2. *a)* $v = k \cdot [H_2SO_4] \cdot [Ca(OH)_2]$

   b) $v = k \cdot [I^-]^5 \cdot [H^+]^6 \cdot [IO_3^-]^3$

   c) $v = k \cdot [HCl]^2$

   d) $v = k \cdot [N_2O_4] \cdot [H_2O]$

3. The waiting time will be shorter, because the concentration of hydrogen peroxide (H_2O_2) will be greater in this product. The greater the concentration of a reactant, the higher the reaction rate will be.

4. *1. Calculation of the number of moles of hydrogen peroxide (H_2O_2):*

$$n = \frac{m}{M} = \frac{22.00\ g}{34.014\ g/mol} = 0.646\ 79\ mol$$

2. Calculation of the concentration of hydrogen peroxide:

$$C = \frac{n}{V} \qquad C = \frac{0.647\ moles}{0.5\ L}$$

$$C = 1.29358\ mol/L$$

3. Calculation of the reaction rate:

$r = k \cdot [H_2O_2]^2$

$r = 5.32 \times 10^{-7}\ L/(mol \cdot s) \cdot [1.293\ 58\ mol/L]^2$

$r = 8.90 \times 10^{-7}\ (L/mol \cdot s) \cdot (mol^2/L^2)$

$r = 8.90 \times 10^{-7}\ mol/(L \cdot s)$

Answer: The reaction rate will be 8.90×10^{-7} mol/(L·s).

5. $r = k \cdot [NO]^2 \cdot [Br_2]$

$$K = \frac{r}{[NO]^2 \cdot [Br_2]} = \frac{1.60\ mol/(L \cdot s)}{[1.0\ mol/L]^2 \cdot [2.0\ mol/L]}$$

$K = 0.80\ L^2/(mol^2 \cdot s)$

Answer: The rate constant will be $0.80\ L^2/(mol^2 \cdot s)$.

7. *1. Calculation of the initial reaction rate:*

$$r_1 = k \cdot [C]^2 \cdot [D]^3 = kx^2y^3$$

2. Calculation of the new reaction rate:

If the volume is reduced, the concentrations of the reactants are doubled.

$$r_2 = k \cdot [C]^2 \cdot [D]^3 = k(2x)^2(2y)^3 = k4x^28y^3$$
$$= 32kx^2y^3$$

$$\frac{r_1}{x^2y^3} = \frac{r_2}{32x^2y^3}$$

$$r_2 = \frac{32x^2y^3 r_1}{x^2y^3} = 32r_1 \qquad r_2 = 32r_1$$

Answer: The reaction rate is 32 greater than the initial rate.

8. *a)* $r = k \cdot [A] \cdot [B]$
$= 3.14 \times 10^{-2}s^{-1} \cdot [1.1 \text{ mol/L}] \cdot [0.83 \text{ mol/L}]$
$= 2.87 \times 10^{-2} \text{ mol}^2/(L^2 \cdot s)$

Answer: The reaction rate is $2.9 \times 10^{-2} \text{ mol}^2/(L^2 \cdot s)$.

b) $r = k \cdot [A] \cdot [B]$
$= 3.14 \times 10^{-2}s^{-1} \cdot [3.2 \times 10^{-3} \text{ mol/L}] \cdot [5.6 \times 10^{-1} \text{ mol/L}]$
$= 5.627 \times 10^{-5} \text{ mol}^2/(L^2 \cdot s)$

Answer: The reaction rate is $5.6 \times 10^{-5} \text{ mol}^2/(L^2 \cdot s)$.

9. *a)* $3\,C_{(s)} + 2\,Fe_2O_{3\,(aq)} \rightarrow 4\,Fe_{(s)} + 3\,CO_{2\,(g)}$

b) $r = k \cdot [Fe_2O_3]^2$

10. *a)* $r = k \cdot [O_2]^8$

b) *1. Conversion of the time into seconds:*

$$\frac{1 \text{ min}}{60 \text{ s}} = \frac{?}{12 \text{ min}}$$

$$? = 60 \text{ s} \cdot \frac{12 \text{ min}}{1 \text{ min}} = 720 \text{ sec}$$

2. Calculation of the reaction rate:

$$r = -\frac{1}{8}\frac{\Delta[O_2]}{\Delta t} = -\frac{1}{8} \cdot \frac{-2.3 \text{ mol/L}}{720 \text{ s}}$$

$$= 3.993 \times 10^{-4} \text{ mol/(L·s)}$$

3. Calculation of the rate constant:

$$r = k \cdot [O_2]^8 = \frac{r}{[O_2]^8} = \frac{3.993 \times 10^{-4} \text{ mol/(L·s)}}{[2.3 \text{ mol/L}]^8}$$

$$k = 5.1 \times 10^{-7} \text{ L}^7\text{/(mol}^7\text{·s)}$$

Answer: The value of the rate constant is 5.1×10^{-7} $L^7/(mol^7·s)$.

c) There will be no change because the sulphur (S) is in solid form.

d) $[O_2] = 3 \cdot 2.3 \text{ mol/L} = 6.9 \text{ mol/L}$

Calculation of the new reaction rate:

$$r = k \cdot [O_2]^8 = 5.1 \times 10^{-7} \text{ L}^7\text{/(mol}^7\text{·s)} \cdot [6.9 \text{ mol/L}]^8$$

$$r = 2.6 \text{ mol/(L·s)}$$

Answer: The new reaction rate is 2.6 mol/(L·s).

11. *a)* $r = k \cdot [A]^2 \cdot [B]^4$

$$k = \frac{r}{[A]^2 \cdot [B]^4}$$

$$K = \frac{5.25 \times 10^{-7} \text{ mol/(L·s)}}{[3.0 \times 10^{-4} \text{ mol/L}]^2 \cdot [5.2 \times 10^{-2} \text{ mol/L}]^4}$$

$$K = 7.978 \times 10^{5} \text{ L}^5\text{/(mol}^5\text{·s)}$$

Answer: The value of the rate constant of this reaction is 8.0×10^{5} $L^5/(mol^5·s)$.

b) If the pressure is doubled by reducing the volume by half, the concentrations are doubled.

[A] $2 \cdot 3.0 \times 10^{-4}$ mol/L $= 6.0 \times 10^{-4}$ mol/L

[B] $2 \cdot 5.2 \times 10^{-2}$ mol/L $= 1.04 \times 10^{-1}$ mol/L

Calculation of the new reaction rate:

$$r = k \cdot [A]^2 \cdot [B]^4$$

$$8.0 \times 10^5 \text{ L}^5\text{/(mol}^5\text{·s)} \cdot (6.0 \times 10^{-4} \text{ mol/L})^2$$

$$(1.04 \times 10^{-1} \text{ mol/L})^4$$

$$r = 3.36 \times 10^{-5}$$

Answer: The new reaction rate is

3.36×10^{-5} mol/L•s

12. *a)* *1. Calculation of the initial reaction rate:*

$$r_1 = k \cdot [NO]^2 \cdot [Br_2] = kx^2y$$

2. Calculation of the new reaction rate:

$$[Br_2] = 3y$$

$$v_2 = k \cdot [NO]^2 \cdot [Br_2] \quad kx^2 3y = 3kx^2y$$

$$\frac{r_1}{x^2y} = \frac{r_2}{3x^2y}$$

$$r_2 = \frac{3x^2y r_1}{x^2y} = 3r_1 \qquad r_2 = 3r_1$$

Answer: The reaction rate will triple.

b) The reaction rate will double.

15. *a)* $S_2O_8^{2-}{}_{(aq)} + 3\, I^-{}_{(aq)} \rightarrow 2\, SO_4^{2-}{}_{(aq)} + I_3^-{}_{(aq)}$

b) $r = k \cdot [S_2O_8^{2-}] \cdot [I^-]^3$

c) *1. Calculation of the reaction rate:*

$$r = \frac{1}{3}\frac{\Delta[I^-]}{\Delta t} = \frac{1}{3} \cdot \frac{-0.45 \text{ mol/L}}{60 \text{ s}}$$

$$= 2.5 \times 10^{-3} \text{ mol/(L} \cdot \text{s)}$$

2. Calculation of the rate constant:

$$r = K [S_2O_8^{-2}] \cdot [I^{-1}]^3$$

$$2.5 \times 10^{-3} = K\, [0.2] \cdot [1.2]^3$$

$$0.0025 = K\, (0.2) \cdot (1.728)$$

$$K = 0.00724$$