NAME _____ Atomic Structure

1. What is the number of neutrons in an atom of aluminum-27? [1]

2. Write the electron configuration of an atom of aluminum-27 in an excited state. [1]

3. Draw an electron-dot (Lewis) structure for an atom of aluminum-27 in the ground state. [1]

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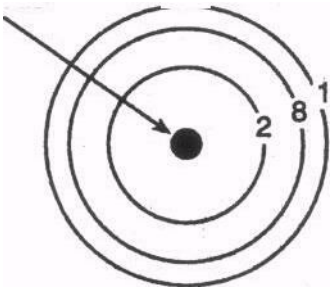
4 Given the data table below concerning isotopes of element *E:*

Isotope	Abundance in Nature (%)	Atomic Mass (amu)
E-25	30.0	25.0
E-27	25.0	27.0
E-30	45.0	30.0

a Show a correct numerical setup for calculating the atomic mass of element E. [1]
b Record the correct answer. [1]

Base your answers to questions 5 through 7 on the diagram below which shows an atom of Na-23 in the ground state.

Nucleus



5 What is the number of protons and neutrons in the nucleus of an atom of Na-23? [1]

6 How many valence electrons are in an atom of Na-23 in the ground state? (1]

7 Create a diagram below to illustrate the electron arrangement of Na-23 in an excited state. [1]

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8 Liquid nitrogen is often used to freeze living cells. The normal boiling point of nitrogen is -195.8°C. In the boxes provided diagram six molecules of nitrogen at the temperatures indicated. Use a circle to represent a nitrogen atom. [1]

150 °C	200 °C

Base your answers to questions 9 and 10 on the data table below, which lists information about three isotopes of sulfur.

Isotope	Atomic Mass (amu)	Percent Natural Abundance
^{32}S	31.97	94.9
^{33}S	32.97	0.8
^{34}S	33.97	4.3

9 State, in terms of numbers of atomic particles, *one* similarity and *one* difference between an atom of *each* of these three isotopes of sulfur. [1]

10 Calculate the atomic mass of sulfur. Your response must include:
• a correct numerical setup [1]
• the calculated result [1]

Base your answers to questions 11 through 14 on the information below.

Fluorescent lights operate more efficiently than incandescent light bulbs. A fluorescent light tube is filled with a noble gas and a drop of mercury. When the fluorescent light is lit, the gas in the tube contains Hg vapor, free-flowing Hg ions, and electrons. The electrons collide with Hg atoms which then emit ultraviolet (UV) radiation. The phosphor coating on the inside of the tube absorbs this UV radiation and causes ion impurities in the coating to emit visible light.

The phosphor coating on a fluorescent light tube is a mixture of chemicals designed to absorb electromagnetic radiation and emit several colors of light that together appear as white light. A phosphor coating used in early fluorescent lights produced some light, but not enough to be acceptable for common use. Modem fluorescent lights use a mixture of phosphors that produce a blend of red, green, and blue light that is more pleasant in home use. A red phosphor in the phosphor mixture is Y_2O_3 activated with europium ions, Eu^{3+} A green phosphor is $CeMgAl_{11}O_{19}$ activated with terbium ions, Tb^{3+} and a blue phosphor is $BaMgAl_{10}O_{17}$ activated with Eu^{2+} ions.

11 State why electricity is able to flow through the mixture in a lit fluorescent tube. [1]

12 Explain, in terms of electrons and energy, how ions in the phosphor coating emit light. [1]

13 Write the chemical name of the compound that is a red phosphor in modem fluorescent lights. **[1]**

14 Calculate the percent composition by mass of aluminum in the compound that is the green phosphor in modem fluorescent lights. Your response must include:
• a correct numerical setup [1]
• the calculated result [1]

Base your answers to questions 15 through 17 on the information below.

A 48.6-gram sample of magnesium reacts completely with bromine to form 368.2 grams of magnesium bromide. The reaction is represented by the balanced equation below.

$$Mg(s) + Br_2(l) \rightarrow MgBr_2(s)$$

15 Determine the total mass of bromine that reacted. [1]

16 Explain, in terms of electrons, why the radius of a magnesium ion is smaller than the radius of a magnesium atom. [1]

17 In the space *below,* draw a Lewis electron-dot diagram representing the product in the reaction. [1]

Base your answers to questions 18 through 20 on the elements of Group 2 on the Periodic Table of the Elements.

18 State the trend in first ionization energy for the elements in Group 2 as they are considered in order of increasing atomic number. [1]

19 State, in terms of number of electron shells, why the atomic radius of an atom of each successive element increases as the elements in Group 2 are considered in order of increasing atomic number. [1]

20 Explain, in terms of atomic structure, why the elements in Group 2 have similar chemical properties. [1]

Base your answers to questions 21 and 22 on the information below.

In 1897, in an experiment, J. J. Thomson showed that cathode rays were deflected by an electric field. T his suggested that cathode rays were composed of negatively charged particles found in all atoms. These negatively charged particles were eventually called electrons. Thomson concluded that the atom was a positively charged sphere of almost uniform density in which negatively charged electrons were embedded. The total negative charge in the atom was balanced by the positive charge, making the atom electrically neutral.

In 1909, Ernest Rutherford bombarded a very thin sheet of gold foil with alpha particles. After interpreting the results of this experiment, Rutherford proposed a model of the atom.

Doran, Chemistry: The Study of Matter, *Prentice Hall, 19S*

21 State *one* fact from the modem model of the atom that agrees with a conclusion made by Thomson. [1]

22 State *one* conclusion from Rutherford's experiment *and the* corresponding conclusion from Thomson's experiment that it contradicts. [1]

Base your answers to questions 23 through 27 on the information below.

Sports Drinks

After a strenuous workout people often quench their thirst with sports drinks. As a person perspires (sweats), many sodium and potassium ions are removed from the body. The ions are deposited on the skin when the water in sweat evaporates. This evaporation cools the skin. Sports drinks have a high concentration of the salts sodium chloride and potassium chloride. A single 250.-gram serving of one sports drink contains 0.055 gram of sodium ions. Recent studies have linked sports drink consumption to tooth damage due to high levels of various acids in the drinks.

23 In the box *on your answer sheet,* draw a Lewis electron-dot diagram for *one* of the ions that is removed from the body as a person perspires. [1]

24 State why the salts in sports drinks are classified as electrolytes. [1]

25 In the space *below,* show a correct numerical setup for calculating the percent by mass of sodium ions in this sports drink. [1]

26 Describe the transfer of energy between the skin and the surroundings as a person perspires. [1]

27 Identify the positive ion found in the compounds that is responsible for tooth damage from sports drinks. [1]