Exam 1-6

EXAM 1

Question 1

1. Convert 1005.3 to exponential form and explain your answer.

2. Convert 4.87 x 10-6 to ordinary form and explain your answer.

Answer:

1. Convert 1005.3 = larger than 1 = positive exponent, move decimal 3 places = 1.0053 x 103

2. Convert 4.87 x 10-6 =negative exponent =smaller than 1, move decimal 6 places = 0.00000487

Question 2

Using the following information, do the conversions shown below, showing all work:

1 ft = 12 inches	1 pound = 16 oz	1 gallon = 4 quarts
1 mile = 5280 feet	1 ton = 2000 pounds	1 quart = 2 pints
kilo (= 1000)	milli (= 1/1000)	centi (= 1/100)

deci (= 1/10)

1. 2.73 liters = ? ml 2. 8.6 pts = ? qts

Answer:

1. 2.73 liters x 1000 ml / 1 liter = 2730 ml

2. 8.6 pts x 1 qt / 2 pts = 4.3 qts

Question 3

Do the conversions shown below, showing all work:

1. 248oC = ? oK

2. 25oF = ? oC

3. 175oK = ? oF

Answer:

1. 248oC + 273 = 521 oK oC → oK (make larger) +273

2. 25oF - 32 ÷ 1.8 = -3.88 oC oF → oC (make smaller) -32 ÷1.8

3. 175oK - 273 = -98 oC x 1.8 + 32 = -144.4 oF oK → oC → oF

Question 4

Be sure to show the correct number of significant figures in each calculation.

1. Show the calculation of the mass of a 17.9 ml sample of chloroform with density of 1.49 g/ml

2. Show the calculation of the volume of 19.4 grams of cresol with density of 1.02 g/ml

Answer:

1. M = D x V = 1.49 x 17.9 = 26.7 g

2. V = M / D = 19.4 / 1.02 = 19.0 ml

Question 5

1. 1.35601 contains ? significant figures.

2. 0.151 contains ? significant figures.

3. 1.35601 + 0.151 = ? (give answer to correct number of significant figures)

Answer:

1. 1.35601 contains 6 significant figures.

2. 0.151 contains 3 significant figures.

3. 1.35601 + 0.151 = 1.50701 = 1.507 (to the thousands place for 0.151)

Question 6

Classify each of the following as an element, compound, solution or heterogeneous mixture and explain your answer.

1. Honey

2. Hydrogen iodide

3. Tea

Answer:

1. Honey - is not on periodic table (not element) - no element names (not compound) appears to be one substance = Solution

2. Hydrogen iodide - is not on periodic table (not element) - has two element names = Compound

3. Tea - is not on periodic table (not element) - no element names (not compound)

appears to be one substance = Solution

Question 7

Classify each of the following as a chemical change or a physical change

1. A silver spoon forms a black tarnish coating

2. Food is digested

3. Rain freezes on a road on a very cold day

Answer:

1. Silver spoon forms black coating - this is Ag → Ag2S (color change) = chemical change

2. Food is digested - breakdown of carbs, proteins, fats to new materials = chemical change

3. Rain freezes on a road on a very cold day - freezing = physical change

Question 8

Show the full Nuclear symbol including any + or - charge (n), the atomic number (y), the mass number (x) and the correct element symbol (Z) for each element for which the protons, neutrons and electrons are shown - symbol should appear as follows: xZy+/- n

53 protons, 74 neutrons, 54 electrons

Answer:53 protons = I53, 74 neutrons = 127I53, 54 electrons = (+53 - 54 = -1) = 127I53-1

Question 9

Name each of the following chemical compounds. Be sure to name all acids as acids (NOT for instance as binary compounds)

1. SF6

2. (NH4)3PO4

3. H2S

Answer:

1. SF6 - binary molecular = sulfur hexafluoride
2. (NH4)3PO4 - nonbinary ionic = ammonium phosphate
3. H2S - binary acid = hydrosulfuric acid

Question 10

Write the formula for each of the following chemical compounds explaining the answer with appropriate charges and/or prefixes and/or suffixes.

1. Iron (III) cyanide

2. Diiodine pentoxide

3. Potassium phosphide

1. Iron (III) cyanide - Fe+3, CN-1 = Fe(CN)3
2. Diiodine pentoxide - ide = binary, two I, 5 O = I2O5
3. Potassium phosphide - ide = binary K+1, P-3 = K3P

EXAM 2

Question 1

Show the calculation of the molecular weight for the following compounds, reporting your answer to 2 places after the decimal.

1. (NH4)2CrO4

2. C8H8NOI

Answer:

1. 2N + 8H + Cr + 4O = 152.08

2. 8C + 8H + N + O + I = 261.05

Question 2

Show the calculation of the number of moles in the given amount of the following substances. Report your answerto 3 significant figures.

1. 12.0 grams of (NH4)2CrO4

2. 15.0 grams of C8H8NOI

Answer:

1. Moles = grams / molecular weight = 12.0 / 152.08 = 0.0789 mole

2. Moles = grams / molecular weight = 15.0 / 261.05 = 0.0575 mole

Question 3

Show the calculation of the number of grams in the given amount of the following substances. Report your answer to 1 place after the decimal.

1. 1.05 moles of (NH4)2CrO4

2. 1.18 moles of C8H8NOI

Answer:

1. Grams = Moles x molecular weight = 1.05 x 152.08 = 159.7 grams

2. Grams = Moles x molecular weight = 1.18 x 261.05 = 308.0 grams

Question 4

Show the calculation of the percent of each element present in the following compounds. Report your answer to 2 places after the decimal.

1. (NH4)2SO4

2. C9H9NO3

Answer:

1. %N = 2 x 14.01/132.15 x 100 = 21.20%

   %H = 8 x 1.008/132.15 x 100 = 6.10%

   %S = 1 x 32.07/132.15 x 100 = 24.27%

   %O = 4 x 16/132.15 x 100 = 48.43%

2. %C = 9 x 12.01/179.17 x 100 = 60.33%

   %H = 9 x 1.008/179.17 x 100 = 5.06%

   %N = 1 x 14.01/179.17 x 100 = 7.82%

   %O = 3 x 16/179.17 x 100 = 26.79%

Question 5

Show the calculation of the empirical formula for each compound whose elemental composition is shown below.

38.76% Ca, 19.87% P, 41.27% O

Answer:

38.76% Ca / 40.08 = 0.9671 / 0.6416 = 1.5 x 2 = 3

19.87% P / 30.97 = 0.6416 / 0.6416 = 1 x 2 = 2

41.27% O / 16.00 = 2.579 / 0.6416 = 4 x 2 = 8 → $Ca_3P_2O_8$

Question 6

Balance each of the following equations by placing coefficients in front of each substance.

1. $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

2. $P + O_2 \rightarrow P_2O_5$

3. $Al + H_2SO_4 \rightarrow Al_2(SO_4)_3 + H_2$

Answer:

1. $2\ C_4H_{10} + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O$

2. $4\ P + 5\ O_2 \rightarrow 2\ P_2O_5$

3. $2\ Al + 3\ H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3\ H_2$

Question 7

Classify each of the following reactions as either:

Combination

Decomposition

Combustion

Double Replacement

Single Replacement

1. $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$

2. $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$

3. $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$

Answer:

1. $C_5H_{12} + 8\ O_2 \rightarrow 5\ CO_2 + 6\ H_2O$ = Combustion, Hydrocarbon + $O_2 \rightarrow CO_2 + H_2O$

2. $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$ = Single Replacement, Metal displaces metal ion

3. $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$ = Combination. Two reactants→ One product

Question 8

Show the calculation of the oxidation number (charge) of ONLY the atoms which are changing in the following redox equations.

$Na_2HAsO_3 + KBrO_3 + HCl \rightarrow NaCl + KBr + H_3AsO_4$

Answer:

Na_2HAsO_3: Na is metal in group I = +1 (total is +2), H = +1, each O is -2 (total is -6), so As is +3

H_3AsO_4: H is +1 (total is +3), each O is -2 (total is -8), so As is +5

$KBrO_3$: K is metal in group I = +1, each O is -2 (total is -6), so Br is +5

KBr: K is metal in group I = +1, so Br is -1

Question 9

Show the balancing of the following redox equation, including the determination of the oxidation number (charge) of ONLY the atoms which are changing.

$$Na2HAsO3 + KBrO3 + HCl \rightarrow NaCl + KBr + H3AsO4$$

Answer:

Na2HAsO3: Na is metal in group I = +1 (total is +2), H = +1, each O is -2 (total is -6), so As is +3

H3AsO4: H is +1 (total is +3), each O is -2 (total is -8), so As is +5

KBrO3: K is metal in group I = +1, each O is -2 (total is -6), so Br is +5

KBr: K is metal in group I = +1, so Br is -1

Since As (on left side) is +3 and As (on right side) is +5: As changes by 2

Since Br (on left side) is +5 and Br (on right side) is -1: Br changes by 6

Multiply As compounds by 3 and Br compounds by 1 and after balancing other atoms =

$$3\ Na2HAsO3 + 1\ KBrO3 + 6\ HCl \rightarrow 6\ NaCl + 1\ KBr + 3\ H3AsO4$$

Question 10

Show the balanced equation and the calculation of the number of moles and grams of CO_2 formed from 25.4 grams of C_8H_{18}. Show your answers to 3 significant figures.

$$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$$

Answer:

$$2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O$$

25.4 g / (8 x 12.01 + 18 x 1.008) = 25.4 / 114.224 = 0.2223 mole x 16/2 = 1.78 mole CO_2

1.78 mole CO_2 x (12.01 + 2 x 16.00) = 78.3 g CO_2

Exam 3

Question 1

A reaction between HCl and NaOH is being studied in a styrofoam coffee cup with NO lid and the heat given off is measured by means of a thermometer immersed in the reaction mixture. Enter the correct thermochemistry term to describe the item listed.

1. The type of thermochemical process

2. The amount of heat released in the reaction of HCl with NaOH

Answer:

1. Heat given off = Exothermic process

2. The amount of heat released = Heat of reaction

Question 2

1. Show the calculation of the final temperature for a 27.4 gram piece of aluminum heated to 100^{o}C which has been added to a 32.5 gram sample of water at 25.6^{o}C in a coffee cup calorimeter.

c (water) = 4.184 J/g ^{o}C; c (Al) = 0.901 J/g ^{o}C

2. Show the calculation of the energy involved in condensation of 95.6 grams of steam at 100^{o}C if the Heat of Vaporization for water is 2.26 kJ/g

Answer:

1.

$- (m_{Al} \times c_{Al} \times \Delta t_{Al}) = (m_{H2O} \times c_{H2O} \times \Delta t_{H2O})$

$- [27.4\ g \times 0.901\ J/g\ ^{o}C \times (T_{mix} - 100^{o}C)] = [32.5\ g \times 4.184\ J/g\ ^{o}C \times (T_{mix} - 25.6^{o}C)]$

$- [24.6874\ J/^{o}C \times (T_{mix} - 100^{o}C)] = [135.98\ J/^{o}C \times (T_{mix} - 25.6^{o}C)]$

$- 24.6874\ J/^{o}C\ (T_{mix}) + 2468.74\ J = 135.98\ J/^{o}C\ (T_{mix}) - 3481.088\ J$

$5949.828\ J = 160.6674\ J/^{o}C\ (T_{mix})$

$T_{mix} = 37.0^{o}C$

2. $q_{l \leftrightarrow g} = m \times \Delta H_{vapor}$ = 95.6 g x 2.26 kJ/g = 216.1 kJ (since heat is removed) = - 216.1 kJ

Question 3

Show the calculation of the amount of heat involved if 18.3 g of S is reacted with excess O_2 to yield sulfur trioxide by the following reaction equation. Report your answer to 4 significant figures.

$$2\ S\ (s) + 3\ O_2\ (g) \rightarrow 2\ SO_3\ (g) \quad \Delta H = -792\ kJ$$

Answer:

$$2\ S\ (s) + 3\ O_2\ (g) \rightarrow 2\ SO_3\ (g) \quad \Delta H = -792\ kJ$$

ΔH_{rx} is for 2 mole of S

reaction uses 18.3 g S = 18.3/32.07 = 0.5706 mole S

q = ΔH_{rx} x new moles / original moles

q = -792 kJ x 0.5706 mole S / 2 mole S = 226.0 kJ given off

Question 4

Show the calculation of the heat of reaction (ΔH_{rxn}) for the reaction:

$$3\ C\ (graphite) + 4\ H_2\ (g) \rightarrow C_3H_8\ (g)$$

by using the following thermochemical data:

$C\ (graphite) + O_2\ (g) \rightarrow CO_2\ (g) \quad \Delta H = -393.51\ kJ$

$2\ H_2\ (s) + O_2\ (g) \rightarrow 2\ H_2O(l) \quad \Delta H = -571.66\ kJ$

$C_3H_8\ (g) + 5\ O_2\ (g) \rightarrow 3\ CO_2\ (g) + 4\ H_2O(l) \quad \Delta H = -2220.0\ kJ$

Answer:

$3\ (C\ (graphite) + O_2\ (g) \rightarrow CO_2\ (g) \quad \Delta H = -393.51\ kJ)2\ (2\ H_2\ (s) + O_2\ (g) \rightarrow 2\ H_2O(l) \quad \Delta H = -571.66\ kJ)$

$3\ CO_2\ (g) + 4\ H_2O(l) \rightarrow C_3H_8\ (g) + 5\ O_2\ (g) \quad \Delta H = +2220.0\ kJ3\ C\ (graphite) + 4\ H_2\ (g) \rightarrow C_3H_8\ (g) \quad \Delta H_{rxn} = -103.85\ kJ$

$$\Delta H_{rxn} = 3(-393.51) + 2(-571.66) + 2220.0 = -103.85 kJ$$

Question 5

Show the calculation of the heat of reaction (ΔH_{rxn}) for the reaction:

$$2\ C_6H_6\ (g) + 9\ O_2\ (g) \rightarrow 12\ CO\ (g) + 6\ H_2O\ (l)$$

by using the following thermochemical data:

ΔH_{f^0} C_6H_6 (g) = +49.1 kJ/mole, ΔH_{f^0} CO (g) = -110.5 kJ/mole, ΔH_{f^0} H_2O (l) = -285.8 kJ/mole

Answer:

2 C_6H_6 (g) + 9 O_2 (g) → 12 CO (g) + 6 H_2O (l)

ΔH_{f^0} C_6H_6 (g) = +49.1 kJ/mole, ΔH_{f^0} CO (g) = -110.5 kJ/mole, ΔH_{f^0} H_2O (l) = -285.8 kJ/mole

ΔH_{rxn} = 2(-49.1) + 9(0) + 12(-110.5) + 6(-285.8) = - 3139.0 kJ/mole

Question 6

Show the calculation of the new pressure of a gas sample which has an original volume of 560 ml when collected at 1.05 atm and 32^oC when the volume becomes 1.35 liters at 50^oC.

Your Answer:

$(P_i \times V_i) / T_i = (P_f \times V_f) / T_f$

560 ml/1000 = 0.560 liters = V_i

1.05 atm = P_i

1.35 liters = P_f

32^oC + 273 = 305^oK = T_i 50^oC + 273 = 323^oK = T_f

(1.05) x (0.560) / 305 = P_f x (1.35) / 323

P_f = 0.461 atm

Question 7

Show the calculation of the volume occupied by a gas sample containing 0.632 mole collected at 710 mm and 35^{o}C.

Answer:P x V = n x R x T

0.632 mole = n R = 0.0821

710 mm/760 = 0.934 atm = P 35^{o}C + 273 = 308^{o}K = T

(0.934) x V = (0.632) x (0.0821) x (308) V = 17.1 liters

Question 8

Show the calculation of the volume of H_2O gas produced by the combustion of 33.5 grams of ethanol by excess O_2 gas at 35^{o}C and 1.05 atm. The combustion of ethanol (C_2H_5OH) takes place by the following reaction equation.

$C_2H_5OH\ (l) + 3\ O_2\ (g) \rightarrow 2\ CO_2\ (g) + 3\ H_2O\ (g)$

Your Answer:

MW = 46) (MW = 32) (MW = 44) (MW = 18)

$C_2H_5OH\ (l) + 3\ O_2\ (g) \rightarrow 2\ CO_2\ (g) + 3\ H_2O\ (g)$

33.5 grams 52.62 liters

(0.0821)(308)/1.05 ↑ ↓ by V = nRT / P = (2.1849 mole)

0.7283 mol →
3/1 x 0.7283 mol

Question 9

Show the calculation of the mole fraction of each gas in a 1.00 liter container holding a mixture of 3.62 g of He and 5.45 g of Ne at 25^{o}C.

Answer:

$n_{He} = g_{He} / (MW_{He}) = 3.62\ g / 4.002 = 0.9045\ mol$

$n_{Ne} = g_{Ne} / (MW_{Ne}) = 5.45\ g / 20.18 = 0.2701\ mol$

$X_{Ne} = 0.9045 / (0.9045 + 0.2701) = 0.7700$

$X_{Ne} = 0.2701 / (0.9045 + 0.2701) = 0.2300$

Question 10

Show the calculation of the molecular weight of an unknown gas if the rate of effusion of Neon gas (Ne) is 1.86 times faster than that of an unknown gas.

Your Answer:

$(r_{N2} / r_{unknown})_2 = MW_{unknown} / MW_{N2}$

$(1.86/1)_2 = MW_{unknown} / 20.18$

$MW_{unknown} = (1.86)_2 \times 20.18 = 69.81$

Exam 4

Question 1

Write the subshell electron configuration (i.e.$1s_2$ $2s_2$, etc.) for the Ni_{28} atom.

Answer:

Ni_{28} = 28 electrons = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

Question 2

Write the subshell electron configuration (i.e.$1s^2\ 2s^2$, etc.) for the K_{19} atom.

Answer:

K_{19} = 19 electrons = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

Question 3

Write the subshell electron configuration (i.e.$1s^2\ 2s^2$, etc.) for the K_{19} atom and identify which are valence (outer shell) electrons and determine how many valence electrons there are.

Answer:

K_{19} = 19 electrons = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$ = 1 valence electron

Question 4

Using up and down arrows, write the orbital diagram for the Ni_{28} atom.

Your Answer:

Ni_{28} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑ ↑

Question 5

Using up and down arrows, write the orbital diagram for the Ni_{28} atom and identify which are unpaired electrons and determine how many unpaired electrons there are.ccess the Periodic Table.This may be helpful throughout the exam.

Answer:

Ni_{28} = $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^8$

↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↓ ↑↑ = 2 unpaired electrons

Question 6

Write the subshell electron configuration (i.e.$1s^2\ 2s^2$, etc.) for the V_{23} atom and then identify the last electron to fill and write the 4 quantum numbers (n, l, m_l and m_s) for this electron.

Answer:

V_{23}: 23 electrons: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$

$3d^3$ is the last electron to fill

n=3, l=2, m_l=0, m_s=+½

Question 6

Write the subshell electron configuration (i.e.$1s^2\ 2s^2$, etc.) for the V_{23} atom and then identify the last electron to fill and write the 4 quantum numbers (n, l, m_l and m_s) for this electron.

Answer: $V_{23} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$: n=3, l=2, $m_l = 0$, $m_s = +½$

Question 7

1. Arrange the following elements in a vertical list from largest (top) to smallest (bottom) atomic size: Cl, Br, I

2. Arrange the following elements in a vertical list from lowest (top) to highest (bottom) electronegativity: S, P, Cl

3. Arrange the following elements in a vertical list from highest (top) to lowest (bottom) ionization energy: S, O, Se

Answer:

1. I

   Br

   Cl

2. P

   S

Cl

3. O

S

Se

Question 8

1. List and explain which of the following atoms holds its valence electrons less tightly.

Si or Cl

2. List and explain which of the following atoms forms a positive ion with more difficulty.

B or F

Answer:

1. Si holds its valence electrons less tightly than Cl since electronegativity increases as you go to the right in a period which means that Si which is further to the left in the period has the lower electronegativity and therefore the lower attraction for its valence electrons.

2. F forms a positive ion less easily than B since ionization potential increases as you go to the right in a period which means that F with the higher ionization potential requires more energy to lose an electron and form a positive ion so it does so less easily.

Question 9

On a piece of scratch paper, draw the orbital configuration of the C_6 atom and use it to draw the Lewis structure for the C_6 atom. Then choose the correct Lewis structure for C_6 from the options listed below.

Answer: C

Question 10

On a piece of scratch paper, draw the orbital configuration of the P_{15} atom and use it to draw the Lewis structure for the P_{15} atom. Then choose the correct Lewis structure for P_{15} from the options listed below.

Answer: B

Exam 5

Question 1

Show the determination of the charge on the ion formed by the Ga_{31} atom.

Answer:

Ga_{31} (metal = lose electrons) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^1$ lose 3e → Ga^{+3}

Question 2

H = 2.1

Li = 1.0 Be = 1.5 B = 2.0 C = 2.5 N = 3.0 O= 3.5 F = 4.0

Na = 1.0 Mg = 1.2 Al = 1.5 Si = 1.8 P = 2.1 S = 2.5
Cl = 3.0

K = 0.8 Ca = 1.0 Ga = 1.6 Ge = 1.8 As = 2.0 Se = 2.4
Br = 2.8

Using the electronegativities from the table above, show the determination of the polarity of each different type of bond in the following molecule

Answer:

H-O bond electronegativity difference = 3.5 - 2.1 = 1.4

1.6 - 0.5 bond is Polar

Br-O bond electronegativity difference = 3.5 - 2.8 = 0.7

1.6 - 0.5 bond is Polar

Question 3

On a piece of scratch paper, draw the Lewis structure for the ClO_3^{-1} ion. Then choose the correct Lewis structure for ClO_3^{-1} from the options listed below.

Answer: B

Question 4

On a piece of scratch paper, draw the Lewis structure for $HClO_3$. Then choose the correct Lewis structure for $HClO_3$ from the options listed below.

Your Answer:

B

Question 5

Determine the electron geometry and explain your answer for the S atom in H_2S.

Answer: The S atom in H_2S has 4 groups of electrons around it in its Lewis structure, therefore, its electron geometry would be tetrahedral.

Question 6

Determine the hybridization and explain your answer for the S atom in H_2S.

Your Answer:The S atom in H_2S has 4 groups of electrons around it in its Lewis structure, therefore, its hybridization would be sp_3.

Question 7

Determine the shape and explain your answer for HCCH.

Answer:The C atoms in HCCH has 2 groups of electrons around it in its Lewis structure, therefore, its electron geometry would be linear and since there are 2 atoms around each central C atom, the shape would be linear.

Question 8

H = 2.1 Li = 1.0 Be = 1.5 B = 2.0 C = 2.5 N = 3.0 O= 3.5

F = 4.0

Na = 1.0 Mg = 1.2 Al = 1.5 Si = 1.8 P = 2.1 S = 2.5

Cl = 3.0

K = 0.8 Ca = 1.0 Ga = 1.6 Ge = 1.8 As = 2.0 Se = 2.4

Br = 2.8

Use the electronegativities above and your knowledge of the shape of PH_3 to determine the molecular polarity of PH_3 explaining your answer in detail.

Answer:

The shape of PH_3 is triangular pyramid and since the P-H bonds are all nonpolar, PH_3 would be nonpolar since all the bonds are nonpolar.

Question 9

Is O_2 Polar, Ionic or Nonpolar and List and Explain whether it is Soluble or

Insoluble in Water?

Answer:O_2 has one nonpolar bond which makes it Nonpolar and since it is Nonpolar it is Insoluble in water.

Question 10

Arrange the following compounds in a vertical list from highest boiling point (top) to lowest boiling point (bottom) and explain your answer on the basis of whether the substance is Polar, Nonpolar, Ionic, Metallic or Hydrogen bonding: Mg, H_2O, Ne, HCl, LiCl

LiCl (ionic) = Mg (metallic)

H_2O (Hydrogen Bonding)

HCl (Polar)

Ne (Nonpolar)

Exam 6

Question 1

Explain the difference between amorphous and crystalline solids and give an example of each.

Answer:Amorphous solids (like glass, plastic or rubber) have their particles arranged in a random fashion and crystalline solids (like salt, sugar, metals, quartz) have their particles arranged in orderly, repeating, geometric patterns.

Question 2

Which is the least common state of matter among elements solids, liquids or gases? Explain your answer.

Answer:Liquids are the least common state of matter among elements because liquids exist over a very narrow temperature range.

Question 3

Rank and explain how the freezing point of 0.100 m solutions of the following ionic electrolytes compare, List from lowest freezing point to highest freezing point.

$GaCl_3$, $Al_2(SO_4)_3$, NaI, $MgCl_2$

$GaCl_3$ → Ga^{+3} + 3 Cl^- $\Delta tf = 1.86 \times 0.1 \times 4 =$ 3rd lowest FP

$Al_2(SO_4)_3$ → 2 Al^{+3} + 3 SO_4^{-3} $\Delta tf = 1.86 \times 0.1 \times 5 =$ lowest FP

NaI → Na^+ + I^- $\Delta tf = 1.86 \times 0.1 \times 2 =$ highest FP

$MgCl_2$ → Mg^{+2} + 2 Cl^- $\Delta tf = 1.86 \times 0.1 \times 3$ = 2nd lowest FP

FP: $Al_2(SO_4)_3 < GaCl_3 < MgCl_2 < NaI$

Question 4

Show the calculation of the mass percent solute in a solution of 18.9 grams of $Ba(MnO_4)_2$ in 400 grams of water. Report your answer to 3 significant figures.

Answer:

Mass % = (g_{solute} / g_{solute} + $g_{solvent}$) x 100%

Mass % = (18.9 / 18.9 + 400) x 100 = 4.51%

Question 5

Show the calculation of the molality of a solution made by dissolving 28.5 grams of $C_8H_{16}O_8$ in 400 grams of water. Report your answer to 3 significant figures.

Answer:

molality = (g_{solute} / MW) / ($g_{solvent}$ / 1000)

molality = (28.5 / 240.208) / (400 / 1000) = 0.297 m

Question 6

Show the calculation of the molarity of a solution made by dissolving 27.3 grams of $Ca(NO_3)_2$ to make 450 ml of solution. Report your answer to 3 significant figures.

Answer:

Molarity = (g_{solute} / MW) / ($ml_{solvent}$ / 1000)

Molarity = (27.3 / 164.10) / (450 / 1000) = 0.370 M

Question 7

Show the calculation of the mass of $Ba(MnO_4)_2$ needed to make 250 ml of a 0.200 M solution. Report your answer to 3 significant figures.

Answer:

Molarity = (moles) / ($ml_{solvent}$ / 1000)

0.200 = (moles) / (250 / 1000)

Moles = 0.200 x 0.250 = 0.0500

Moles = (g_{solute} / MW)

0.0500 = (g_{solute} / 375.41)

g_{solute} = 0.0500 x 375.41 = 18.8 g

Question 8

Show the calculation of the volume of 0.667 M solution which can be prepared using 37.5 grams of $Ba(NO_3)_2$.

Answer:

$moles_{solute}$ = g_{solute} / MW

$moles_{solute}$ = 37.5 g / 261.55 = 0.1434 mol

Molarity = moles / (mL /1000)

0.667 = 0.1434 / (mL / 1000)

mL / 1000 = 0.1434 / 0.667 = 0.2150

mL = 0.2150 x 1000 = 215 mL

Question 9

Show the calculation of the boiling point of a solution made by dissolving 20.9 grams of the nonelectrolyte $C_4H_8O_4$ in 250 grams of water. K_b for water is 0.51, BP of pure water is 100^{o}C. Calculate your answer to 0.01^{o}C.

$\Delta t_b = K_b \times m$

Your Answer:

molality = (g_{solute} / MW) / ($g_{solvent}$ / 1000)

molality = (20.9 / 120.104) / (250 / 1000) = 0.6961 m

$\Delta t_b = K_b \times m$ = 0.51 x 0.6961 = 0.355^{o}C

$BP_{solution} = BP_{solvent} - \Delta t_b = 100^oC + 0.355 = 100.35^oC$

Question 10

Show the calculation of the molar mass (molecular weight) of a solute if a solution of 13.5 grams of the solute in 200 grams of water has a freezing point of -1.20^oC. K_f for water is 1.86 and the freezing point of pure water is 0^oC. Calculate your answer to 0.1 g/mole.

Answer: $\Delta t_f = K_f \times m$

molality = $\Delta t_f / K_f = 1.20 / 1.86 = 0.645$ m

molality = $(g_{solute} / MW) / (g_{solvent} / 1000)$

0.645 = (moles) / (200 / 1000)

Moles = 0.645 x 0.200 = 0.129

0.129 = (13.5 / MW)

MW = 13.5 / 0.129 = 104.7g/mole

Final:

Question 1

1. Convert 0.0000726 to exponential form and explain your answer.

2. Convert 5.82×10^3 to ordinary form and explain your answer.

Answer:

1.Convert 0.0000726 = smaller than 1 = negative exponent, move decimal 5 places = 7.26×10^{-5}

2.Convert 5.82×10^3 = positive exponent = larger than 1, move decimal 3 places = 5820

Question 2

Do the conversions shown below, showing all work:

1. $28^oC = ?\ ^oK$

2. $158^oF = ?\ ^oC$

3. $343^oK = ?\ ^oF$

Answer:

1. $28\,^{o}C + 273 = 301\,^{o}K$ $\quad\quad$ $^{o}C \rightarrow {}^{o}K$ (make larger) +273

2. $158\,^{o}F - 32 \div 1.8 = 70\,^{o}C$ $\quad\quad$ $^{o}F \rightarrow {}^{o}C$ (make smaller) -32 ÷1.8

3. $343\,^{o}K - 273 = 70\,^{o}C \times 1.8 + 32 = 158\,^{o}F$ $\quad\quad$ $^{o}K \rightarrow {}^{o}C \rightarrow {}^{o}F$

Question 3

Show the calculation of the number of moles in the given amount of the following substances. Report your answerto 3 significant figures.

1. 12.0 grams of $Ca_3(PO_4)_2$

2. 15.0 grams of $C_9H_8NO_4Cl$

Answer:

1. Moles = grams / molecular weight = 12.0 / 310.18 = 0.0387 mole

2. Moles = grams / molecular weight = 15.0 / 229.61 = 0.0653 mole

Question 4

Not yet graded / 10 pts

Click this link to access the **Periodic Table.**

This may be helpful throughout the exam.

Show the calculation of the percent of each element present in the following compounds. Report your answer to 2 places after the decimal.

1. $Al_2(CO_3)_3$

2. $C_8H_6NO_4Cl$

Answer:

1. %Al = 2 x 26.98/233.99 x 100 = 23.06%

%C = 3 x 12.01/233.99 x 100 = 15.40%

%O = 9 x 16.00/233.99 x 100 = 61.54%

2. %C = 8 x 12.01/215.59 x 100 = 44.57%

%H = 6 x 1.008/215.59 x 100 = 2.81%

%N = 1 x 14.01/215.59 x 100 = 6.50%

%O = 4 x 16.00/215.59 x 100 = 29.69%

%Cl = 1 x 35.45/215.59 x 100 = 16.44%

Question 5

Show the calculation of the heat of reaction (ΔH_{rxn}) for the reaction:

$$CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l)$$

by using the following thermochemical data:

$\Delta H_{f0}\ CH_4\ (g)$ = -74.6 kJ/mole, $\Delta H_{f0}\ CO_2\ (g)$ = -393.5 kJ/mole, $\Delta H_{f0}\ H_2O\ (l)$ = -285.8 kJ/mole

Answer:

$$CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l)$$

$\Delta H_{f0}\ CH_4\ (g)$ = -74.6 kJ/mole, $\Delta H_{f0}\ CO_2\ (g)$ = -393.5 kJ/mole, $\Delta H_{f0}\ H_2O\ (l)$ = -285.8 kJ/mole

ΔH_{rxn} = (+74.6) + 2(0) + (-393.5) + 2(-285.8) = - 890.5 kJ/mole

Question 6

Show the calculation of the molecular weight of a gas sample with a mass of 0.456 grams which has a volume of 230 ml when collected at 29^{o}C and 740 mm.

Answer:

P x V = (g/MW) x R x T

740 mm/760 = 0.974 atm = P R = 0.0821

V = 230 ml/1000 = 0.230 liters 29^{o}C + 273 = 302^{o}K = T

0.456 = g

(0.974) x (0.230) = (0.456/MW) x (0.0821) x (302) MW = 50.5

Question 7

Write the subshell electron configuration (i.e.1s^{2} 2s^{2}, etc.) for the V$_{23}$ atom and then identify the last electron to fill and write the 4 quantum numbers (n, l, m$_{l}$ and m$_{s}$) for this electron.

Answer: V$_{23}$ = 1s^{2} 2s^{2} 2p^{6} 3s^{2} 3p^{6} 4s^{2} **3d^{3} : n=3, l=2, m$_{l}$ = 0, m$_{s}$ = +½**

Question 8

1. List and explain which of the following atoms holds its valence electrons less tightly.

Si or Cl

2. List and explain which of the following atoms forms a positive ion with more difficulty.

B or F

Answer: 1. Si holds its valence electrons less tightly than Cl since electronegativity increases as you go to the right in a period which means that Si which is further to the left in the period has the lower electronegativity and therefore the lower attraction for its valence electrons.

2. F forms a positive ion less easily than B since ionization potential increases as you go to the right in a period which means that F with the higher ionization potential requires more energy to lose an electron and form a positive ion so it does so less easily.

Question 9

Is KNO_3 Polar, Ionic or Nonpolar and List and Explain whether it is Soluble or Insoluble in Water?

KNO_3 is Ionic since it has Ionic bonds and since it is Ionic it is Soluble in water.

Question 10

Show the determination of the charge on the ion formed by the Ga_{31} atom.

Answer:

Ga_{31} (metal = lose electrons) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^1$ lose $3e \rightarrow Ga^{+3}$

Question 11

Water (H_2O) with a molecular weight of 18 has a boiling point of 100^oC and methane (CH_4) with a somewhat similar molecular weight of 16 has a boiling point of -161^oC. This difference is much higher than can be explained by the polarity of water. Explain what causes this difference.

Answer: Hydrogen bonds which are strong intermolecular attractive forces form between water molecules requiring much more energy to separate the molecules than for other molecules.

Question 12

Show the calculation of the molar mass (molecular weight) of a solute if a solution of 12.5 grams of the solute in 200 grams of water has a freezing point of -1.30^oC. K_f for water is 1.86 and the freezing point of pure water is 0^oC. Calculate your answer to 0.1 g/mole.

$\Delta t_f = K_f \times m$

molality = $\Delta t_f / K_f = 1.30 / 1.86 = 0.699$ m

molality = (g_{solute} / MW) / ($g_{solvent}$ / 1000)

0.699 = (moles) / (200 / 1000)

Moles = 0.699 x 0.200 = 0.1398

0.1398 = (12.5 / MW)

MW = 12.5 / 0.1398 = **89.4**