MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) A chemical bond formed between two identical atoms is a(an) _____ bond. 1) _____

A) covalent B) ionic C) molecular D) atomic E) hydrogen

2) A chemical bond formed when two atoms share two electrons is a _____ bond; it is best described as _____. 2) _____

A) double; ionic

B) double; covalent

C) triple; covalent

D) single; covalent

E) single; ionic

3) Which representation of a hydrogen molecule is **not** correct? 3) _____

A) H=H

B) H–H

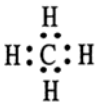
C) H:H

D) H_2

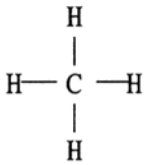
E) none of the above

4) Which representation of a methane molecule is **not** correct? (A methane molecule is composed of one carbon atom and four hydrogen atoms.) 4) _____

A)

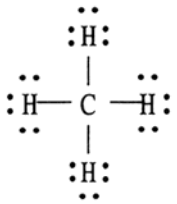


B)



C) CH_4

D)



E) none of the above

5) Which element is most likely to form three covalent bonds? 5) _____

A) P B) Si C) C D) Se E) S

6) In a covalent compound the bond length can be defined as 6) _____

A) the distance between two nuclei when the repulsion is greatest.

B) the distance between two nuclei when repulsion and attraction are balanced.

C) the distance between two nuclei when the attraction is greatest.

D) the distance between the two largest atoms.

E) the distance between any two pairs of electrons.

7) Which group contains only elements which normally exist as diatomic molecules? 7) _____

A) oxygen, phosphorus, germanium

B) nitrogen, sulfur, bromine

C) nitrogen, oxygen, fluorine

D) hydrogen, lithium, sodium

E) helium, neon, argon

8) A chemical bond formed when two atoms share one pair of electrons is a _____ bond; it is best described as _____. 8) _____

A) single; ionic

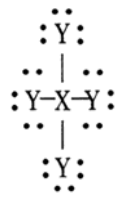
B) double; covalent

C) triple; covalent

D) double; ionic

E) single; covalent

9) For the dot structure shown the most likely elements are X =_____ and Y = _____. 9) _____



A) carbon; oxygen

B) carbon; hydrogen

C) fluorine; carbon

D) hydrogen; carbon

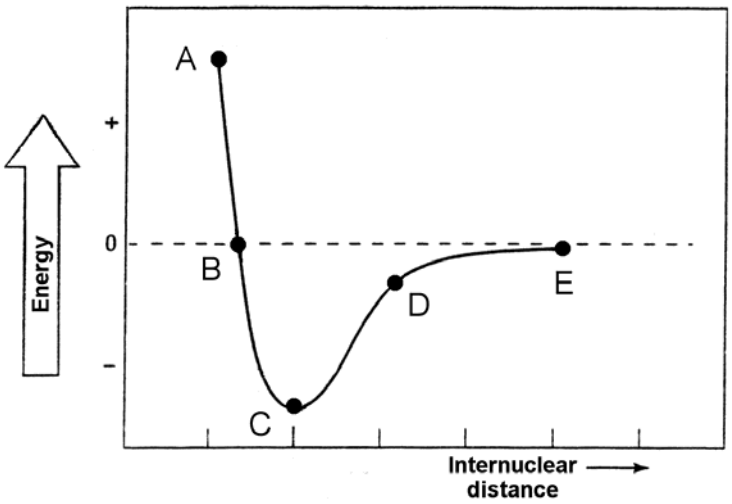
E) carbon; fluorine

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

10) When two atoms share one or more pairs of electrons, a covalent bond is formed. 10) _____

11) When a non–metal atom bonds with another non–metal atom, an ionic bond is formed. 11) _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.



12) Which point identifies the bond length between the two atoms of the diatomic molecule whose potential energy is shown on the graph? 12) _____

13) Which point identifies the maximum repulsion between the two atoms of the diatomic molecule whose potential energy is shown in the graph? 13) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

14) Which element is most likely to be "X" in the diatomic molecule shown? 14) _____

A) fluorine B) hydrogen C) oxygen D) nitrogen E) helium

15) Which group in the Periodic Table is most likely to contain the element X in the molecule whose dot structure is shown? 15) _____

A) 2A B) 4A C) 3A D) 6A E) 5A

16) A chemical bond formed when two atoms share three pairs of electrons is a _____ bond; it is best described as _____. 16) _____

A) triple; covalent

B) double; ionic

C) double; covalent

D) triple; ionic

E) single; covalent

17) A chemical bond formed when two atoms share four electrons is a _____ bond; it is best described as _____. 17) _____

A) triple; covalent

B) single; ionic

C) double; covalent

D) single; covalent

E) double; ionic

18) A chemical bond formed when two atoms share six electrons is a _____ bond; it is best described as _____. 18) _____

A) single; ionic

B) double; ionic

C) single; covalent

D) triple; covalent

E) double; covalent

19) For the structure shown, the most likely elements are X = _____ and Y = _____. 19) _____

A) carbon; oxygen

B) oxygen; hydrogen

C) carbon; hydrogen

D) nitrogen; oxygen

E) oxygen; carbon

20) The element in the list given that is most likely to form a coordinate covalent bond is 20) _____

A) H. B) Fe. C) C. D) Ca. E) K.

21) The element least likely to obey the octet rule in forming chemical bonds is 21) _____

A) fluorine. B) calcium. C) sulfur. D) nitrogen. E) sodium.

22) In forming covalent bonds where the octet rule is obeyed, sulfur usually forms _____ bonds and chlorine usually forms _____ bonds. 22) _____

A) two; one B) one; one C) two; two D) one; two E) six; seven

23) The element **least** likely to obey the octet rule in forming chemical bonds is 23) _____

A) boron. B) carbon. C) oxygen. D) nitrogen. E) fluorine.

24) The element **least** likely to obey the octet rule in forming chemical bonds is 24) _____

A) oxygen. B) fluorine. C) nitrogen. D) neon. E) carbon.

25) Elements in Period 3 or below don't always "obey" the octet rule because they 25) _____

A) can use s, p, and d orbitals for bonding.

B) cannot use s orbitals for bonding.

C) cannot use d orbitals for bonding.

D) can only use p orbitals for bonding.

E) can use s and p orbitals for bonding.

26) A chemical bond formed when two atoms share two pairs of electrons is a _____ bond; it is best described as _____. 26) _____

A) triple; covalent

B) single; covalent

C) double; ionic

D) double; covalent

E) single; ionic

27) In a Lewis dot structure the electrons which complete an octet but are not located between two atoms are referred to as 27) _____

A) bonding pairs.

B) excess electrons.

C) delta minus electrons.

D) lone pairs.

E) filled shells.

28) The number of valence electrons in the acetic acid molecule (CH_3CO_2H) is _____. 28) _____

A) 24 B) 8 C) 32 D) 16 E) 0

29) Which formula is **least** likely to represent a molecular compound that really exists? 29) _____

A) C_2H_6 B) PCl_5 C) Br_3Cl_5 D) SF_6 E) SF_4

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

30) Explain why it is unlikely that an organic molecule would have an odd number of valence electrons. 30) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

31) A molecule in which the central atom has no lone pairs and forms four single bonds is said to have a _____ shape. 31) _____

A) bent

B) planar

C) pyramidal

D) linear

E) tetrahedral

32) The molecule $SiCl_4$ has a _____ shape. 32) _____

A) pyramidal

B) bent

C) linear

D) tetrahedral

E) planar

33) A molecule in which the central atom forms three single bonds and has one lone pair is said to have a _____ shape. 33) _____

A) linear

B) pyramidal

C) planar

D) bent

E) tetrahedral

34) A molecule in which the central atom forms one double bond and two single bonds is said to have a _____ shape. 34) _____

A) pyramidal

B) bent

C) planar triangular

D) linear

E) tetrahedral

35) According to VSEPR theory, a molecule with three charge clouds including one lone pair would have a _____ shape. 35) _____

A) planar triangular

B) linear

C) bent

D) pyramidal

E) tetrahedral

36) The water molecule has a _____ geometry because its central atom has _____ bonds and _____ lone pairs of electrons. 36) _____

A) pyramidal; three; one

B) linear; two; two

C) tetrahedral; four; zero

D) planar triangular; three; one

E) bent; two; two

37) The bond angle in the molecule H_2S is _____ because the _____. 37) _____

A) exactly 109.5°; S atom has four charge clouds

B) exactly 180°; the S atom has two bonds

C) less than 109.5°; lone pairs force the hydrogen atoms closer together

D) exactly 120°; lone pairs are counted as one charge cloud

E) greater than 109.5°; lone pairs allow the bond angle to expand

38) Which of the following molecules has a CCH bond angle of 180°? 38) _____

A) H_2CCH_2

B) H_3CCHO

C) HCCH

D) H_3CCH_3

E) none of them

39) Which element listed is the **least** electronegative? 39) _____

A) fluorine B) hydrogen C) oxygen D) nitrogen E) chlorine

40) Which element listed is the **most** electronegative? 40) _____

A) bromine B) aluminum C) sodium D) chlorine E) iodine

41) A section of the Periodic Table containing representative elements is shown. Which bond would be **least** polar? 41) _____

W	X
Y	Z

A) WY

B) YZ

C) WZ

D) WX

E) cannot be determined without more specific information

42) If the elements W, X, Y, and Z have electronegativity values of 1.0, 2.0, 2.5, and 3.5, respectively, which bond is the **least** polar? 42) _____

A) XZ B) WX C) XY D) WZ E) YZ

43) If the elements W, X, Y, and Z have electronegativity values of 1.0, 2.0, 2.5, and 3.5, respectively, which bond is ionic? 43) _____

A) YZ B) XZ C) XY D) WY E) WZ

44) Consider the molecule $SiCl_4$. The electronegativity values for Si and Cl are 1.8 and 3.0, respectively. Based on these values and on consideration of molecular geometry, the Si–Cl **bond** is _____ and the **molecule** is _____. 44) _____

A) polar; non–polar

B) non–polar; polar

C) non–polar; non–polar

D) polar; polar

E) none of the above

45) The carbon dioxide molecule is linear. The electronegativities of C and O are 2.5 and 3.5, respectively. Based on these values and on consideration of molecular geometry, the C–O **bond** is _____ and the **molecule** is _____. 45) _____

A) polar; non–polar

B) polar; polar

C) non–polar; polar

D) non–polar; non–polar

E) none of the above

46) Consider a bent molecule, such as H_2Se, in which the central atom has two lone pairs of electrons. The electronegativities of H and Se are 2.1 and 2.4, respectively. Based on these values and on consideration of molecular geometry, the H–Se **bond** can be considered almost _____ and the **molecule** is _____. 46) _____

A) non–polar; polar

B) polar; polar

C) non–polar; non–polar

D) polar; non–polar

E) none of the above

47) The VSEPR model or molecular structure requires a knowledge of _____ to predict the geometry of an atom in a molecule. 47) _____

A) the total number of atoms in the molecule

B) the number of atoms bonded to the atom of interest

C) the number of electron pairs on the atom of interest

D) both A and C

E) none of the above

48) A molecule that contains three identical polar bonds to the central atom will be _____. 48) _____

A) polar in all cases.

B) impossible to tell the polarity.

C) nonpolar if the geometry is planer triangular.

D) either polar or nonpolar depending on the identity of the atoms bonded to the central atom.

E) nonpolar in all cases.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

49) Explain how it is possible for CCl_4 to have polar bonds but be a non–polar molecule. A diagram may be helpful in your answer, but it **must** be explained. 49) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

50) What is the systematic name of ICl_3? 50) _____

A) triiodine chloride

B) iodine trichloride

C) iodine chloride

D) iodine(III) chloride

E) tri(iodine chloride)

51) The formula for phosphorus pentafluoride is _____. 51) _____

A) P_5F B) P_5F_5 C) PhF_5 D) $(PF)_5$ E) PF_5

52) Although noble gases do not normally form covalent compounds, XeO_3 has been prepared. The systematic name of this compound is 52) _____

A) xenon (III) oxide.

B) trioxy xenon.

C) trixenon trioxide.

D) xenon trioxide.

E) none of the above

53) The formula for sulfur hexabromide is _____. 53) _____

A) SBr_4 B) SF_6 C) SBr_6 D) SiB_6 E) $SiBr_6$

54) The formula for carbon disulfide is _____. 54) _____

A) $(CS)_2$ B) CSi_2 C) CaS_2 D) C_2S E) CS_2

55) If $SiCl_4$ is named as a covalent compound, what would it be called? 55) _____

A) sulfur tetrachloride

B) chlorosilicate

C) silicon tetrachloride

D) sulfur chloride

E) silicon chloride

56) The compound BrF_3 would be called 56) _____

A) tribromine fluoride.

B) tri (bromine fluoride).

C) triboron fluoride.

D) bromine trifluoride.

E) boron trifluoride.

57) In the common nomenclature of ions, ous and ic are used as endings for the ions. In this system, which species is named with the ous ending? 57) _____

A) The species with the lower negative charge.

B) It varies from species to species.

C) The species with the higher positive charge.

D) The species with the higher negative charge.

E) The species with the lower positive charge.

58) The smallest possible unit of a covalent compound is a(an) 58) _____

A) atom.

B) cation.

C) molecule.

D) polyatomic ion.

E) formula unit.

59) The covalent bonding model is most useful in describing which of the following compounds? 59) _____

A) $CoCl_2$

B) $NiCl_2$

C) SCl_2

D) $MgCl_2$

E) none of the above

60) Which property could describe a covalent compound? 60) _____

A) It conducts electricity when dissolved in water.

B) It is composed of a non–metal and a metal.

C) It conducts electricity when melted.

D) It is a gas at room temperature.

E) none of the above

61) Which set of properties would identify a unknown white solid as a molecular compound? 61) _____

I. Contains a metal.
II. Has a definite crystal structure.
III. Dissolves in water, but not in organic liquids.
IV. Melts at 80 degrees Celsius.
V. Does not conduct electricity when melted.

A) II, III, IV B) II, IV, V C) I, III, V D) I, IV, V E) I, II, III

62) Which physical property is most closely associated with covalent molecules? 62) _____

A) It is composed of a metal and a nonmetal.

B) It conducts electricity when dissolved in water.

C) It is a gas at room temperature.

D) It has a very high melting point.

E) none of these.

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

63) Covalent compounds form distinct molecules, and therefore may exist as gases, liquids, or solids at room temperature, depending on the characteristics of the compound. 63) _____

MATCHING. Choose the item in column 2 that best matches each item in column 1.

Match the following.

64) iodine heptafluoride	A) SF_6	64) _____
65) oxygen difluoride	B) PCl_3	65) _____
66) dinitrogen tetroxide	C) NH_3	66) _____
67) bromine pentafluoride	D) SO_2	67) _____
68) ammonia	E) N_2O_4	68) _____
69) carbon tetrachloride	F) OF_2	69) _____
70) phosphorus trichloride	G) CH_4	70) _____
71) carbon monoxide	H) BrF_5	71) _____
72) sulfur hexafluoride	I) CCl_4	72) _____
73) sulfur dioxide	J) ICl	73) _____
74) methane	K) IF_7	74) _____
75) iodine monochloride	L) CO	75) _____

1) A
2) D
3) A
4) D
5) A
6) B
7) C
8) E
9) E
10) TRUE
11) FALSE
12) C
13) A
14) C
15) D
16) A
17) C
18) D
19) E
20) B
21) C
22) A
23) A
24) D
25) A
26) D
27) D
28) A
29) C
30) In most molecules, the Lewis dot structure includes bonds that consist of one, two, or three pairs of electrons. The remaining electrons are drawn as lone pairs on one or more atoms. Note that both of these includes **pairs** of electrons. Also most of these atoms obey the octet rule, which means that each atom has eight electrons in its outer shell. The most common exception to the octet rule is hydrogen, which usually has two electrons. Note again that these numbers are all **even** numbers.
31) E
32) D
33) B
34) C
35) C
36) E
37) C
38) C
39) B
40) D
41) E
42) C
43) E
44) A
45) A
46) A

47) B
48) C
49) (This question could also be asked about CF_4 or CO_2.)
The bonds in this compound are polar due to the difference in their electronegativity values. However, the molecule is not polar because the molecule is symmetrical, which means that the polar forces in different directions balance each other out. In this case, the overall distribution of electrons in the molecule is even.
50) B
51) E
52) D
53) C
54) E
55) C
56) D
57) E
58) C
59) C
60) D
61) B
62) C
63) TRUE
64) K
65) F
66) E
67) H
68) C
69) I
70) B
71) L
72) A
73) D
74) G
75) J