Temperature

Tuesday, April 12, 2016 2:33 PM

It's Getting Hot in Here!

What is hot? Heat? Temperature?

Heat is the average of the kinetic energy of all the particles in a substance. When you put your hand in hot water, the H_2O molecules are hitting your skin faster, and more often.

If the water is too hot those water molecules will actually do damage to your skin when they impact. This is a burn.

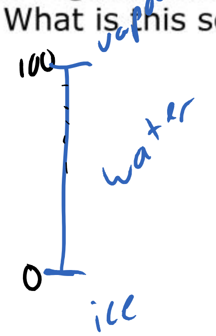
We have three main ways to measure temperature:

1) The dumb way: Fahrenheit. Based off silliness.
If you must convert it:

$$°C = \frac{5(°F - 32)}{9}$$

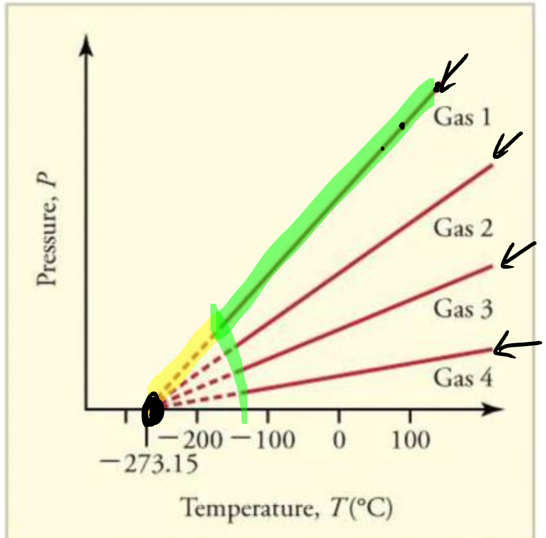
I will never ask you to go the other way: (℉→ ℃). Why would anyone want to?

2) The regular human way: ℃.
What is this scale? Where does it come from?



3) The way of science (ie: the most awesomest way):
Kelvin (K).

Scientists noticed that as things cooled they all went to the same number. The solid line is data, the dotted line is projected (remember this for you lab reports! Always).



They realized that the projected line for everything went to the same value.

−273.15°C

The lowest temperature possible. If temperature is a measure of kinetic movement -- this temperature is zero kinetic movement.

The Kelvin scale just uses this point as zero. And counts up by degrees. A nice day of 22°C is the same as ~~285~~K. 295 K.

$$K = {}^{\circ}C + 273$$

$${}^{\circ}C = K - 273$$

The amount of heat energy in an object is related to three things.

1. Temperature of an object

2. Mass of the object

3. Type of object (specific heat properties)

$$E_H = mc\Delta T$$

m is mass. c is specific heat capacity, this is specific to the material being heated. T is temperature and we need to use kelvins. (NOTE: this formula is not good for calculating through matter states)

Find the energy needed to heat up my 1L of coffee from 20℃ to 70℃. c of water = 4190

$$E_H = mc\Delta T$$
$$= (1kg)(4190)(50)$$
$$= 210 kJ$$

Is energy still conserved? ←

$$\Delta E = 0 = mc\Delta T + mc\Delta T$$

I pour some 10mL of 3℃ cream into my 200mL of 70℃ coffee. What is the new Temperature?

$$0 = (10\times10^{-3})(4190)(T_f - 3) + (.2)(4190)(T_f - 70)$$
$$41.9(T_f - 3) + 838(T_f - 70)$$
$$-41.9(T_f - 3) = 838(T_f - 70)$$

$-41.9(T_f - 3) = 838(T_f - 70)$

$-41.9T_f + 125.7 = 838T_f - 58660$

$125.7 + 58660 = 838T_f + 41.9T_f$

$58785.7 = 879.9T_f$

$66.8° = T_f$

Some of you went to a hot spring instead of coming to physics class... If the water was 65℃ and you are at 37℃. There is 2 tonnes of water and 60kg of human (specific heat capacity of human is 3,200) what will the final water temp be? (assume it is not being refreshed from underneath).

$(2k)(4190)(T_f - 65) = -60(3200)(T_f - 37)$

$T_f = 64.4°C$

Dale loves skiing. What should his speed be 16m down the mountain if he lost no energy to heat (E_H)?

$E_{po} + E_{ko} = E_{pf} + E_{kf}$

$(9.8)(16) + 0 = 0 + \frac{v^2}{2}$

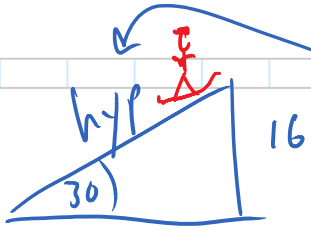
$v = 17.7\ m/s$

Owen has a speed gun at the bottom and tells Dale that he only got up to 12m/s. If Dale weighs 70kg, how much energy was lost to heat?

$E_{po} + E_{ko} = E_{pf} + E_{kf} + E_H$

$(70)(9.8)(16) = \frac{70(12)^2}{2} + E_H$

$E_H = 5940\ J = \Delta E = W = fd$



F_f

$\sin 30 = \frac{16}{hyp}$

$hyp = \frac{16}{1/2} = 32$

$F_f = 186N$

What is the efficiency?

$$Eff = \frac{useful}{total} \times 100\%$$

$$= \frac{\frac{70(12)^2}{2}}{70(9.8)16} \times 100\% = 45.9\%$$

If Jana kicks a 50kg zombie off of a 30m building and 750J of E_H was produced, how fast was the zombie going when it hit the ground?

$V_f = ? \rightarrow 23.6\ m/s$

Next Class is a lab.

After that Review.

Then Test on this.

That’s the end of my time with you.


YOU'RE
AWESOME


THANK YOU FOR
LISTENING TO MY
PRESENTATION
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