Exam 4 Special Code 111111
Petrovich, Fall 2009

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1. Use the solubility rules to identify the balanced net ionic equation for the precipitation reaction that occurs when the following aqueous solutions are mixed:
$K_2Cr_2O_7$ and $CaCl_2$

A) $2K^{1+}(aq) + Cl_2^{2-}(aq) \rightarrow K_2Cl_2(s)$

B) $Ca^{2+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow CaCr_2O_7(s)$

C) $K^{2+}(aq) + Cl_2^{2-}(aq) \rightarrow KCl_2(s)$

D) $2Ca^{1+}(aq) + Cr_2O_7^{2-}(aq) \rightarrow Ca_2Cr_2O_7(s)$

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2. Use the solubility rules to identify the balanced net ionic equation for the precipitation reaction that occurs when the following aqueous solutions are mixed:
strontium acetate and ammonium phosphate

A) $NH_4^{1+}(aq) + C_2H_3O_2^{1-}(aq) \rightarrow NH_4C_2H_3O_2(s)$

B) $3Sr^{1+}(aq) + PO_4^{3-}(aq) \rightarrow Sr_3PO_4(s)$ $SrPO_4^{3-}$

C) $2NH_4^{1+}(aq) + CO_3^{2-}(aq) \rightarrow (NH_4)_2CO_3(s)$

D) $3Sr^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Sr_3(PO_4)_2(s)$

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3. How many moles of sodium phosphate are required to make 3000 mL of a solution that is 0.25 M in $[PO_4^{3-}]$?

A) 0.75 **B)** 0.25 **C)** 0.073 **D)** 0.000073

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4. Choose the compounds below that would be **MORE** soluble in water (H_2O) than hexane ($CH_3CH_2CH_2CH_2CH_2CH_3$). Polar

I) CH_3OH II) $CH_3CH_2CH_2OCH_2CH_2CH_3$ III) CS_2 IV) $NH_4C_2H_3O_2$

A) I & II **B)** III & IV **C)** I & IV **D)** II & III

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5. Choose the compound(s) below that are electrolytes. Ionic or acedic

I) CH_3CH_2OH II) $CH_3CH_2CH_2CH_2COONa$ III) SO_3 IV) H_2SO_4

A) I & II **B)** III & IV **C)** II & IV **D)** I & III **E)** III

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6. Choose the following amounts and compounds that can be added to 1.00 liter of water to give a solution that is 0.40 M in $[Cl^{1-}]$ .4 mol of Cl

I) 0.40 mol NH_4Cl .4 mol Cl II) 0.20 mol Hg_2Cl_2 .4 mol Cl III) 0.40 mol $MgCl_2$ .8 mol Cl

IV) 0.20 mol $NiCl_2$ .4 mol Cl V) 0.40 mol $AlCl_3$ 1.2 mol Cl

A) I, III & V **B)** II & V **C)** I & III **D)** I & V **E)** I & IV

7. Which of the following ions is present in the solution if no precipitate was observed with the addition of Ag^{1+} but a precipitate was observed with the addition of Ca^{2+}?

A) NO_3^{1-} **B)** SO_4^{2-} **C)** PO_4^{3-} **D)** $C_2H_3O_2^{1-}$ **E)** Br^{1-}

8. Choose the MOST soluble phosphate salt.

A) $Cd_3(PO_4)_2$ $K_{sp} = 2.5 \times 10^{-33}$ **B)** $Mg_3(PO_4)_2$ $K_{sp} = 9.9 \times 10^{-25}$

C) $Co_3(PO_4)_2$ $K_{sp} = 2.1 \times 10^{-35}$ **D)** $Ni_3(PO_4)_2$ $K_{sp} = 4.7 \times 10^{-32}$

9. The redox reaction for a direct methanol fuel cell is shown below. What is the oxidation state of carbon in methanol (CH_3OH)?

$$2\,CH_3OH\,(aq) + 3\,O_2\,(g) \rightarrow 2CO_2\,(g) + 4H_2O\,(l)$$

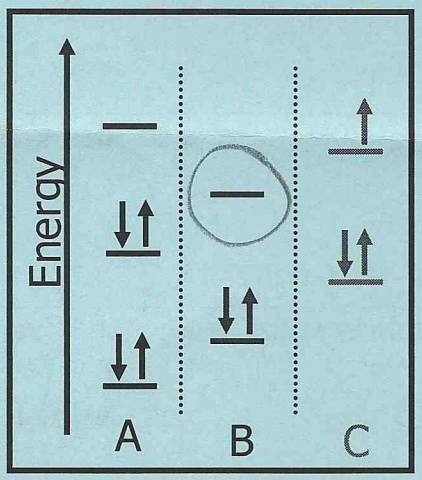
-2 +1 -2 +1 0 +4 -2 +1 -2

A) -2 **B)** 0 **C)** +2 **D)** +6 **E)** -1

10. What is the reducing agent and how many electrons are transferred in the reaction above?

A) CH_3OH, 2 **B)** CH_3OH, 6 **C)** O_2, 6 **D)** O_2, 12 **E)** CH_3OH, 12

11. Using the valence orbital diagram below, what is the best OXIDIZING AGENT?



A) C^{1-}

B) C

C) B

D) A^{4+}

E) A^{2-}

Best Oxidizing agent has the lowest unoccupied orbital

12. Using the valence orbital diagram above, choose the spontaneous reaction below.

A) $B + A \rightarrow B^{2+} + A^{2-}$ **B)** $2C + A^{2+} \rightarrow 2C^{1+} + A$ **C)** $C^{1+} + B \rightarrow C^{3+} + B^{2-}$

13. Identify the spontaneous net redox reaction that occurs, if any, when the following materials are mixed: **a nickel coin is added to an acidic aqueous solution of $K_2Cr_2O_7$.**

A) $K_2Cr_2O_7(aq) + 14H^{1+}(aq) \rightarrow 2Cr^{3+}(aq) + 2K^{1+}(aq) + 7H_2O$

B) $2K^{1+}(aq) + Ni(s) \rightarrow 2K(s) + Ni^{2+}(aq)$

C) $Cr_2O_7^{2-}(aq) + 3Ni(s) + 14H^{1+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Ni^{2+}(aq) + 7H_2O$

D) $Ni^{2+}(aq) + 2K(s) + \rightarrow Ni(s) + 2K^{1+}(aq)$

E) No reaction occurs.

14. Identify the net redox reaction that spontaneously occurs when a **Ni^{2+}/Ni** couple is connected to a **Na^{1+}/Na** couple.

A) $Ni^{2+}(aq) + 2Na(s) \rightarrow Ni(s) + 2Na^{1+}(aq)$

B) $2Ni^{2+}(aq) + Na(s) \rightarrow 2Ni(s) + Na^{1+}(aq)$

C) $2Na^{1+}(aq) + Ni(s) \rightarrow 2Na(s) + Ni^{2+}(aq)$

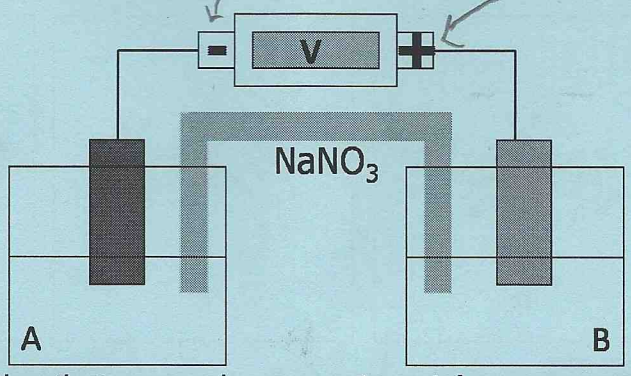
D) $Na^{1+}(aq) + Ni(s) \rightarrow Na(s) + Ni^{2+}(aq)$

$Ni^{2+} + 2Na \rightarrow Ni + 2Na^{1+}$

15. Use the information below to answer the next three questions. Build an electrochemical cell from a Cr^{3+}/Cr and In^{1+}/In couple in which the measured voltage is positive.

$In^{1+}(aq) + 1e^- \rightarrow In(s)$ -0.14 V

$Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$ -0.73 V



Choose the ½ reaction that occurs in compartment A.

A) $Cr^{3+}(aq) + 3e^- \rightarrow Cr(s)$

B) $In^{1+}(aq) + 1e^- \rightarrow In(s)$

C) $Cr(s) \rightarrow Cr^{3+}(aq) + 3e^-$

D) $In(s) \rightarrow In^{1+}(aq) + 1e^-$

16. What is the value of E^o_{cell}? $E_{cat} - E_{an}$ $-0.14 - (-0.73)$

A) +0.59 V **B)** +0.87 V **C)** -0.59 V **D)** -0.87 V

17. Select the **FALSE** statement from below

A) The nitrate ion migrates toward compartment A.

B) The electrons travel from the electrode in compartment B to the electrode in compartment A.

C) The Cr electrode gets smaller as the reaction progresses.

D) The In^{1+} ion concentration decreases as the reaction progresses.

18. Use your knowledge of oxidation states and electrons transferred to balance the half reaction below. +5 -2

$$\underline{1}\ ClO_3^{1-}(aq) + \underline{6}\ e^- + \underline{6}\ H^{1+}(aq) \rightarrow \underline{1}\ Cl^{1-}(s) + \underline{3}\ H_2O(l)$$

A) 1,6,6,1,3 **B)** 1,6,2,1,1 **C)** 2,1,6,2,3 **D)** 1,2,2,1,1 **E)** 1,4,6,1,3

19. Choose the electrolytic cell from below.

Ionic or acid

A) $Ni(s) + 2H^{1+}(aq) \rightarrow Ni^{2+}(aq) + H_2(g)$

B) $6I^{1-}(aq) + 2NO_3^{1-}(aq) + 8H^{1+}(aq) \rightarrow 3I_2(s) + 2NO(g) + 4H_2O$

C) $2Br^{1-}(aq) + 2Fe^{3+}(aq) \rightarrow Br_2(l) + 2Fe^{2+}(aq)$

20. Choose the reaction that occurs in a D-Cell battery. → alkaline

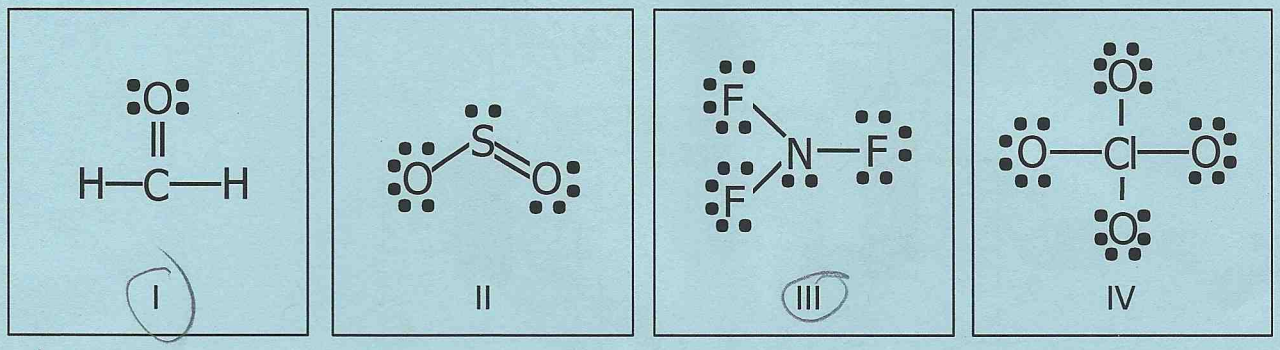
A) $Ag_2O + Zn + H_2O \rightarrow 2Ag + Zn(OH)_2$

B) $PbO_2 + Pb + 4H^{1+} + 2SO_4^{2-} \rightarrow 2PbSO_4 + 2H_2O$

C) $2MnO_2 + Zn + H_2O \rightarrow Mn_2O_3 + Zn(OH)_2$

D) $4Fe + 3O_2 \rightarrow 2Fe_2O_3$

21. Choose the molecules below that can act as Lewis acids.



A) III & IV **B)** I & III **C)** II & IV **D)** I & II

22. Choose the correct name for H_2SO_3. Sulfite

A) sulfurous acid **B)** dihydrogen sulfite

C) sulfuric acid **D)** dihydrogen sulfur trioxide

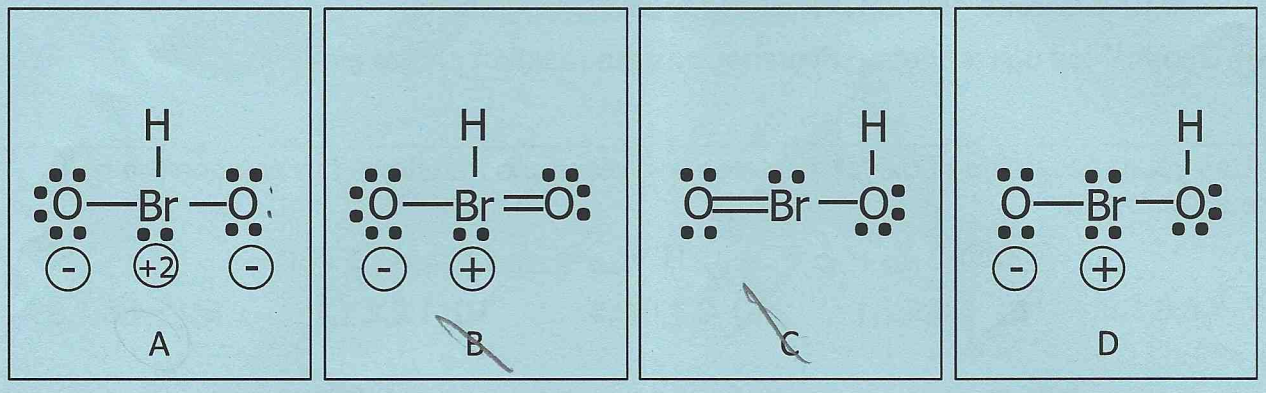
23. Choose the correct formula for hydrobromic acid.

A) $HBrO_4$ Bromide **B)** HBr

C) $HBrO_2$ **D)** HBrO

Br = 26
VE = 20
SP = 3
LP = 7

24. Choose the correct Lewis structure for $HBrO_2$. 1+7+6+6=20



25. Identify the balanced net acid-base reaction that occurs when the following aqueous solutions are mixed:

Na_3PO_4 and H_2SO_4

PO_4^{3-}

A) $H_3O^{1+}(aq) + PO_4^{3-}(aq) \rightarrow H_2O + HPO_4^{2-}(aq)$

B) $H_3PO_4(aq) + SO_4^{2-}(aq) \leftrightarrow HSO_4^{1-}(aq) + H_2PO_4^{1-}(aq)$

C) $H_2SO_4(aq) + PO_4^{3-}(aq) \rightarrow HSO_4^{1-}(aq) + HPO_4^{2-}(aq)$

D) $3H_3O^{1+}(aq) + PO_4^{3-}(aq) \rightarrow 3H_2O + H_3PO_4(aq)$

E) $H_2SO_4(aq) + PO_4^{3-}(aq) \rightarrow SO_4^{2-}(aq) + H_2PO_4^{1-}(aq)$

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26. Identify the balanced net acid-base reaction that occurs when the following aqueous solutions are mixed:

H_2S and $NaHCO_3$

$\frac{[1.0\times10^{-7}][4.7\times10^{-11}]}{[1.3\times10^{-13}][4.3\times10^{-7}]}$

A) $H_2S(aq) + CO_3^{2-}(aq) \rightarrow HS^{1-}(aq) + HCO_3^{1-}(aq)$

B) $H_2S(aq) + CO_3^{2-}(aq) \leftrightarrow S^{2-}(aq) + H_2CO_3(aq)$

C) $H_2S(aq) + HCO_3^{1-}(aq) \leftrightarrow HS^{1-}(aq) + H_2CO_3(aq)$

D) $H_3O^{1+}(aq) + HCO_3^{1-}(aq) \rightarrow H_2O + H_2CO_3(aq)$

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27. Choose the strongest BASE

A) ClO_3^{1-} **B)** ClO_2^{1-} **C)** BrO_3^{1-} **D)** BrO_2^{1-}

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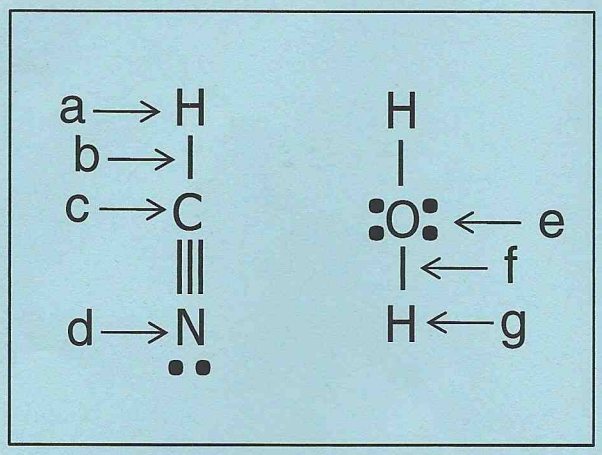
28. Use letters to indicate the electron pushing arrows describing the H transfer that occurs between the two species below.



A) dg, fe

B) ea, bc

C) gb, ef

D) ae, cb

I pledge that I have neither given nor received aid on this exam.

Signature: Redacted

Answer Sheet ex4-1.dat 2009/11/23

Name	Campus Number	Spec Code	Misc Data	Total Score	Score by Part 1	2	3	4	5	Pct
Redacted			10/90 M .	21	21	.	.	.	.	75.0

1-B	2-D	3-A	4-C	5-C
6-E	7-B	8-B	9-A	10-E
11-C (D)	12-C (B)	13-B (C)	14-A	15-C
16-A	17-B	18-A	19-A (C)	20-C
21-B (D)	22-A	23-B	24-D	25-C (A)
26-C	27-D	28-D (B)