Instructor: Mills

Chemistry 101: 3rd Midterm Examination Practice Questions

(see the class notes for answers to these questions)

Answer all four questions. Each question is worth 25 points. Please ensure you have all *four* pages of questions, as well as a formula sheet and a copy of the periodic table *before* starting work. For numerical answers, include the correct number of **significant figures** and appropriate **S.I. unit(s)**. For full credit you must….

SHOW ALL WORK

Question	Score
1	
2	
3	
4	
Total	

"Electron Addresses"

Question 1 (25 points)   Draw *ground state orbital 'box' diagrams* and write *ground state electronic configurations* for the following atoms and ions:

Carbon atom

Orbital 'box' diagram

Electronic Configuration

Oxide *anion*

Orbital 'box' diagram

Electronic Configuration

Sodium atom

Orbital 'box' diagram

Electronic Configuration

Hydrogen atom

Orbital 'box' diagram

Electronic Configuration

Magnesium *cation*

Orbital 'box' diagram

Electronic Configuration

"Lewis"

Question 2a (20 points) Draw Lewis structure(s) for the PO_4^{3-} ion, *include all possible resonance forms **and** include formal charge labels on one of your structures*. Assume a completely expanded octet for phosphorus.

Question 2b (5 points) Use VSEPR theory to determine the electronic and molecular geometry of the phosphate ion:

Electronic geometry:

Molecular geometry:

"Trends"

Question 3a (15 points) List the following properties of Li, K and Ne in order of:

Increasing atomic radius (smallest first)

Increasing effective nuclear charge, Z_{eff}, (smallest first)

Decreasing 1st ionization energy (largest first)

Question 3b (10 points)   State whether the following bonds are considered to be covalent, polar covalent or ionic:

Bond coordinate	Type of bond (covalent, polar covalent or ionic)
O=O	
O-H	
Na-Cl	
K-F	
S-F	

"Raft"

Question 4 (25 points)   The following reaction between calcium hydride and water is used to inflate life rafts and weather balloons:

$$CaH_2(s) + 2 H_2O(l) \rightarrow Ca(OH)_2(aq) + 2 H_2(g)$$
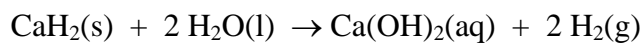
If 47.0 grams of $CaH_2(s)$ is completely reacted with an excess of water, then:

A. How many moles of hydrogen gas will be produced?

B. What volume (in L) would the hydrogen gas generated in part (a) occupy at 15.0^oC and 725 Torr?

Extra Credit

Expect a descriptive style question taken from the reading.

Data sheet

Density = mass/volume   1 kg = 2.205 lb $1 cm^3 = 1 mL = 1 \times 10^{-6} m^3$
Density copper (Cu) = 8.95 gcm^{-3} 1 inch = 2.54 cm   1 mile = 1.6039 km
1 a.m.u. = 1.6606 x 10^{-24} g   1 ft = 12 inches (exactly) 1 gallon = 3.786 L
Volume cylinder = $\pi r^2 h$ $1 dm^3 = 1L = 10^{-3} m^3$ R = 0.0821 Latm/molK
1 atm = 760 torr = 101 kPa

Common Decimal Prefixes

Prefix	Symbol	Exponential Notation
Giga	G	10^9
Mega	M	10^6
Kilo	k	10^3
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

Solubility rules:

Soluble Compounds		Exceptions
Compounds containing	NO_3^-	None
	Cl^-	Ag^+, Hg^{2+}, Pb^{2+}
	Br^-	Ag^+, Hg^{2+}, Pb^{2+}
	I^-	Ag^+, Hg^{2+}, Pb^{2+}
	SO_4^{2-}	Ba^{2+}, Hg^{2+}, Pb^{2+}

Insoluble Compounds		Exceptions
Compounds containing	CO_3^{2-}	NH_4^+ & group IA cations
	PO_4^{3-}	NH_4^+ & group IA cations
	OH^-	group IA cations Ca^{2+}, Sr^{2+}, Ba^{2+} & NH_4^+