_____

Max

Base your answers to questions **1** through **3** on on the information below.

In the modern model of the atom, each atom is composed of three major subatomic (or fundamental) particles.

1. Name the subatomic particles contained in the nucleus of the atom.

   proton & neutron

2. State the charge associated with *each* type of subatomic particle contained in the nucleus of the atom.

   (+) & neutral

3. What is the sign of the net charge of the nucleus?

   overall (+)

4. Base your answers to the following questions on the information below.

   A hot pack contains chemicals that can be activated to produce heat. A cold pack contains chemicals that feel cold when activated.

   a Based on energy flow, state the type of chemical change that occurs in a hot pack.

   exothermic

   b A cold pack is placed on an injured leg. Indicate the direction of the flow of energy between the leg and the cold pack.

   from leg to cold pack

   c What is the Law of Conservation of Energy? Describe how the Law of Conservation of Energy applies to the chemical reaction that occurs in the hot pack.

   energy can't be created or destroyed — heat is transferred from the pack to leg

5. A student used a balance and a graduated cylinder to collect the following data:

Sample mass	10.23 g
Volume of water	20.0 mL
Volume of water and sample	21.5 mL

   a Calculate the density of the element. Show your work. Include the appropriate number of significant figures and proper units.

   $21.5 - 20.0 = 1.5$

   $D = \dfrac{m}{V} = \dfrac{10.23}{1.5} = 6.82 \rightarrow 6.83 / mL$

   b If the accepted value is 6.93 grams per milliliter, calculate the percent error

   $\dfrac{(6.8 - 6.93)}{6.93} \times 100 = -1.88\%$

   c What error is introduced if the volume of the sample is determined first?

   water may be on the sample ↑ the mass

6. After a neutral sulfur atom gains two electrons, what is the resulting charge of the ion?

   -2

7. As a neutral sulfur atom gains two electrons, what happens to the radius of the atom?

   gets larger

Went over in class

8. Electron affinity is defined as the energy released when an atom and an electron react to form a negative ion. The data for Group 1 elements are presented below.

Element	Atomic Number	Electron Affinity in kJ/mole
Cs	55	45.5
H	1	72.8
K	19	46.4
Li	3	59.8
Na	11	52.9
Rb	37	?

44
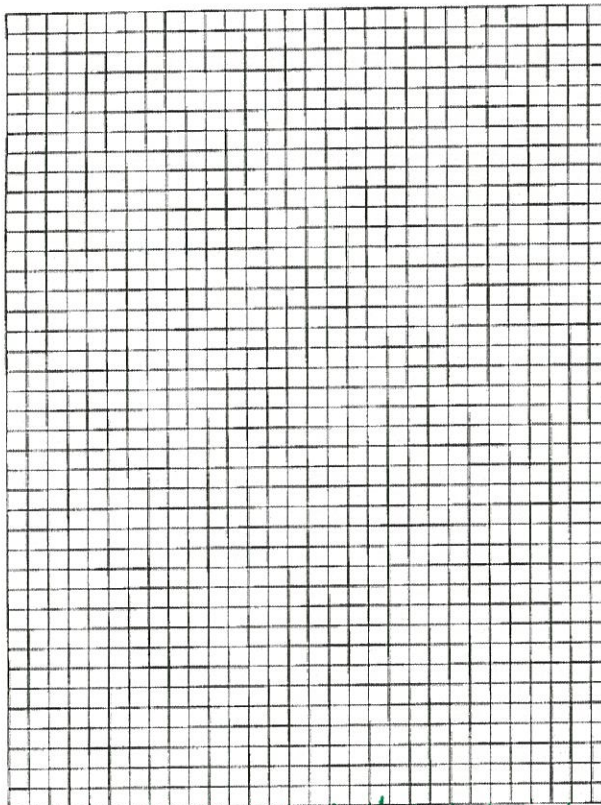
0 4 8 12 16   32 40   52 56

On the graph above , draw a graph to show the relationship between *each* member of Group 1 and its electron affinity by following the directions below.

a Label the y-axis "Electron Affinity" and choose an appropriate scale. Label the x-axis "Atomic Number" and choose an appropriate scale.

b Plot the data from the data table and connect the points with straight lines. *read all graph*

c Using your graph, estimate the electron affinity of Rb, in kiloJoules/mole.page> ~46 KJ/mol

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Base your answers to questions **9** and **10**on the electron configuration table shown below.

| Element	Electron Configuration
X	$2 - 8 - 8 - 2$
Y	$2 - 8 - 7 - 3$
Z	$2 - 8 - 8$

9. What is the total number of valence electrons in an atom of electron configuration X?

2

10.Which electron configuration represents the excited state of a calcium atom?

y

11. Given below the reaction between two different elements in the gaseous state. Box *A* below represents a mixture of the two reactants before the reaction occurs. The product of this reaction is a gas. In Box *B* provided below, draw the system after the reaction has gone to completion, based on the Law of Conservation of Matter.
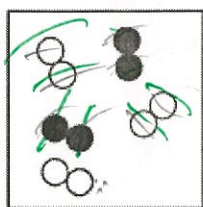
Box A
System Before Reaction
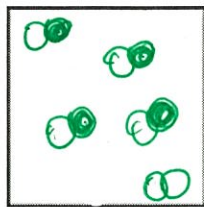
Box B
System After Reation Has
Gone to Completion

Base your answers to questions **12** and **13** on the information below.

Given: Samples of Na, Ar, As, Rb

12. Which *two* of the given elements have the most similar chemical properties? Na Rb

13. Explain your answer in terms of the Periodic Table of the Elements. They're in the same group

---

14. *a* Calculate the heat released when 25.0 grams of water freezes at 0°C. Show all work.

$Q = mH_f = 25g(334 J/g)$

b Record your answer with an appropriate unit.

8350 J

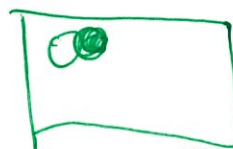15. Draw the electron-dot (Lewis) structure of an atom of calcium.

Ca :

16. What is the gram-formula mass of $(NH_4)_2CO_3$? Use atomic masses rounded to the nearest whole number.

$2(14) + 8(1) + 12 + 3(16)$

96 g

17. Draw the electron-dot (Lewis) structure of an atom of chlorine.

: Cl :

18. *a* Draw *two* different compounds, one in each box, using the representations for atoms of element X and element Z given below.

Atom of element X = O
Atom of element Z = ●

b Draw a mixture of these two compounds.

19. John Dalton was an English scientist who proposed that atoms were hard, indivisible spheres. In the modern model, the atom has a different internal structure.

a Identify one experiment that led scientists to develop the modern model of the atom.
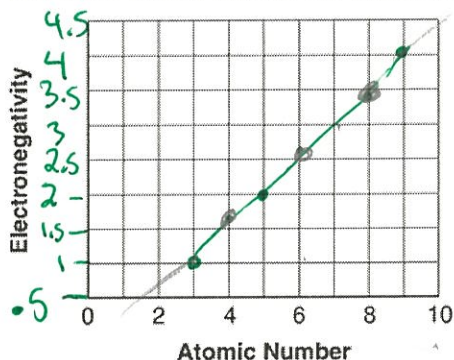
Gold foil

b Describe this experiment. α particles shot at gold foil

c State one conclusion about the internal structure of the atom, based on this experiment.

- atom mostly empty space
- ⊕ dense center (small)

20. The table below shows the electronegativity of selected elements of the Periodic Table.

Element	Atomic Number	Electronegativity (g/mL)
Beryllium	4	1.6
Boron	5	2.0
Carbon	6	2.6
Fluorine	9	4.0
Lithium	3	1.0
Oxygen	8	3.4

a On the grid set up a scale for electronegativity on the y-axis. Plot the data by drawing a best-fit line.

b Using the graph, predict the electronegativity of nitrogen. _____3.0_____

c For these elements, state the trend in electronegativity in terms of atomic number.

As atomic # ↑ electronegativity ↑

21. On a field trip, Student X and Student Y collected two rock samples. Analysis revealed that both rocks contained lead and sulfur. One rock contained a certain percentage of lead and sulfur by mass, and the other rock contained a different percentage of lead and sulfur by mass. Student X stated that the rocks contained two different mixtures of lead and sulfur. Student Y stated that the rocks contained two different compounds of lead and sulfur. Their teacher stated that both students could be correct.

Draw particle diagrams in *each* of the rock diagrams *below* to show how Student X's and Student Y's explanations could both be correct. Use the symbols in the key provided *below* to sketch lead and sulfur atoms.
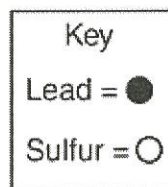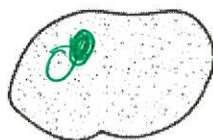

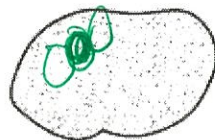Student X's explanation:

Rock A   Rock B

Key
Lead = ●
Sulfur = O
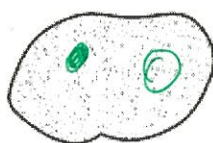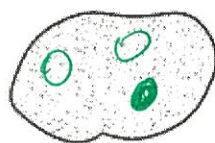
Student Y's explanation:

Rock A   Rock B

22. One electron is removed from both an Na atom and a K atom, producing two ions. Using principles of atomic structure, explain why the Na ion is much smaller than the K ion. Discuss both ions in your answer.
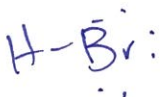
Na has 1 fewer shell than K so its smaller
(2-8-X) Na
(2-8-8-X) K

Version 2

23. Draw an electron-dot diagram for *each* of the following substances:

   a calcium oxide (an ionic compound) $[Ca]^{+2}$ $[:\ddot{O}:]^{-2}$
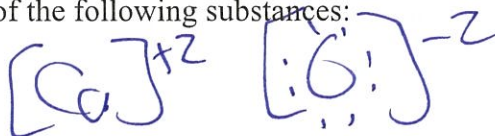
   b hydrogen bromide H–$\ddot{\underset{..}{B}}$r:

   c carbon dioxide

   $\ddot{O}=C=\ddot{O}$

Base your answers to questions **24** through **26** on the information and diagram below.

   One model of the atom states that atoms are tiny particles composed of a uniform mixture of positive and negative charges. Scientists conducted an experiment where alpha particles were aimed at a thin layer of gold atoms.

   Most of the alpha particles passed directly through the gold atoms. A few alpha particles were deflected from their straight-line paths. An illustration of the experiment is shown below.

Alpha particles

Deflected alpha particle
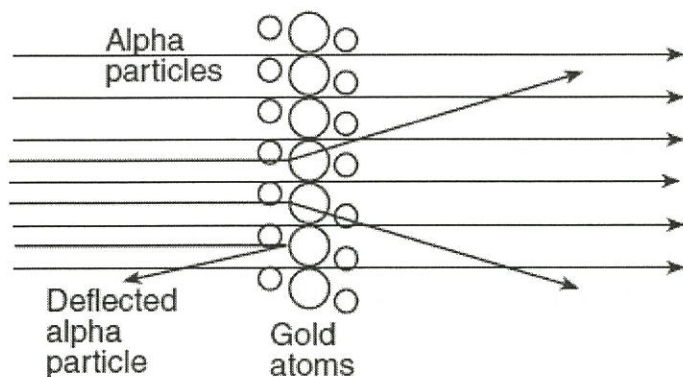
Gold atoms

24. Most of the alpha particles passed directly through the gold atoms undisturbed. What does this evidence suggest about the structure of the gold atoms? Most of an atom is empty space

25. A few of the alpha particles were deflected. What does this evidence suggest about the structure of the gold atoms? small ⊕ center called nucleus

26. How should the original model be revised based on the results of this experiment?
   put all ⊕ in nucleus

27. The table below gives information about two isotopes of element *X*.

| Isotope	Mass	Relative Abundance
X − 10	10.01	19.91%
X − 11	11.01	80.09%

$\dfrac{(10.01)(19.91)+(11.01)(80.09)}{100} = 10.81$

10.81

Calculate the average atomic mass of element *X*.•   Show a correct numerical setup.
   • Record your answer.
   • Express your answer to the correct number of significant figures.

Base your answers to questions **28** through **30** on the graph below, which shows the vapor pressure curves for liquids A and B.
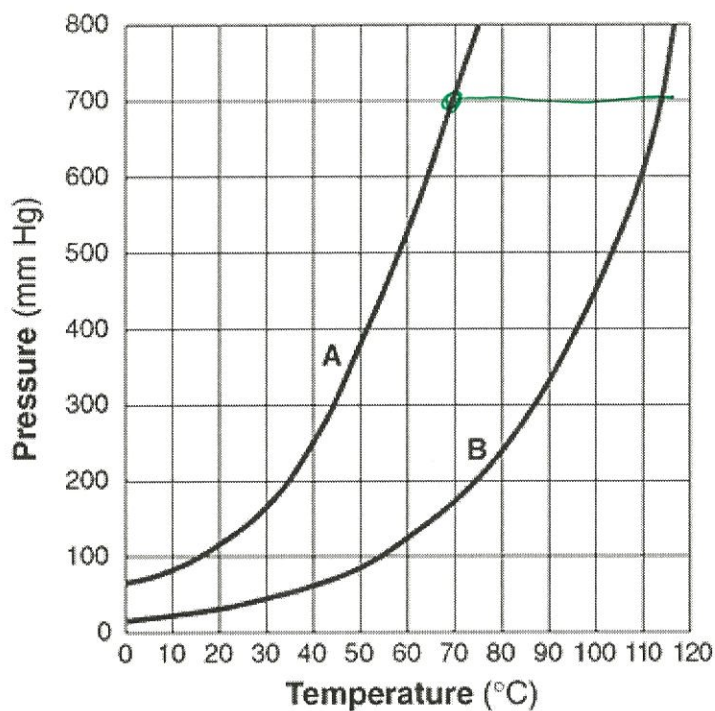
28. What is the vapor pressure of liquid A at 70°C? Your answer must include correct units.

700 mm Hg

29. At what temperature does liquid B have the same vapor pressure as liquid A at 70°C? Your answer must include correct units.

114 °C

30. Which liquid will evaporate more rapidly? Explain your answer in terms of intermolecular forces.

A has weaker intermolecular forces

Base your answers to questions **31** and **32** on the diagram below, which shows bright-line spectra of selected elements.

Bright-Line Spectra
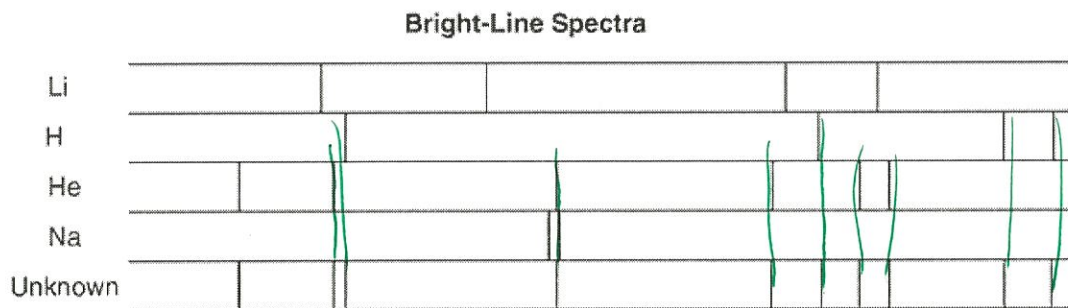
**31.** Identify the *two* elements in the unknown spectrum.

H & He

32. Explain how a bright-line spectrum is produced, in terms of *excited state, energy transitions,* and *ground state.* when an electron goes from the excited state to the ground state energy is released

33. A student determines the density of zinc to be 7.56 grams per milliliter. If the accepted density is 7.14 grams per milliliter, what is the student's percent error?

Base your answers to questions **34** and **35** on the information below.

Given the unbalanced equation:

$$C_6H_{12}O_6 \xrightarrow{\text{enzyme}} C_2H_5OH + CO_2$$
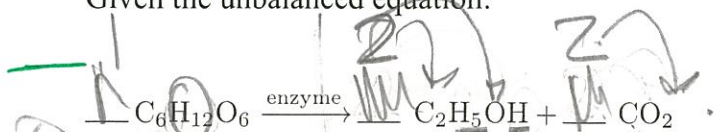
34. Balance the equation provided, using the lowest whole-number coefficients.

35. Identify the type of reaction represented.
decomposition

Base your answers to questions **36** and **37** on the diagram below, which shows a piston confining a gas in a cylinder.

36. Sketch the general relationship between the pressure and the volume of an ideal gas at constant temperature.

37. The gas volume in the cylinder is 6.2 milliliters and its pressure is 1.4 atmospheres. The piston is then pushed in until the gas volume is 3.1 milliliters while the temperature remains constant.

$(6.2)(1.4) = (3.1)X$ $X = 2.8$

a Calculate the pressure, in atmospheres, after the change in volume. Show all work.

b Record your answer. 2.8 atm

Base your answers to questions **38** through **40** on the information below.

A weather balloon has a volume of 52.5 liters at a temperature of 295 K. The balloon is released and rises to an altitude where the temperature is 252 K.

38. How does this temperature change affect the gas particle motion?
The particles move more slowly

39. The original pressure at 295 K was 100.8 kPa and the pressure at the higher altitude at 252 K is 45.6 kPa. Assume the balloon does not burst. Show a correct numerical setup for calculating the volume of the balloon at the higher altitude.
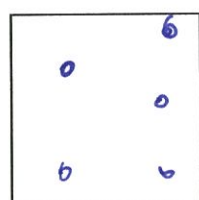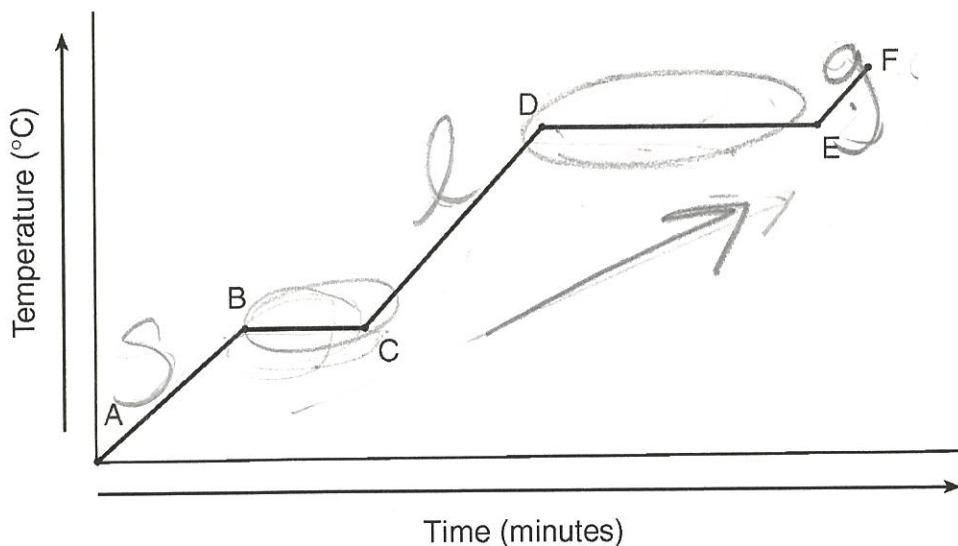
$$\frac{(100.8)(52.5)}{295} = \frac{(45.6)(x)}{252}$$

40. What Celsius temperature is equal to 252 K? $-21°C$ $252 = \text{\#} x + 273$

Base your answers to questions **41** through **44** on the information below.

Given the heating curve where substance X starts as a solid below its melting point and is heated uniformly:

41. Identify the process that takes place during line segment DE of the heating curve.

42. Identify a line segment in which the average kinetic energy is increasing. →temp

43. Using (•) to represent particles of substance X, draw at least *five* particles as they would appear in the substance at point F. Use the box provided above.

44. Describe, in terms of *particle behavior* or *energy*, what is happening to substance X during line segment $\overline{BC}$. The particles are getting more space btwn them potential energy is increasing

45. Show a correct numerical setup for calculating the number of moles of CO_2 (gram-formula mass = 44 g/mol) present in 11 grams of CO_2.
$x = \dfrac{11}{44}$ or $11g \left(\dfrac{1\,mol}{44g} \right) =$