Green

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 8:30 A Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.

(1 atm = 760 mm Hg = 760 torr) (Kelvin = ^oC + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) Give the temperature and pressure at STP (standard pressure and atmosphere). 1) D
A) 32K and 1 torr Hg
B) 0°C and 1 mm Hg
C) 25°C and 1.00 in Hg
D) 0°C and 1.00 atm
E) 0K and 1.00 atm

2) In which orbital below would an electron (on average) be closest to the nucleus? 2) E
A) 5d B) 2p C) 4s D) 2p E) 2s

3) How many H^+ ions can the acid, H_3PO_4, donate per molecule? 3) D
A) 0 B) 2 C) 1 D) 3

4) The number of cycles that pass through a stationary point in a wave is called 4) D
A) median
B) wavelength
C) area
D) frequency
E) amplitude

5) Describe the shape of a p orbital. 5) E
A) spherical
B) three balls
C) four balls
D) eight balls
E) dumbbell shaped

6) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as 6) D
(otherwise in equation form: $P_T = P_a + P_b + P_c$ ...)
A) Avogadro's Law
B) Charles's Law
C) Ideal Gas Law
D) Dalton's Law
E) Boyle's Law

7) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 7) D

A) $H^+(aq) + OH^-(aq) + 2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$

B) $2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$

C) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$

(D) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ (all acid base rxn-net ionic)

E) No reaction occurs.

8) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15 °K? (volume is the same, $V_1 = V_2$) 8) A

$[(P_1V_1)/(P_2V_2) = T_1/T_2]$ $\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2} \rightarrow \frac{P_1}{P_2} = \frac{T_1}{T_2}$

(A) 1.74 atm B) 2.00 atm C) 1.80 atm D) 2.08 atm

9) What is the maximum number of p orbitals that are possible (number of m_ℓ values for $\ell = 1$)? 9) E

A) 7 B) 5 C) 9 D) 1 (E) 3

$m_\ell = -1, 0, +1 \rightarrow 3$

10) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains C_2H_4, flask B contains O_3, and flask C contains F_2. Which flask contains the largest number of molecules? 10) D

same # molecules = same # moles; same V = same size flask

A) flask A B) flask B

C) flask C (D) All contain same number of molecules.

at STP, all gases have same volume – same size flask

11) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 11) A

(A) 715 torr B) 13.8 torr C) 28.1 torr D) 760 torr E) 31.8 torr

mmHg = torr

$$\frac{1.90\,atm}{P_2} = \frac{297.15\,K}{272.15}$$

$$P_2 = \frac{(1.90)\,272.15}{297.15} = 1.74\,atm$$

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (42 pts)

1. For the following unbalanced precipitation reaction complete **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Ca(NO_3)_2\,(aq) + Na_3PO_4\,(aq) \rightarrow Ca_3(PO_4)_2\,(s) + NaNO_3\,(aq)$

a. Complete ionic form:

$Ca^{+2}\,(aq) + 2\,NO_3^{-1}\,(aq) + 3\,Na^{+1}(aq) + PO_4^{-3}\,(aq) \rightarrow Ca_3(PO_4)_2\,(s) + Na^{+1}\,(aq) + NO_3^{-1}\,(aq)$

b. Net ionic form

$Ca^{+2}\,(aq) + PO_4^{-3}\,(aq) \rightarrow Ca_3(PO_4)_2\,(s)$

2. Among the following compounds, circle all strong acids (1 pt each, 6 pts total)

H_2SO_4 HF HNO_3 CH_3COOH HCl $HC_2H_3O_2$

3 For the following titration reaction if you neutralize a 1.5 M solution of HNO_3 of volume 250.0 mL with a 0.55 M NaOH solution, how many mL of NaOH do you need?

$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$ $\dfrac{(1.5)(250.0)}{0.55} = 681.8$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer**. (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = 1.5 M Vacid = 250.0 ml

M base = 0.55 M V base = don't know

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. O in O_2 Zero b. S in SO_4^{-2} +6 c. Fe in FeO +2

$S + 4(-2) = -2$

$S = -2 + 8$

$S = +6$

(-2)

$Fe - 2 = 0$

$Fe = +2$

5 If the total gas pressure inside a gas tank is 1.2 atm. The gas tank has a mixture of helium and hydrogen and the hydrogen pressure is 0.8 atm. What is the pressure of the helium ? ($P_{total} = P_a + P_b + P_c$ .....)(show work) (4 pts)

$P_{total} = P_{He} + P_{H_2}$ $P_{total} = 1.2\,atm$

$P_{H_2} = 0.8\,atm$ $1.2\,atm = P_{He} + 0.8\,atm$

$P_{He} = 1.2 - 0.8 = 0.4\,atm$

6 If the principal investigator number (n) = 3, what are the possible values of angular momentum quantum number (ℓ) (circle one) (6 pts)

a) -1, 0, +1
b) 0, 1,2
c) + ½ or – ½

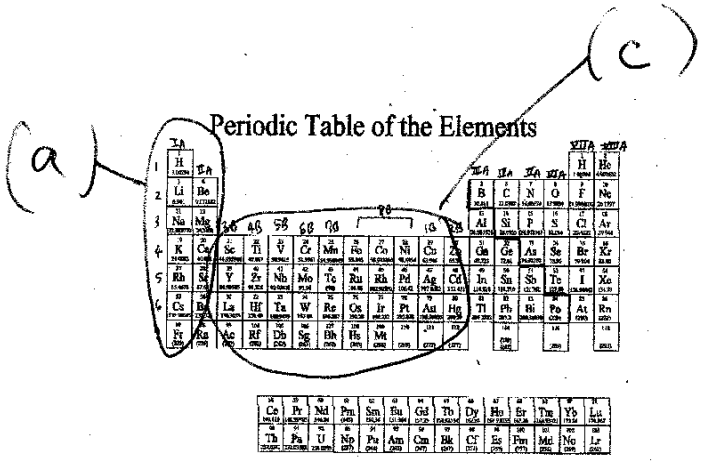
$n = 3, \quad \ell = 0, \ldots (n-1)$

$n - 1 = 3 - 1 = 2$

$\ell = 0, 1, 2$

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



Part III. Long Answer **Please show work for full credit and to receive partial credit. (34 pts)**
****** Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.******

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1. If a gas in a tank of volume 3.72 Liters is at temperature of 273.2 Kelvin has pressure 1.07 atmospheres. If the tank is allowed to heat up to 303.7 Kelvin temperature, what is the new pressure in atmospheres assuming that the volume has not changed ? $[(P_2V_2)/(P_1V_1) = (T_2/T_1)]$ (17 pts)

$V_1 = 3.72\ \ell$ $\quad V_2 = 3.72\ \ell$

$T_1 = 273.2\ K$ $\quad T_2 = 303.7\ K$

$P_1 = 1.07\ atm$ $\quad P_2 = ?$

$$\frac{P_2(3.72\ \ell)}{(1.07\ atm)(3.72\ \ell)} = \frac{303.7\ K}{273.2\ K}$$

$$P_2 = \left(\frac{303.7\ K}{273.2\ K}\right)(1.07\ atm)$$

$$P_2 = 1.19\ atm$$

2. If you do the following reaction starting with 12.3 mL of a 2.5 M solution of H_3PO_4 (assume excess NaOH), what is the theoretical yield of the $H_2O(g)$ in Liters ? (1 mole gas = 22.4 liters) (hint: think moles of H_3PO_4) (17 pts)

$H_3PO_4(aq) + 3\ NaOH(aq) \rightarrow 3H_2O(g) + Na_3PO_4\ (aq)$

$$12.7\ ml\ H_3PO_4 \times \frac{2.5\ mol\ H_3PO_4}{1000\ ml\ H_3PO_4} \times \frac{3\ mol\ H_2O(g)}{1\ mol\ H_3PO_4} \times \frac{22.4\ l}{1\ mol\ H_2O(g)}$$

$$= 2.13\ l\ H_2O(g)$$

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 8:30 B Dr. Hahn Exam # _____

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(1 atm = 760 mm Hg = 760 torr) (Kelvin = °C + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) Describe the shape of a p orbital. 1) D
A) eight balls
B) spherical
C) four balls
D) dumbbell shaped
E) three balls

2) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains C_2H_4, flask B contains O_3, and flask C contains F_2. Which flask contains the largest number of molecules? 2) D
A) flask A B) flask B
C) flask C D) All contain same number of molecules.

3) The number of cycles that pass through a stationary point in a wave is called 3) A
A) frequency
B) wavelength
C) median
D) amplitude
E) area

4) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15 ~~°C~~ K? (volume is the same, $V_1 = V_2$) 4) B
$[(P_1V_1)/(P_2V_2) = T_1 / T_2]$
A) 1.80 atm B) 1.74 atm C) 2.08 atm D) 2.00 atm

5) Give the temperature and pressure at STP (standard pressure and atmosphere). 5) B
A) 0°C and 1 mm Hg
B) 0°C and 1.00 atm
C) 0K and 1.00 atm
D) 25°C and 1.00 in Hg
E) 32K and 1 torr Hg

6) How many H+ ions can the acid, H_3PO_4, donate per molecule? 6) C
A) 1 B) 2 C) 3 D) 0

7) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as (otherwise in equation form: $P_T = P_a + P_b + P_c$ ...) 7) E

A) Boyle's Law
B) Avogadro's Law
C) Charles's Law
D) Ideal Gas Law
E) Dalton's Law

8) In which orbital below would an electron (on average) be closest to the nucleus? 8) C

A) 5d B) 4s C) 2s D) 2p E) 2p

9) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 9) C

A) 28.1 torr B) 31.8 torr C) 715 torr D) 13.8 torr E) 760 torr

10) What is the maximum number of p orbitals that are possible (number of m_ℓ values for $\ell = 1$)? 10) D

A) 5 B) 1 C) 9 D) 3 E) 7

11) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 11) C

A) $2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$

B) $H^+(aq) + OH^-(aq) + 2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$

C) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

D) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$

E) No reaction occurs.

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

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1. For the following unbalanced precipitation reaction **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Ca(NO_3)_2\,(aq) + Na_3PO_4\,(aq) \rightarrow Ca_3(PO_4)_2\,(s) + NaNO_3\,(aq)$

a. Complete ionic form:

$Ca^{+2}(aq) + 2NO_3^{-1}\,(aq) + 3Na^{+}_{(aq)} + PO_4^{-3}\,(aq) \rightarrow Ca_3(PO_4)_2\,(s) + Na^{+}(aq) + NO_3^{-}\,(aq)$

b. Net ionic form:

$3\,Ca^{+2}\,(aq) + 2\,PO_4^{-3}\,(aq) \rightarrow Ca_3(PO_4)_2\,(s)$

2. Among the following compounds, circle all weak acids (1 pt each, 6 pts total)

H_2SO_4 (HF) HNO_3 (CH_3COOH) H Cl ($HC_2H_3O_2$)

3 For the following titration reaction if you neutralize a 3.7 M solution of HNO_3 of volume 73.2 mL with a 2.55 M NaOH solution, how many mL of NaOH do you need?

$HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$ $\quad \frac{(3.7)(73.2)}{(2.55)} = 106.2\,mL$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer**. (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = 3.7 M Vacid = 73.2 mL

M base = 2.55 M V base = don't know

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. K in KCl +1 group IA

b. Ca in Ca zero element

c. C in K_2CO_3 +4

+1 −2(6−8=−2)

$(+1)2 + C + 3(-2) = 0$

$C = -2 + 6 = +4$

5 If the total gas pressure inside a gas tank is 738 torr. The gas tank has a mixture of helium and hydrogen and the hydrogen pressure is 28 torr. What is the pressure of the ~~hydrogen~~ He ? ($P_{total} = P_a + P_b + P_c$ .....) (show work) (4 pts)

$P_{total} = P_{He} + P_{H_2} = 738\,torr + P_{He} + 28\,torr$

$P_{He} = 738\,torr - 28\,torr = 710\,torr$

6 If the principal investigator number (n) = 4, what are the possible values of angular momentum quantum number (ℓ) (circle one) (6 pts) $\ell = 0, \ldots (n-1)$

a) -2, -1, 0, +1, +2

(b) 0, 1,2, 3

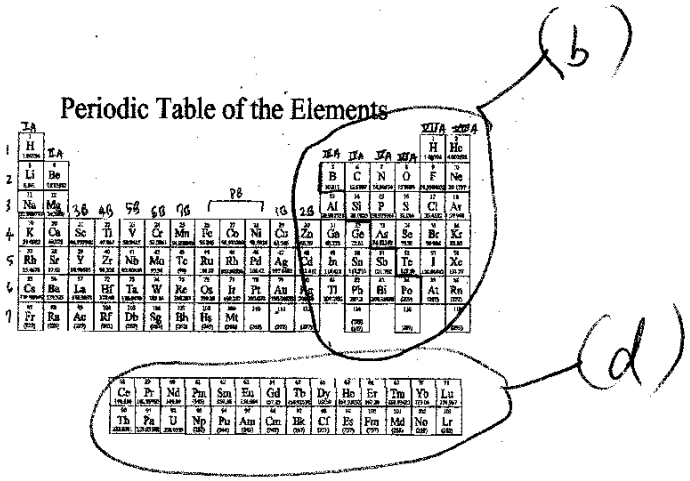
c) + ½ or – ½

$n-1 = 4-1 = 3$

$\ell = 0, 1, 2, 3$

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



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1. 7.23 moles of a gas at temperature of 278.2 Kelvin and pressure of 0.978 atmospheres occupies what volume in liters ? [PV=nRT, R=0.08206 (Liter atm) / (mol Kelvin)] (17 pts)

$n = 7.23\ \text{mole}$

$T = 278.2\ \text{K}$

$P = 0.978\ \text{atm}$

$V = ?\ \text{l}$

$PV = nRT$

$(0.978\ \text{atm})\,V = (7.23\ \text{mol})\left(\frac{0.08206\ \text{l atm}}{\text{mol K}}\right)(278.2\ \text{K})$

$V = \frac{(7.23\ \text{mol})\left(\frac{0.08206\ \text{l atm}}{\text{mol K}}\right)(278.2\ \text{K})}{(0.978\ \text{atm})}$

$V = 168.8\ \text{liters}$ – sig. fig.

$\downarrow$

$169\ \text{liters}$

2 If you do the following reaction starting with 250.2 mL of 1.5 M solution of H_2SO_4(assume excess Al) , what is the theoretical yield of the $H_2(g)$ in Liters ? (1 mole gas = 22.4 liters) (hint: think moles of H_2SO_4) (show work) (17 pts)

$2Al\,(s) + 3\,H_2SO_4\,(aq) \rightarrow Al_2(SO_4)_3\,(aq) + 3H_2(g)$

$$(250.2\ mL\ H_2SO_4\ soln.) \times \left(\frac{1.5\ mol\ H_2SO_4}{1000\ mL\ H_2SO_4\ soln}\right) \times \left(\frac{3\ mol\ H_2}{3\ mol\ H_2SO_4}\right) \times \left(\frac{22.4\ L\ H_2(g)}{1\ mol\ H_2(g)}\right)$$

$= 8.4$ liters $H_2(g)$

(W correct sig fig)

orange

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 9:55 A Dr. Hahn Exam # _____

Name Key (print) Name _____(sign)

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(1 atm = 760 mm Hg = 760 torr) (Kelvin = °C + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) How many H^+ ions can the acid, H_2SO_4, donate per molecule? 1) D
A) 0 B) 1 C) 3 (D) 2

2) Give the temperature and pressure at STP (standard pressure and atmosphere). 2) C
A) 0K and 1.00 atm
B) 0°C and 1 mm Hg
(C) 0°C and 1.00 atm
D) 25°C and 1.00 in Hg
E) 32K and 1 torr Hg

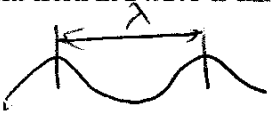
3) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 3) A
(A) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
B) $H^+(aq) + OH^-(aq) + 2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$
C) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$
D) $2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$
E) No reaction occurs.

4) Which of the following samples will have the greatest volume at STP? 4) B
A) 1.09 mol Ne
(B) 5.5 mol He
C) 0.31 mol Cl_2
D) 3.12 mol O_2
E) All of these samples would have the same volume at STP.

greatest # moles has greatest volume at STP

5) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? (mm Hg = torr) 5) B
A) 28.1 torr (B) 715 torr C) 31.8 torr D) 760 torr E) 13.8 torr

6) The distance between adjacent crests in a wave is called 6) D
A) frequency
B) median
C) area
(D) wavelength
E) amplitude



7) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15 °K? (volume is the same, $V_1 = V_2$) 7) B

$[(P_1V_1)/(P_2V_2) = T_1/T_2]$

A) 2.00 atm (B) 1.74 atm C) 2.08 atm D) 1.80 atm

8) What is the maximum number of d orbitals that are possible? (number of m_ℓ values for $\ell = 2$) 8) B

A) 3 (B) 5 C) 9 D) 7 E) 1

9) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as (otherwise in equation form: $P_T = P_a + P_b + P_c$ ...) 9) D

A) Boyle's Law
B) Charles's Law
C) Ideal Gas Law
(D) Dalton's Law
E) Avogadro's Law

10) Describe the shape of a s orbital. 10) E

A) eight balls
B) three balls
C) four balls
D) dumbbell shaped
(E) spherical

11) In which orbital below would an electron (on average) be farthest from the nucleus? 11) D

A) 3s B) 1s C) 2p (D) 4f E) 3d

principal quantum # determines distance from nucleus

$$\frac{(1.90\ atm)(V_1)}{(P_2?)(V_1)} = \left(\frac{297.15\ K}{272.15\ K}\right)$$ cancel

$$P_2 = \frac{(1.90)(272.15K)}{(297.15K)} = 1.74\ atm$$

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

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1. For the following unbalanced precipitation reaction, complete **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Mg\,Cl_2\,(aq) + Li_2S\,(aq) \rightarrow Mg\,S\,(s) + LiCl\,(aq)$

a. Complete ionic form:

$Mg^{+2}(aq) + 2Cl^{-1}(aq) + 2Li^{+1}(aq) + S^{-2}(aq) \rightarrow MgS\,(s) + Li^{+1}(aq) + Cl^{-1}(aq)$

b. Net ionic form:

$Mg^{+2}(aq) + S^{-2}(aq) \rightarrow MgS\,(s)$

2. Among the following compounds, circle all strong bases (1 pt each, 6 pts total)

NaOH NH_4OH $Ba(OH)_2$ $Ca(OH)_2$ NH_3 LiOH

3 For the following titration reaction if you neutralize a 0.55 M solution of KOH of volume 125.0 mL with a 2.50 M H Cl solution, how many mL of H Cl do you need?

$KOH + HCl \rightarrow KCl + H_2O$ $\quad \frac{(0.55)(125.0)}{(2.50)} = 27.5$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer**. (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = 2.50 M Vacid = Unknown

M base = 0.55 M V base = 125.0 mL

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. I in I_2 zero element

b F in CaF_2 −1 group 7 $7-8=-1$

c. P in PO_4^{-3} +5 $P + (-2)4 = -3$ $P = -3 + 8 = +5$

5 If the total gas pressure inside a gas tank is 770 mm Hg. The gas tank has a mixture of nitrogen and hydrogen and the nitrogen pressure is 23.8 mm Hg. What is the pressure of the nitrogen ? ($P_{total} = P_a + P_b + P_c$ .....) (show work)(4 pts)

$P_{total} = P_{H_2} + P_{N_2}$ $P_{total} = 770\,mmHg$ $770\,mmHg = P_{H_2} + 23.8\,mmHg$ $P_{N_2} = 23.8\,mmHg$ $P_{H_2} = 770\,mmHg - 23.8\,mmHg$ $P_{H_2} = 746.2\,mmHg$

6. If the angular momementum quantum number (ℓ) = 4, what are the possible values of the magnetic quantum number (m_ℓ) (circle one) (6 pts)

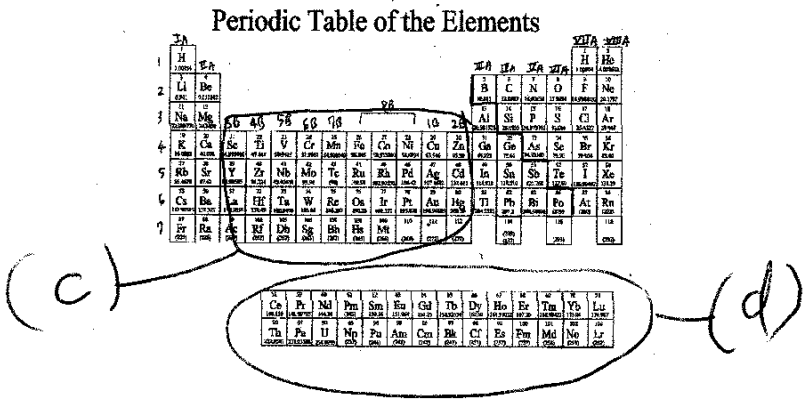
a) -4, -3, -2, -1, 0, +1, +2, +3, +4
b) + ½ or – ½
c) 0,1,2,3,4,5

$m_\ell = -4, -3, -2, -1, 0, +1, +2, +3, +4$

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements

Periodic Table of the Elements



Part III. Long Answer **Please show work for full credit and to receive partial credit. (34 pts)**
****** Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.******

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work

1. A gas in an internal combustion engine is heated from 298.2 K to 378.2 K. The volume of the gas changes from 1.58 Liters to 3.27 Liters. If the initial pressure was 0.987 atmospheres, what was the final pressure in atmospheres? $[(P_2V_2)/(P_1V_1) = (T_2/T_1)]$ (17 pts)

$T_1 = 298.2\,K$ $T_2 = 378.2\,K$

$V_1 = 1.58\,\ell$ $V_2 = 3.27\,\ell$

$P_1 = 0.987\,atm$ $P_2 = ?$

$$\frac{(P_2)(3.27\,\ell)}{(0.987\,atm)(1.58\,\ell)} = \left(\frac{378.2\,K}{298.2\,K}\right)$$ algebra

$$P_2 = \left(\frac{378.2\,K}{298.2\,K}\right)\frac{(0.987\,atm)(1.58\,\ell)}{(3.27\,\ell)}$$

$P_2 = 0.6048\,atm \rightarrow 0.605\,atm$ sig fig correct

2 If you do the following reaction with 5.23 grams of the O_2 (Formula Mass of O_2 = 32.00 g/mol) (assume limiting reagent of O_2), what is the theoretical yield of the $N_2(g)$ in Liters ? (hint: think moles of O_2) (1 mole gas = 22.4 Liters) (17 pts)

$4NH_3(g) + 4\ NO(g) + O_2(g) \rightarrow 4\ N_2(g) + 6\ H_2O(g)$

$$5.23\ g\ O_2 \times \frac{1\ mol\ O_2}{32.00\ g\ O_2} \times \frac{4\ mol\ N_2}{1\ mol\ O_2} \times \frac{22.4\ l}{1\ mol\ N_2} = 14.644\ l\ N_2$$

sig fig

14.6 l N_2

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 9:55 B Dr. Hahn Exam # _____

Name Key (print) Name _____ (sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.

(1 atm = 760 mm Hg = 760 torr) (Kelvin = °C + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) Describe the shape of a s orbital. 1) D
A) four balls
B) three balls
C) dumbbell shaped
D) spherical
E) eight balls

2) In which orbital below would an electron (on average) be farthest from the nucleus? 2) E
A) 1s B) 2p C) 3d D) 3s E) 4f

3) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15 K? (volume is the same, $V_1 = V_2$) 3) D
[$(P_1V_1)/(P_2V_2) = T_1 / T_2$]

A) 2.00 atm B) 1.80 atm C) 2.08 atm D) 1.74 atm

4) The distance between adjacent crests in a wave is called 4) B
A) median
B) wavelength
C) amplitude
D) frequency
E) area

5) Give the temperature and pressure at STP (standard pressure and atmosphere). 5) A
A) 0°C and 1.00 atm
B) 0°C and 1 mm Hg
C) 32K and 1 torr Hg
D) 25°C and 1.00 in Hg
E) 0K and 1.00 atm

6) How many H^+ ions can the acid, H_2SO_4, donate per molecule? 6) B
A) 0 B) 2 C) 3 D) 1

7) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as (otherwise in equation form: $P_T = P_a + P_b + P_c$ ...) 7) C

A) Boyle's Law
B) Charles's Law
C) Dalton's Law
D) Avogadro's Law
E) Ideal Gas Law

8) What is the maximum number of d orbitals that are possible? (number of m_ℓ values for $\ell = 2$) 8) C

A) 7 B) 1 C) 5 D) 3 E) 9

9) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 9) B

A) $2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$
B) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
C) $H^+(aq) + OH^-(aq) + 2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$
D) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$
E) No reaction occurs.

10) Which of the following samples will have the greatest volume at STP? 10) A

A) 5.5 mol He
B) 0.31 mol Cl_2
C) 3.12 mol O_2
D) 1.09 mol Ne
E) All of these samples would have the same volume at STP.

11) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 11) C

A) 28.1 torr B) 13.8 torr C) 715 torr D) 760 torr E) 31.8 torr

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (42 pts)

1. For the following unbalanced precipitation reaction, complete **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Mg\,Cl_2\,(aq) + Li_2S\,(aq) \rightarrow Mg\,S\,(s) + LiCl\,(aq)$

a. Complete ionic form:

$Mg^{+2}(aq) +$ Cl^- $(aq) + 2\,Li^{+1}(aq) + S^{-2}\,(aq) \rightarrow Mg\,S\,(s) +$ Li^+ $(aq) + Cl^{-1}\,(aq)$

b. net ionic equation

Mg^{+2} $(aq) +$ S^{-2} $(aq) \rightarrow Mg\,S\,(s)$

2 Among the following compounds, circle all weak bases .(1 pt each, 6 pts total)

NaOH (NH4OH) Ba(OH)2 Ca(OH)2 (NH3) LiOH

3 For the following titration reaction if you neutralize a 3.77 M solution of KOH of volume 37.8 mL with a 2.55 M HCl solution, how many mL of HCl do you need?

$KOH + HCl \rightarrow KCl + H_2O$ $\quad \frac{(3.77)(37.8)}{(2.55)} = 55.9$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer.** (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = 2.55 M Vacid = don't know

M base = 3.77 M V base = 37.8 mL

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. N in NO_2 +4 b. Li in Li zero element c. S in H_2SO_3 +4

$N + 2(-2) = 0$ $6 - 8 = -2$ $N = +4$

$2(+1) + S + 3(-2) = 0$ $S = 0 - 2 + 6 = +4$

5 If the total gas pressure inside a gas tank is 1.13 atm. The gas tank has a mixture of oxygen and argon and the argon pressure is 0.7 atm. What is the pressure of the argon ? ($P_{total} = P_a + P_b + P_c$ .....) (show work) (4 pts)

$P_{total} = P_{O_2} + P_{Ar}$ $1.13\,atm = P_{O_2} + 0.7\,atm$ $P_{O_2} = 1.13\,atm - 0.7\,atm$ $P_{O_2} = 0.43\,atm$

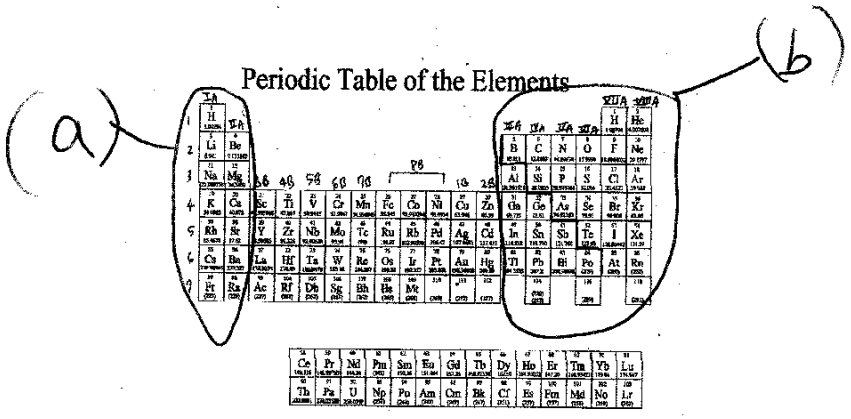
6 If the angular momementum quantum number (ℓ) = 3, what are the possible values of the magnetic quantum number (m_ℓ) (circle one) (6 pts) $\ell = 3$

a) -3, -2, -1, 0, +1, +2, +3
b) 0,1,2,3,4
c) 0,1,2,3,4,5

$m_\ell = -3, -2, -1, 0, +1, +2, +3$

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



Part III. Long Answer **Please show work for full credit and to receive partial credit. (34 pts)**
****** Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.******

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work

1. If 2.33 moles of a gas at pressure 2.30 atmosphere occupies a volume of 325.3 liters, what is the temperature of the gas in kelvin ? [PV=nRT, R=0.08206 (Liter atm) / (mol Kelvin)] (17 pts)

$n = 2,33\ mol$

$P = 2,30\ atm.$

$V = 325,3\ l$

$T = ?$

$$(2,30\ atm)(325,3\ l) = \left(\frac{2,33}{mol}\right)\left(\frac{0.08206\ l\ atm}{mol\ K}\right)(T)$$

$$T = \frac{(2,30\ atm)(325,3\ l)}{(2,33\ mol)\left(0,08206\ \frac{l\ atm}{mol\ K}\right)}$$

$T = 3913\ K \rightarrow 3,91 \times 10^3\ K$

sig fig (3)

Correct sig fig + not ambiguous

2 If you do the following reaction starting with 7.237 grams of the Fe_2O_3 (s) (Formula Mass of Fe_2O_3 = 159.7 g/mole) (assume excess CO), what is the theoretical yield of the CO_2 (g) in Liters ? (hint: think moles of Fe_2O_3 (1 mole gas = 22.4 Liters) (17 pts)

Fe_2O_3 (s) + 3CO(g) → 2Fe(s) + $3CO_2$ (g)

$$7{,}237\ g\ Fe_2O_3\ (s) \times \frac{1\ mol\ Fe_2O_3}{159{,}7\ g\ Fe_2O_3} \times \frac{3\ mol\ CO_2\ (g)}{1\ mol\ Fe_2O_3} \times \frac{22{,}4\ l}{1\ mol\ CO_2\ (g)} =$$

$$3{,}04\ l\ CO_2\ (g)$$

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 8:30 A Dr. Hahn Exam # green 2-11

Name_____ (print) Name _____(sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.

(1 atm = 760 mm Hg = 760 torr) (Kelvin = ^oC + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) Give the temperature and pressure at STP (standard pressure and atmosphere). 1) _____
A) 32K and 1 torr Hg
B) 0°C and 1 mm Hg
C) 25°C and 1.00 in Hg
D) 0°C and 1.00 atm
E) 0K and 1.00 atm

2) In which orbital below would an electron (on average) be closest to the nucleus? 2) _____
A) 5d B) 2p C) 4s D) 2p E) 2s

3) How many H+ ions can the acid, H_3PO_4, donate per molecule? 3) _____
A) 0 B) 2 C) 1 D) 3

4) The number of cycles that pass through a stationary point in a wave is called 4) _____
A) median
B) wavelength
C) area
D) frequency
E) amplitude

5) Describe the shape of a p orbital. 5) _____
A) spherical
B) three balls
C) four balls
D) eight balls
E) dumbbell shaped

6) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as 6) _____
(otherwise in equation form: $P_T = P_a + P_b + P_c$ ...)
A) Avogadro's Law
B) Charles's Law
C) Ideal Gas Law
D) Dalton's Law
E) Boyle's Law

7) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 7) _____

A) $H^+(aq) + OH^-(aq) + 2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$

B) $2\,K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$

C) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$

D) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

E) No reaction occurs.

8) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15 ~~°C~~ K? (volume is the same, $V_1 = V_2$) 8) _____

$[(P_1V_1)/(P_2V_2) = T_1/T_2\ ]$

A) 1.74 atm B) 2.00 atm C) 1.80 atm D) 2.08 atm

9) What is the maximum number of p orbitals that are possible (number of m_ℓ values for $\ell = 1$)? 9) _____

A) 7 B) 5 C) 9 D) 1 E) 3

10) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains C_2H_4, flask B contains O_3, and flask C contains F_2. Which flask contains the largest number of molecules? 10) _____

A) flask A B) flask B

C) flask C D) All contain same number of molecules.

11) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 11) _____

A) 715 torr B) 13.8 torr C) 28.1 torr D) 760 torr E) 31.8 torr

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (42 pts)

1. For the following unbalanced precipitation reaction complete **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Ca(NO_3)_2\,(aq) + \quad Na_3PO_4\,(aq) \rightarrow \quad Ca_3(PO_4)_2\,(s) + \quad NaNO_3\,(aq)$

a. Complete ionic form:

_____ $(aq) + 2\,NO_3^{-1}\,(aq) + 3\,Na^{+1}(aq) + PO_4^{-3}\,(aq) \rightarrow$ _____ $(s) + Na^{+1}\,(aq) + NO_3^{-1}\,(aq)$

b. Net ionic form

_____(aq) + $PO_4^{-3}\,(aq) \rightarrow$ _____ (s)

2. Among the following compounds, circle all strong acids (1 pt each, 6 pts total)

H_2SO_4 HF HNO_3 CH_3COOH H Cl $HC_2H_3O_2$

3 For the following titration reaction if you neutralize a 1.5 M solution of HNO_3 of volume 250.0 mL with a 0.55 M NaOH solution, how many mL of NaOH do you need?

$H\,NO_3 + Na\,OH \rightarrow Na\,NO_3 + H_2O$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer**. (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = _____ Vacid = _____

M base = _____ V base = _____

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. O in O_2 _____ b. S in SO_4^{-2} _____ c. Fe in Fe O _____

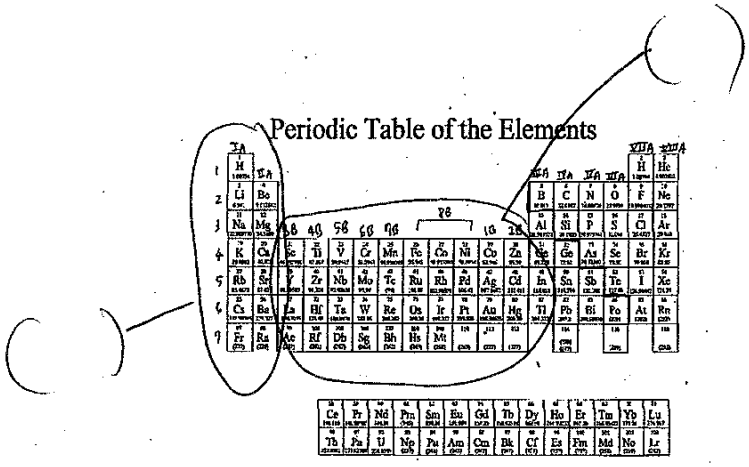
5 If the total gas pressure inside a gas tank is 1.2 atm. The gas tank has a mixture of helium and hydrogen and the hydrogen pressure is 0.8 atm. What is the pressure of the helium ? ($P_{total} = P_a + P_b + P_c$ .....)(show work) (4 pts)

6 If the principal investigator number (n) = 3, what are the possible values of angular momentum quantum number (ℓ) (circle one) (6 pts)

a) -1, 0, +1
b) 0, 1,2
c) + ½ or – ½

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



Part III. Long Answer **Please show work for full credit and to receive partial credit. (34 pts)**
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Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work

1. If a gas in a tank of volume 3.72 Liters is at temperature of 273.2 Kelvin has pressure 1.07 atmospheres. If the tank is allowed to heat up to 303.7 Kelvin temperature, what is the new pressure in atmospheres assuming that the volume has not changed ? $[(P_2V_2)/(P_1V_1) = (T_2/T_1)]$ (17 pts)

2. If you do the following reaction starting with 12.3 mL of a 2.5 M solution of H_3PO_4 (assume excess NaOH) , what is the theoretical yield of the $H_2O(g)$ in Liters ? (1 mole gas = 22.4 liters) (hint: think moles of H_3PO_4) (17 pts)

$H_3PO_4(aq) + 3\ NaOH(aq) \rightarrow 3H_2O(g) + Na_3PO_4\ (aq)$

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 8:30 B Dr. Hahn Exam # 2-12

Name_____ (print) Name _____(sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multiple choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.

(1 atm = 760 mm Hg = 760 torr) (Kelvin = ^oC + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) Describe the shape of a p orbital. 1) _____
   A) eight balls
   B) spherical
   C) four balls
   D) dumbbell shaped
   E) three balls

2) Three identical flasks contain three different gases at standard temperature and pressure. Flask A contains C_2H_4, flask B contains O_3, and flask C contains F_2. Which flask contains the largest number of molecules? 2) _____
   A) flask A
   B) flask B
   C) flask C
   D) All contain same number of molecules.

3) The number of cycles that pass through a stationary point in a wave is called 3) _____
   A) frequency
   B) wavelength
   C) median
   D) amplitude
   E) area

4) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15°K? (volume is the same, $V_1 = V_2$) 4) _____
   $[(P_1V_1)/(P_2V_2) = T_1 / T_2]$

   A) 1.80 atm B) 1.74 atm C) 2.08 atm D) 2.00 atm

5) Give the temperature and pressure at STP (standard pressure and atmosphere). 5) _____
   A) 0°C and 1 mm Hg
   B) 0°C and 1.00 atm
   C) 0K and 1.00 atm
   D) 25°C and 1.00 in Hg
   E) 32K and 1 torr Hg

6) How many H^+ ions can the acid, H_3PO_4, donate per molecule? 6) _____
   A) 1 B) 2 C) 3 D) 0

7) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as (otherwise in equation form: $P_T = P_a + P_b + P_c$ ...) 7) _____

A) Boyle's Law
B) Avogadro's Law
C) Charles's Law
D) Ideal Gas Law
E) Dalton's Law

8) In which orbital below would an electron (on average) be closest to the nucleus? 8) _____

A) 5d B) 4s C) 2s D) 2p E) 2p

9) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 9) _____

A) 28.1 torr B) 31.8 torr C) 715 torr D) 13.8 torr E) 760 torr

10) What is the maximum number of p orbitals that are possible (number of m_ℓ values for $\ell = 1$)? 10) _____

A) 5 B) 1 C) 9 D) 3 E) 7

11) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 11) _____

A) $2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$

B) $H^+(aq) + OH^-(aq) + 2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$

C) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

D) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$

E) No reaction occurs.

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (42 pts)

1. For the following unbalanced precipitation reaction **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Ca(NO_3)_2$ (aq) + Na_3PO_4 (aq) → $Ca_3(PO_4)_2$ (s) + $NaNO_3$ (aq)

a. Complete ionic form:

Ca^{+2}(aq) + $2NO_3^{-1}$ (aq) + _____(aq) + PO_4^{-3} (aq) → $Ca_3(PO_4)_2$ (s) + Na^{+}(aq) + _____ (aq)

b. Net ionic form:

_____ (aq) + _____ (aq) → $Ca_3(PO_4)_2$ (s)

2. Among the following compounds, circle all weak acids (1 pt each, 6 pts total)
3.

H_2SO_4 HF HNO_3 CH_3COOH H Cl $HC_2H_3O_2$

3 For the following titration reaction if you neutralize a 3.7 M solution of HNO_3 of volume 73.2 mL with a 2.55 M NaOH solution, how many mL of NaOH do you need?

H NO_3 + Na OH → Na NO_3 + H_2O

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer**. (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = _____ Vacid = _____

M base = _____ V base = _____

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. K in KCl _____ b. Ca in Ca _____ c. C in K_2CO_3 _____

5 If the total gas pressure inside a gas tank is 738 torr. The gas tank has a mixture of helium and hydrogen and the hydrogen pressure is 28 torr. What is the pressure of the hydrogen ? ($P_{total} = P_a + P_b + P_c$ .....) (show work) (4 pts)

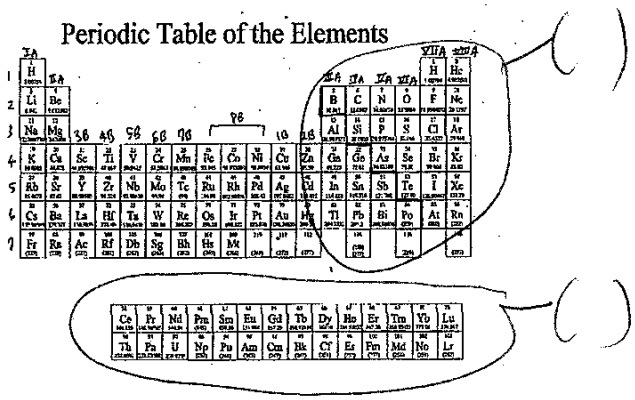
He

6 If the principal investigator number (n) = 4, what are the possible values of angular momentum quantum number (ℓ) (circle one) (6 pts)

a) -2, -1, 0, +1, +2
b) 0, 1,2, 3
c) + ½ or – ½

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



Part III. Long Answer **Please show work for full credit and to receive partial credit. (34 pts)**
****** Please attempt every problem for partial credit. You will get no partial credit if you just rewrite the question with no change in anything.******

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work

1. 7.23 moles of a gas at temperature of 278.2 Kelvin and pressure of 0.978 atmospheres occupies what volume in liters ? [PV=nRT, R=0.08206 (Liter atm) / (mol Kelvin)] (17 pts)

2 If you do the following reaction starting with 250.2 mL of 1.5 M solution of H_2SO_4(assume excess Al) , what is the theoretical yield of the $H_2(g)$ in Liters ? (1 mole gas = 22.4 liters) (hint: think moles of H_2SO_4) (show work) (17 pts)

$2Al\,(s) + 3\,H_2SO_4\,(aq) \rightarrow Al_2(SO_4)_3\,(aq) + 3H_2(g)$

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 9:55 A Dr. Hahn Exam # _____

Name_____ (print) Name _____(sign)

Please show work for partial credit and full credit on the Long Answers and in some of the Short Answer Questions. Multip choice questions have no partial credit. Please write anything you want graded legibly. If I cannot read your work, I obviously cannot grade it. (2 pts print and sign exam) If you run out of space, please continue on the back page of the exam and clearly tell me where the remaining answer can be found.

(1 atm = 760 mm Hg = 760 torr) (Kelvin = ^{o}C + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) How many H+ ions can the acid, H_2SO_4, donate per molecule? 1) _____
A) 0 B) 1 C) 3 D) 2

2) Give the temperature and pressure at STP (standard pressure and atmosphere). 2) _____
A) 0K and 1.00 atm
B) 0°C and 1 mm Hg
C) 0°C and 1.00 atm
D) 25°C and 1.00 in Hg
E) 32K and 1 torr Hg

3) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 3) _____
A) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
B) $H^+(aq) + OH^-(aq) + 2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$
C) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$
D) $2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$
E) No reaction occurs.

4) Which of the following samples will have the greatest volume at STP? 4) _____
A) 1.09 mol Ne
B) 5.5 mol He
C) 0.31 mol Cl_2
D) 3.12 mol O_2
E) All of these samples would have the same volume at STP.

5) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 5) _____
A) 28.1 torr B) 715 torr C) 31.8 torr D) 760 torr E) 13.8 torr

6) The distance between adjacent crests in a wave is called 6) _____
A) frequency
B) median
C) area
D) wavelength
E) amplitude

7) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15°K? (volume is the same, $V_1 = V_2$) 7) _____

$[(P_1V_1)/(P_2V_2) = T_1 / T_2\ ]$

A) 2.00 atm B) 1.74 atm C) 2.08 atm D) 1.80 atm

8) What is the maximum number of d orbitals that are possible? (number of m_ℓ values for $\ell = 2$) 8) _____

A) 3 B) 5 C) 9 D) 7 E) 1

9) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as (otherwise in equation form: $P_T = P_a + P_b + P_c$ ...) 9) _____

A) Boyle's Law
B) Charles's Law
C) Ideal Gas Law
D) Dalton's Law
E) Avogadro's Law

10) Describe the shape of a s orbital. 10) _____

A) eight balls
B) three balls
C) four balls
D) dumbbell shaped
E) spherical

11) In which orbital below would an electron (on average) be farthest from the nucleus? 11) _____

A) 3s B) 1s C) 2p D) 4f E) 3d

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

Please show all work on this exam itself. If you are going to show work on the scratch paper and want me to grade it, clearly indicate where I can find your work. (42 pts)

1. For the following unbalanced precipitation reaction, complete **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Mg\,Cl_2\,(aq) + Li_2S\,(aq) \rightarrow Mg\,S\,(s) + LiCl\,(aq)$

a. Complete ionic form:

$$\_\_\_\_\_(aq) + 2Cl^{-1}\,(aq) + 2Li^{+1}(aq) + S^{-2}(aq) \rightarrow \_\_\_\_\_\,(s) + Li^{+1}(aq) + Cl^{-1}(aq)$$

b. Net ionic form:

$$Mg^{+2}\,(aq) + \_\_\_\_\_(aq) \rightarrow \_\_\_\_\_\,(s)$$

2. Among the following compounds, circle all strong bases .(1 pt each, 6 pts total)

$NaOH$ NH_4OH $Ba(OH)_2$ $Ca(OH)_2$ NH_3 $LiOH$

3 For the following titration reaction if you neutralize a 0.55 M solution of KOH of volume 125.0 mL with a 2.50 M H Cl solution, how many mL of H Cl do you need?

$KOH + HCl \rightarrow KCl + H_2O$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer**. (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = _____ Vacid = _____

M base = _____ V base = _____

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. I in I_2 _____ b F in CaF_2 _____ c. P in PO_4^{-3} _____

5 If the total gas pressure inside a gas tank is 770 mm Hg. The gas tank has a mixture of nitrogen and hydrogen and the nitrogen pressure is 23.8 mm Hg. What is the pressure of the nitrogen ? ($P_{total} = P_a + P_b + P_c$ .....) (show work)(4 pts)

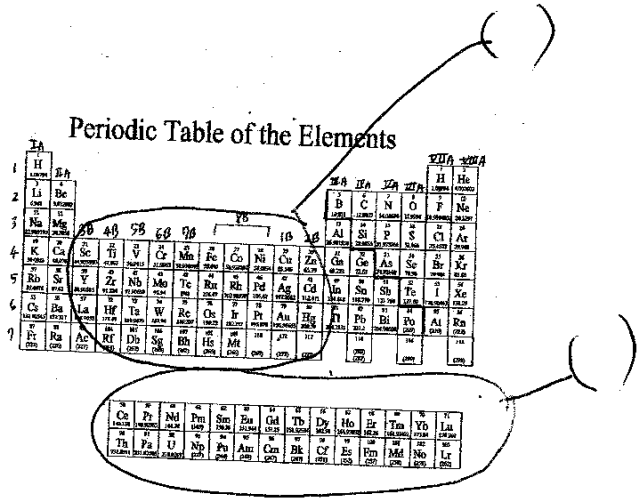
H_2

6. If the angular momementum quantum number (ℓ) = 4, what are the possible values of the magnetic quantum number (m_ℓ) (circle one) (6 pts)

a) -4, -3, -2, -1, 0, +1, +2, +3, +4
b) + ½ or – ½
c) 0,1,2,3,4,5

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



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1. A gas in an internal combustion engine is heated from 298.2 K to 378.2 K. The volume of the gas changes from 1.58 Liters to 3.27 Liters. If the initial pressure was 0.987 atmospheres, what was the final pressure in atmospheres? $[(P_2V_2)/(P_1V_1) = (T_2/T_1)]$ (17 pts)

2 If you do the following reaction with 5.23 grams of the O_2 (Formula Mass of O_2 = 32.00 g/mol) (assume limiting reagent of O_2), what is the theoretical yield of the $N_2(g)$ in Liters ? (hint: think moles of O_2) (1 mole gas = 22.4 Liters) (17 pts)

$4NH_3(g) + 4\ NO(g) + O_2(g) \rightarrow 4\ N_2(g) + 6\ H_2O(g)$

Exam III General Chemistry I Lecture Spring 2014 4/1/14 Tuesday form 9:55 B Dr. Hahn Exam # 1-8

Name_____ (print) Name _____(sign)

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(1 atm = 760 mm Hg = 760 torr) (Kelvin = ^oC + 273.15)(PV=nRT, R = 0.08206 (L atm)/(mol K)] [$(P_2V_2) / (P_1 V_1)=T_2/T_1$]

Part I MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question. No partial credit for MC. (2 pts per question, 22 pts pts total)

1) Describe the shape of a s orbital. 1) _____
A) four balls
B) three balls
C) dumbbell shaped
D) spherical
E) eight balls

2) In which orbital below would an electron (on average) be farthest from the nucleus? 2) _____
A) 1s B) 2p C) 3d D) 3s E) 4f

3) A basketball is inflated to a pressure of 1.90 atm in a 297.15 °K garage. What is the pressure of the basketball outside where the temperature is 272.15°C? (volume is the same, $V_1 = V_2$) 3) _____
$[(P_1V_1)/(P_2V_2) = T_1 / T_2]$

A) 2.00 atm B) 1.80 atm C) 2.08 atm D) 1.74 atm

4) The distance between adjacent crests in a wave is called 4) _____
A) median
B) wavelength
C) amplitude
D) frequency
E) area

5) Give the temperature and pressure at STP (standard pressure and atmosphere). 5) _____
A) 0°C and 1.00 atm
B) 0°C and 1 mm Hg
C) 32K and 1 torr Hg
D) 25°C and 1.00 in Hg
E) 0K and 1.00 atm

6) How many H+ ions can the acid, H_2SO_4 , donate per molecule? 6) _____
A) 0 B) 2 C) 3 D) 1

7) The total pressure of a gas mixture is the sum of the partial pressure of its components is known as (otherwise in equation form: $P_T = P_a + P_b + P_c$ ...) 7) _____

A) Boyle's Law
B) Charles's Law
C) Dalton's Law
D) Avogadro's Law
E) Ideal Gas Law

8) What is the maximum number of d orbitals that are possible? (number of m_ℓ values for $\ell = 2$) 8) _____

A) 7 B) 1 C) 5 D) 3 E) 9

9) Give the **net ionic equation** for the reaction (if any) that occurs when aqueous solutions of H_2SO_4 and KOH are mixed. 9) _____

A) $2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow K_2SO_4(s)$
B) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
C) $H^+(aq) + OH^-(aq) + 2\ K^+(aq) + SO_4^{2-}(aq) \rightarrow H_2O(l) + K_2SO_4(s)$
D) $H_2^{2+}(aq) + OH^-(aq) \rightarrow H_2(OH)_2(l)$
E) No reaction occurs.

10) Which of the following samples will have the greatest volume at STP? 10) _____

A) 5.5 mol He
B) 0.31 mol Cl_2
C) 3.12 mol O_2
D) 1.09 mol Ne
E) All of these samples would have the same volume at STP.

11) The atmospheric pressure is 715 mm Hg. What is the pressure in torr? 11) _____

A) 28.1 torr B) 13.8 torr C) 715 torr D) 760 torr E) 31.8 torr

Part II Short Answer: Write the word or phrase or circle the choice that best completes each statement or answers the question. Some questions may require that you show work. If you do not show work, you may lose points. Even on questions which do not require work, if you legibly show work, you may get some partial credit.

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1. For the following unbalanced precipitation reaction, complete **by filling in the blanks**. The reaction does not need to be balanced. (2 pts each, 8 pt total)

$Mg\,Cl_2\,(aq) + Li_2S\,(aq) \rightarrow Mg\,S\,(s) + LiCl\,(aq)$

a. Complete ionic form:

$Mg^{+2}(aq) +$ _____ $(aq) + 2\,Li^{+1}(aq) + S^{-2}\,(aq) \rightarrow Mg\,S\,(s) +$ _____ $(aq) + Cl^{-1}\,(aq)$

b. net ionic equation

_____ $(aq) +$ _____ $(aq) \rightarrow Mg\,S\,(s)$

2 Among the following compounds, circle all weak bases .(1 pt each, 6 pts total)

NaOH NH_4OH $Ba(OH)_2$ $Ca(OH)_2$ NH_3 LiOH

3 For the following titration reaction if you neutralize a 3.77 M solution of KOH of volume 37.8 mL with a 2.55 M HCl solution, how many mL of HCl do you need?

$KOH + HCl \rightarrow KCl + H_2O$

To answer this question fill in the blanks below. Just complete the following for using the acid base titration equation. ($M_{acid}V_{acid}=M_{base}V_{base}$). **You do not need to solve for the actual final answer.** (this question is designed to allow you to complete your exam on time by not completely answering the question.) (2 pts each, 8 pts total)

M acid = _____ Vacid = _____

M base = _____ V base = _____

4 Give the oxidation state for the following. Show work. (2 pts each, 6 pts total)

a. N in NO_2 _____ b. Li in Li _____ c. S in H_2SO_3 _____

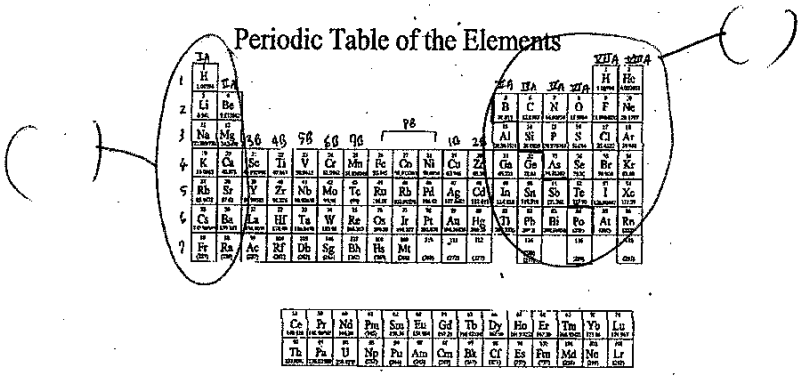
5 If the total gas pressure inside a gas tank is 1.13 atm. The gas tank has a mixture of oxygen and argon and the argon pressure is 0.7 atm. What is the pressure of the ~~argon~~ O_2 ? ($P_{total} = P_a + P_b + P_c$ .....) (show work) (4 pts)

6 If the angular momementum quantum number (ℓ) = 3, what are the possible values of the magnetic quantum number (m_ℓ) (circle one) (6 pts)

a) -3, -2, -1, 0, +1, +2, +3
b) 0,1,2,3,4
c) 0,1,2,3,4,5

7 Match the following to the letters shown. The letters may only be used one time or not at all. (2 pts each, 4 pts total)

(a) s block elements (b) p block elements (c) d block elements (d) f block elements



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1. If 2.33 moles of a gas at pressure 2.30 atmosphere occupies a volume of 325.3 liters, what is the temperature of the gas in kelvin ? [PV=nRT, R=0.08206 (Liter atm) / (mol Kelvin)] (17 pts)

2 If you do the following reaction starting with 7.237 grams of the Fe_2O_3 (s) (Formula Mass of Fe_2O_3 = 159.7 g/mole) (assume excess CO), what is the theoretical yield of the CO_2 (g) in Liters ? (hint: think moles of Fe_2O_3 (1 mole gas = 22.4 Liters) (17 pts)

Fe_2O_3 (s) + 3CO(g) → 2Fe(s) + $3CO_2$ (g)