

Chem 209-MT-Fall 2016 © Preplol/Pavel Sedach

1. B $\frac{(82.631\text{g} - 18.39\text{g})}{(52.87\text{mL} - 47.43\text{mL})} = \frac{64.24}{5.44} = 11.8\text{g/mL}$

Annotations: 2 decimals (pointing to 64.24), 3 sig figs (pointing to 11.8), 11.8 kg/L (written below 11.8)

2. D $12.01\text{g C} \times \frac{1\text{mol}}{12.01\text{g}} = 1\text{mol C}$

$12.01 \times 18 + 34.34 + 32 = 20.79\text{g}$ $\text{C}_{18}\text{H}_{34}\text{O}_2 \times \frac{1\text{mol}}{282.52\text{g}} \times \frac{18\text{C}}{54\text{atoms}} = 0.0245\text{mol C}$

$= 282.52\text{g/mol}$ *Annotations:* 54 atoms (under H₃₄), 18 C (under 18C)

78.12 $24.21\text{g C}_6\text{H}_6 \times \frac{1\text{mol}}{78.12\text{g}} \times \frac{6\text{C}}{6\text{atoms}} = 0.31\text{mol C}$

30.08 **D** $31.05\text{g C}_2\text{H}_6 \times \frac{1\text{mol}}{30.08\text{g}} \times \frac{2\text{C}}{6\text{atoms}} = 0.345\text{mol C}$

$12.01 + 35.45 \cdot 4 = 42.89\text{g}$ $\text{CCl}_4 \dots$, not worth doing \rightarrow mostly Cl by mass

$= 153.81\text{g/mol}$

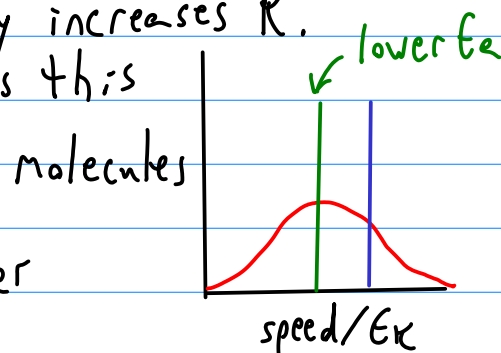
3. C a) false \rightarrow activation energy increases k.
A catalyst typically does this

b) false, rate constant is independent of any concentrations, regardless of order

c) true, $k = A e^{-\frac{E_a}{RT}}$ *related*

d) false, big K is technically unaffected.

e) false, same [J], same rate



4. B $rate = k [CH_3CHO]^2$, $rate = k [\frac{1}{2} CH_3CHO]^2$
 $rate = \frac{1}{4} k [CH_3CHO]^2$

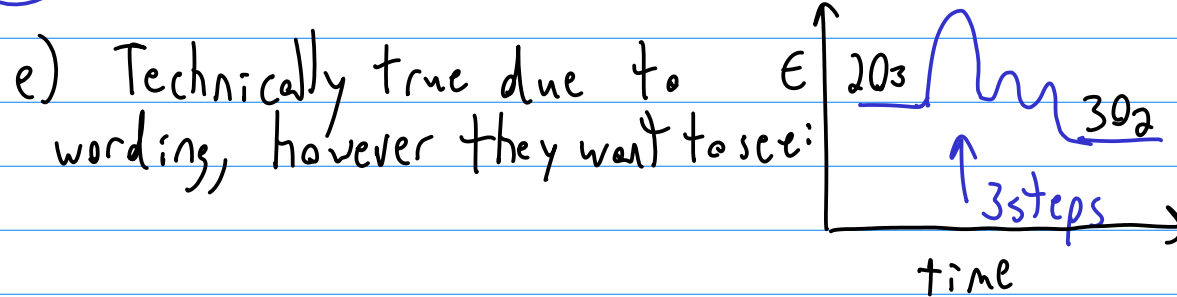
5. B

P_4	H_2	Rate _i
0.0110	0.0075	3.2
0.0110	0.0150	6.4
0.0220	0.0150	~6.4

$[2H_2]^n = 2 \times rate, n = 1$
 $[2P_4]^m = 1 \times rate, m = 0$
 $rate = k [H_2]^1$ overall

6. A , based on slow step

7. D $rate = k [Cl][O_3]$ based on slow step
- a) false, breaking a bond on the edge ; easier
 - b) false
 - c) false
 - d) Yes... it is used and regenerated



8. C 0.25, AgCl, 1.25L $4.6 \times 10^{-6} \text{ M AgCH}_3\text{COO}$
 $2.3 \times 10^{-3} \text{ M Cl}^-$
 $1.1 \times 10^{-8} \text{ M H}^+$
 $0.010 \text{ M CH}_3\text{COOH}$

At first glance D looks correct BUT we need to determine if the system is unsaturated. If it is unsaturated, more will dissolve.

$$Q = \frac{[\text{Ag}(\text{CH}_3\text{COO})][\text{Cl}^-][\text{H}^+]}{[\text{AgCl}][\text{CH}_3\text{COOH}]} = \frac{(4.6 \times 10^{-6} \text{ M})(2.3 \times 10^{-3} \text{ M})(1.1 \times 10^{-8} \text{ M})}{1 \cdot 0.010 \text{ M}}$$

$$Q = 1.1638 \times 10^{-14} \quad K = 5.87 \times 10^{-16} \dots \quad K < Q$$

← supersaturated!

C) true, assuming system shifts left at some point due to supersaturation

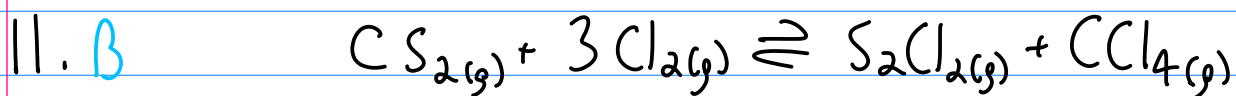
9. B exothermic → increasing T shifts left (and K is smaller)

Note that we say 'because heat is a product', but really equilibrium is when rate forward = rate reverse

Due to this, $K = \frac{k_f}{k_r}$ ← the two are affected differently by T due to different E_a's.

Mence system shifts because K changes

10. D
- a) Shift to more moles gas (right), H^+ decreases, \therefore pH increases
- b) $BaCO_3$ is a solid, no shift.
- c) Reaction will shift right infinitely, H^+ decreases, \therefore pH increases
- d) Adding $BaCl_2 =$ adding Ba^{2+} , shift left, H^+ increase, \therefore pH decrease



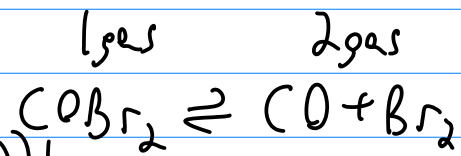
I	0.500 mol/L	1.50 mol/L	\emptyset	\emptyset
C	-x	-3x	+x	+x
E	0.375	1.125	0.125	0.125

$\emptyset + x = 0.125$
 $x = 0.125$

$$1.125 \text{ mol/L} \cdot 2 \text{ L} = 2.250 \text{ mol}$$

12. C $K_p = K_c(RT)^{\Delta n_{\text{gas}}}$

$= 0.190 \left((0.08205 \frac{\text{Latm}}{\text{molK}}) (346.15\text{K}) \right)^1$



$\Delta n_{\text{gas}} = +1$

$73 + 273.15 = 346.15$

$= 5.396$ using atm, $0.190 \cdot 0.08314 \cdot 346.15 = 5.468$

USING BAR
 (very atypical!!)

in past exams, always used atm. What an odd twist...

13. C Highest pH = least acidic

	1M	a	1.75×10^{-5}	← exclude both these
	0.1M	b	1.75×10^{-5}	
this one is →	0.1M	c	1.52×10^{-5}	
the weaker acid so c	1M	d	3.37×10^{-3}	