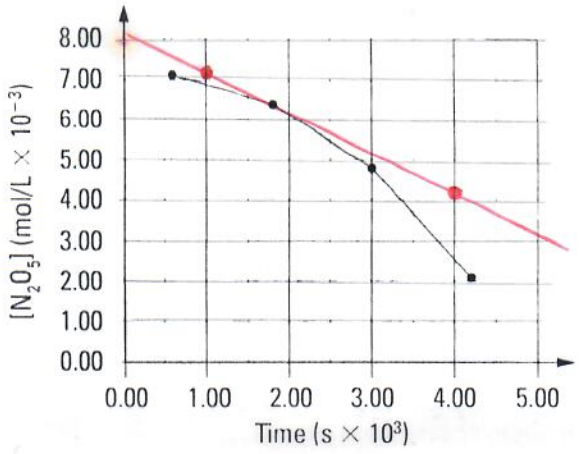
P. 228

#3)



- $r_{N_2O_5}$ = slope of tangent
  $t = 2000$ sec
- choose 2 points that are on tangent line

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x}$$

$$\text{slope} = \frac{(7.1 \times 10^{-3}) - (4.2 \times 10^{-3})}{(1 \times 10^3) - (4 \times 10^3)}$$

$$\text{slope} = -\frac{2.9 \times 10^{-3}}{3 \times 10^3}$$

$$\text{slope} = -0.97 \times 10^{-6}$$

$$\text{Rate} = 0.97 \times 10^{-6} \text{ mol/L·s}$$

(answers may slightly vary)

#4) a) It is a reactant because concentration is decreasing.

b) Average Rate = slope of Secant

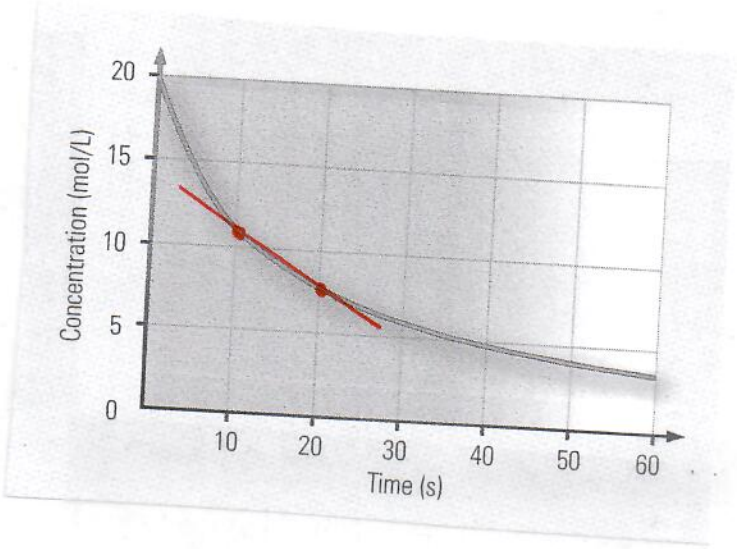
t = 10 - 20 sec

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{slope} = \frac{12 - 8}{10 - 20} = -0.4$$

Rate = 0.4 mol/L·s

(answers may slightly vary)



c) Instant Rate = slope of tangent

t = 20 sec

→ Pick 2 points that are on tangent line

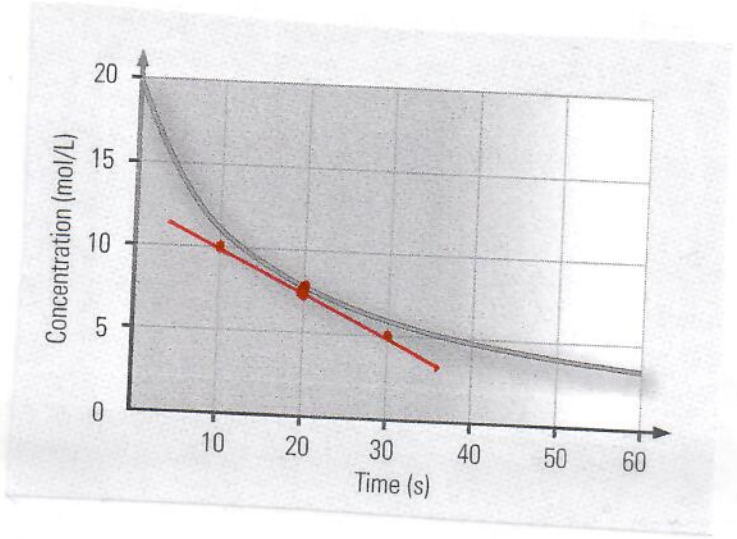
$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{slope} = \frac{10 - 5}{10 - 30}$$

$$\text{slope} = -0.25$$

Rate = 0.25 mol/L·s

(answers may slightly vary)



#5) a) Average Rate = slope of secant

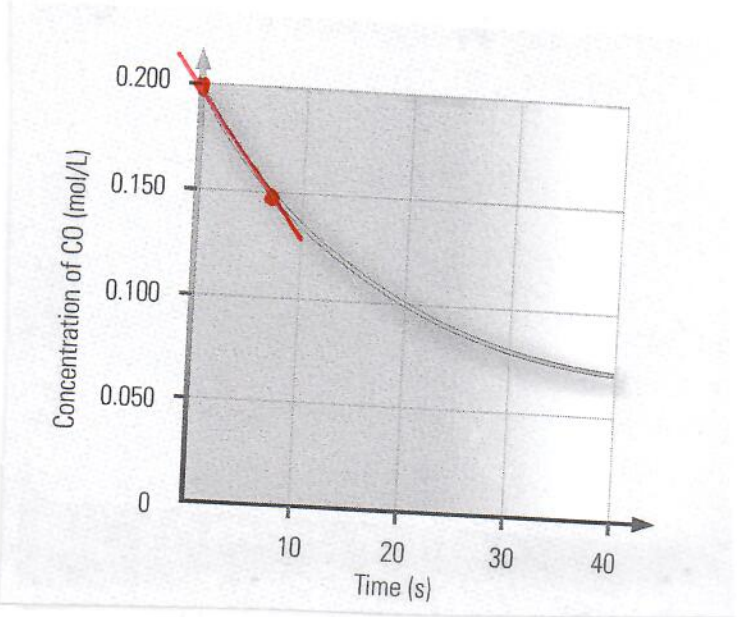
$t = 0 - 10$ sec

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{slope} = \frac{0.2 - 0.134}{0 - 10}$$

$$\text{slope} = -6.6 \times 10^{-3}$$

$$\text{Rate} = 6.6 \times 10^{-3} \text{ mol/L-s}$$



b) Average Rate = slope of secant

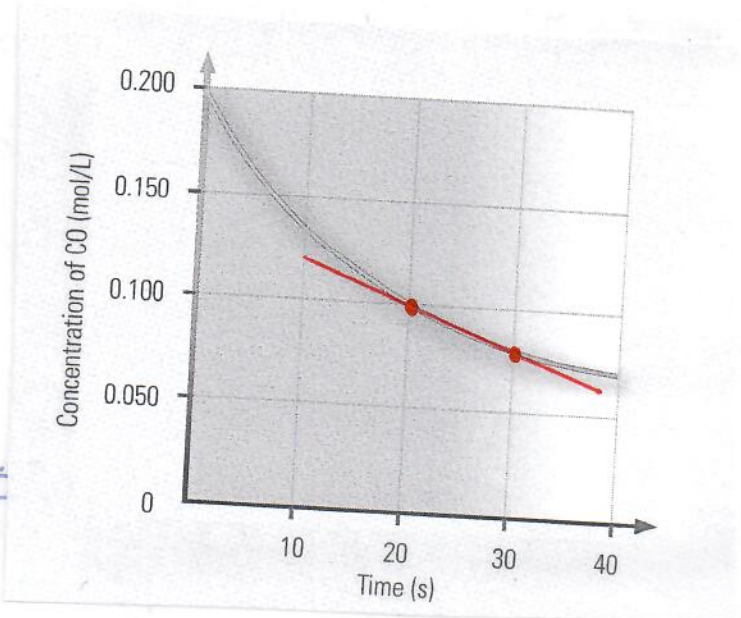
$t = 20 - 30$ sec

$$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\text{slope} = \frac{0.1 - 0.08}{20 - 30}$$

$$\text{slope} = -2.0 \times 10^{-3}$$

$$\text{Rate} = 2.0 \times 10^{-3} \text{ mol/L-s}$$



5c) Instant Rate = slope of Tangent

$t = 10\,sec$

→ Pick 2 points on the tangent line

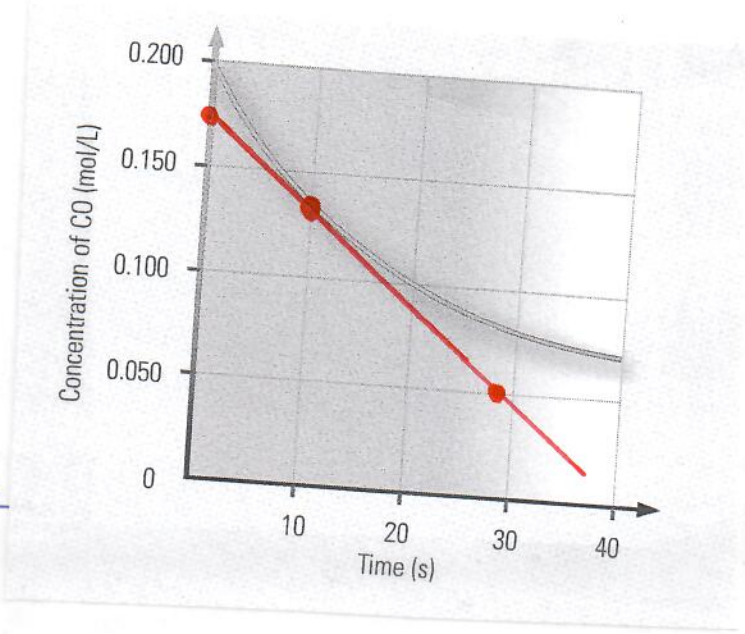
$$slope = \frac{y_2 - y_1}{x_2 - x_1}$$

$$slope = \frac{0.175 - 0.05}{0 - 28}$$

$$slope = -4.4 \times 10^{-3}$$

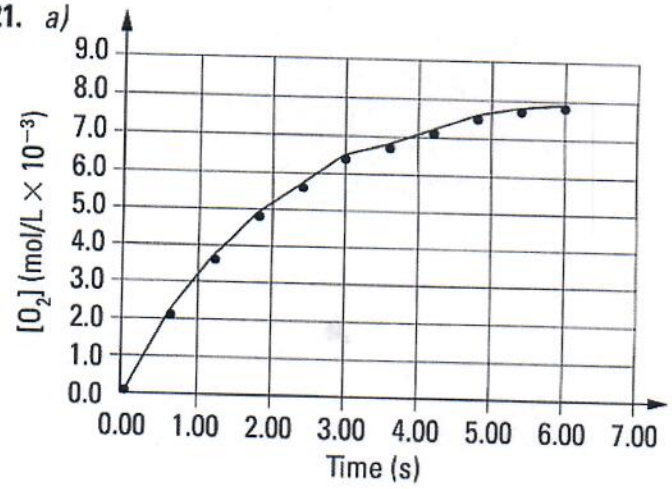
$$Rate = 4.4 \times 10^{-3}\ mol/L \cdot s$$

(answers may slightly vary)



P.233

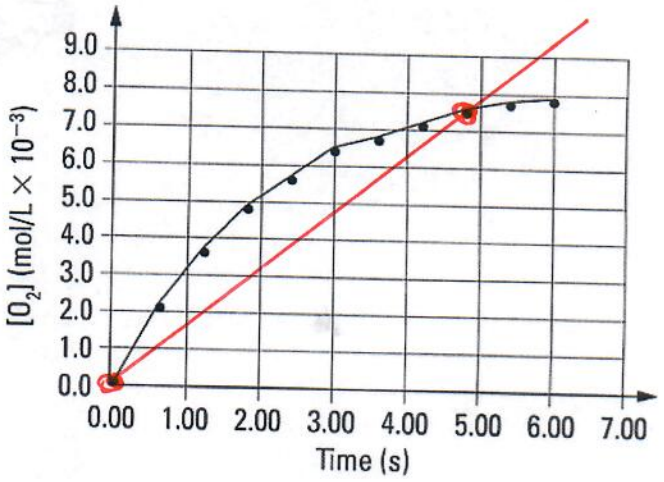
21. *a)*



b) $r_{\bar{x}} = \dfrac{\Delta[O_2]}{\Delta t} = \dfrac{7.5 \times 10^{-3}\ \text{mol/L} - 0\ \text{mol/L}}{4800\ \text{s} - 0\ \text{s}}$

$= 1.562 \times 10^{-6}\ \text{mol/(L·s)}$

Answer: The average rate during the first 4800 seconds is 1.56×10^{-6} mol/(L·s) as a function of oxygen (O_2).



c) *1. Calculation of the instantaneous rate at 1200 s:*

$r_{t=1200\,\text{s}} = \dfrac{\Delta[O_2]}{\Delta t}$

$= \dfrac{5.0 \times 10^{-3}\ \text{mol/L} - 2.3 \times 10^{-3}\ \text{mol/L}}{1.80 \times 10^{3}\ \text{s} - 6.00 \times 10^{2}\ \text{s}}$

$= 2.25 \times 10^{-6}\ \text{mol/(L·s)}$ (Approx)

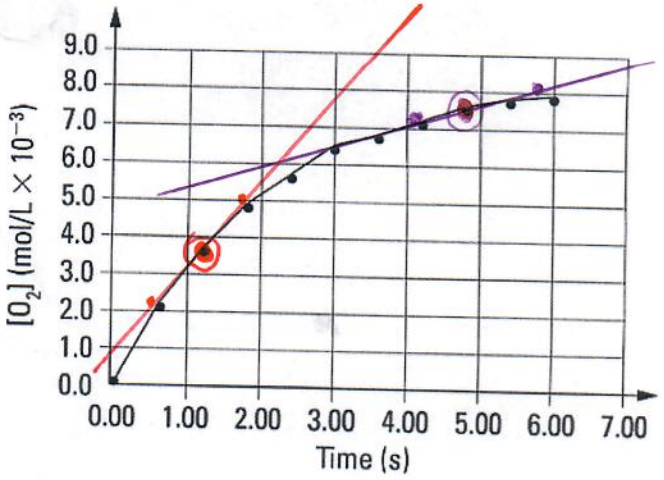
2. Calculation of the instantaneous rate at 4800 s:

$r_{t=4800\,\text{s}} = \dfrac{\Delta[O_2]}{\Delta t}$

$= \dfrac{8.0 \times 10^{-3}\ \text{mol/L} - 7.0 \times 10^{-3}\ \text{mol/L}}{5.80 \times 10^{3}\ \text{s} - 3.80 \times 10^{2}\ \text{s}}$

$= 1.84 \times 10^{-7}\ \text{mol/(L·s)}$ (Approx)

Answer: The instantaneous reaction rate at 1200 s is 2.3×10^{-6} mol/s, while at 4800 s it is 1.8×10^{-7} mol/(L·s) as a function of oxygen (O_2).



d) The more the reaction progresses, the fewer reactants are present. Therefore, the reaction will take place increasingly slower.