XPT #	$[F_2]_0$ /M	$[ClO_2]_0$ /M	init. rate /$M s^{-1}$
1	0.10	0.010	1.2×10^{-3}
2	0.10	0.040	4.8×10^{-3}
3	0.20	0.010	2.4×10^{-3}

look @ XPT 1+3

- ×2 init conc F_2
- ×2 init rate

$\Big\}$ rate $\propto [F_2]^1$

look @ XPT 1+2

→ ×4 init conc ClO_2
→ ×4 init rate

$\Big\}$ rate $\propto [ClO_2]^1$

$$\left.\begin{aligned} \text{rate} &\propto [F_2] \\ &\propto [ClO_2] \end{aligned}\right\} \rightarrow \text{rate} \propto [F_2][ClO_2]$$

$$\Rightarrow \text{rate} = \underbrace{k}_{\text{rate constant.}}[F_2][ClO_2]$$

So, what's k?

$$\Rightarrow k = \frac{\text{rate}}{[F_2][ClO_2]}$$

XPT #1

$$= \frac{1.2 \times 10^{-3}\ \cancel{M} \cdot s^{-1}}{0.10\cancel{M} \times 0.010M}$$

$$= 1.2\ M^{-1}s^{-1} \quad \text{OR} \quad \frac{1}{M \cdot s} = \frac{L}{mol \cdot s}$$

$= \ldots$

In general, for a rxn:

$$aA + bB \longrightarrow cC + dD$$

$$\text{rate} = k[A]^x[B]^y$$

x = order with respect to (wrt) A

y = order wrt B.

$x+y$ = overall order.

x, y ⇝ have to be det'd xptlly.
⇝ un-related to stoich coeff (a, b)

How do we figure out the orders x and y?

- Normally use a combination of the ISOLATION method + initial rates method.

↑ keep all concs same, but 1.

ex: $\overset{(+4)(-2)}{2SO_2(g)} + \overset{(0)}{O_2(g)} \longrightarrow \overset{(+6)(-2)}{2SO_3(g)}$

XPT	$[SO_2]_0$ /M	$[O_2]_0$ /M	init rate / $M \cdot s^{-1}$
1	0.20	0.10	1.48×10^{-2}
2	0.40	0.10	2.96×10^{-2}
3	0.40	0.25	18.5×10^{-2}

$$\text{rate} = K[SO_2]^x[O_2]^y$$

Here's the LONG + reliable method... to solve for K, x, y.

- let's compare 2 XPTS where only 1 conc changes...

$$\text{rate}(2) = 2.96 \times 10^{-2} M \cdot s^{-1} = K \cdot [0.40M]^x [0.10M]^y$$

$$\text{rate}(1) = 1.48 \times 10^{-2} M \cdot s^{-1} = K [0.20M]^x [0.10M]^y$$

$$\frac{\text{rate}(2)}{\text{rate}(1)} = \frac{2.96 \times 10^{-2} \cancel{M \cdot s^{-1}}}{1.48 \times 10^{-2} \cancel{M \cdot s^{-1}}} = \frac{\cancel{K}[0.40M]^x \cancel{[0.10M]^y}}{\cancel{K}[0.20M]^x \cancel{[0.10M]^y}}$$

$$= 2.00 = \frac{[0.40M]^x}{[0.20M]^x} = \left(\frac{0.40M}{0.20M}\right)^x$$

$$\boxed{2.00 = 2.0^x}$$

$\log(a^n) = n \cdot \log(a)$

Solve by ① inspection: $x = 1$

② $\log(2.00) = \log(2.0^x)$

$$\log(2.00) = x \cdot \log(2.0)$$

$$\Rightarrow x = \frac{\log(2.00)}{\log(2.0)} = 1$$

$x^{\checkmark}, y^{?}, k^{?}$

$$\text{rate}(3) = k[SO_2]^x[O_2]^y$$

$$\Rightarrow \text{rate}(2) = k[SO_2]^x[O_2]^y$$

$$\Rightarrow \frac{\text{rate}(3) = 18.5 \times 10^{-2} \cancel{M \cdot s^{-1}} = \cancel{k}[\cancel{0.40M}]^x[0.25M]^y}{\text{rate}(2) = 2.96 \times 10^{-2} \cancel{M \cdot s^{-1}} = \cancel{k}[\cancel{0.40M}]^x[0.10M]^y}$$

$$\Rightarrow 6.25 = \left(\frac{0.25\cancel{M}}{0.10\cancel{M}}\right)^y = 2.5^y$$

$$\log(6.25) = \log(2.5^y) = y \cdot \log(2.5)$$

$$\Rightarrow \frac{\log(6.25)}{\log(2.5)} = y = 2$$

$x = 1$ ⇝ order wrt SO_2
$y = 2$ ⇝ order wrt O_2

$$\text{rate} = k[SO_2]^1[O_2]^2$$

overall order $= 3 = 1+2$

(k)

$$k = \frac{\text{rate}}{[SO_2][O_2]^2}$$

X PT # 1

$$k = \frac{1.48 \times 10^{-2} \cancel{M} \cdot s^{-1}}{[0.20\cancel{M}][0.10M]^2}$$

$$= 7.4 \frac{s^{-1}}{M^2} \text{ or } M^{-2}s^{-1}.$$