Module 3 Lesson 1 Exercises Answer Key

Part A

1. a) $\text{rate} = -\frac{\Delta A}{\Delta t} = -\frac{12.0\text{ g} - 25.0\text{ g}}{5.0\text{ min} - 0.0\text{ min}} = -\frac{-13.0\text{ g}}{5.0\text{ min}} = 2.6\text{ g/min}$

   b) $\text{rate} = -\frac{\Delta A}{\Delta t} = -\frac{13.0\text{ g} - 17.0\text{ g}}{4.0\text{ min} - 2.0\text{ min}} = -\frac{-4.0\text{ g}}{2.0\text{ min}} = 2.0\text{ g/min}$

2. a) $\text{rate} = -\frac{\Delta[CH_3CHO]}{\Delta t} = -\frac{0.00586 - 0.00667\text{ mol/L}}{105\text{ s} - 42\text{ s}}$

   $= -\frac{-8.10\times10^{-4}\text{ mol/L}}{63\text{ s}} = 1.29\times10^{-5}\text{ mol/L}\cdot\text{s}$

   b) $\text{rate} = -\frac{\Delta[CH_3CHO]}{\Delta t} = -\frac{0.00342 - 0.00505\text{mol/L}}{480\text{ s} - 190\text{ s}}$

   $= -\frac{-1.63\times10^{-3}\text{ mol/L}}{290\text{ s}} = 5.62\times10^{-6}\text{ mol/L}\cdot\text{s}$

3.

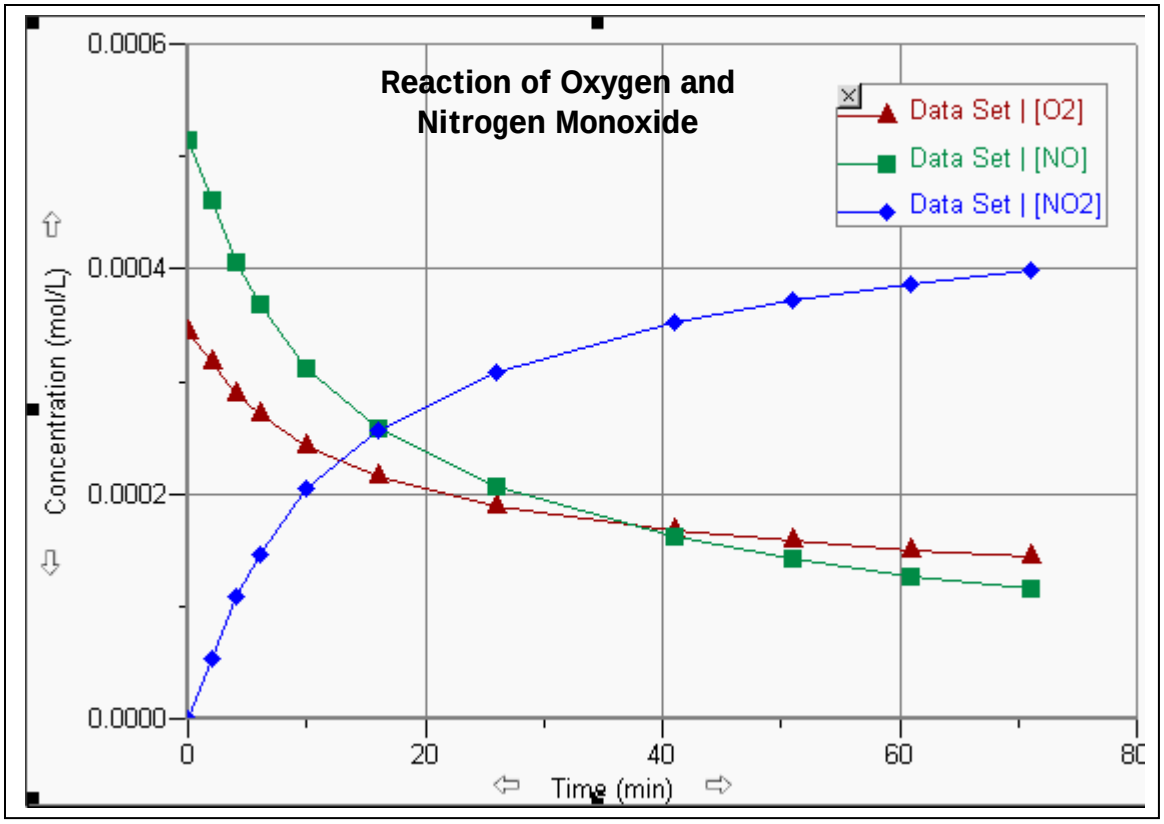
Time (min)	Mass of beaker and contents (g)	Mass loss (CO_2 produced) (g)	
0.0	200.00	0.00	
1.0	199.40	0.60	(200.00 – 199.40)
2.0	199.00	1.00	(200.00 – 199.00)
3.0	198.65	1.35	(200.00 – 198.65)
4.0	198.35	1.65	(200.00 – 198.35)
5.0	198.10	1.90	(200.00 – 198.10)
6.0	197.90	2.10	(200.00 – 197.90)
7.0	197.75	2.25	(200.00 – 197.75)
8.0	197.65	2.35	(200.00 – 197.65)
9.0	197.57	2.43	(200.00 – 197.57)
10.0	197.52	2.48	(200.00 – 197.52)

   b) $\text{rate} = \frac{\Delta\text{ mass } CO_2}{\Delta t} = \frac{2.48\text{ g} - 0.0\text{ g}}{10.0 - 0.0\text{ min}} = 0.248\text{ g } CO_2/\text{min}$

c) i) $\text{rate} = \dfrac{\Delta \text{ mass } CO_2}{\Delta t} = \dfrac{1.35 \text{ g} - 0.0 \text{ g}}{3.0 - 0.0 \text{ min}} = 0.450 \text{ g } CO_2/\text{min}$

ii) $\text{rate} = \dfrac{\Delta \text{ mass } CO_2}{\Delta t} = \dfrac{2.48 \text{ g} - 2.25 \text{ g}}{10.0 - 7.0 \text{ min}} = \dfrac{0.23 \text{ g}}{3.0 \text{ min}} = 0.077 \text{ g } CO_2/\text{min}$

Part B



1. $\text{rate} = -\dfrac{\Delta[O_2]}{\Delta t} = -\dfrac{1.44 \times 10^{-4} \text{ mol/L} - 3.43 \times 10^{-4} \text{ mol/L}}{71 \text{ min} - 0.0 \text{ min}} = \dfrac{-1.99 \times 10^{-4} \text{ mol/L}}{71 \text{ min}}$

$= 2.80 \times 10^{-6} \text{ mol/Lmin}$

$\text{rate} = -\dfrac{\Delta[NO]}{\Delta t} = -\dfrac{1.16 \times 10^{-4} \text{ mol/L} - 5.14 \times 10^{-4} \text{ mol/L}}{71 \text{ min} - 0.0 \text{ min}} = \dfrac{-3.98 \times 10^{-4} \text{ mol/L}}{71 \text{ min}}$

$= 5.60 \times 10^{-6} \text{ mol/Lmin}$

2. $\text{rate} = \dfrac{\Delta[NO_2]}{\Delta t} = \dfrac{3.99 \times 10^{-4} \text{ mol/L} - 0}{71 \text{ min} - 0.0 \text{ min}} = \dfrac{3.99 \times 10^{-4} \text{ mol/L}}{71 \text{ min}}$

$= 5.60 \times 10^{-6} \text{ mol/Lmin}$

3. a) $\text{rate} = -\dfrac{\Delta[O_2]}{\Delta t} = -\dfrac{2.42 \times 10^{-4} \text{ mol/L} - 3.43 \times 10^{-4} \text{ mol/L}}{10 \text{ min} - 0.0 \text{ min}} = \dfrac{-1.01 \times 10^{-4} \text{ mol/L}}{10 \text{ min}}$

$= 1.01 \times 10^{-5} \text{ mol/Lmin}$

$$\text{rate} = -\frac{\Delta[NO]}{\Delta t} = -\frac{3.11\times10^{-4}\ \text{mol/L} - 5.14\times10^{-4}\ \text{mol/L}}{10\ \text{min} - 0.0\ \text{min}} = \frac{-2.03\times10^{-4}\ \text{mol/L}}{10\ \text{min}}$$
$$= 2.03\times10^{-5}\ \text{mol/Lmin}$$
$$\text{rate} = \frac{\Delta[NO_2]}{\Delta t} = \frac{2.04\times10^{-4}\ \text{mol/L} - 0}{10\ \text{min} - 0.0\ \text{min}} = \frac{2.04\times10^{-4}\ \text{mol/L}}{10\ \text{min}}$$
$$= 2.04\times10^{-5}\ \text{mol/Lmin}$$

b) $$\text{rate} = -\frac{\Delta[O_2]}{\Delta t} = -\frac{1.44\times10^{-4}\ \text{mol/L} - 1.50\times10^{-4}\ \text{mol/L}}{71\ \text{min} - 61\ \text{min}} = \frac{-6.00\times10^{-6}\ \text{mol/L}}{10\ \text{min}}$$
$$= 6.00\times10^{-7}\ \text{mol/Lmin}$$
$$\text{rate} = -\frac{\Delta[NO]}{\Delta t} = -\frac{1.16\times10^{-4}\ \text{mol/L} - 1.27\times10^{-4}\ \text{mol/L}}{71\ \text{min} - 61\ \text{min}} = \frac{-1.10\times10^{-5}\ \text{mol/L}}{10\ \text{min}}$$
$$= 1.10\times10^{-6}\ \text{mol/Lmin}$$
$$\text{rate} = \frac{\Delta[NO_2]}{\Delta t} = \frac{3.99\times10^{-4}\ \text{mol/L} - 3.87\times10^{-4}\ \text{mol/L}}{71\ \text{min} - 61\ \text{min}} = \frac{1.20\times10^{-5}\ \text{mol/L}}{10\ \text{min}}$$
$$= 1.20\times10^{-6}\ \text{mol/Lmin}$$

4. Initial Rates

O_2=1.30 × 10^{-5} mol/Lmin
NO=2.65 × 10^{-5} mol/Lmin
NO_2=2.65 × 10^{-5} mol/Lmin

4 min

O_2=9.00 × 10^{-6} mol/Lmin
NO=1.90 × 10^{-5} mol/Lmin
NO_2=1.90 × 10^{-5} mol/Lmin

41 min

O_2=9.00 × 10^{-7} mol/Lmin
NO=1.90 × 10^{-6} mol/Lmin
NO_2=1.90 × 10^{-6} mol/Lmin