Gas laws

1. $X: t_1 = 28.3 sec$ RMM = ?
$Q_2: t_2 = 20.0 sec$ RMM=32

$T \propto \sqrt{MM}$ ✓

$\frac{T_1}{T_2} = \sqrt{\frac{X}{32}}$

$\left(\frac{T_1}{T_2}\right)^2 = \frac{X}{32}$ ✓

$\left(\frac{28.3}{T_2}\right)^2 = \frac{X}{32}$ ✓

$X = \frac{28.3^2 \times 32}{400}$ ✓

$X = 64$ ✓

2. (a) The rate of diffusion of a gas is inversely proportional to the square root of its density under the same conditions of temperature and pressure

(b) Rate of gas $V = \frac{1}{5} \times \frac{100cm}{10sec}$

$= 2cm/sec$ ✓ ½

Rate of $W = \frac{10cm}{10sec}$

$= 1cm/sec$ ✓ ½

$\frac{RV}{RW} = \sqrt{\frac{MW}{MV}}$ $= \frac{2}{1} = \sqrt{\frac{MW}{16}}$

$\left(\frac{2}{1}\right)^2 = \left(\sqrt{\frac{MW}{16}}\right)^2$

$\frac{4}{1} = \frac{MW}{16}$; $= \frac{4 \times 16}{1}$

$MW = 64$

3. (a) The volume of a fixed mass of a gas is directly proportional to its absolute temperature at constant Pressure ✓

(b) Apply combined gas law; $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$V_1 = 3.5 \times 10^{-2} m^3$ $V_2 = 2.8 \times 10^{-2} m^3$
$P_1 = 1.0 \times 10^5 Pa$ $P_2 = 1.0 \times 105Pa$ ✓ ½
$T_1 = 291K$ $T_2 = ?$

$T_2 = \frac{P_2V_2T_1}{P_1V_1}$

$T_2 = \frac{1.0 \times 10^5 Pa \times 2.8 \times 10^{-2} m^3}{} \times 291K$

$1.0 \times 10^5 Pa \times 3.5 \times 10^{-2} m^3$

$T_2 = 232.8k$ ✓

4. $\frac{TsO_2}{TO_2} = \frac{R.M.N.SO_2}{R.M.MO_2}$ ½

$SO_2 = 32 + (16 \times 2) = 64$ ½

$O_2 = (16 \times 2) = 32$ ½

$\frac{TsO_2}{50} = \sqrt{\frac{64}{32}}$ ½ $= 70.75$ ½

5. a) The rate of diffusion of a fixed mass of a gas is inversely proportional to the square root of it density at constant temperature and pressure

b) $RHCl = \frac{30\ cm^3}{20\ se} = 1.5\ cm^3$ see

$\frac{RHCL}{RSO_2} = \frac{\sqrt{MSO_2}}{\sqrt{MHCL}}$

$\frac{(1.5)^2}{RSO_2} = \frac{\sqrt{64}}{\sqrt{36.5}}$

$(RSO_2)^2 = \frac{2.25 \times 36.5}{64}$

$RSO_2 = \sqrt{\frac{2.25 \times 36.5}{64}}$

1.133 cm/ sec

$1.133\ cm^3$ ____________ 1 sec

$42\ cm^3 = \frac{42 \times 1}{1.133}$

= 37 sec

6. a) Boyles' law For a fixed mass of a gas, volume is inversely promotional to pressure at constant temperature

b)

c) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ √ ½ $V_2 = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2}$ √ ½

$\frac{250 \times 273 - 23}{273 + 127}$ √ ½

$= 156.5cm^3$

7. a) RFM of $CaCO_3 = 40 + 12 + 48$

= 100kg. √½

∴ 100 kg of $CaCO_3 \equiv 22.4dm^3$ of $CO_2(g)$

1000 kg " " ⟶ ?

$= \frac{22.4 \times 1000}{100}$ √1 $= 224\ dm^3$ √½

8. $T_1 = 23+273 = 296$ $T_2 = -25+273 = 248$

$V_1 = 200cm^3$ $V_2 = ?$

$P_1 = 740mmHg$ $P_2 = 780mmHg$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{740x200}{296} \surd 1 = \frac{780x?}{248} \surd 1$$

$$\therefore x = \frac{740 \times 200 \times 248}{296 \times 780}$$

$= 158.974\ cm^3 \surd\ 1$ (penalize ½ mark for units)

9. $$\frac{Rk}{Rs} = \sqrt{\frac{Ms}{Mk}}$$

$$\therefore \frac{12}{7.2} = \sqrt{\frac{x}{16}} \surd \tfrac{1}{2}$$

$$X = \frac{12^2}{7.2^2} \times 16 \surd \tfrac{1}{2}$$

$= 44.464\surd$

10. (a) When gases combine they do so in volume which bear a simple ratio to one another and to the product if gaseous under standard temperature and pressure $\surd 1$

11. a) Rate of diffusion is whereby proportional to molecular mass of a gas. $\surd 1$

b) $$\frac{TCO_2}{TCO} = \sqrt{\frac{MCO_2}{MCO}} \surd\tfrac{1}{2}$$

$$\Rightarrow \frac{200}{T} = \sqrt{\frac{44}{28}} = \sqrt{\frac{\cancel{44}\ 11}{\cancel{28}\ 7}} \surd\tfrac{1}{2}$$

$$\Rightarrow \left(\frac{200}{T}\right)^2 = \frac{11}{7}$$

$$\Rightarrow \frac{T}{200} = \sqrt{\frac{7}{11}}$$

$\Rightarrow$ $T = 200.0.79772^{\surd\frac{1}{2}} = 159.5$ Seconds. $\surd\tfrac{1}{2}$