Key ①

CH40S — RATE REVIEW

① a) $Rate_{CO} = \frac{\Delta[CO]}{\Delta t} = \frac{0.013 mol/L - 0.019 mol/L}{45 min - 27 min} = \boxed{3.33 \times 10^{-4} \frac{mol/L}{min}}$

b) By stoich of rxn, $Rate_{CO_2}$ is = to $rate_{CO}$ (1:1 relationship)

② $Rate_{CO_2} = 0.15 mol/L \cdot s \times \frac{1 mol CO_2}{2 mol CO} = \boxed{0.075 mol/L \cdot s \ CO_2}$

③ a) $4.5 \times 10^{-2} mol/L \cdot s \times \frac{6 mol H_2O}{4 mol NH_4} = \boxed{6.75 \times 10^{-2} mol/L \cdot s \ H_2O}$

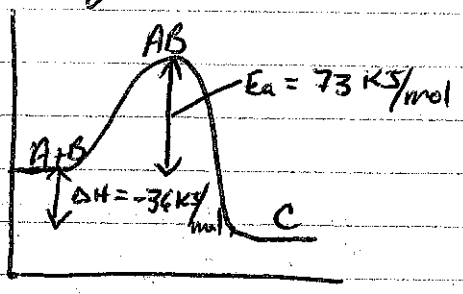
B) 1:1 ratio, $\therefore \boxed{4.5 \times 10^{-2} mol/L \cdot s \ NO}$

c) $4.5 \times 10^{-2} mol/L \cdot s \times \frac{5 mol O_2}{4 mol NH_3} = \boxed{5.63 mol/L \cdot s \ O_2}$

④ i) not enough energy to break & make Bonds
ii) improper orientation

⑤ Amount of energy required for reaction to proceed.

⑥ a)



b) $E_{a\ reverse} = 73 + 36 = 109 KJ/mol$

⑦ a) first order in OH^- b) first order in C_2H_5Br
c) 2nd order overall

⑧ i) temperature
ii) concentration
iii) nature of substances
iv) Particle Size
v) Pressure (gases only)
vi) addition of a catalyst

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(9) (a) & (b) b/c they are both ionic compds in solution with few bonds to break/make
(c) is slow b/c it is rxn of only solids

(10) Activated complex is the reactants with appropriate Ea to proceed.

(11) As temp. increases, K.E. of molecules increases, ∴ more collisions, ∴ faster reaction.

(12) At room temp, not enough Ea to proceed, Spark provides the needed Ea, & reaction is exothermic ∴ produces a large amount of NRG.

(13) Same as #12 (not enough Ea to react)

(14) In order for a rxn to proceed, particles must collide with enough energy & proper orientation.

(15) Simple ions involve the breaking/making of ionic bonds, complex molecules involve covalent bond rearrangement

(16) Activated Complex.

(17) Ea is energy required for reaction to proceed, Activated Complex is the reactants (or some form of reactants) in enough energy to proceed.

(18) Homogeneous - Same state as reactants
Heterogeneous - different state than reactants.

(4)

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(28) C_2H_5Br → takes less energy to react, ∴ faster.

(29) trial 1 & 2, $[CH_3CHO]$ x2, Rate x4
therefore relationship is 2nd order

(30) trial 1 & 2 $[HBr]$ = const, $[O_2]$ x2, rate x2
∴ 1st order in $[O_2]$
trial 2 & 3 $[O_2]$ = const, $[HBr]$ x2, rate x2
∴ 1st order in $[HBr]$

(31) a) $RATE = K[CH_3CHO]^2$
b) 2nd order (overall)
c) $K = \frac{RATE}{[CH_3CHO]} = \frac{5.0 \times 10^{-3}\ mol/L \cdot s}{(0.05\ mol/L)^2} = \boxed{2\ L/mol \cdot s}$

(32) a) $RATE = K[HBr][O_2]$
b) 2nd order (overall)
c) $K = \frac{RATE}{[HBr][O_2]} = \frac{0.0042\ mol/L \cdot s}{(0.010\ mol/L)(0.010\ mol/L)} = \boxed{42\ L/mol \cdot s}$

(33) a) 2nd order in $[A]$, Zero order in $[B]$
b) $RATE = K[A]^2$

c) $K = \frac{RATE}{[A]^2} = \frac{0.03\ mol/L \cdot s}{(0.1\ mol/L \cdot s)^2} = \boxed{3\ L/mol \cdot s}$

d) $RATE = (3\ L/mol \cdot s)(0.5\ mol/L \cdot s)^2 = \boxed{0.75\ mol/L \cdot s}$

(34) $2NO + O_2 \longrightarrow 2NO_2$
→ if O_2 doubles, rate 2x
∴ answer: (E) + (B)

(35) $Cl + CO \rightarrow COCl$
$COCl + Cl_2 \rightarrow COCl_2 + Cl$
a) $CO + Cl_2 \rightarrow COCl_2$
b) $COCl$ - intermediate
c) Cl - catalyst

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(19) Fastest at start b/c of higher concentrations, ∴ more collisions

(20) Order of rxn indicates how concentration of reactants affects the rate of a reaction.

(21) Can be found by interpretation of experimental results, or by the coefficients in an elementary reaction.

(22) Rate = the speed at which reactants disappear or products appear.
Rate Constant = the proportionality between rate & concentration of reactants

(23) a) no b) no c) yes, temp is only factor affecting rate const.

(24) a) 2nd order b) 2nd order c) 3rd order.

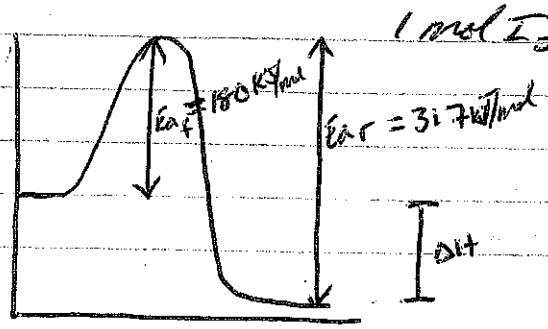
(25) a) $\text{RATE} = \frac{0.0148\,M - 0.0162\,M}{600_s - 190s} = \boxed{3.41 \times 10^{-6}\ M/s}$

b) $\text{RATE} = \frac{0.0110\,M - 0.0162\,M}{2180s - 190s} = \boxed{2.61 \times 10^{-6}\ M/s}$

(26) a) $\boxed{3.7 \times 10^{-5}\ mol/L \cdot s}$ (1:1 relationship)

b) $3.7 \times 10^{-5}\ mol/L \cdot s \times \frac{2\ mol\ I^-}{1\ mol\ I_2} = \boxed{7.4 \times 10^{-5}\ mol/L \cdot s}$

(27)



$\Delta H_{forward} = 180 - 317 = -137\ KJ/mol$

$\Delta H_{reverse} = 317 - 180 = +137\ KJ/mol$

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(36) a) $RATE = k[H_2]^2[O_2]^1$

b) $k = \frac{RATE}{[H_2]^2[O_2]} = \frac{0.0036\ mol/L \cdot min}{(0.02\ mol/L)^2(0.02\ mol/L)} = \boxed{450\ L^2/mol^2 \cdot min^2}$

(37) 6.15×10^{-7} mol/L·s @ 25°C

a) $6.15 \times 10^{-7}\ M/s \div 2 = \boxed{3.075 \times 10^{-7}\ M/s\ @\ 15°C}$

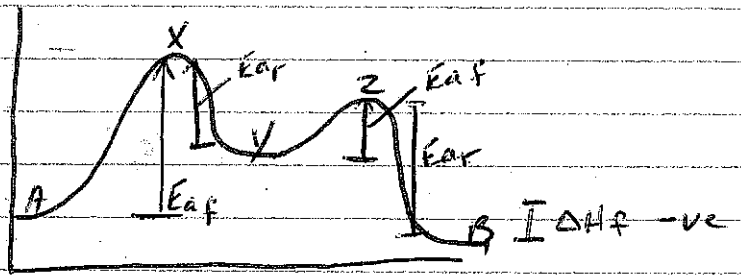
b) $6.15 \times 10^{-7}\ M/s \times 2 = 1.23 \times 10^{-6}$ @ 35°C

$1.23 \times 10^{-6}\ M/s \times 2 = 2.46 \times 10^{-6}\ M/s$ @ 45°C

$2.46 \times 10^{-6}\ M/s \times 2 = \boxed{4.92 \times 10^{-6}\ M/s\ @\ 55°C}$

(38) Set 3.

(39)



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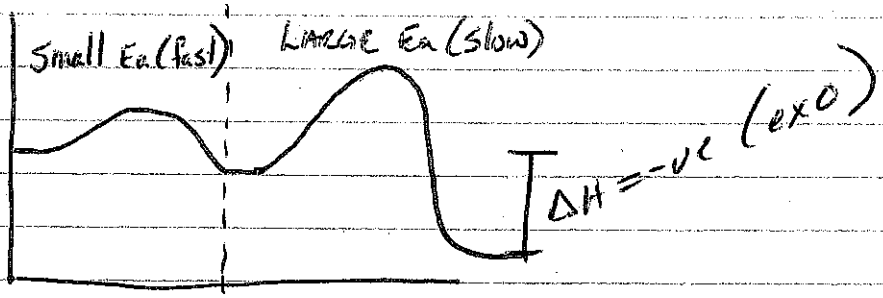

(41) a) NO_2 is an intermediate (not reactant or product)