Solving problems involving gas laws

There isn't a wide variety of questions from the IB about gases. By far the most common ones will involve the ideal gas law, most easily remembered as

$$pV = nRT$$

where p is the pressure, in Pa, V is the volume, in m^3, n is the number of moles of gas, R is the gas constant $8.31\ \mathrm{J\ mol^{-1}\ K^{-1}}$, and T is the temperature in **kelvin**.

Remember that the assumptions for an ideal gas are:

1. Gas particles are point particles (total volume of particles is much much smaller than the volume of the container).
2. Collisions are elastic.
3. The motion of gas particles is frictionless.
4. No other external forces act on the particles.

Even though no gases in the real world exhibit these properties, an ideal gas is well approximated by real gases at high temperatures and low pressures.

Working with the ideal gas law

The questions in the exam will often ask you to find how one quantity changes when others are changed. For example, how does the pressure change when the volume is halved, and the temperature is tripled?

1. Rearrange the ideal gas law to make the subject the variable under investigation.

   In this case, rearrange the equation to be $p = \frac{nRT}{V}$.

2. Make the changes to the other variables.

   In this case, change V to $\frac{1}{2}V$ and change T to $3T$. Then the new pressure becomes:

$$p' = \frac{nR(3T)}{\frac{1}{2}V} = 6\frac{nRT}{V} = 6p$$

   So the pressure increased by a factor of 6 (hextupled?).

It is often quite useful to denote changes by the addition of an apostrophe $'$ ("primed") above the variable to keep track of which variables correspond to which situation. For example, in the previous question, we would have had from the ideal gas laws

$$p = \frac{nRT}{V}$$
$$p' = \frac{n'R'T'}{V}$$

The equations denoting our change would be

$$n' = n$$
$$R' = R$$
$$T' = 3T$$
$$V' = \frac{1}{2}V$$

where $R' = R$ will always be the case as it is a constant. Then, you can substitute these into the equation for p':

$$p' = \frac{nR(3T)}{\frac{1}{2}V}$$

and rearrange to find p' in terms of p:

$$p' = \frac{nR(3T)}{\frac{1}{2}V} = 6\frac{nRT}{V} = 6p$$