Unit 4 Practice Problems (with answers at end)

> Yet no man is called happy until his death and all the taxes at his wake and funeral paid.--Ovid

Atomic structure

1. Complete the following table:

Element	*Z*	*A*	#e^-	#p	#n
N					7
Si		28			
	18	40			
Fe					30

> Rebellion to tyrants is obedience to God.
> --Thomas Jefferson

Wave behavior

2. Change 6.4 x 10^{14} Hz to wavelength (λ) in metres.

3. Same as above, but for 1.2 x 10^{11} Hz.

4. Find the frequency (ν) corresponding to light with a wavelength of 2 x 10^{-10} m.

5. Calculate the energy of a quantum of light associated with the frequency of 6.4 x 10^{14} Hz.

Atomic emission

6. If the quantum of energy emitted in an electron transition between two levels is 2.96 x 10^{-23} kJ, what is the frequency of light emitted as a result of the transition? What is the wavelength?

> Size is not grandeur.
> --Thomas Henry Huxley

Electron configuration

7. An atom in the ground state has two electrons in n = 1, eight electrons in n = 2 and seven in n = 3. From these data, supply the following values (if insufficient information is given, say so)
a. the mass number
b. the atomic number
c. the electron configuration

8. Write the electron configurations for S and Tc.

9. Write the electron configuration for the element with *Z* = 21.

10. Identify the element from the ground-state electron configurations:
a. $[Ne]3s^2 3p^2$
b. $[Ar]4s^2 3d^7$
c. $[Xe]6s^2 5d^1 4f^3$

11. Consider the element Scandium, #21. If you could construct the element "from scratch" so to speak, into which orbital (and on which level) would the final electron be placed?

12. If you now want to produce a scandium ion with a charge of +1, from which orbital (and what level) would the electron be removed?

13. How many electrons are in the 4d sublevel of Nb?

> When what is shameful is condoned by noble people, then certainly the lower class will think it good.
> --Euripedes

Periodic properties and arrangement of the table

14. What name(s) is(are) given to elements in a vertical column in the table?

15. What name(s) is(are) given to elements in a horizontal row in the table?

16. What name is given to the elements whose atoms usually differ in electron configuration by the filling of successive d-electrons in a sub-level?

17. Same question as above, but for f-electrons in a sub-level.

18. What is true about the electron configurations of elements with similar properties?

19. What is the significance of the zig-zag line running diagonally down and to the right near the right end of the periodic table?

20. Consider the element Eu. How would you expect it to compare with gold (Au) in
a. atomic radius?
b. chemical reactivity?
c. electron affinity?

21. Explain, in terms of electron configuration, why
a. H shows properties similar to both Li and F.
b. the decrease in atomic radius from Ca to Ga is greater than that from Mg to Al

22. How does ionization energy vary within a group? Why?

23. Explain the decrease in first ionization energy between Groups IIA and IIIA in periods 2 and 3.

24. Between which two other groups in periods 2 and 3 is there another decrease in first ionization energy?

25. Why is the ionization energy required to remove an outer electron from Na^+ so much greater than that needed to remove the outer electron from Na?

26. Excluding the noble gases, state the location in the periodic table of the most active metal and the most active non-metal.

Properties of individual groups

27. Write a balanced equation for the reaction of rubidium with water.

28. Write a balanced equation for the reaction of magnesium with bromine.

29. Write a balanced equation for the production of metallic sodium and elemental chlorine from table salt.

30. Write a balanced equation for the reaction of hydrogen gas with
a. any halogen
b. any Group IIA element

Answers:

1. -,7,14,7,7,-
-,14,-,14,14,14
Ar,-,-,18,18,22
-,26,56,26,26,-
2. 4.7 x 10^{-7} m
3. 2.5 x 10^{-3} m
4. 2 x 10^{18} Hz
5. 4.2 x 10^{-19} J
6. ν = 4.46 x 10^{13} Hz, λ = 6.7 x 10^{-6} m
7. a) insufficient--isotope unknown, b) 17, c) [Ne]$3s^2 3p^5$
8. S [Ne]$3s^2 3p^4$ Tc [Kr]$5s^2 4d^5$
9. [Ar]$4s^2 3d^1$
10. Si, Co, Nd
11. level 3, in a d-orbital
12. level 4, the 4s orbital
13. 3
14. group or family
15. period or level
16. transition metals
17. inner transition metals
18. they are the same except for level
19. it divides the metals from the non-metals
20. larger, greater, less
21. a. like Li it has one electron in its outer level like F it requires only one more electron for a noble gas structure (full level)
b. ten additional protons are added to the nucleus between Ca and Ga compared to Mg and Al; the added electrostatic attraction pulls the electrons closer
22. ionization energy decreases as you go down a group since the size of the atom is increasing, placing the outer electron farther from the pull of the nucleus and more heavily shielded by inner electrons
23. the added p electron in group IIIA is well-shielded by the full s orbital and is thus easily removed
24. VA and VIA
25. after the removal of one electron, repulsions decrease although the nuclear charge remains constant; this causes a contraction of the ion and thus places the next electron to be removed closer to the nucleus
26. Fr and F
27. $2\ Rb + 2\ H_2O \rightarrow 2\ RbOH + H_2$
28. $Mg + Br_2 \rightarrow MgBr_2$
29. $2\ NaCl \rightarrow 2\ Na + Cl_2$
30. a. $H_2 + X_2 \rightarrow 2\ HX$
b. $M + H_2 \rightarrow MH_2$