First, a brief review of the ideal gas law. "Ideal gas" is a gas whose molecules almost do not interact. Ideal gas obeys very simple laws. Most gases at room temperature behave close to an ideal gas.

Let p be the pressure of a gas, V be its volume, N be the number of molecules of gas in this volume. Then the combination

$$\frac{pV}{N}$$

is the same for any two gases which have the same temperature. (Recall that by definition two objects have the same temperature if the heat does not flow from one to the other when they are brought into contact). One can take this combination as the definition of the temperature. That is, one can define the "absolute" temperature T by the formula

$$T = \frac{pV}{N}.$$

How is this temperature related to the usual one? Well, they are linearly related. That is, T is related to the usual (i.e. centigrade) temperature as follows:

$$T = k(T_{usual} + 273).$$

Here k is essentially a conversion factor. It is known as the Boltzmann constant, after an Austrian physicist Ludwig Boltzmann. Its numerical value is

$$k = 1.38 \cdot 10^{-23} Joules/degree.$$

Note that T_{usual} is measured in degrees (centigrade, not Fahrenheit!), while T is measured in Joules, like energy.

Note also that $T = 0$ corresponds to $T_{usual} = -273$. This temperature is called absolute zero (as opposed to $T_{usual} = 0$, which is not as important in the grand scheme of things).

In practice, it is often convenient to measure both T and T_{usual} in the same units. On the other hand, it is convenient to use the scale where the absolute zero is zero, not -273 degrees! For this reason, in chemistry and physics one uses a hybrid temperature scale. Let us call it T_K, where K stands for Kelvin, a famous British physicist who proposed this scale. The Kelvin temperature is proportional to T:

$$T = kT_K.$$

But it is measured in degrees, just like T_{usual}. The relation between T_K and T_{usual} is a simple shift:

$$T_K = T_{usual} + 273.$$

By the way, the unit in which T_K is measured is usually called Kelvin, not degree centigrade. It is actually the same thing, so why change the name? This is done to avoid confusion between T_K and T_{usual}. If someone tells you that the temperature outside is 25 degrees centigrade, you can assume (correctly) that this is 25 degrees above zero centigrade, not 25 degrees above absolute zero. So it is safe to go outside in shorts and a T-shirt. But if someone tells you that the temperature outside is 25 Kelvin, this means that it is 25 degrees above absolute zero, which is the same as -248 degrees below freezing. You better stay inside then! So, if the temperature is given in Kelvin, you know that what is meant is T_K. If it is given in degrees centigrade, you know that what is meant is T_{usual}.

In terms of T_K one writes the gas law as follows:

$$pV = NkT_K.$$

It relates four quantities: p, V, T_K, N. Usually, N is not changing (i.e. molecules are not escaping), so the gas law tells you how pressure changes if you vary V and temperature, and so on. For example, if T is not changing, the gas law says that pV cannot change either. So if volume increases by a factor 2, then pressure must decrease by the same factor. On the other hand, if V is fixed (for example, if the container with gas has rigid walls), then p is proportional to the temperature.

Now the problems.

(1) How many air molecules are there is a room whose width and length are 6 meters and the height is 3 m? The temperature is 25 degrees centigrade, the pressure is normal air pressure (i.e. $10^5 N/m^2$).

(2) What will happen to a balloon which has been placed into a refrigerator? Why?

(3) If the volume occupied by air is decreasing, then its temperature is

(a) increasing

(b) decreasing

(c) you can't tell.