

Part A: Multiple Choice. Circle the choice that best answers the question or statement. (30)

1. What was John Dalton's major contribution to the atomic model?

- ☒ a. All atoms are identical.      c. Atoms of each element are identical.  
b. Atoms are indivisible.      d. Atoms are all unique.

2. What did the gold foil experiment demonstrate?

- a. Gold contains densely packed electrons.      ☒ c. The nucleus contains neutrons.  
b. The nucleus is highly negative.      d. The mass of an atom is at the centre.

3. What is the Lewis diagram for bromine?

- a.  $\cdot \text{Br}$       b.  $\cdot \text{Br} \cdot$       c.  $\cdot \ddot{\text{Br}} \cdot$       ☒ d.  $\cdot \ddot{\text{Br}} :$       e.  $:\ddot{\text{Br}}:$

4. Why are the first four electrons in a Lewis diagram drawn separately?

- a. The first four electrons attract the nucleus at opposite poles.  
b. The first four electrons repel one other.  
c. The first four electrons balance out the shape of the atom.  
☒ d. Since the location of the electrons is unknown, this arrangement is easier to see.

5. Which particles are responsible for the similar chemical and physical properties of elements in the same group?

- ☒ a. protons and neutrons      c. isotopes  
b. neutrons      d. valence electrons

6. The most common isotope of potassium has a mass of 39 u. Use the atomic number ( $Z = 19$ ) to determine the number of neutrons.

- a. 19      ☒ b. 20      c. 39      d. 58

7. An unknown element has an atomic mass of 45.45 u. Which two isotopes (ordered from most to least abundant) are likely the most abundant for this element?

- a. 46, 45      b. 47, 46      ☒ c. 45, 46      d. 44, 45

8. Which of the following groups is known for having both metallic and non-metallic properties?

- a. alkali metals      ☒ c. metalloids  
b. alkali earth metals      d. non-metals

9. List the following elements in order of increasing size:

- I. titanium      II. silicon      III. thallium      IV. nitrogen  
a. III, I, II, IV      c. IV, II, III, I  
b. IV, III, I, II      ☒ d. IV, II, I, III

10. Which of the following statements is false regarding electronegativity?

- a.  $F > O$       b.  $O > Ti$       c.  $Al > Na$       ☒ d.  $Fr > Na$

11. The number of neutrons and protons is not the same in which element?

- a. beryllium      b. calcium      c. magnesium      ☒ d. strontium

12. This element has an electronegativity greater than 0.7 but less than 4.0. It forms a diatomic molecule prior to reaction and has three lone pairs of electrons.

- a. aluminum      b. nitrogen      ☒ c. chlorine      d. oxygen

13. Why are noble gases always found in their elemental form?

- ☒ a. All gases are found in this state.  
b. Noble gases do not react.  
c. Noble gases are only present in the gaseous state.  
d. Noble gases do not mix well with other gases.

14. Which bonds are found in carbon dioxide?

- ☒ a. two single bonds      c. four double bonds  
b. two double bonds      d. four single bonds

15. Which of the following molecules is known for having a single bond?  
 a. oxygen c. nitrogen  
 b. hydrogen ☒ d. carbon dioxide
16. Using electronegativity, determine which of the following is *true* regarding the carbon-fluorine bond.  
 a. Electrons spend more time around the carbon. ☒ c. Electrons spend more time around the fluorine.  
 b. Electrons move evenly between the carbon and fluorine. d. Electrons are shared evenly.
17. Using electronegativity, determine the case exhibiting the most even electron sharing.  
 a. C-O b. C-N ☒ c. C-C d. C-H
18. Determine the approximate electronegativity difference and identity (polar, non-polar) of the bond between nitrogen and oxygen.  
 a. 0.0 non-polar c. 1.0 polar  
☒ b. 0.5 polar d. 1.5 non-polar
19. Which is *true* of a compound with a high boiling point?  
☒ a. The melting point is even higher. c. The compound must be ionic.  
 b. The compound must be polar. d. The compound must be held together by very strong forces.
20. Ionic compounds have a \_\_\_\_ boiling point since the \_\_\_\_ forces holding them together are strong.  
☒ a. low, ionic c. medium, electron  
 b. medium, electrostatic d. high, electrostatic
21. Why is distilled water used as the solvent for conductivity tests?  
 a. It is always used in chemistry laboratories. c. It does not have ions in it, ensuring an accurate test.  
 b. It conducts electricity to ensure a positive test. ☒ d. It is neither a molecule nor an ion.
22. Which is *false* regarding all ionic compounds?  
☒ a. contain a metal c. held together with electrostatic forces  
☒ b. contain a non-metal d. contain two atoms
23. Why is nitrogen gas generally inert?  
 a. Humans cannot use it. c. The triple bond is very hard to break.  
 b. Nitrogen gas is stable. ☒ d. The lone pairs of electrons indicate it has noble gas properties.
24. Determine the number of bonding pairs in a water molecule.  
 a. 1 b. 2 ☒ c. 3 d. 4
25. Which best describes a covalent bond?  
☒ a. complete even sharing of electrons c. sharing of electrons between two atoms  
 b. movement of electrons to a metal d. has a partially positive charge
26. What does conductivity tell a scientist about an unknown substance?  
 a. The substance is ionic. c. The substance has already reacted.  
 b. The substance is covalent. ☒ d. both (a) and (b)
27. In a solution of  $\text{NaCl}_{(s)}$  and  $\text{H}_2\text{O}_{(l)}$ , the intermolecular forces present are:  
 I. H-bonding II. Ion-dipole III. dipole-dipole IV. Dispersion  
☒ a. I, III c. II, III, IV  
 b. II, IV d. I, II, III, IV
28. The strongest of all intermolecular forces is:  
☒ a. electrostatic c. dipole-dipole  
 b. H-bonding d. dispersion
29. Which bonds are found in carbon dioxide?  
☒ a. polar covalent bonds c. pure covalent bonds  
 b. non-polar covalent bonds d. ionic bonds
30. Place the following atoms in terms of decreasing atomic size: Si, P, Ge, As  
 a. Si, P, Ge, As ☒ c. Ge, As, P, Si  
 b. Ge, As, Si, P d. Ge, P, As, Si

Part B: Quicks. Answer each question with correct answers. (10 marks)

31. For an alkali metal, what information would expect to see under "Firefighting Information" on an MSDS information paper? reacts with water

32. The amount of bonded pairs and lone pairs around a pyramidal shape are: 1BP, 3LP

33. The amount of energy released when an atom is added to an atom is called: negative electron affinity

34. The correct order of decreasing ionization energy for Rb, K, Ca, Sr is: K, Ca, Rb, Sr

35. The name of the shape of  $\text{CHCl}_3$  is: tetrahedral

36. Is  $\text{CHCl}_3$  a polar or non-polar molecule? non-polar molecule

37. What type of intermolecular forces would be present in a solution of  $\text{CHCl}_3(l)$ ? dispersion

38. Which molecule would have a higher boiling point,  $\text{HF}_{(aq)}$  or  $\text{H}_2\text{O}_{(l)}$ ? HF

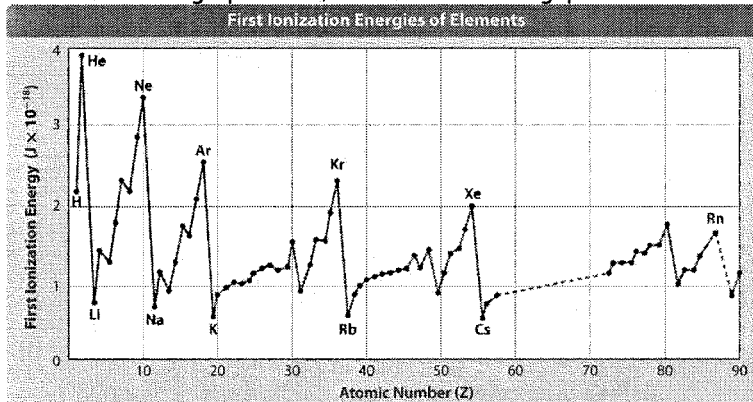
39. Why does the atom you chose in #28, have a higher boiling point? it is an acid

40. What alkaline earth metal is isoelectric with argon?  $\text{K}^+$

41. Silicon has three common isotopes, with the masses and isotopic abundances shown: (3)
- | Isotope    | Mass (u) | Abundance (%) |
|------------|----------|---------------|
| Silicon-28 | 27.98 u  | 92.2%         |
| Silicon-29 | 28.98 u  | 4.68%         |
| Silicon-30 | 29.97 u  | 3.10%         |

Determine the average atomic mass of silicon.  $= 28.08 \text{ u}$   $\therefore$  the avg. atomic mass is  $28.08 \text{ u}$

42. Based on the graph below, answer the following questions.



- a) Explain the significance of the peaks on the graph above. (3)

- The peaks are the noble gases
- noble gases have the highest I.E. b/c they don't want to ~~react~~ lose  $e^-$
- they don't want to ~~react~~ lose  $e^-$  b/c they already have a stable octet.

43. Rank the following atoms in order of biggest to smallest atomic radius: Si, C, N, P. With a detailed description, explain your ranking. (4)

Si, P, N, C

44. Nitrogen gas is a diatomic molecule. Draw the Lewis structure for this gas and give two possible reasons why it is so unreactive. (4)

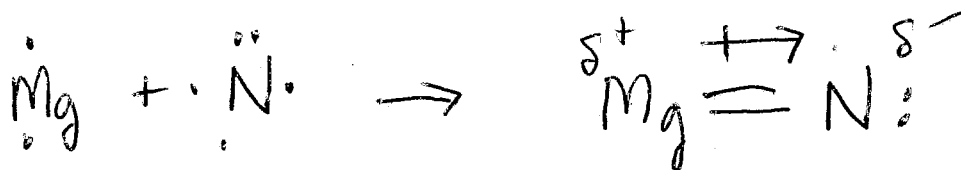


① pure covalently bonded  $\therefore$  difficult to remove  $e^-$

45. Define electron affinity and state its units. What is the difference between positive and negative electron affinity.

How does each occur? (6) - E.A.: the CHANGE in energy when an  $e^-$  is added to an atom  
units =  $\text{kJ/mol}$   
Positive  
Negative

46. Illustrate how magnesium and nitrogen bond to form magnesium nitride. (4)



47. Complete the following table (16 marks)

Compound	Lewis Diagram	3-D Structural Formula (show partial charges if present)	Name of Molecular Shape	Polarity of Molecule (polar/non)
$\text{H}_2\text{O}$ $\Delta \text{EN}$ $\text{O } 3.44$ $\text{H } 2.20$ $\hline 1.24$			bent	polar
$\text{Cl}_4$ $\Delta \text{EN}$ $\text{I } 2.66$ $\text{C } 2.55$ $\hline 0.11$			tetrahedral	polar
$\text{SnS}_2$ $\Delta \text{EN}$ $\text{S } 2.58$ $\text{Sn } 1.96$ $\hline 0.62$			bent	polar
$\text{NF}_3$ $\Delta \text{EN}$ $\text{F } 3.98$ $\text{N } 3.04$ $\hline 0.94$			pyramidal	polar