

Answer Key: Quiz Ch 14 - 15, Version E (28 pts)

1. a) $-\Delta[\text{ClO}_2]/\Delta t = 2([\text{ClO}_2^-]/\Delta t)$

b) $\text{rate} = k[\text{ClO}_2]^2[\text{OH}^-]^1$

c) $5.75 \times 10^{-2} \text{ M/s} = k(0.050)^2(0.100)$

$$\text{M/s} = k\text{M}^3$$

$$k = 230 \text{ M}^{-2}\text{s}^{-1}$$

d) $\text{rate} = 230.(0.175)^2(0.0844)$

$$\text{rate} = 0.594 \text{ M/s}$$

2. a) $\text{rate} = k[\text{F}_2]^1[\text{CHF}_3]^1$

b) 2^{nd}

3.		Fe^{3+}	SCN^{-1}	$\text{Fe}(\text{SCN})_2^+$
	I	2.00M	1.50M	0
	C	-x	-2x	x
	E	1.80M	1.10M	0.200M

$$x = 0.200\text{M}$$

$$K_c = [\text{Fe}(\text{SCN})_2^+] / ([\text{Fe}^{3+}][\text{SCN}^-]^2)$$

4. a) reverse-replace Fe^{3+} which is lost

b) forward-exothermic rxn

c) no change-pressure has little effect on solubility of aqueous solutions

Answer Key: Quiz Ch 14 - 15, Version F (28 pts)

1. a) $-\Delta[\text{ClO}_2]/\Delta t = 2([\text{ClO}_3^-]/\Delta t)$

b) $\text{rate} = k[\text{ClO}_2]^3[\text{OH}^-]^1$

c) $1.80 \times 10^{-2} = k(0.100)^3(0.100)$

$$k = 180. \text{ M}^{-3}\text{s}^{-1}$$

$$\text{M/s} = k$$

d) $\text{rate} = (180.)(0.0705)^3(0.0445)$

$$\text{rate} = 2.81 \times 10^{-3} \text{ M/s}$$

2. a) $\text{rate} = k[\text{O}_2][\text{HBr}]$

b) 2^{nd}

3.		Cr^{3+}	Br^-	CrBr_2^+
	I	1.50M	2.00M	0
	C	-x	-2x	x
	E	0.400M	-0.2M	1.1M

$$x = 1.1\text{M}$$

$$K_c = [\text{CrBr}_2^+] / ([\text{Cr}^{3+}][\text{Br}^-]^2)$$

4. a) reverse-replace last

b) reverse-exo

c) no change-inc. rate of fwd + reverse reactions

Answer Key: Quiz Ch 14 - 15, Version I (29 pts)

1. Reaction order: 1, 2, 3

- a. $r_1 / r_2 = ([5 \times 10^{-4}]^x [1 \times 10^{-4}]^y) / ([1 \times 10^{-3}]^x [3.0 \times 10^{-4}]^y) = 1 \times 10^{-12} / 1.8 \times 10^{-11} = (1/2)^x (1/3)^y$
 $r_2 / r_3 = 1.8 / .45 = ([3 \times 10^{-4}] / [1.5 \times 10^{-4}])^y$
 $x = 1, y = 2$
 Order $C_2H_4 = 2$, Order $O_3 = 1$
- b. $1 \times 10^{-12} = k [5 \times 10^{-4}] [1 \times 10^{-4}]$
 $k = 0.20 \text{ M}^{-2} \text{ s}^{-1}$
- c. Inconsistent, orders (2,1) don't match stoichiometry (2,2)
- d. Termolecular

e. $E = 9.6 \times 10^4 \text{ J/mol}$
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2.

- a. $K_C = [CO_2]^2 / [CO_2]$
- b. $K_P = K_C (RT)^{\Delta n} = 1.90 \times 10^{-3} (0.0821 \times 1000)^{(2-1)}$
 $K_P = 0.156$

c.

	CO ₂	CO
I	1.0	0
C	-0.125	+0.250
E	1 - 0.125	0.250

$$[CO_2] = (1 - 0.125) / 40 = 0.0219 \text{ M or } 0.0206 \text{ M}$$

d.

	CO ₂	CO
I	1.00	0
C	-x	+2x
E	1 - x	2x

$$K_C = ((2/3) / v)^2 / ((2/3) / v) = 1.90 \times 10^{-3} = (2/3) / v$$

$$1 - x = 2x > 1 = 3x > x = 1/3 \text{ mol}$$

$$v = 351 \text{ L}$$

3. Reactants
4. Products
5. Neither

Answer Key: Quiz Ch 14-15, Version J (29 pts)

1.

Initial [O ₃], mol/L	Initial [C ₂ H ₄], mol/L	Initial rate of formation of CH ₂ O, mol L ⁻¹ s ⁻¹
1.0 x 10 ⁻⁴	5.0 x 10 ⁻⁴	2.0 x 10 ⁻¹²
3.0 x 10 ⁻⁴	1.0 x 10 ⁻³	3.6 x 10 ⁻¹¹
1.5 x 10 ⁻⁴	1.0 x 10 ⁻³	9.0 x 10 ⁻¹²

a.

$$\begin{aligned}
 r_2/r_3 &= (3.6 \times 10^{-11})/(9.0 \times 10^{-12}) \\
 &= [k(3.0 \times 10^{-4})^x(1.0 \times 10^{-3})^y]/[k(1.5 \times 10^{-4})^x(1.0 \times 10^{-3})^y] \\
 4 &= (2)^x (1)^y \\
 0.602 &= x (0.301) + 0 \\
 x &= 2
 \end{aligned}$$

$$\begin{aligned}
 r_1/r_3 &= (2.0 \times 10^{-12})/(9.0 \times 10^{-12}) \\
 &= [k(1.0 \times 10^{-4})^x(5.0 \times 10^{-4})^y]/[k(1.5 \times 10^{-4})^x(1.0 \times 10^{-3})^y] \\
 0.222 &= (0.666)^x(0.5)^y \\
 \log(0.222) &= x \log(0.666) + y \log(0.5) \\
 +0.654 &= +0.176x + 0.301y \\
 y &= 1
 \end{aligned}$$

Order of C₂H₄ = 1

Order of O₃ = 2

b. $2.0 \times 10^{-12} = k[1.0 \times 10^{-4}]^2[5.0 \times 10^{-4}]^1$
 $k = 0.4 \text{ M}^{-2}\text{s}^{-1}$

c. No, steps 1 + 2 → 2 C₂H₄ + 2 O₃, while orders are 1 and 2.

d. Bimolecular

e. $\ln(k_1/k_2) = (-E_a/R)(1/T_2 - 1/T_1)$

$E_a = 22704 \rightarrow 23 \text{ kJ/mol}$

2.

a. $K_c = [\text{CO}]^2/[\text{CO}_2]$

b. $K_p = K_c (RT)^{\Delta n} = 1.33 \times 10^{-4} (0.0821 \times 1500)^{(2-1)}$
 $K_p = 0.0164$

c.

(mol)	CO ₂	CO
I	2.00	0
C	-x	+2x
E	2.00 - x	2x

CO: $2x = 0.100 \quad x = 0.0500$

CO₂: $2.00 - 0.0500 = 1.95 \text{ mol}$

$(1.95 \text{ mol})/(50 \text{ L}) = 0.0390 \text{ M} = [\text{CO}_2(\text{g})]$

Or

(M)	CO ₂	CO
I	0.04	0
C	-0.001	+0.002
E		0.002

$$[\text{CO}_2(\text{g})] = 0.0301 \text{ M}$$

d.

	CO ₂	CO
I	2.00	0
C	-x	2x
E	2.00 - x	2x

$= 1.60$ $= 0.80$

$$2.00 - x = 2(2x)$$

$$2.00 = 5x$$

$$x = 0.400 \text{ mL}$$

$$K_c = 1.33 \times 10^{-4} = \frac{(0.80/V)^2}{(1.60/V)} = 0.4/V$$

$$V = 3007.7 = 3010 \text{ L}$$

$$\text{Volume} = 3010 \text{ L}$$

3. Neither

4. Products

5. Products