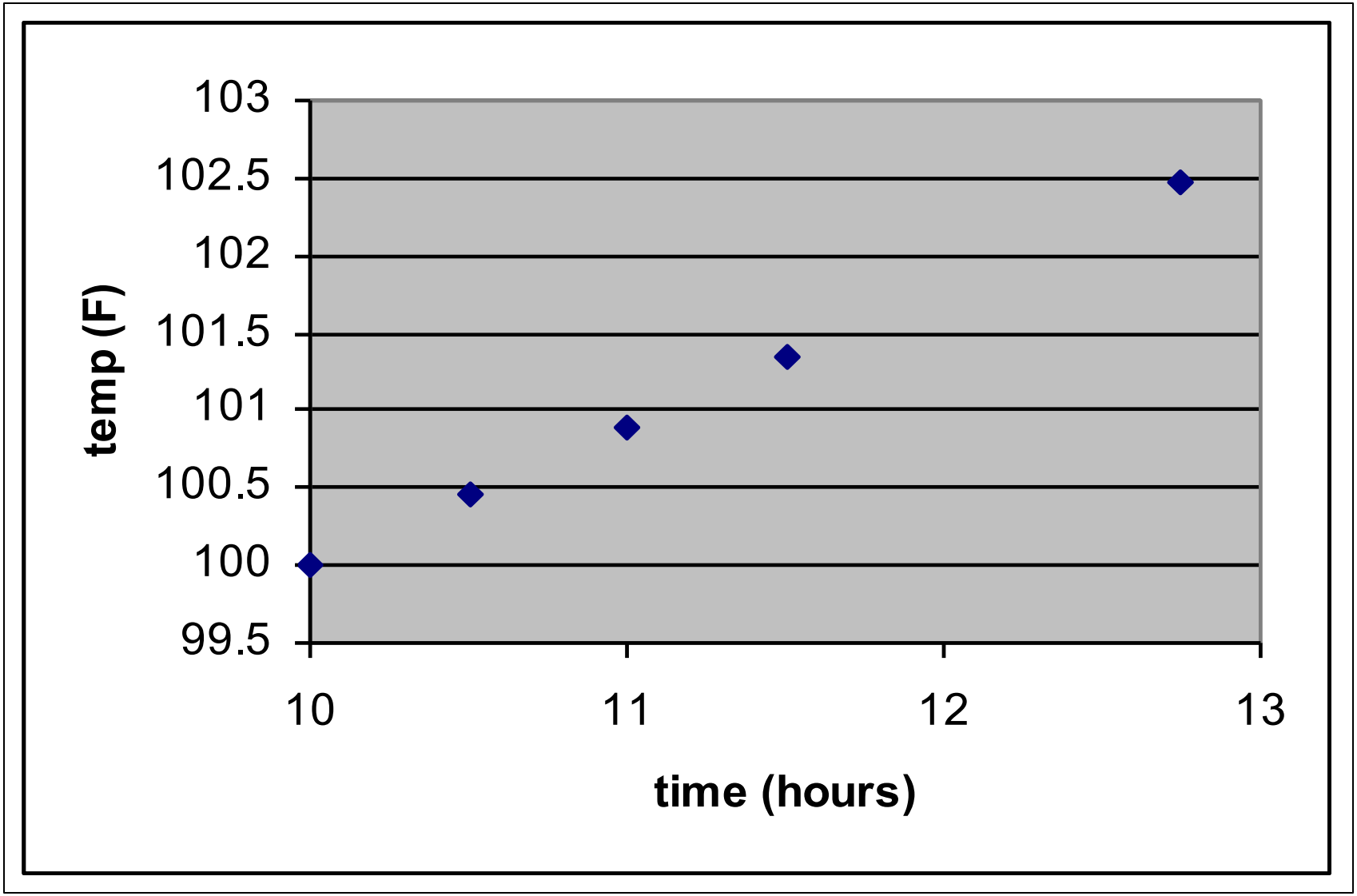
① DAP Draw a picture
② KNU Knowns and unknowns
③ EQN Equation(s)
④ SSF Solve symbolically first
⑤ CYA Check your answer

Our second problem

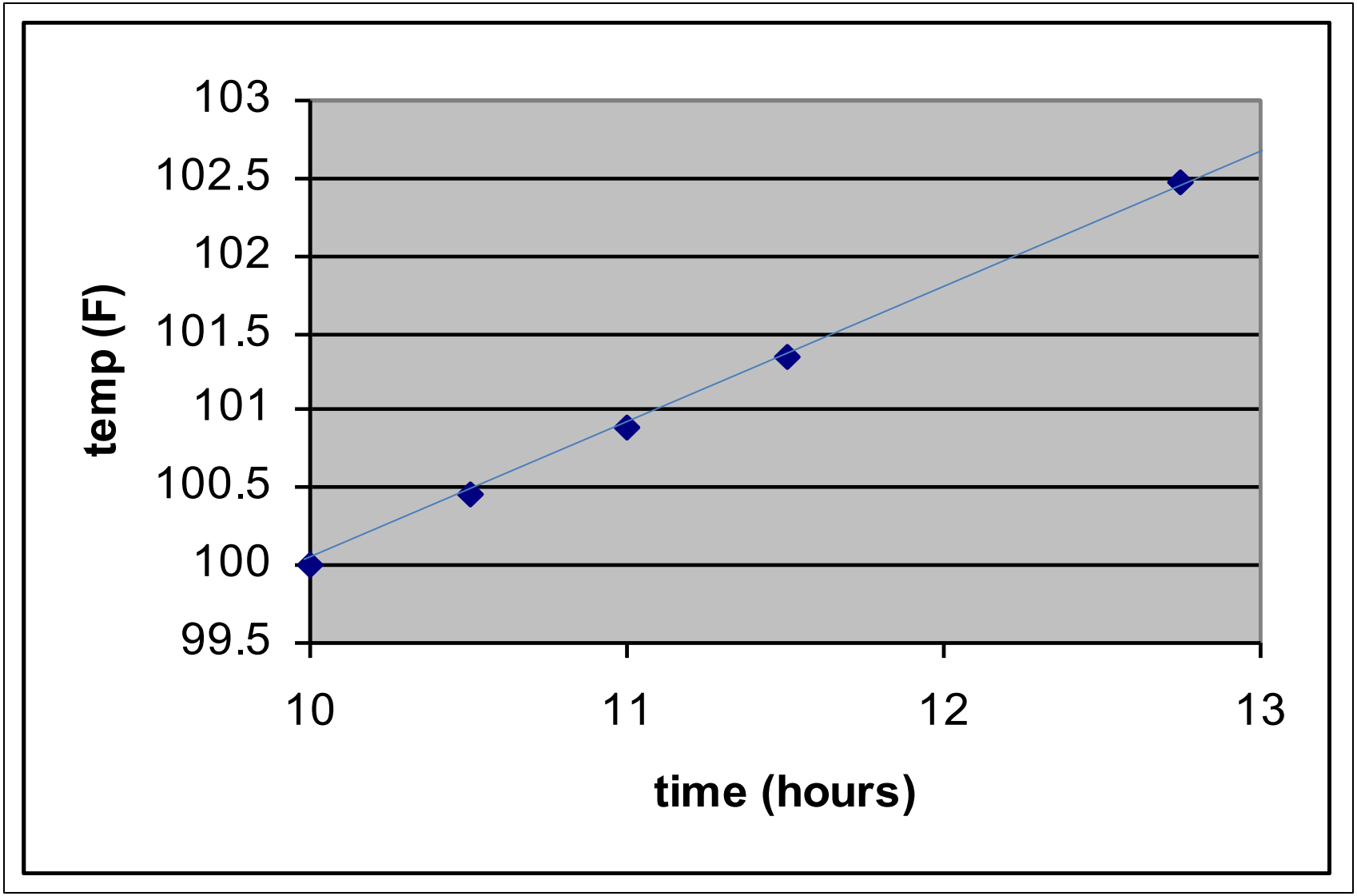
Chapter 1, Problem 55: A nurse recorded the values shown in the following chart for a patient's temperature. Plot a graph of the temperature versus elapsed time. From the graph, find (a) an estimate of the temperature at noon and (b) the slope of the graph.

Time	Temperature (Fahrenheit)
10AM	100.00
10:30AM	100.45
11:00AM	100.90
11:30AM	101.35
12:45PM	102.48

What does it take to learn physics?



What does it take to learn physics?



Tablecloth Trick!

Clicker question 1

If the length of a box is reduced to one third of its original value and the width and height are doubled, by what factor has its volume changed?

A. 2/3
B. 1
C. 4/3
D. 3/2

Clicker question 1

If the length of a box is reduced to one third of its original value and the width and height are doubled, by what factor has its volume changed?

A. 2/3
B. 1
C. 4/3
D. 3/2

Physics Problem Solving

① DAP Draw a picture
② KNU Knowns and unknowns
③ EQN Equation(s)
④ SSF Solve symbolically first
⑤ CYA Check your answer

Our third problem

1.75: The total length of the blood vessels in the body is roughly 100,000 km. Most of this length is due to the capillaries, which have an average diameter of 8 microns. Estimate the total volume of blood in the human body by assuming that all the blood is found in the capillaries and that they are always full of blood.

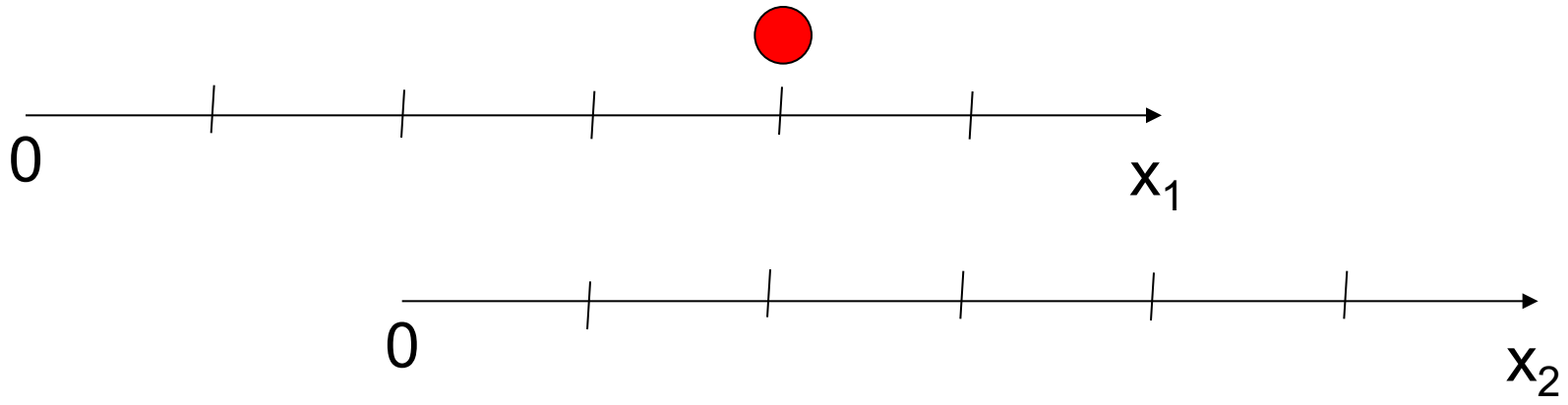
Now on to Chapter 2

Another set of Three **Big** Questions

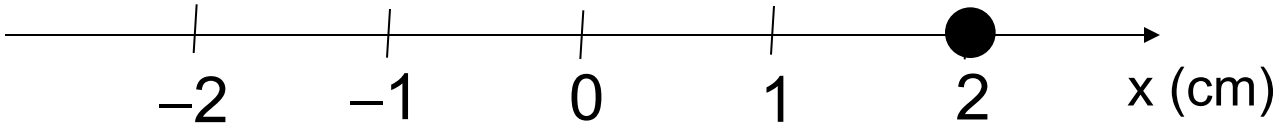
- How does one define position, displacement, velocity, and acceleration?
- How does one describe motion along a line with constant velocity?
- How does one describe motion along a line with constant acceleration?

Position

The **position** (x) of an object describes its location relative to some origin or other reference point.

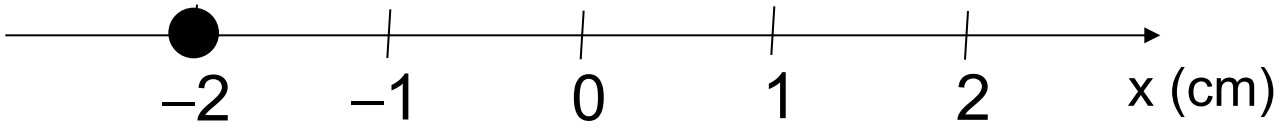


The *position* of the red ball differs in the two shown coordinate systems.



The position of the ball is $x = +2\ \text{cm}$

The + indicates the direction to the right of the origin.



The position of the ball is $r_x = x = -2\,\text{cm}$

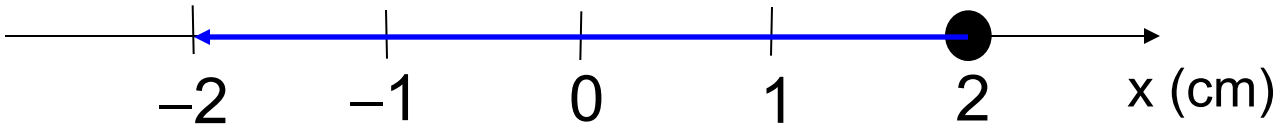
The – indicates the direction to the left of the origin.

Displacement

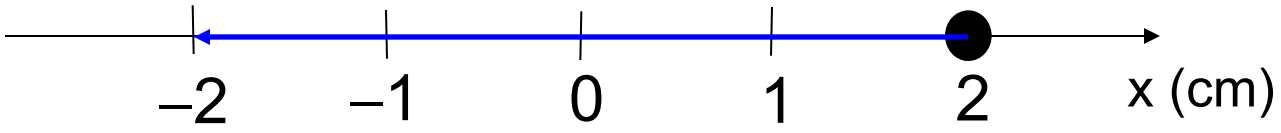
The **displacement** is the change in an object's position. It depends only on the beginning and ending positions.

$$\Delta x = x_f - x_i$$

Example: A ball is initially at x = +2 cm and is moved to x = -2 cm. What is the displacement of the ball?



Example: A ball is initially at x = +2 cm and is moved to x = -2 cm. What is the displacement of the ball?



$$\Delta x = x_f - x_i$$
$$= -2\ \text{cm} - 2\ \text{cm}$$
$$= -4\ \text{cm}$$

Example (text problem 2.4): At 3 PM a car is located 20 km south of its starting point. One hour later it is 96 km farther south. After two more hours it is 12 km south of the original starting point.

(a) What is the displacement of the car between 3 PM and 6 PM?

Clicker Question 2

What is the displacement of the car between 3 PM and 6 PM?

A. 76 km
B. 8 km
C. -8 km
D. -76 km

Clicker Question 2

What is the displacement of the car between 3 PM and 6 PM?

A. 76 km
B. 8 km
C. -8 km
D. -76 km

Example (text problem 2.4): At 3 PM a car is located 20 km south of its starting point. One hour later it is 96 km farther south. After two more hours it is 12 km south of the original starting point.

(a) What is the displacement of the car between 3 PM and 6 PM?

Use a coordinate system where north is positive.

$x_i = -20$ km and $x_f = -12$ km

$$\Delta x = x_f - x_i$$
$$= -12\ \text{km} - (-20\ \text{km}) = +8\ \text{km}$$

Example continued

(b) What is the displacement of the car from the starting point to the location at 4 pm?

(c) What is the displacement of the car from 4 PM to 6 PM?

Example continued

(b) What is the displacement of the car from the starting point to the location at 4 pm?

$x_i = 0$ km and $x_f = -96$ km

$$\Delta x = x_f - x_i$$
$$= -96\ \text{km} - (0\ \text{km}) = -96\ \text{km}$$

(c) What is the displacement of the car from 4 PM to 6 PM?

$x_i = -96$ km and $x_f = -12$ km

$$\Delta x = x_f - x_i$$
$$= -12\ \text{km} - (-96\ \text{km}) = +84\ \text{km}$$

Cart on a track demo!