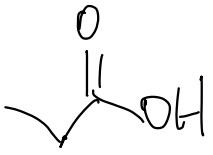
1. polymer — many

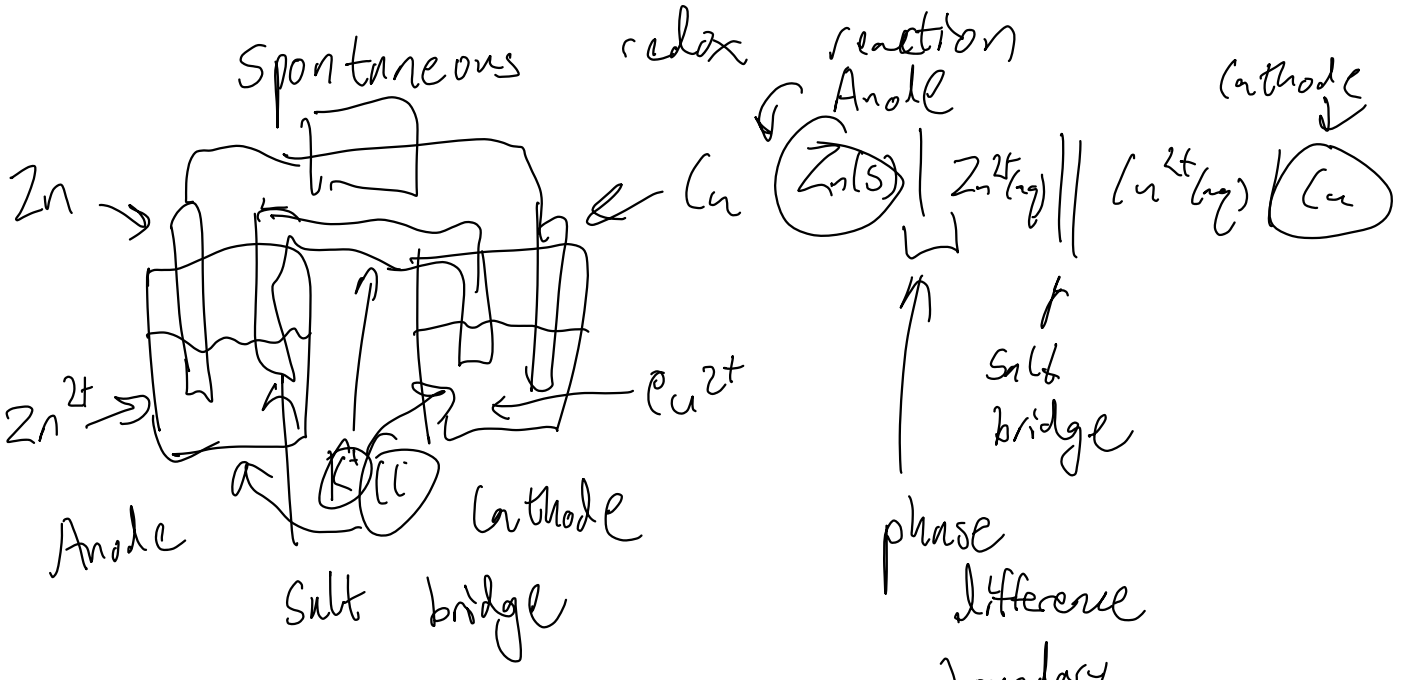
polypropylene

E $CH_2=CHCH_3$

3. C_6H_6



8. Galvanic (Voltaic) cell



$Cu^{2+} + Zn(s) \rightarrow Zn^{2+} + Cu(s)$

$Cu^{2+} + 2e^- \rightarrow Cu$

$Zn \rightarrow Zn^{2+} + 2e^-$

15. $SO_2 + O_2 \rightarrow$

Reaction is exothermic $\Delta H < 0$

C

21. 2.145g → 204.23 $\frac{2.145}{204.23} = .0105$ moles KHP

.00105 moles KHP per titration

.1036 M NaOH .10137 10.14 mL

A obviously wrong

Glass not dry → no real change

Not true, 30 seconds more than enough

First trials too low
Later trials too high] Consistent

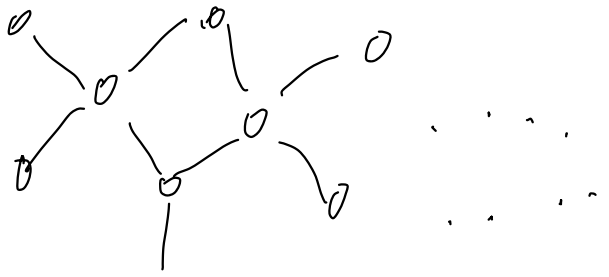
CO_2 absorption, decrease conc of NaOH, does NOT explain under shoot in first few titrations

D is correct

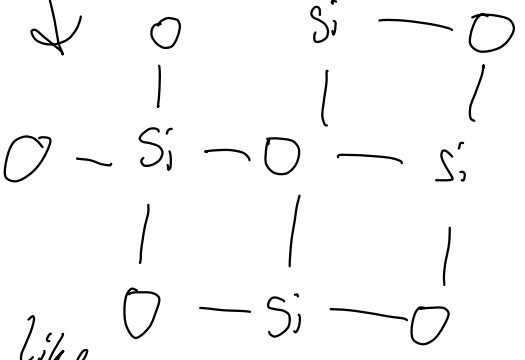
23. Dumb trivia question

A NO_2 → orange/red toxic

27. C Network covalent



SiO_2



Ionic

↓

Ions

NaCl

Fe Ni

An

Delocalized sea

of electrons

smth like this...

29. K

4th $n=4$, eliminates C/E

l s electron, $l=0$

orbital

$m_l = \pm l$ $m_l = 0$

$m_s = \pm 1/2$

$n=4$

$l=0$

$m_l=0$

$m_s = 1/2$

32. $[HF] = .08M$ $K_a = 6.8\cdot10^{-4}$

$[H_3O^+] = 7.4\cdot10^{-3}$

$7.4\cdot10^{-3}$

$[H_3O^+][F^-] \rightarrow .00735M$

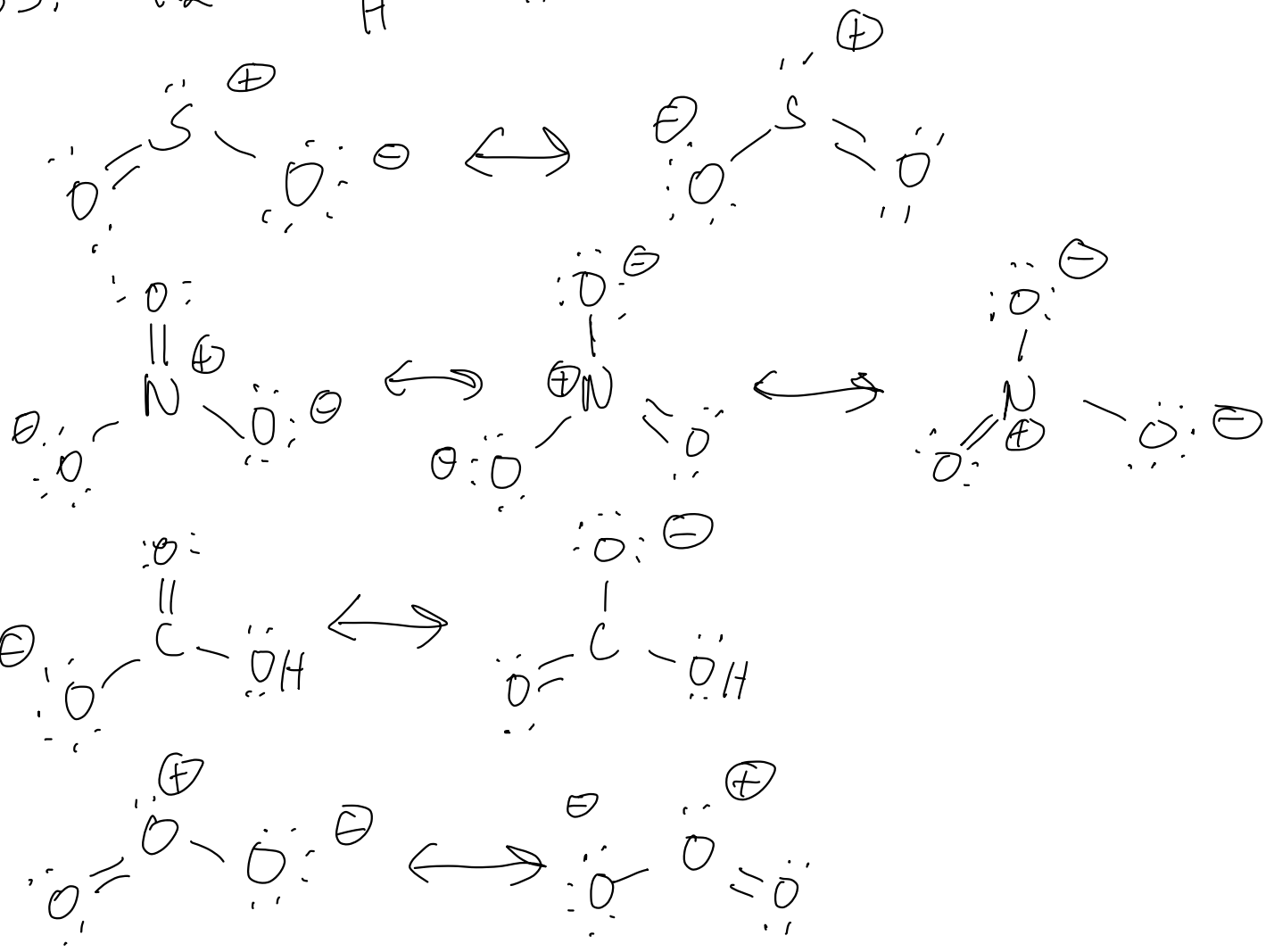
$6.8\cdot10^{-4} = \frac{[H_3O^+][F^-]}{[HF]}$

$[HF] \rightarrow .08$

$\frac{.00735}{.08} = .0919$

$\rightarrow$ 9.2% dissociation

33. H_2O



37. Physics question

$$F = kx$$

x: displacement of spring

k: spring constant

$$\omega = \sqrt{\frac{k}{m}}$$

strong chemical bond is like a higher value of k

(B)

$$c = \lambda \nu$$

ν: nu

40. Isotropes: same # of protons

diff # of neutrons

79 81

E X X X = Br

35 35

58. $C_xH_yO_z + aO_2 \rightarrow CO_2 + H_2O$

100 − 38.71 − 9.68 = 51.61%

↓ O

9.86 H 38.71 C 51.61 O

1 12 16

9.86 / 9.86 = 1

38.71 / 12 = 3.226

3.226 / 3.226 = 1

51.61 / 16 = 3.226

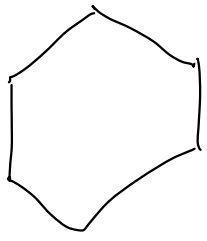
3.226 / 3.226 = 1

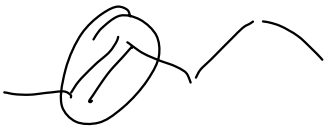
CH_3O

E

3.06 ~ 3

59.





cis or trans here ???

E → same formula → same molar mass

→ when vaporized, same density

60. Exothermic

Inert gas → no effect on equilibrium

Catalyst do not affect equilibrium

63. KMT → energy + orientation

successful reaction requires proper alignment and velocity to occur

$A + B \rightarrow C + D$

74. ΔG° ← standard conditions — 1 atm 25°C

standard T P — 1 atm 0°C

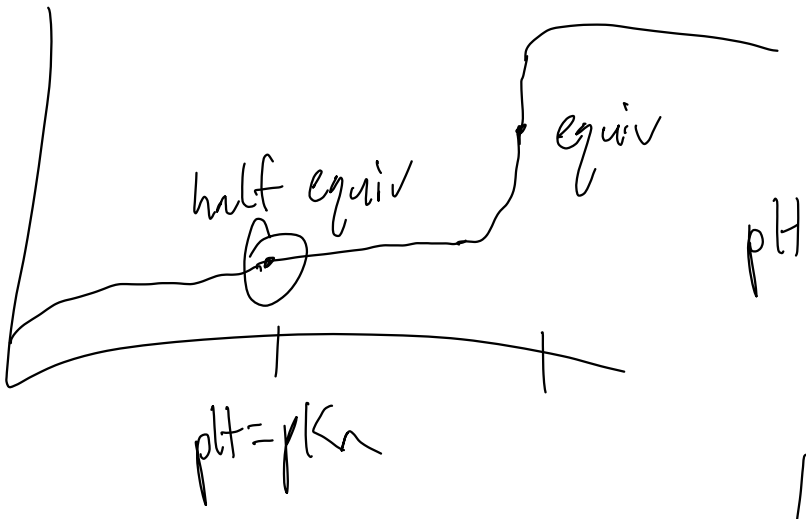
ΔG refers to ACTUAL conditions

$\Delta G > 0$, nonspontaneous

B

5. pH meter computer to track data, standardized base, other titration equipment

a)



$pH = pK_a + \log\left(\frac{[A^-]}{[HA]}\right)$

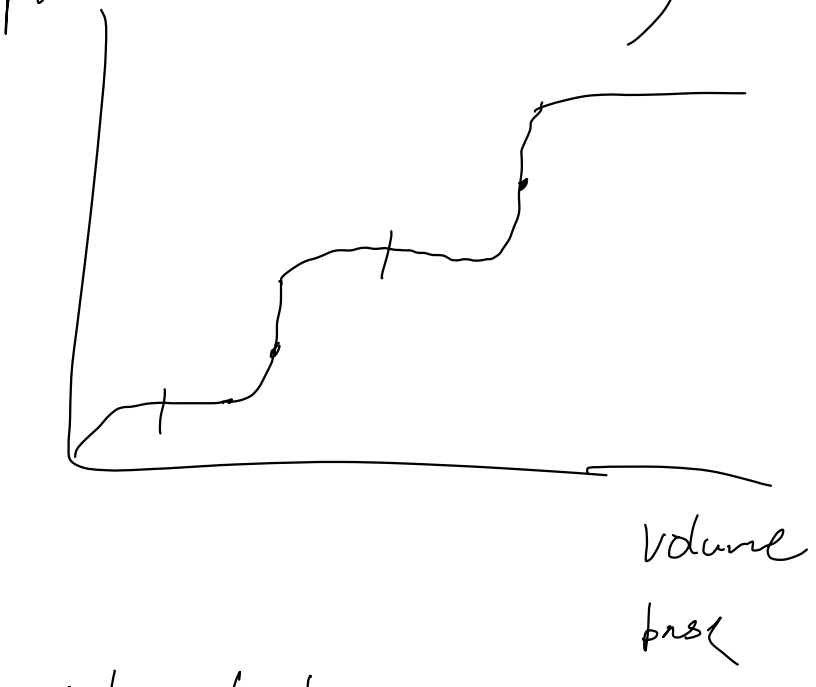
$\log(1) = 0$

$[A^-] = [HA]$

halfway

b) H_2SO_4

H_2CO_3



c) Yes

weigh the mass of compound, dissolve, perform titration → moles of base = moles of acid

$\frac{\text{mass of acid}}{\text{moles of acid}}$ = molar mass

d) Strong base (NaOH), new acid, phenolphthalein

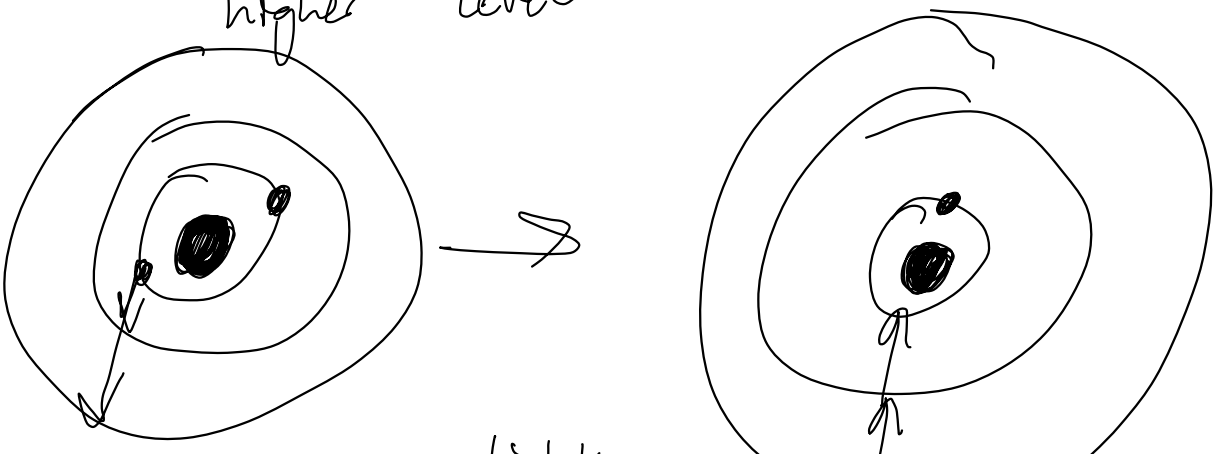
e) Computer monitor, pH meter

f) Beakers, flasks, burettes, stir bar

6. a) Bunsen burner / flame tests

$$E = h\nu = \frac{hc}{\lambda} \leftarrow \text{wavelength}$$

heat / voltage → excites electrons, jump up to higher level



Energy released as light

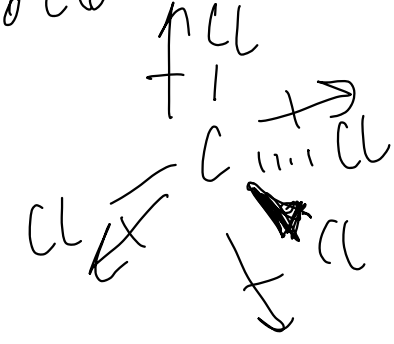
b) Isoelectronic

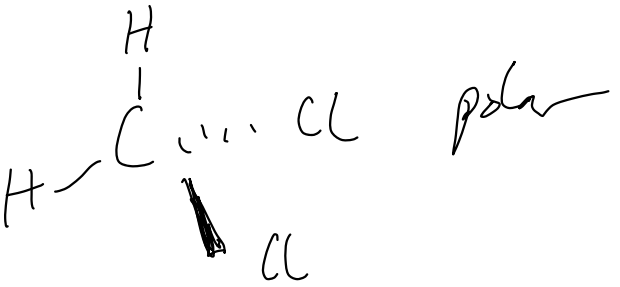
same octet rule

Na^+ K^+ O^{2-} Cl^-

Mg^{2+} F^-

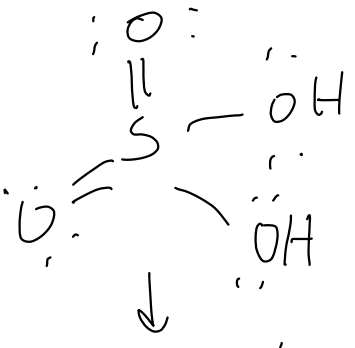
c)



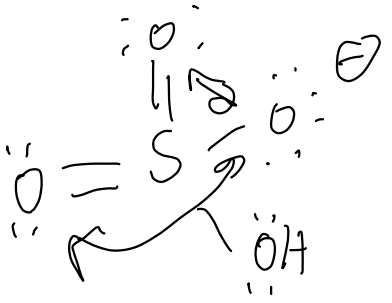


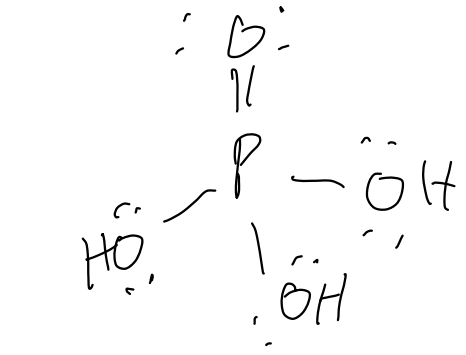
polar

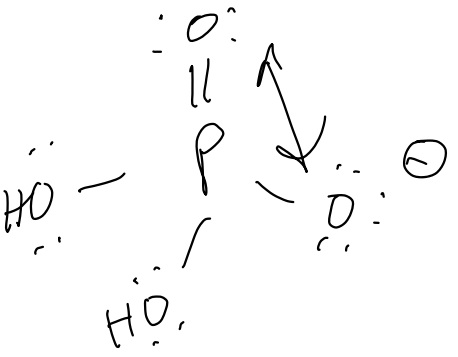
d) Acid strength correlated with stability of conjugate base



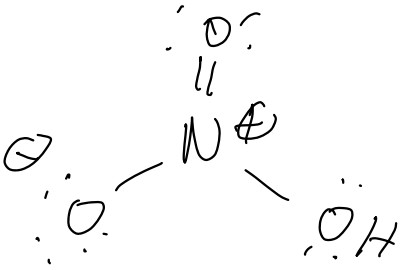
more able to delocalize

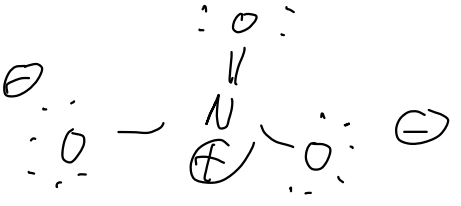






HNO_3 strong acid



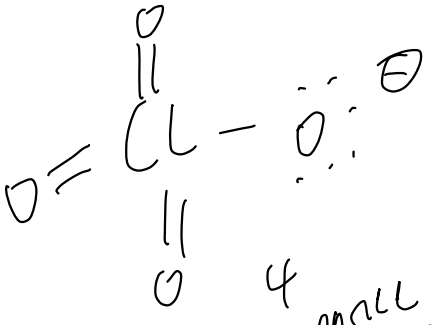


e) C_4H_{10}
$C_{10}H_{22}$
$C_{22}H_{46}$

LDFs → molecule gets bigger

f) ClO_4^-

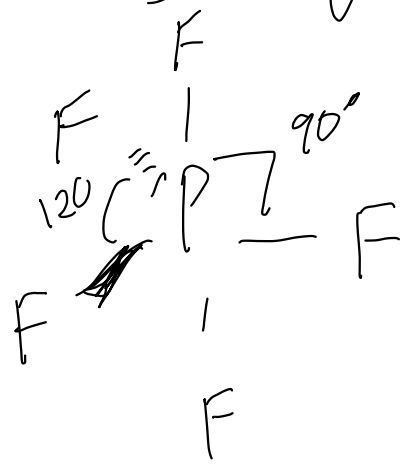
ClO^- → only 1, not real resonance structure

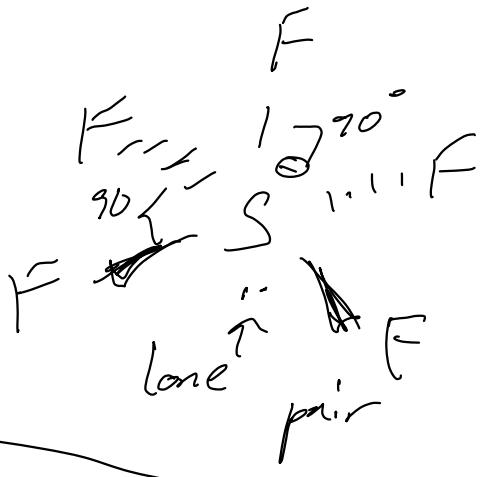


4 resonance structures

$HClO_4$ is a strong acid

g) PF_5 trigonal bipyramidal





h) $C \equiv C$

Takes too much energy

Cannot properly hybridize

$C-C$ sp^3

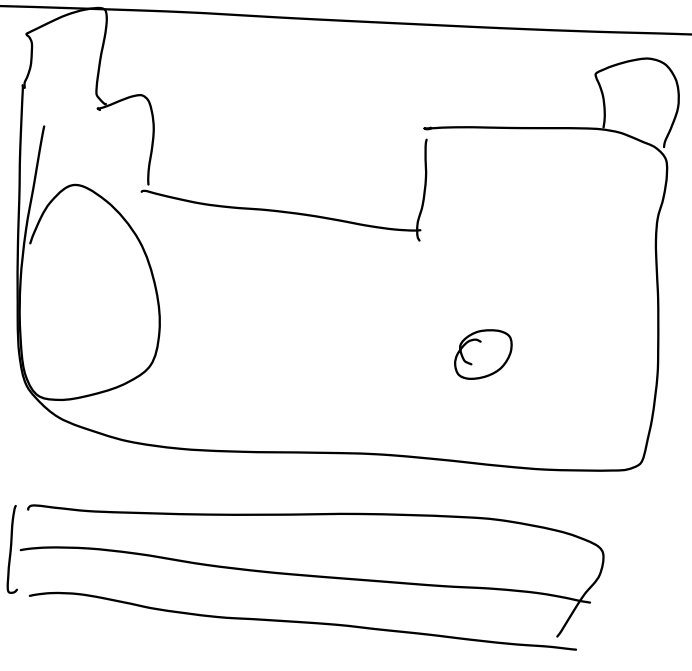
$C=C$ sp^2

$C \equiv C$ sp

---

i. D Tl

Shielding, harder to remove for s electrons post-d block elements



3. Amphoteric → acid + base

1/3 $Zn(OH)_2 + 2OH^- \rightarrow Zn(OH)_4^{2-}$

7. HSO_4^- SO_4^{2-} ⊏ basic

acidic

HS^- ↑ weakly basic

HCO_3^- ↑ basic

8. .407g .407/226

2 Equiv Na_2CO_3 $NaHCO_3$ 1 equiv = .0080 moles

HCO_3^- 3 Equivs HCL ↓

.00540 moles

H_2CO_3 43.2mL

↓

$H_2O + CO_2$

12. Law of pressure

(D)

15. Coulomb's law $= \frac{q_1 q_2}{r^2}$

MgO $\frac{+2 \quad +2}{}$

18. Bomb $\Delta V = 0$

$q = \Delta H$

27. $k = Ae^{-\frac{E_a}{RT}}$

$$e^{-\frac{E_a}{RT_1}} = 37e^{-\frac{E_a}{RT_2}}$$

T_1: $75^\circ C \rightarrow 348$

T_2: $25^\circ C \rightarrow 298$

26. $\ln[A] = -kt + \ln[A]_0$

$\ln(.3) = -k \cdot 5$ $\quad [A]_0 = 1$

$-\ln(.3)/5 = .241$ $\quad [A] = .3$

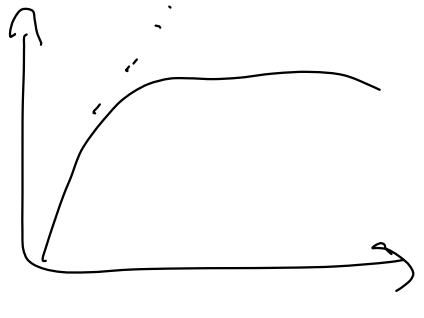
$.24$/min

29. B

Cl is intermediate

$Cl_2(g) \rightleftharpoons 2Cl(g)$ $\quad [Cl_2]^{1/2}$

32.



33. $K_a = 1.9 \cdot 10^{-4} = \frac{x^2}{.10} \rightarrow \frac{[H^+][HCOO^-]}{[HCOOH]}$

$X = .00436$

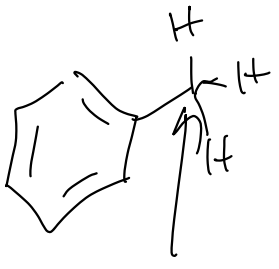
$.00436 / .1 = 4.4\%$

36. $K_{sp} = [Ca^{2+}][OH^-]^2$

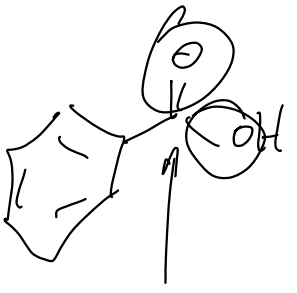
$s \quad 2s \rightarrow K_{sp} = 4s^3$

$s = 1.0 \cdot 10^{-2}$

38.



1C, 3H
-3



3O, 1C
+3

C-C O

C-O +1
C-Cl

C-H -1

42. $.150 \cdot .115 \cdot 2 = .0345$ moles Cr^{6+}

$.0345 \cdot 4 = .138$ F

$Cr_2O_7^{2-}$
↓ 6+

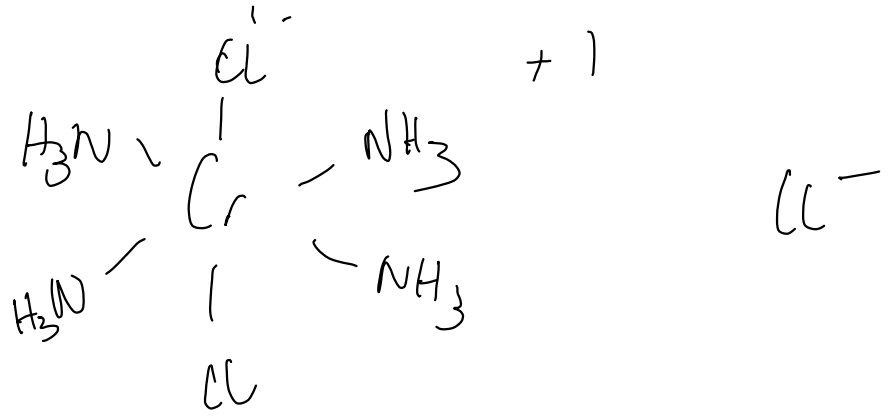
48. $Al_2O_3 \rightarrow$ in minerals

$SiO_2 \rightarrow$ net work covalent

$P_4O_{10} \Rightarrow$

51. If it can't have an expanded octet, can't make more than 4 bonds

53.



Unit 1: Atomic structure / properties

Moles / molar mass

Periodic trends, structure

PES photoelectron spectroscopy

Valence electrons, octet rule, ionic compounds
↳ ionic bonds
crystal structure

Unit 2: Compounds

2 or more distinct atoms

O_2 molecule

H_2O compound

Ionic vs. covalent

Intermolecular forces

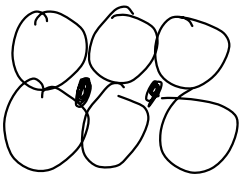
metallic bonds
↳ sea of electrons (delocalized)

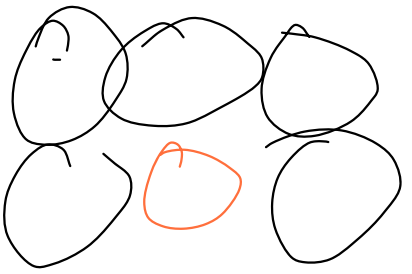
Alloys

↳ Bronze Cu/Sn

Brass Cu/Zn

Cast iron Fe/C → interstitial





Lewis diagrams

Resonance, formal charge, oxidation states

↓

stability ⇒ sp^3, sp^2, sp

VSEPR, hybridization

↓

predict geometry of bonds

Unit 3: Mixtures

IMFs: LDFs, DD, hydrogen bonding

Solids, Liquids, gases

↳ Ideal gas law

Solutions → net ionic equation, solubility rules

spectroscopy, $E = \frac{hc}{\lambda} = h\nu$, photons

Absorbance of light → concentration

Beer-Lambert Law $A = \varepsilon b c$

Unit 4: Chemical Reactions

Physical vs. chemical change

Stoichiometry, types of chemical reactions

Analytical methods → titrations (acid base)

Redox reactions

Unit 5: Kinetics

Reaction rates, rate laws, 0th 1st 2nd order Integrated Rate Laws

Graphs ↙ ↘

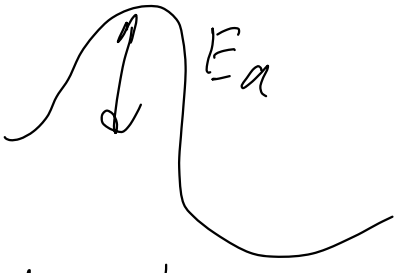
Equations to know

KMT

Collision model → orientation + energy

$k = Ae^{-\frac{E_a}{RT}}$

Energy profile



Elementary reactions / mechanisms → ↯

Catalysts

Unit 6: Thermo

endo vs exothermic processes

ΔH q w T ΔS ΔG

heat capacity, heating curves → phase changes

enthalpy, calorimetry

Hess's Law → calculate heats ΔH, ΔG

Bond enthalpies → energy necessary to break a covalent bond

"takes to break"

Unit 7: Equilibrium

IGNORE (s) (l)

Q vs. K → (g) (aq)

$\rightleftharpoons$

reaction quotient

ICE boxes

I

C

E

Le Châtelier's Principle

A stress in the given state will shift reaction

gases → change P, V (Δn)

K_c K_p $K_p = K_c (RT)^{\Delta n}$

solubility → K_{sp}

S ↘ solubility

$[K^+][Br^-]$ $[K^+] = [Br^-]$ s 2s

$Zn(OH)_2$ $2[Zn^{2+}] = [OH^-]$ $4s^3$

s^2 $4s^3$ $27s^4$ .....

Common ion effect

$PbCl_2 \rightarrow Pb^{2+} + 2Cl^-$

solubility will decrease even more

Cl^- exists already in solution

$AgCl \rightarrow Ag^+ + Cl^-$

NH_3

$Ag^+ + 2NH_3 \rightarrow Ag(NH_3)_2^+$

Acid dissociation / ionization

weak acid $K_a = \frac{X^2}{[M]}$

$[H_3O^+]$

Unit 8: Acids/Bases

3 definitions Arrhenius, Bronsted, Lewis

H^+, OH^- proton acceptor/donor electron pair acceptor/donor

pH/pOH $-\log([H^+])$

$-\log([OH^-])$

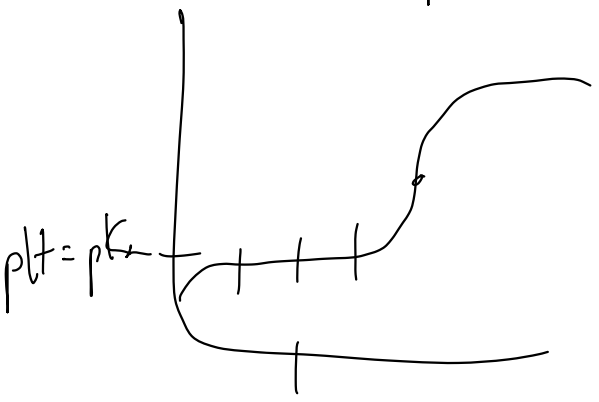
$14 + \log([OH^-]) = pH$

Buffers → maintain stable pH

$$pH = pK_a + \log\left(\frac{[A^-]}{[HA]}\right)$$

HH - equation

Titration curves, given a curve, can determine end point, pK_a weak acid - strong base titrations



buffers are valid ± 1 pH of pK_a

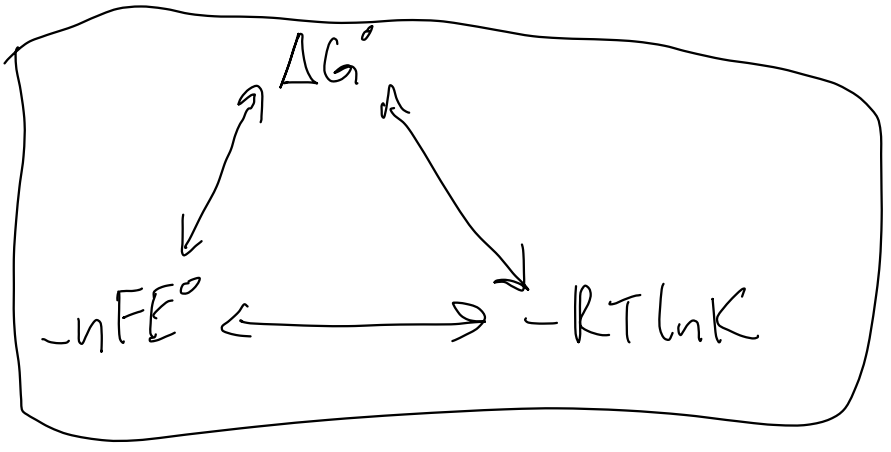
pH / solubility $Zn(OH)_2$

9. Thermodynamics / Electrochemistry

$\Delta S \rightarrow$ degrees of freedom / microstates

$s \rightarrow l \rightarrow g$ $\Delta G < 0$ spont

ΔG° > nonspont



Galvanic (Voltaic) cells
↳ spontaneously

Standard reduction potential
↓ redox

$$E = E^\circ - \frac{RT}{nF} \ln Q$$

Electrolysis, Faraday's law

Electrolytic cells>

$Cu^{2+} + 2e^- \rightarrow Cu(s)$ +.34V

$Zn^{2+} + 2e^- \rightarrow Zn(s)$ -.76V

$Cu^{2+} + Zn(s) \rightarrow Cu(s) + Zn^{2+}$ 1.10V

Relax, before exam: DO NOT stay up late to cram, get a lot of rest night before, sleep well, eat breakfast, and take a deep breath.