Chemistry 123 | Spring 2007 | Oregon State University
Final Exam | June 14, 2007 | Dr. Richard Nafshun

DO NOT OPEN THIS EXAM UNTIL INSTRUCTED. CALCULATORS ARE NOT TO BE SHARED.

Instructions: You should have with you several number two pencils, an eraser, your 3" x 5" note card, a calculator, and your University ID Card. If you have notes with you, place them in a sealed backpack and place the backpack OUT OF SIGHT or place the notes directly on the table at the front of the room.

Fill in the front page of the Scantron answer sheet with your last name, first name, middle initial, and student identification number. **Leave the test form number and class section number blank.**

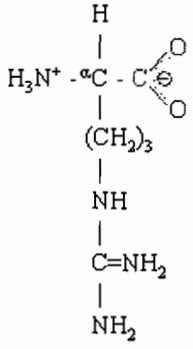
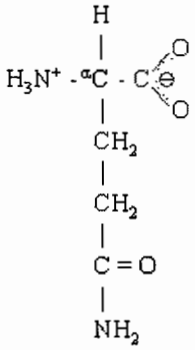
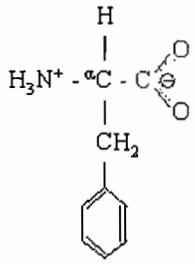
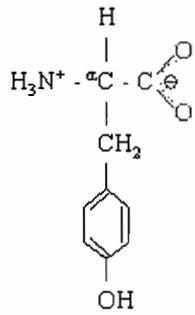
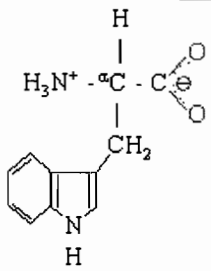
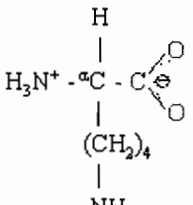
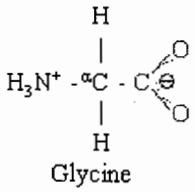
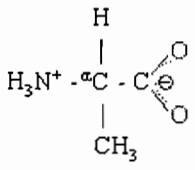
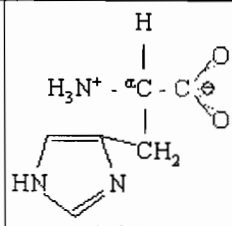
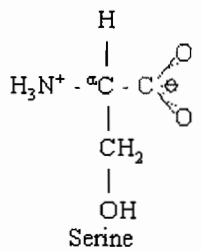
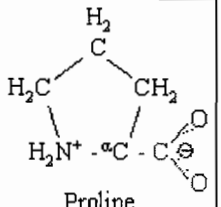
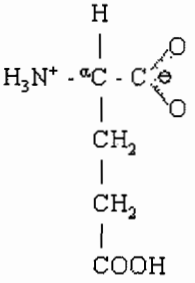
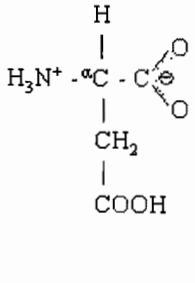
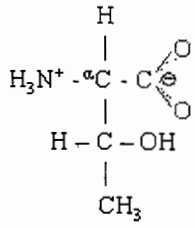
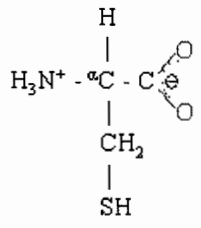
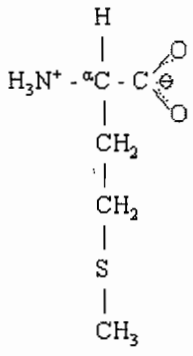
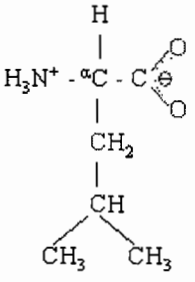
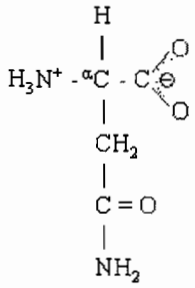
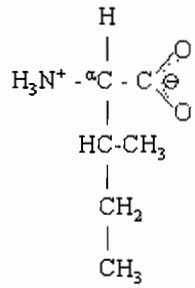
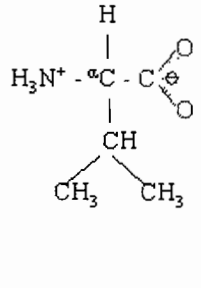
This exam consists of 36 multiple-choice questions. Each question has four points associated with it; except Question 36 which has five points associated with it. Select the best multiple-choice answer by filling in the corresponding circle on the rear page of the answer sheet. If you have any questions before the exam, please ask. If you have any questions during the exam, please ask the proctor. Open and start this exam when instructed. When finished, place your Scantron form in the appropriate stack. You may keep the exam packet, so please show your work and mark the answers you selected on it.

IA		IIIB	IVB	VB	VIB	VIIB	VII			1B	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1 H Hydrogen 1.0079																	2 He Helium 4.0026
3 Li Lithium 6.941	4 Be Beryllium 9.01218											5 B Boron 10.81	6 C Carbon 12.011	7 N Nitrogen 14.0067	8 O Oxygen 15.9994	9 F Fluorine 18.9984	10 Ne Neon 20.179
11 Na Sodium 22.98977	12 Mg Magnesium 24.305											13 Al Aluminum 26.9815	14 Si Silicon 28.0855	15 P Phosphorus 30.97376	16 S Sulfur 32.06	17 Cl Chlorine 35.453	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.08	21 Sc Scandium 44.9559	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.996	25 Mn Manganese 54.9380	26 Fe Iron 55.847	27 Co Cobalt 58.9332	28 Ni Nickel 58.70	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.72	32 Ge Germanium 72.59	33 As Arsenic 74.9216	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.9059	40 Zr Zirconium 91.22	41 Nb Niobium 92.9064	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.4	47 Ag Silver 107.868	48 Cd Cadmium 112.41	49 In Indium 114.82	50 Sn Tin 118.69	51 Sb Antimony 121.75	52 Te Tellurium 127.60	53 I Iodine 126.9045	54 Xe Xenon 131.30
55 Cs Cesium 132.9054	56 Ba Barium 137.33	57–71 *Rare earths	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.2	77 Ir Iridium 192.22	78 Pt Platinum 195.09	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.37	82 Pb Lead 207.2	83 Bi Bismuth 208.9804	84 Po Polonium (209)	85 At Astatine (210)	86 Rn Radon (222)
87 Fr Francium (223)	88 Ra Radium 226.0254	89–103 †Actinides	104 Rf Rutherfordium (261)	105 Ha Hahnium (262)	106 Sg Seaborgium (263)	107 Ns Neilsbohrium (262)	108 Hs Hassium (265)	109 Mt Meitnerium (266)	110 ‡ (269)	111 ‡			114				

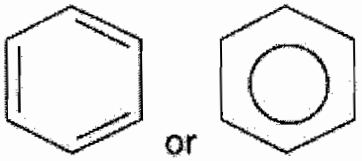
→ Stable region?

57 La Lanthanium 138.9055	58 Ce Cerium 140.12	59 Pr Praseodymium 140.9077	60 Nd Neodymium 144.24	61 Pm Promethium 145	62 Sm Samarium 150.4	63 Eu Europium 151.96	64 Gd Gadolinium 157.25	65 Tb Terbium 158.9254	66 Dy Dysprosium 162.50	67 Ho Holmium 164.9304	68 Er Erbium 167.26	69 Tm Thulium 168.9342	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
89 Ac Actinium 227.0278	90 Th Thorium 232.0381	91 Pa Protactinium 231.0359	92 U Uranium 238.029	93 Np Neptunium 237.0482	94 Pu Plutonium (244)	95 Am Americium (243)	96 Cm Curium (247)	97 Bk Berkelium (247)	98 Cf Californium (251)	99 Es Einsteinium (254)	100 Fm Fermium (257)	101 Md Mendelevium (258)	102 No Nobelium 259	103 Lr Lawrencium 262

Reduction Half-Reaction	E°, volt
Acidic Solution	
$F_2\ (g) + 2\ e^- \rightarrow 2F^-\ (aq)$	+2.866
$O_3(g) + 2\ H^+(aq) + 2\ e^- \rightarrow O_2\ (g) + H_2O(l)$	+2.075
$S_2O_8^{2-}\ (aq) + 2\ e^- \rightarrow 2\ SO_4^{2-}\ (aq)$	+2.01
$H_2O_2\ (aq) + 2H^+\ (aq) + 2\ e^- \rightarrow 2\ H_2O(l)$	+1.763
$MnO_4^-(aq) + 8H^+\ (aq) + 5\ e^- \rightarrow Mn^{2+}(aq) + 4\ H_2O(l)$	+1.51
$PbO_2\ (s) + 4H^+\ (aq) + 2\ e^- \rightarrow Pb^{2+}(aq) + 2\ H_2O(l)$	+1.455
$Cl_2\ (g) + 2\ e^- \rightarrow 2\ Cl^-\ (aq)$	+1.358
$Cr_2O_7^{2-}\ (aq) + 14\ H^+\ (aq) + 6\ e^- \rightarrow 2\ Cr^{3+}(aq) + 7\ H_2O(l)$	+1.33
$MnO_2(s) + 4H^+\ (aq) + 2\ e^- \rightarrow Mn^{2+}(aq) + 2\ H_2O(l)$	+1.23
$O_2(g) + 4H^+\ (aq) + 4\ e^- \rightarrow 2\ H_2O(l)$	+1.229
$2\ IO_3^-\ (aq) + 12H^+\ (aq) + 10\ e^- \rightarrow I_2(s) + 6\ H_2O(l)$	+1.20
$Br_2(l) + 2\ e^- \rightarrow 2\ Br^-\ (aq)$	+1.065
$NO_3^-\ (aq) + 4H^+\ (aq) + 3\ e^- \rightarrow NO(g) + 2\ H_2O(l)$	+0.956
$Ag^+\ (aq) + e^- \rightarrow Ag(s)$	+0.800
$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$	+0.771
$O_2(g) + 2H^+\ (aq) + 2\ e^- \rightarrow H_2O_2(aq)$	+0.695
$I_2(s) + 2\ e^- \rightarrow 2\ I^-\ (aq)$	+0.535
$Cu^{2+}(aq) + 2\ e^- \rightarrow Cu(s)$	+0.340
$SO_4^{2-}\ (aq) + 4H^+\ (aq) + 2\ e^- \rightarrow 2\ H_2O(l) + SO_2(g)$	+0.17
$Sn^{4+}\ (aq) + 2\ e^- \rightarrow Sn^{2+}\ (aq)$	+0.154
$S(s) + 2H^+\ (aq) + 2\ e^- \rightarrow H_2S(g)$	+0.14
$2H^+(aq) + 2\ e^- \rightarrow H_2(g)$	0
$Pb^{2+}(aq) + 2\ e^- \rightarrow Pb(s)$	-0.125
$Sn^{2+}(aq) + 2\ e^- \rightarrow Sn(s)$	-0.137
$Co^{2+}(aq) + 2\ e^- \rightarrow Co(s)$	-0.277
$Fe^{2+}(aq) + 2\ e^- \rightarrow Fe(s)$	-0.440
$Zn^{2+}(aq) + 2\ e^- \rightarrow Zn(s)$	-0.763
$Al^{3+}(aq) + 3\ e^- \rightarrow Al(s)$	-1.676
$Mg^{2+}(aq) + 2\ e^- \rightarrow Mg(s)$	-2.356
$Na^+(aq) + e^- \rightarrow Na\ (s)$	-2.713
$Ca^{2+}(aq) + 2\ e^- \rightarrow Ca(s)$	-2.84
$K^+(aq) + e^- \rightarrow K(s)$	-2.924
$Li^+(aq) + e^- \rightarrow Li(s)$	-3.040
Basic Solution	
$O_3(g) + H_2O(l) + 2\ e^- \rightarrow O_2(g) + 2\ OH^-(aq)$	+1.246
$OCl^-(g) + H_2O(l) + 2\ e^- \rightarrow Cl^-(aq) + 2\ OH^-(aq)$	+0.890
$O_2(g) + 2\ H_2O(l) + 4\ e^- \rightarrow 4\ OH^-(aq)$	+0.401
$2\ H_2O(l) + 2\ e^- \rightarrow H_2(g) + 2\ OH^-(aq)$	-0.828

 Arginine (Arg / R)	 Glutamine (Gln / Q)	 Phenylalanine (Phe / F)	 Tyrosine (Tyr / Y)	 Tryptophan (Trp, W)
 Lysine (Lys / K)	 Glycine (Gly / G)	 Alanine (Ala / A)	 Histidine (His / H)	 Serine (Ser / S)
 Proline (Pro / P)	 Glutamic Acid (Glu / E)	 Aspartic Acid (Asp / D)	 Threonine (Thr / T)	 Cysteine (Cys / C)
 Methionine (Met / M)	 Leucine (Leu / L)	 Asparagine (Asn / N)	 Isoleucine (Ile / I)	 Valine (Val / V)

Selected Functional Groups:

Name	Condensed Formula	Description
alkene	$R_2C=CR_2$	contains a C=C double bond
alkyne	RC≡CR	contains a C≡C triple bond
alcohol	ROH	contains O singly bonded to a C and a H
thiol (thiol alcohol)	RSH	contains S singly bonded to a C and a H
Disulfide	SS	contains S singly bonded to an S
ether	ROR	contains O singly bonded to two C
aldehyde	RCHO	contains C doubly bonded to O and singly to H
ketone	RCOR	contains C doubly bonded to O and singly to two C
hemiacetal	ROCOHR	contains C singly bonded to O of ether and of alcohol
carboxylic acid	RCOOH	contains C doubly bonded to O and singly to O of OH
ester	RCOOR	contains C doubly bonded to O and singly to O
amine	N	contains N bonded to C and/or H
amide	RCONR	contains C doubly bonded to O and singly to N
aromatic	 or	contains a flat six-member ring

Possibly Useful Information:

$K_a[HCOOH\ (aq)] = 1.80 \times 10^{-4}$
$K_a[CH_2ClCOOH\ (aq)] = 1.40 \times 10^{-3}$
$K_a[CH_3COOH\ (aq)] = 1.80 \times 10^{-5}$
$K_a[C_9H_8O_4\ (aq)] = 3.0 \times 10^{-4}$
$K_a[NH_4^+\ (aq)] = 5.6 \times 10^{-10}$
1 Amp = 1 Coulomb/second
K_{sp} [PbF_2, lead fluoride] = 3.6×10^{-8}

$K_a[C_6H_5COOH\ (aq)] = 6.30 \times 10^{-5}$
$K_b[NH_3\ (aq)] = 1.80 \times 10^{-5}$
$K_a[C_6H_8O_6\ (aq)] = 8.00 \times 10^{-5}$
$R = 8.314\ J/mol \cdot K$
$F = 96{,}485$ Coulombs/mole e^-
$N_A = 6.02 \times 10^{23}$
K_{sp} [MgF_2, mag fluoride] = 3.7×10^{-8}

1. The pH of 0.440 M sulfuric acid, H_2SO_4 (aq), is:

$H_2SO_4(aq) \xrightarrow{100\%} H^+ + HSO_4^-$

Strong Acid

(A) 13.56
(B) 1.440
(C) 0.821
(D) 0.357
(E) 0.440

$pH = -\log[H^+] = -\log(0.440) = 0.357$

2. The pH of 0.0545 M benzoic acid, C_6H_5COOH (aq), is:

$C_6H_5COOH(aq) \rightleftharpoons C_6H_5COO^- + H^+$

x x

Weak Acid

(A) 3.00
(B) 5.46
(C) 1.26
(D) 0.0545
(E) 2.73

$K_a = 6.30 \times 10^{-5} = \frac{x^2}{0.0545 - x}$

$x = [H^+] = 0.00185\ M$

$pH = -\log[H^+] = -\log(0.00185) = 2.73$

3. The pH of a buffer system which is
0.225 M CH_3CH_2COOH (aq) and 0.225 M CH_3CH_2COONa (aq) is 4.88.

The pH of a buffer system which is
0.225 M CH_3CH_2COOH (aq) and 0.450 M CH_3CH_2COONa (aq) is:

↑ More base (higher pH)

(A) 4.88
(B) greater than 4.88
(C) less than 4.88

4. A student titrates 1.417 grams of an unknown acid to the equivalence point with 45.11 mL of 0.1000 M NaOH (aq). The molar mass of the acid is:

(A) 204.4 g/mol
(B) 227.3 g/mol
(C) 250.7 g/mol
(D) 302.8 g/mol
(E) 314.1 g/mol

$M_{Base} V_{Base} = \frac{g_{Acid}}{MWT_{Acid}}$

$(0.1000\ M)(0.04511\ L) = \frac{1.417\ g}{MWT_{Acid}}$

$MWT_{Acid} = 314.1\ g/mol$

5. The pH of 0.250 M ammonium nitrate, NH_4NO_3 (aq), is:

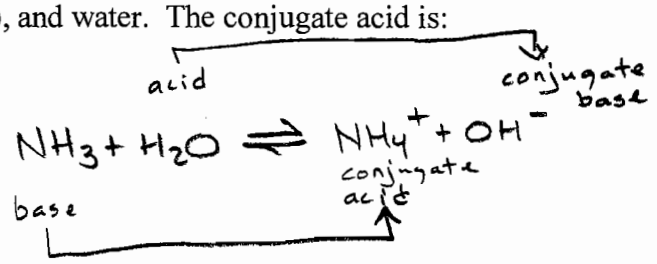
NO_3^- is a spectator ion

NH_4^+ is an acid (low pH)

(A) Greater than 7.00.
(B) Less than 7.00.
(C) 7.00.

6. Consider the reaction of ammonia (NH_3), and water. The conjugate acid is:

(A) H_2O
(B) NH_3
(C) $HCOO^-$
(D) H^+
(E) NH_4^+



7. Consider the combustion of propane: $C_3H_8\,(g) + 5\,O_2\,(g) \rightarrow 3\,CO_2\,(g) + 4\,H_2O\,(g)$

(A) $\Delta H = (+)$, $\Delta S = (+)$, and $\Delta G = (-)$
(B) $\Delta H = (+)$, $\Delta S = (-)$, and $\Delta G = (-)$
(C) $\Delta H = (-)$, $\Delta S = (+)$, and $\Delta G = (-)$
(D) $\Delta H = (-)$, $\Delta S = (-)$, and $\Delta G = (-)$

6 mol gas → 7 mol gas

more disorder $\Delta S = (+)$

Exothermic (combustion) $\Delta H = (-)$

8. Which of the following processes exhibits an increase in entropy of the system?

(A) $NaCl\,(aq) \rightarrow NaCl\,(s)$ ✗
(B) $CH_3OH\,(g) \rightarrow CH_3OH\,(l)$ ✗
(C) $H_2O\,(g) \rightarrow H_2O\,(s)$ ✗
(D) $2\,NO_2\,(g) \rightarrow N_2O_4\,(g)$ ✗
(E) $CH_3CH_2OH\,(s) \rightarrow CH_3CH_2OH\,(l)$

solid → liquid (more disorder — increase in entropy)

9.

Formula	$\Delta H°_f$ (kJ/mol)	$\Delta G°_f$ (kJ/mol)	$S°$ (J/mol•K)
$C_3H_8\,(g)$	-103.8	-23.56	270.2
$O_2\,(g)$	0	0	205.0
$CO_2\,(g)$	-393.5	-394.4	213.6
$H_2O\,(l)$	-285.8	-237.2	69.91

$C_3H_8\,(g) + 5\,O_2\,(g) \rightarrow 3\,CO_2\,(g) + 4\,H_2O\,(l)$
270.2 205.0 213.6 69.91

$\Delta S°_{reaction}$ (298 K) for the combustion of propane is:

(A) -374.8 ~~kJ/mol K~~
(B) +393.5 ~~kJ/mol K~~
(C) 0 ~~J/mol K~~
(D) -393.5 ~~J/mol K~~
(E) +374.8 ~~J/mol K~~

$\Delta S°_{rxtn}$ = products − reactants = $[(3\,mol\,CO_2)(213.6\,J/mol{\cdot}K) + (4\,mol\,H_2O)(69.91\,J/mol{\cdot}K)] - [(1\,mol\,C_3H_8)(270.2\,J/mol{\cdot}K) + (5\,mol\,O_2)(205.0\,J/mol{\cdot}K)] = -374.8\,J/K$

10. A solution was made 3.4×10^{-3} M in $[Pb^{2+}]$ and 2.5×10^{-3} M in $[F^-]$.

(A) A precipitate will form.
(B) A precipitate will not form.

$PbF_2(s) \rightleftharpoons Pb^{2+}(aq) + 2F^-(aq)$

$K_{sp} = 3.6 \times 10^{-8}$ $Q = [Pb^{2+}][F^-]^2 = (3.4 \times 10^{-3})(2.5 \times 10^{-3})^2$

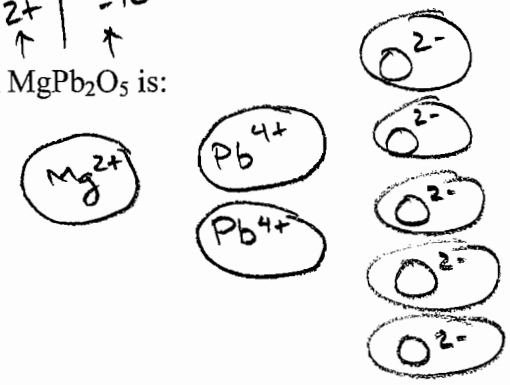
$Q = 2.13 \times 10^{-8}$

$Q < K$ No precipitate will form

11. The oxidation number of each lead in $MgPb_2O_5$ is:

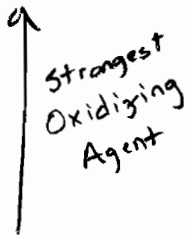
(A) +2
(B) +3
(C) +4
(D) +5
(E) +6

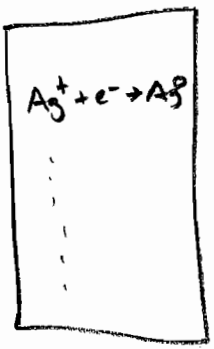
+4 each
2+ -10



12. Consider Na^+ (aq), Pb^{2+} (aq), Zn^{2+} (aq), Ag^+ (aq), and Li^+ (aq). The strongest oxidizing agent is:

(A) Na^+ (aq)
(B) Pb^{2+} (aq)
(C) Zn^{2+} (aq)
(D) Ag^+ (aq)
(E) Li^+ (aq)





$Cr^{3+} + 3e^- \rightarrow Cr^0$

13. A student provides a current of 12.00 amps through an aqueous solution of $Cr(NO_3)_3$ for 4.00 hours. The voltage is such that chromium metal is deposited at the cathode. The mass of chromium deposited is:

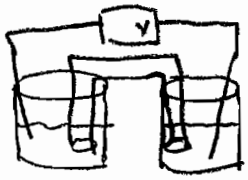
(A) 26.0 g
(B) 17.3 g
(C) 0.0192 g
(D) 52.0 g
(E) (31.0 g)

$4.00\,h \left(\frac{3600\,s}{1\,h}\right)\left(\frac{12.00\,C}{1\,s}\right)\left(\frac{1\,mole^-}{96{,}485\,C}\right)\left(\frac{1\,mol\,Cr}{3\,mole^-}\right)\left(\frac{52.00\,g}{1\,mol\,Cr}\right) = 31.0\,g$

12.00 Amps ↑ ; F ↑

14. Consider a "General Chemistry Battery" in which one beaker contains aqueous tin sulfate ($SnSO_4$) and a tin metal electrode and the other beaker contains aqueous lead sulfate ($PbSO_4$) and a lead metal electrode. Which of the following statements is **false**?

(A) The mass of the tin electrode will decrease as the process proceeds True
(B) (Sn^{2+} (aq) is oxidized) FALSE
(C) Electrons flow from the tin beaker to the lead beaker True
(D) Sulfate ions flow through the salt bridge from the lead beaker to the tin beaker True
(E) The concentration of Pb^{2+} (aq) increases as the process proceeds True



$Pb^{2+} + 2e^- \rightarrow Pb^0$ $\quad$ $Sn^0 \rightarrow Sn^{2+} + 2e^-$

15. The calculated cell potential (voltage) for: $2\,Li\,(s) + Cu^{2+}\,(aq) \rightarrow 2\,Li^+\,(aq) + Cu\,(s)$ is:

(A) + 0.340 V
(B) + 2.700 V
(C) + 3.040 V
(D) (+ 3.380 V)
(E) + 5.906 V

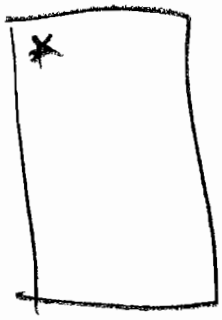
$Cu^{2+} + 2e^- \rightarrow Cu^0$ $\quad +0.340\,V$

$Li^+ + e^- \rightarrow Li^0$ $\quad -3.040\,V$

difference is 3.380 V

16. Consider F_2 (g), Cl_2 (g), Cu^{2+} (aq), H^+ (aq), and Li^+ (aq). The strongest oxidizing agent is:

(A) F_2 (g)
(B) Cl_2 (g)
(C) Cu^{2+} (aq)
(D) H^+ (aq)
(E) Li^+ (aq)



17. When the reaction Mn^{2+} (aq) + Bi^{5+} (aq) → Bi^{3+} (aq) + MnO_4^- (aq) is correctly balanced in acid,

(A) 3 water molecules (H_2O) are consumed
(B) 4 water molecules (H_2O) are consumed
(C) 8 water molecules (H_2O) are consumed
(D) 12 water molecules (H_2O) are consumed
(E) 5 water molecules (H_2O) are consumed

$5 \times \{ 2e^- + Bi^{5+} \rightarrow Bi^{3+} \}$

$2 \times \{ \underbrace{4H_2O + Mn^{2+}}_{2+} \rightarrow \underbrace{MnO_4^- + 8H^+}_{7+} + 5e^- \}$

$10e^- + 5\,Bi^{5+} + 8\,H_2O + 2\,Mn^{2+} \rightarrow 5\,Bi^{3+} + 2\,MnO_4^- + 16H^+ + 10e^-$

18. When an X-ray is generated,

(A) An electron is converted to a helium nucleus
(B) A gamma ray is released
(C) Two gamma rays are released
(D) A proton is converted to a neutron
(E) A neutron is converted to a proton

19. In smoke detectors, Am-241 decays to produce an alpha particle and _____.

(A) ^{241m}Am
(B) ^{241}Cm
(C) ^{239}Cm
(D) ^{239}Np
(E) ^{237}Np

$^{241}_{95}Am \rightarrow {}^{4}_{2}\alpha + {}^{237}_{93}Np$

20. Th-234 decays to produce a beta particle and _____.

(A) Ra-229
(B) U-231
(C) U-235
(D) Ac-234
(E) Pa-234

$^{234}_{90}Th \rightarrow {}^{0}_{-1}\beta + {}^{234}_{91}Pa$

21. A student obtains a sample of ^{208}Po ($t_{1/2}$ = 2.91 years) containing 0.624 grams. How long will it take for the sample to decay to 0.0561 grams of ^{208}Po?

(A) 10.1 years
(B) 9.28 years
(C) 11.1 years
(D) 32.4 years
(E) 9.57 years

① Calc k $\quad \ln\frac{1}{2} = -k(t_{1/2})$

$-0.6931 = -k(2.91\,y)$

$k = 0.2382\,y^{-1}$

② Calc t $\quad \ln\left[\frac{0.0561\,g}{0.624\,g}\right] = -0.2382\,y^{-1}(t)$

$t = 10.1\,y$

22. A radioactive decay series that begins with ^{256}Md ends with formation of the stable nuclide ^{208}Pb. How many alpha particle emissions and how many beta particle emissions are involved in the sequence of radioactive decays?

(A) 7 alpha and 22 beta decays.
(B) 14 alpha and 11 beta decays.
(C) 48 alpha and 24 beta decays.
(D) 12 alpha and 11 beta decays.
(E) 12 alpha and 5 beta decays.

48

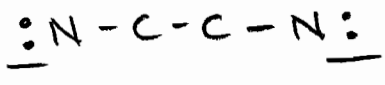
$^{256}_{101}Md \rightarrow \underline{12}\ ^{4}_{2}\alpha + \underline{5}\ ^{0}_{-1}\beta + \underline{\ }\ ^{208}_{82}Pb$

23. Considering nuclear chemistry, which of the following statements is **false**?

(A) An example of nuclear fusion is $^{1}_{1}H + {}^{2}_{1}H \rightarrow {}^{3}_{2}He$. True
(B) An example of nuclear fission is $^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{137}_{52}Te + {}^{97}_{40}Zr + 2\,{}^{1}_{0}n$. True
(C) The half-life is half the time required for a sample to completely decay.
(D) Gamma emission is electromagnetic radiation. True
(E) Radioactive decay is a first-order decay process. True

24. An example of a bidentate is:

(A) edta
(B) F^-
(C) Cu^{2+}
(D) $NH_2CH_2CH_2NH_2$
(E) H_2O

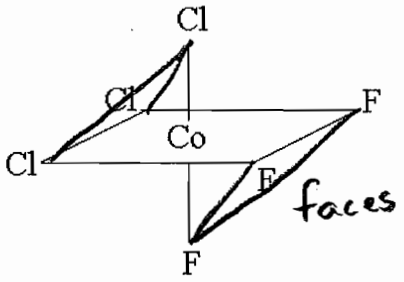


2 teeth

25. The coordination number for Fe in $[Fe(ox)_3]^{3-}$ is:

(A) 1
(B) 2
(C) 3
(D) 4
(E) 6

26. The complex:



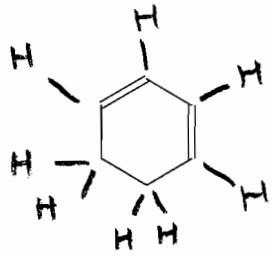
(A) is cis-$[CoCl_3F_3]^{3-}$
(B) is trans-$[CoCl_3F_3]^{3-}$
(C) is mer-$[CoCl_3F_3]^{3-}$
(D) is fac-$[CoCl_3F_3]^{3-}$
(E) is college-world-series-$[CoCl_3F_3]^{3-}$

27. How many **unpaired** electrons are present in $[Co(CN)_6]^{3-}$?
[Co is the Co^{3+} ion; CN is the CN^- ion; and the Co^{3+} is **low spin**].

(A) 0
(B) 1
(C) 2
(D) 3
(E) 5

$Co^{3+} \Rightarrow 9-3=6 \quad d^6$

28. The molecular formula of



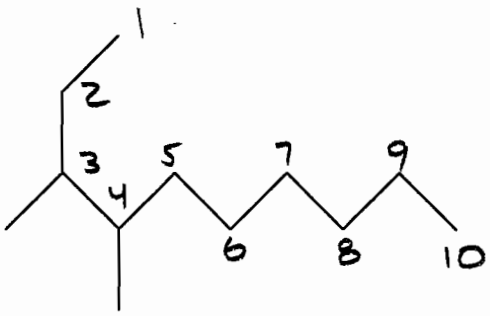
C_6H_8

(A) is C_4H_{10}
(B) is C_6H_{14}
(C) is C_6H_{12}
(D) is C_6H_{10}
(E) is C_6H_8

29. When an amine and a carboxylic acid react in a condensation reaction (such as two amino acids reacting):

(A) an ester is formed
(B) an alkane is formed
(C) an alkene is formed
(D) an amide is formed
(E) an alcohol is formed

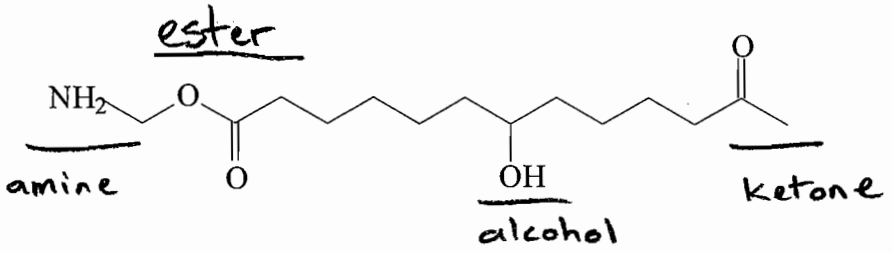
30. The systematic name of:



3,4-dimethyldecane

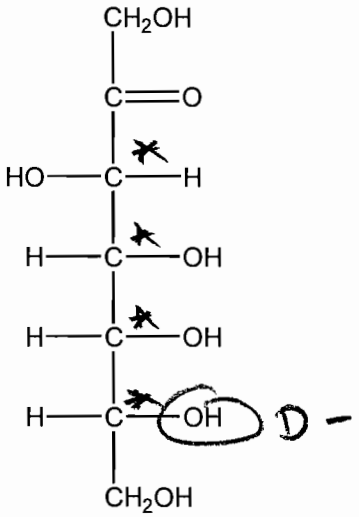
(A) is 7-ethyl-8-methylnonane
(B) is 8-ethyl-7-methylnonane
(C) is 3,4-dimethyldecane
(D) is 3-ethyl-2-methylnonane
(E) is 2-ethyl-3-methylnonane

31. Identify the functional groups in the following molecule:



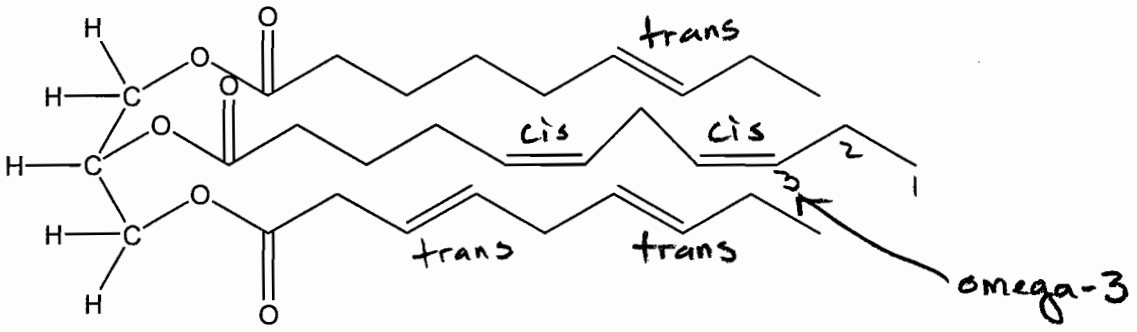
(A) aldehyde, alcohol, ester, amine
(B) aldehyde, alcohol, ether, amine
(C) carboxylic acid, amine, ether, alcohol
(D) ketone, alcohol, ester, amine
(E) ester, carboxylic acid, alcohol, amine

32. Identify the number of chiral carbons and whether the sedoheptulose shown is L- or D-.



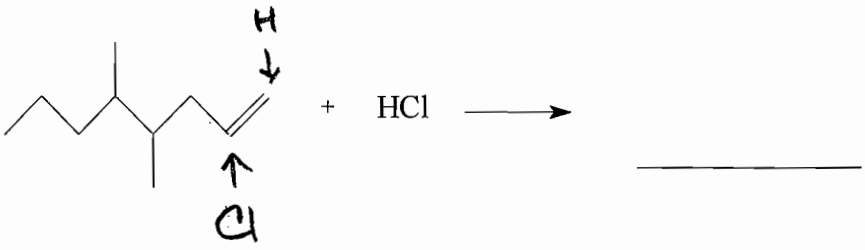
(A) 5 chiral carbons and L-
(B) 5 chiral carbons and D-
(C) 4 chiral carbons and L-
(D) 4 chiral carbons and D-
(E) 6 chiral carbons and L-

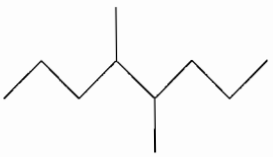
33. Consider the fat molecule below. Which of the following is **false**?

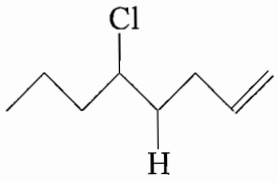


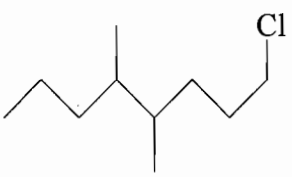
(A) This is a saturated fat. FALSE - there are C=C
(B) This fat contains 2 cis- and 3 trans- bonds. ✓
(C) This fat is an omega-3 fat. ✓
(D) This fat contains three ester groups. ✓

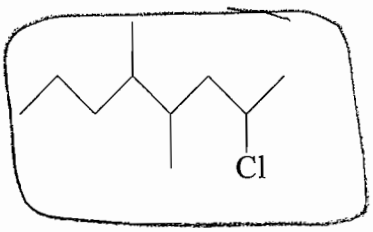
34. Complete the following addition reaction:

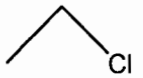


(A) 

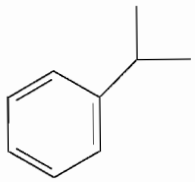
(B) 

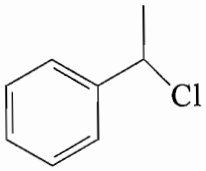
(C) 

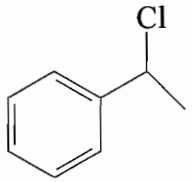
(D) 

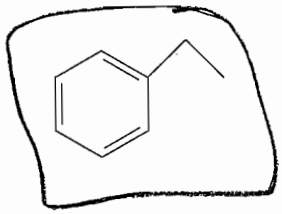
35. The organic product of benzene and 

in the presence of $AlCl_3$ is:

(A) 

(B) 

(C) 

(D) 

36. Make up your own question here.

(A) Paris Hilton
(B) ~~Paris Hilton~~
(C) Paris Hilton
(D) Paris Hilton
(E) Paris Hilton

[Any response will receive full credit; even no response.]

Questions 1 through 35 have four points attached (140 total). Any response to Question 36 will receive full credit (5 Points); even no response. The point total for this exam is 145 points. See the grade sheet or CH 123 web syllabus for grade computation details. Final exam keys, scores, and course grades will be posted on the CH 123 website as they become available. Have a great life. Go out there and do some really cool stuff :)