REVIEW FOR TEST

Spontaneity, Entropy and Free Energy

10. Which of the following involve an increase in the entropy of the system:
    a. Melting of a solid
    b. Sublimation
    c. Freezing
    d. Mixing
    e. Separation
    f. Boiling

11. Predict the sign on ΔS_{surr} for the following processes:
    a. $C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$ $\Delta H = -2221$ kJ
    b. $2NO_{2)g)} \rightarrow 2NO_{(g)} + O_{2(g)}$ $\Delta H = 112$ kJ

decrease for surr.
decrease for surr

12. Given the following ΔH and ΔS, which of the following changes will be spontaneous at constant T and P?
    a. ΔH = +25 kJ, ΔS = +5.0 J/K, T = 300K no
    b. ΔH= -10 kJ, ΔS = -40 J/K, T = 200K yes

$\Delta G = \Delta H - T\Delta S$
$+23.5 = +25 - (300)(0.005)$
$-2 = -10 - (200)(-0.040)$

13. For the reaction

$$CS_{2(g)} + 3O_{2(g)} \rightarrow CO_{2(g)} + 2SO_{2(g)}$$

ΔS^0 is equal to -143 J/K. Use the values on the table to calculate the value of S^0 fo CS_2

$\Delta S^0 = \sum S_{prod} - \sum S_{reac}$
$-143\ \frac{J}{K} = [1(214\ \frac{J}{K}) + 2(248\ \frac{J}{K})] - [1(x) + 3(205\ \frac{J}{K})]$
$-143 = 710 - (x + 615$
$-143 = 710 - x - 615$
$-x = 238\ \frac{J}{K}$
$x = 238\ \frac{J}{K}$

14. Consider the reaction

$2O_{(g)} \rightarrow O_{2(g)}$

a) Predict the signs on ΔH and ΔS

b) Would the reaction be more spontaneous at high or low temperatures? Explain.

a) ΔH: would be - because bonds are formed

ΔS: would be - because moles of gas is decreasing

b) $\Delta G = \Delta H - T\Delta S$

$: (-) - (-)$

in order for ΔG to be negative, temp must be low

15. Balance the following REDOX reactions

$Cu_{(s)} + NO_3^-{}_{(aq)} \rightarrow Cu^{+2}{}_{(aq)} + NO_{(g)}$ in an acidic solution

$[Cu \rightarrow Cu^{+2} + 2e^-]3$

$[3e^- + 4H^+ + NO_3^- \rightarrow NO + 2H_2O]2$

$3Cu + 8H^+ + 2NO_3^- \rightarrow 3Cu^{+2} + 2NO + 4H_2O$

$NO_2^-{}_{(aq)} + Al_{(s)} \rightarrow NH_{3(g)} + AlO_2^-{}_{(aq)}$ in a basic solution

$6e^- + 7H^+ + NO_2^- \rightarrow NH_3 + 2H_2O$

$[2H_2O + Al \rightarrow AlO_2^- + 4H^+ + 3e^-]2$

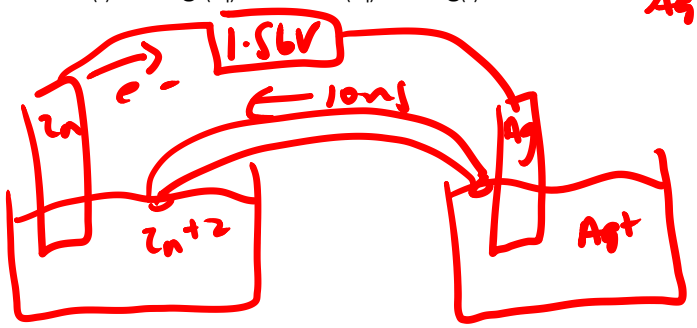
$OH^- + 2H_2O + NO_2^- + 2Al \rightarrow NH_3 + 2AlO_2^- + H^+ + OH^-$

$OH^- + H_2O + NO_2^- + 2Al \rightarrow NH_3 + 2AlO_2^-$

16. Sketch and label all the parts of the following galvanic cell, calculate the voltage across the cell and give the standard line notation

ox Red

$Zn_{(s)} + Ag^{+}_{(aq)} \rightarrow Zn^{+2}_{(aq)} + Ag_{(s)}$



Anode

$Zn|Zn^{+2} \,||\, Ag^{+}|Ag$

$Zn^{+2} + 2e^- \rightarrow Zn$ $\quad -0.76$

$Ag^{+} + 1e^- \rightarrow Ag$ $\quad 0.80$

$E_{cell} = E_{red} - E_{ox}$

$= 0.80 - -0.76 = 1.56V$

17. Use the reduction potential table to determine the order of increasing strength as reducing agents

Cu^{+} , F^{-} , H^{-} , H_2O , I_2 , K

Smallest RA
- least likely to lose e-
- most likely to gain e-

largest RA
- most likely to lose e-
- least likely to gain e-

$H_2O < Cu^{+} < I_2 < H^{-} < F^{-} < K$

18. Consider the cell described below:

$Zn|Zn^{+}$ (1.00M)$||Cu^{+2}$ (1.00M)$|Cu$

Calculate the cell potential after the reaction has operated long enough for the $[Zn^{+2}]$ to have changed by 0.20 M (assume T=25^{0}C)

$Zn \rightarrow Zn^{+2} + 2e^-$ $\quad -.76$ $\quad$ @ 1.00 M

$Cu^{+2} + 2e^- \rightarrow Cu$ $\quad 0.34$

$E^\circ_{cell} = E^\circ_{red} - E^\circ_{ox} = 0.34 - -0.76 = 1.10V$

$E_{cell} = E^\circ_{cell} - \frac{0.059}{n} \log Q$ $\quad Zn + Cu^{+2} \rightarrow Zn^{+2} + Cu$ $\quad -0.20 \quad +0.20$

$= 1.10V - \frac{0.059}{2} \log \frac{1.20}{0.80}$

$1.10V - 0.00520 = 1.09V$

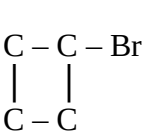
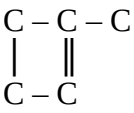
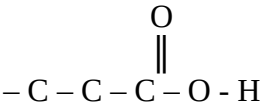
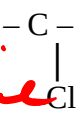
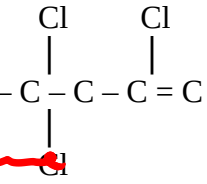
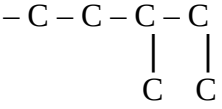
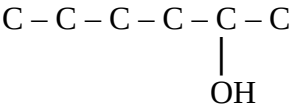
19. How long will it take to plate out 1.0 g Ni from a Ni^{+2} solution with a current of 100.0 A?

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

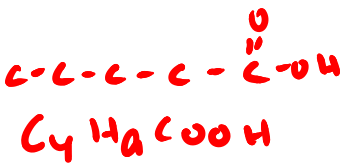
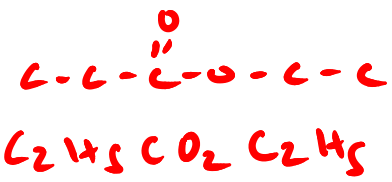
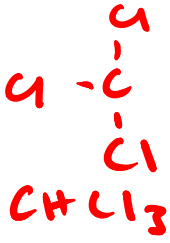
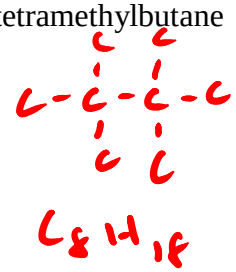
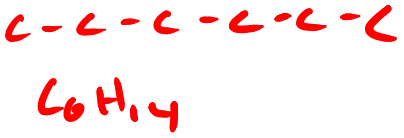
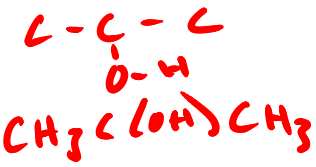
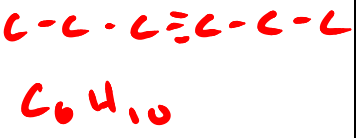
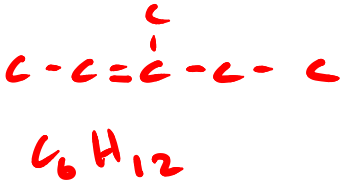
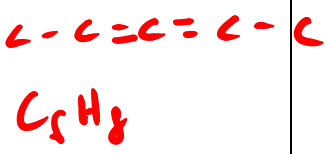
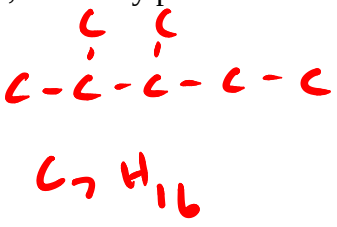
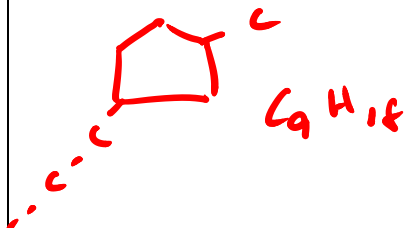
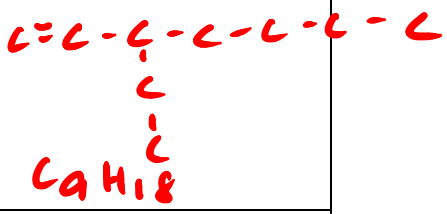
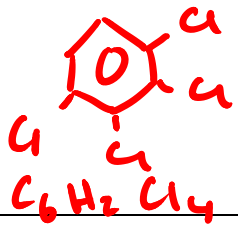
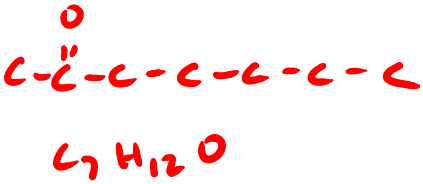
$$1.0g\ Ni: \frac{1mole\ Ni}{58.70g\ Ni} \left| \frac{2mole\ e^-}{1mole\ Ni} \right| \frac{96,485C}{1mole\ e^-} \left| \frac{1sec}{100.0C} \right. = 33\ sec$$

20. What mass of Co will plate out from a Co^{+2} solution in 1.0 hour with a current of 15 A?

$$1.0hr \left| \frac{60min}{1hr} \right| \frac{60sec}{1min} \left| \frac{15C}{1sec} \right| \frac{1mole\ e^-}{96,485C} \left| \frac{1mole\ Co}{2mole\ e^-} \right| \frac{58.93g}{1mole\ Co} = 16.5g\ Co$$

Classification		Name
cycloalkane halogen derivative	1. 	bromocyclobutane
Cycloalkene	2. 	1-methyl-1-cyclobutene
alkyne	3. C ≡ C – C – C	1-butyne
acid	4. 	butanoic acid
alkyne halogen derivative	5. 	4-chloro-1-butyne
alkene halogen derivative	6. 	2,4,4-trichloro-1-pentene
alkane	7. C – C – C – C – C – C	hexane
alkane	8. 	3-methyl-hexane
ether	9. C – C – O – C – C – C	ethoxypropane
alcohol	10. 	2-hexanol
aldehyde	11. C – C – C – C = O	butanal
ketone	12. 	2-pentanone

Draw the condensed structural formula and the skeletal formula for the following

pentanioc acid 	Ethyl propanoate 	trichloromethane 
tetramethylbutane 	hexane 	2-propanol 
3-hexyne 	3-methyl-2-pentene 	2,3-pentadiene 
2,3-dimethylpentane 	1-methyl-3-propylcylcopentane 	3-ethyl-1-heptene 
1,2,3,4-tetrachlorobenzene 	2-heptanone 	Methanal