Midterm 2 Test Review 06
Answer Section

SHORT ANSWER

1. ANS:
   85
2. ANS:
   104 protons; 104 electrons
3. ANS:
   19 protons, 19 electrons, 20 neutrons
4. ANS:
   14 protons, 14 electrons, 14 neutrons
5. ANS:
   $^{133}_{55}Cs$
6. ANS:
   $^{234}_{92}U$
7. ANS:
   24
8. ANS:
   12
9. ANS:
   76
10. ANS:
    Nb
11. ANS:
    190.2
12. ANS:
    atomic mass units
13. ANS:
    osmium: 76 protons, 76 electrons; niobium: 41 protons, 41 electrons
14. ANS:
    The quantum mechanical model treats electrons as waves and does not describe the electrons' path around the nucleus. The Bohr model treats electrons as particles traveling in specific circular orbits.
15. ANS:
    Noble-gas notation uses the bracketed symbol of the nearest preceding noble gas atom in the periodic table in the electron configurations of an atom. Using noble-gas notation allows you to represent the complete electron configuration of an atom with many electrons in a shorthand form.
16. ANS:
    $[Ar]4s^2 3d^{10} 4p^2$
17. ANS:
    Sodium and potassium have the same number of valence electrons.
18. ANS:
    The energy level indicates the period. For example, lithium's valence electron is in the second energy level and lithium is found in period 2.

19. ANS:
Ionization energy is the energy required to remove an electron from a gaseous atom.
20. ANS:
The first ionization energies generally increase as you move left-to-right across a period. The increased nuclear charge of each successive element produces an increased hold on the valence electrons.
21. ANS:
The first ionization energies generally decrease as you move down a group. Because atomic size increases down a group, the valence electrons are farther from the nucleus and, therefore, less strongly attracted to the nucleus. As a result, less energy is required to remove the valence electrons.
22. ANS:
sodium iodide
23. ANS:
calcium chloride
24. ANS:
ammonium bromide
25. ANS:
calcium nitride
26. ANS:
magnesium hypochlorite
27. ANS:
lithium peroxide
28. ANS:
iron(III) iodate
29. ANS:
Be_3N_2
30. ANS:
$NiCl_2$
31. ANS:
$KClO_2$
32. ANS:
Cu_2O
33. ANS:
$(NH_4)_2S$
34. ANS:
$Ca(IO_3)_2$
35. ANS:
$Fe(ClO_4)_3$
36. ANS:

Chemical Formula	Name
$CdSO_4$	Cadmium sulfate, anhydrous
$CdSO_4 \cdot H_20$	Cadmium sulfate monohydrate
$CdSO_4 \cdot 4H_2O$	Cadmium sulfate tetrahydrate

37. ANS:
$$\frac{6.02 \times 10^{23}\,\text{Cu atoms}}{1\,\text{mol Cu}}$$

38. ANS:
$$\frac{1\ \text{mol}\ CH_4}{6.02\times10^{23}\ \text{molecules}\ CH_4}$$

39. ANS:
$$\frac{1\ \text{mol Xe}}{6.02\times10^{23}\ \text{atoms Xe}}$$

40. ANS:
$$\frac{6.02\times10^{23}\ \text{molecules}\ F_2}{1\ \text{mol}\ F_2}$$

41. ANS:
2

42. ANS:
•Ca•

43. ANS:

Element	Symbol	Orbitals					Electron Configuration
		1s	2s	$2p_x$	$2p_y$	$2p_z$	
a. Nitrogen	N	↑↓	↑↓	↑	↑	↑	$1s^2 2s^2 2p^3$
b. Fluorine	F	↑↓	↑↓	↑↓	↑↓	↑	$1s^2 2s^2 2p^5$
c. Carbon	C	↑↓	↑↓	↑	↑		$1s^2 2s^2 2p^2$
d. Lithium	Li	↑↓	↑				$1s^2 2s^1$

44. ANS:

Element	Atomic Number	Protons	Electrons
a. Li	3	3	3
b. Fr	87	87	87
c. Np	93	93	93
d.Hg	80	80	80
e. TI	81	81	81
f. Re	75	75	75
g. B	5	5	5

45. ANS:
neon-12

46. ANS:
neon-12

47. ANS:
They have an equal number of protons.

48. ANS:
They have an equal number of electrons.

49. ANS:
Na, Al, P, S

50. ANS:
Ga, Ge, As

PROBLEM

51. ANS:
Mass contribution = (mass)(percent abundance)
63_X: (62.930 amu)(69.17%) = 43.53 amu
65_X: (64.928 amu)(30.83%) = 20.02 amu
Atomic mass of X = 43.53 amu + 20.02 amu = 63.55 amu
The element is copper.

52. ANS:
7.89 ~~g K~~ × 1 mol K/39.10 ~~g K~~ = 0.202 mol K
2.42 ~~g C~~ × 1 mol C/12.01 ~~g C~~ = 0.201 mol C
9.69 ~~g O~~ x 1 mol O/16.00 ~~g O~~ = 0.606 mol O
0.202 mol K/0.201 mol C = 1.00 mol K/1.00 mol C = 1 mol K/1 mol C
0.201 mol C/0.201 mol C = 1.00 mol C/1.00 mol C = 1 mol C/1 mol C
0.606 mol O/0.201 mol C = 3.01 mol O/1.00 mol C = 3 mol O/1 mol C
1 mol K : 1 mol C: 3 mol O
empirical formula: KCO_3
(39.10 g + 12.01 g + 48.00 g) = 99.11 g
molar mass KCO_3 = 99.11 g/mol KCO_3
n = molar mass of molecular formula/molar mass of empirical formula = 198.22 ~~g/mol~~/99.11 ~~g/mol~~ = 2
$(KCO_3)n$
The molecular formula of the compound is $K_2C_2O_6$.

53. ANS:
2.00 g $FeCl_2 \cdot xH_2O$ – 1.27 g $FeCl_2$ = →.73 g H_2O
0.73 g $H_2O \times 1$ mol H_2O/18.02 g H_2O = 0.040 mol H_2O
1.27 g $FeCl_2 \times 1$ mol $FeCl_2$/126.75 g $FeCl_2$ = 0.0100 mol $FeCl_2$
0.040 mol H_2O/0.0100 mol $FeCl_2$ = 4 mol H_2O/1 mol $FeCl_2$
4 mol H_2O : 1 mol $FeCl_2$
$FeCl_2 \cdot 4H_2O$
iron(II) chloride tetrahydrate

54. ANS:

Mass of Hg = 80.68 g Hg

Mass of O = 12.87 g O

Mass of S = 6.45 g S

$$80.68 \text{ g Hg} \times \frac{1 \text{ mol Hg}}{200.59 \text{ g Hg}} = 0.4022 \text{ mol Hg}$$

$$12.87 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 0.8044 \text{ mol O}$$

$$6.45 \text{ g S} \times \frac{1 \text{ mol S}}{32.07 \text{ g S}} = 0.2011 \text{ mol S}$$

$$\frac{0.4022 \text{ mol Hg}}{0.2011 \text{ mol S}} = \frac{2.000 \text{ mol Hg}}{1.000 \text{ mol S}} = \frac{2 \text{ mol Hg}}{1 \text{ mol S}}$$

$$\frac{0.8044 \text{ mol O}}{0.2011 \text{ mol S}} = \frac{4.000 \text{ mol O}}{1.000 \text{ mol S}} = \frac{4 \text{ mol O}}{1 \text{ mol S}}$$

$$\frac{0.2011 \text{ mol S}}{0.2011 \text{ mol S}} = \frac{1.000 \text{ mol S}}{1.000 \text{ mol S}} = \frac{1 \text{ mol S}}{1 \text{ mol S}}$$

2 mol Hg : 4 mol O : 1 mol S

The empirical formula is Hg_2SO_4.

55. ANS:

$$49.47 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} = 4.119 \text{ mol C}$$

$$28.85 \text{ g N} \times \frac{1 \text{ mol N}}{14.01 \text{ g N}} = 2.059 \text{ mol N}$$

$$16.48 \text{ g O} \times \frac{1 \text{ mol O}}{16.00 \text{ g O}} = 1.030 \text{ mol O}$$

$$5.20 \text{ g H} \times \frac{1 \text{ mol H}}{1.01 \text{ g H}} = 5.15 \text{ mol H}$$

$$\frac{4.119 \text{ mol C}}{1.030 \text{ mol O}} = \frac{3.999 \text{ mol C}}{1.000 \text{ mol O}} = \frac{4 \text{ mol C}}{1 \text{ mol O}}$$

$$\frac{2.059 \text{ mol N}}{1.030 \text{ mol O}} = \frac{1.999 \text{ mol N}}{1.000 \text{ mol O}} = \frac{2 \text{ mol N}}{1 \text{ mol O}}$$

$$\frac{5.15 \text{ mol H}}{1.030 \text{ mol O}} = \frac{5.00 \text{ mol H}}{1.00 \text{ mol O}} = \frac{5 \text{ mol H}}{1 \text{ mol O}}$$

$$\frac{1.030 \text{ mol O}}{1.030 \text{ mol O}} = \frac{1.000 \text{ mol O}}{1.000 \text{ mol O}} = \frac{1 \text{ mol O}}{1 \text{ mol O}}$$

4 mol C : 2 mol N : 5 mol H : 1 mol O

The empirical formula of caffeine is $C_4H_5N_2O$.

56. ANS:

$$4 \text{ mol C} \times \frac{12.01 \text{ g C}}{1 \text{ mol C}} = 48.04 \text{ g C}$$

$$2 \text{ mol N} \times \frac{14.01 \text{ g N}}{1 \text{ mol N}} = 28.02 \text{ g N}$$

$$5 \text{ mol H} \times \frac{1.01 \text{ g H}}{1 \text{ mol H}} = 5.05 \text{ g H}$$

$$1 \text{ mol O} \times \frac{16.00 \text{ g O}}{1 \text{ mol O}} = 16.00 \text{ g O}$$

$(48.04 \text{ g} + 28.02 \text{ g} + 5.05 \text{ g} + 16.00 \text{ g})$
$= 97.11 \text{ g}$

The molar mass of the empirical formula is 97.11 g/mol.

$$n = \frac{\text{molar mass of compound}}{\text{molar mass of empirical formula}}$$

$$= \frac{194.19 \text{ g/mol}}{97.11 \text{ g/mol}} = 2.00$$

The molecular formula for caffeine is $(C_4H_5N_2O)2$, which is $C_8H_{10}N_4O_2$