1. Given the balanced equation representing a reaction:

   $H_2 + \text{energy} \rightarrow H + H$

   What occurs as bonds are broken in one mole of H_2 molecules during this reaction?

   A) Energy is absorbed and one mole of unbonded hydrogen atoms is produced.
   B) Energy is absorbed and two moles of unbonded hydrogen atoms are produced.
   C) Energy is released and one mole of unbonded hydrogen atoms is produced.
   D) Energy is released and two moles of unbonded hydrogen atoms are produced.

2. Given the balanced equation representing a reaction:

   $O_2 \rightarrow O + O$

   What occurs during this reaction?

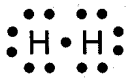
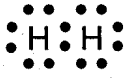
   A) Energy is absorbed as bonds are broken.
   B) Energy is absorbed as bonds are formed.
   C) Energy is released as bonds are broken.
   D) Energy is released as bonds are formed.

3. Which symbol represents an atom in the ground state with the most stable valence electron configuration?

   A) B B) O C) Li D) Ne

4. Which electron-dot diagram represents H_2?

   A) H • H B) H : H

   C)  D) 

5. What is the most likely electronegativity value for a metallic element?

   A) 1.3 B) 2.7 C) 3.4 D) 4.0

6. Which element has an atom with the greatest tendency to attract electrons in a chemical bond?

   A) carbon B) chlorine
   C) silicon D) sulfur

7. Given the electron dot diagram:

   The electrons in the bond between hydrogen and fluorine are more strongly attracted to the atom of

   A) hydrogen, which has the higher electronegativity
   B) fluorine, which has the higher electronegativity
   C) hydrogen, which has the lower electronegativity
   D) fluorine, which has the lower electronegativity

8. Which compound has the least ionic character?

   A) KCl B) $CaCl_2$
   C) $AlCl_3$ D) CCl_4

9. Which pair of elements forms a bond with the *least* ionic character?

   A) P–Cl B) Br–Cl
   C) H–Cl D) O–Cl

10. A sample of a substance has these characteristics:

    • melting point of 984 K
    • hard, brittle solid at room temperature
    • poor conductor of heat and electricity as a solid
    • good conductor of electricity as a liquid on in an aqueous solution

    This sample is classified as

    A) a metallic element
    B) a radioactive element
    C) a molecular compound
    D) an ionic compound

11. Which type of substance can conduct electricity in the liquid phase but *not* in the solid phase?

    A) ionic compound
    B) molecular compound
    C) metallic element
    D) nonmetallic element

12. A student determined the solubility of an unknown solid in various solvents as shown in the table below.

Solvent	Solubility
benzene	insoluble
water	soluble
ethanol	slightly soluble
toluene	insoluble

Based on these solubility results, the unknown solid is best described as

A) ionic
B) nonpolar
C) network
D) metallic

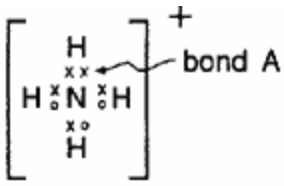
13. A chemist performs the same tests on two homogeneous white crystalline solids, *A* and *B*. The results are shown in the table below.

	Solid A	Solid B
Melting Point	High, 801°C	Low, decomposes at 186°C
Solubility in H_2O (grams per 100.0 g H_2O at 0°C)	35.7	3.2
Electrical Conductivity (in aqueous solution)	Good conductor	Nonconductor

The results of these tests suggest that

A) both solids contain only ionic bonds
B) both solids contain only covalent bonds
C) solid *A* contains only covalent bonds and solid *B* contains only ionic bonds
D) solid *A* contains only ionic bonds and solid *B* contains only covalent bonds

14. In the diagram of an ammonium ion to the right, why is bond *A* considered to be a coordinate covalent bond?



A) Hydrogen provides a pair of electrons to be shared with nitrogen.
B) Nitrogen provides a pair of electrons to be shared with hydrogen.
C) Hydrogen transfers a pair of electrons to the nitrogen.
D) Nitrogen transfers a pair of electrons to hydrogen.

15. The table below lists the melting points of various substances.

SUBSTANCE	PHASECHANGE (solid − liquid)	MELTINGPOINT (K)
chlorine	$Cl_2 - Cl_2(\ell)$	172
water	$H_2O(s) - H_2O(\ell)$	273
sodiumchloride	$NaCl(s) - NaCl(\ell)$	1073
copper	$Cu(s) - Cu(\ell)$	1356

Based on this table, which type of substance has the highest melting point?

A) nonpolar covalent B) polar covalent
C) ionic D) metallic

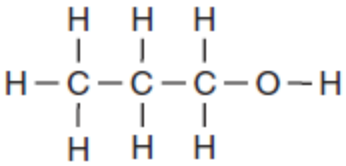
16. The table below shows properties of four solids, *A*, *B*, *C*, and *D*.

Substance	Melting Point	Conductivity in SolidState	Solubilityin Water
A	high	no	soluble
B	high	yes	insoluble
C	high	no	insoluble
D	low	no	insoluble

Which substance could represent diamond, a network solid?

A) *A* B) *B* C) *C* D) *D*

17. Given the formula:



The bond between which two atoms has the greatest degree of polarity?

A) C and C B) C and O
C) H and C D) H and O

18. Which formula represents a polar molecule?

A) O_2 B) CO_2 C) NH_3 D) CH_4

19. Which formula represents a polar molecule?

A) H_2 B) H_2O C) CO_2 D) CCl_4

20. Which formula represents a nonpolar molecule?

A) CH_4 B) HCl C) H_2O D) NH_3

21. The shape of methane molecules, CH_4, is

A) bent B) triangular
C) tetrahedral D) octahedral
E) planar

22. The shape of an NH_3 molecule is

A) linear B) tetrahedral
C) planar triangular D) trigonal pyramidal
E) bipyramidal

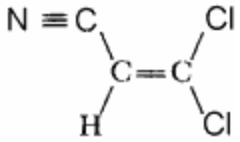
23. Predict the geometry and polar nature of the CO_2 molecule.

A) bent dipole
B) linear dipole
C) linear nondipole
D) tetrahedral dipole
E) tetrahedral nondipole

24. The arrangement of atoms in a water molecule, H_2O, is best described as

A) ring
B) trigonal planar
C) linear
D) trigonal pyramidal
E) bent

25. How many sigma bonds and pi bonds are in the following compound?



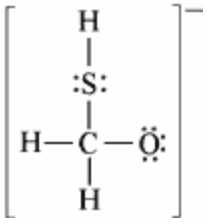
A) 5 sigma and 4 pi
B) 6 sigma and 3 pi
C) 7 sigma and 2 pi
D) 8 sigma and 1 pi
E) 9 sigma and 0 pi

26. Which substance is a nonpolar molecular crystal?

Substance	Melting Point	Boiling Point	Electrical Conductivity	
	°C	°C	In Solid	In liquid
I	776	1500	Poor	Good
II	–39	356	Good	Good
III	–190	–42	Poor	Poor
IV	961	1950	Good	Good

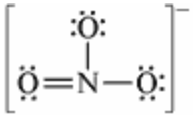
A) I
B) II
C) III
D) IV
E) None of the above

27. What is the formal charge on oxygen in the molecule below?



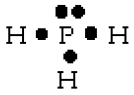
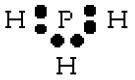
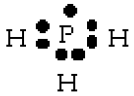
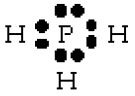
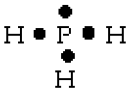
A) –2 B) –1 C) 0 D) +1 E) +2

28. What is the formal charge on nitrogen in the structure show below?



A) –2 B) –1 C) 0 D) +1 E) +2

29. Which is the Lewis electron dot diagram for PH_3?

A) 
B) 
C) 
D) 
E) 

30. Elements that readily gain electrons tend to have

A) high ionization energy and high electronegativity
B) high ionization energy and low electronegativity
C) low ionization energy and low electronegativity
D) low ionization energy and high electronegativity