Chem 209 - Winter 2017 - MT - © Pavel Sedach/Prep101

1. E

4 sig. figs. = 4 decimals

$$k = \frac{\ln\left(\frac{[0.002324\,M]}{[0.001017\,M]}\right)}{(10.25\,s - 0.5322\,s)}$$

2 decimals

$$k = \frac{0.8264}{\underbrace{9.72}_{\text{3 sig. figs.}}} = 0.0850\,s^{-1}$$

(9.7178)

2. A

25 mL $ZnCl_2$, 0.987 M → 100 mL.

use 50 mL of above = irrelevent

$C_1V = C_2V_2$, $25\,mL \cdot 0.987\,M = 100\,mL \cdot C_2$,

$C_2 = 0.24675\,M$

3. B $40.0\%\,C + 6.73\%\,H + 53.3\%\,O = 100.03\%$

% by mass = grams

↑ inaccurate but OK.

$40.0\,g\,C$ $6.73\,g\,H$ $53.3\,g\,O$

$\div 12.01\,g/mol$ $\div 1.008\,g/mol$ $\div 16.00\,g/mol$

$3.33\,mol$ $6.677\,mol$ $3.33\,mol$

$\div 3.33$ $\div 3.33$ $\div 3.33$ ← divide by smallest #

1 2 1

$C_1H_2O_1$ ← empirical formula

B. $C_3H_6O_3$ is the only multiple of this, $C_2H_4O_2$ would also work

4. D a) false, $k[A]^1[B]^1 \rightarrow [2A]^1 = \underset{\sim}{2}[A]^1$

b) false, ↑ T always ↑ k

c) false, catalyst changes k & perhaps order

d) somewhat true, $e^{-\frac{E_a}{RT}}$ = number of collisions with E_a

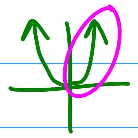
as written, it can increase either k or E_a...

e) false, if concentration is constant, so is rate.

5. C $\text{rate} = k[CH_3CHO]^2$

$\text{rate} \propto [CH_3CHO]^{\textcircled{2}}$ resembles $y = x^{\textcircled{2}}$ curve

(parabola)



6. A $\text{rate} = 3.2\ M/s$, $\text{coeff} = 2\ \ 1\ \ 2$

↑ for coeff. of 1 → 6.4 M/s, 3.2 M/s, 6.4 M/s

7. A To be consistent, 1. steps must add to net rxn.

2. rate law slow step = rate experiment

I $1NOCl \rightarrow \cancel{NO} + \cancel{Cl}$ slow, $k[NOCl]^1 = \text{rate}$

$\cancel{Cl} + NOCl \rightarrow \cancel{NOCl_2}$

$\cancel{NOCl_2} + \cancel{NO} \rightarrow 2NO + Cl_2$ NOT CONSISTENT

$2NOCl \rightarrow 2NO + Cl_2$ OK

II $2NOCl \rightarrow \cancel{NOCl_2} + NO$ slow, $\text{rate} = k[NOCl]^2$

$\cancel{NOCl_2} \rightarrow NO + Cl_2$

true

$2NOCl \rightarrow 2NO + Cl_2$ OK

III is consistent, $2NOCl \rightarrow Cl_2 + 2NO$, 1 step

* a) is II and III (the II is covered up by blue circle)

8. B   Slow step <u>must</u> have higher activation energy.

a) yes but ~~endothermic~~   c) E_a doesn't

b) exothermic ✓   d) ~~3 steps~~

9. C exothermic, $\overbrace{CS_{2(g)} + 3Cl_{2(g)}}^{4\text{ gases}} \rightleftharpoons \overbrace{S_2Cl_{2(g)} + CCl_{4(g)}}^{2\text{ gases}} + \text{heat}$

a) Add heat, shift left

b) H_2 is NOT part of rxn, no shift (same as inert gas)

c) compress = shift to less moles gas = shift right (to CCl_4)

d) Catalysts = no shift (like inert gas)

e) Adding S_2Cl_2, a product, will cause a shift left (to reactants)

10. A $CS_{2(g)} + 3Cl_{2(g)} \rightleftharpoons S_2Cl_{2(g)} + CCl_{4(g)}$

I	0.500 mol/L	1.50 mol/L	0	0
C	−x	−3x	+x	+x
E	0.375	1.125	0.125	0.125

$0 + x = 0.125$

$x = 0.125$

$$K = \frac{[CCl_4][S_2Cl_2]}{[CS_2][Cl_2]^3} = \frac{(0.125)(0.125)}{(0.375)(1.125)^3} = 0.0293$$

11. A $HA + OH^- \rightarrow H_2O + A^-$

this is not an equilibrium this is one way, K is massive!

12. D By definition, Ka is

$$HA_{(aq)} + H_2O_{(l)} \rightleftharpoons A^-_{(aq)} + H_3O^+_{(aq)}$$

Kb is $A^-_{(aq)} + H_2O_{(l)} \rightleftharpoons HA_{(aq)} + H_3O^+_{(aq)}$

13. D $2ICl \rightleftharpoons I_2 + Cl_2 \quad K_c = 0.110$

few.

$$K = \frac{[I_2][Cl_2]}{[ICl]^2} = \text{small}$$

many

Only C & D look like they can work, hard to tell

c) $K = \frac{[1]^2}{[2]^2} = 0.25$ d) $K = \frac{(0.33)(0.66)}{(1.50)^2} = 0.09\overline{6}$

closest out of all given