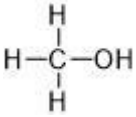
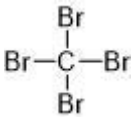
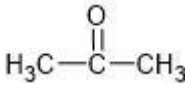
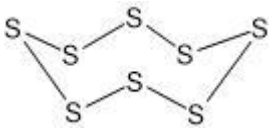
Structure and Bonding - 08

01. Fill in the blanks using following terms.
Terms: Bonds, charges, dipole, forces, dipole-dipole forces, hydrogen bonding, ions, ionic, London dispersion forces, unchanged, unequal)

i) When a molecular substance changes states (ex: from liquid to gas), the atoms within the molecules are …….
ii) No …….. are broken when a molecular substance changes state.
iii) The force holding ……. together in …….. solids are ionic electrostatic forces. Opposite charges attract each other. These are the strongest intra-particle……
iv) The strongest intermolecular forces in a sample of oxygen gas are the ……
v) …….. sharing of electrons in a molecule result in the formation of partial ……. on the molecule.
vi) A ……. occurs because one part of a molecule has a partial positive charge while another part of a molecule has a partial negative charge.

02. There are 3 intermolecular forces present in a sample of water. List the 3 intermolecular forces in order of strength from strongest to weakest.

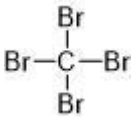
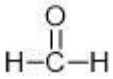
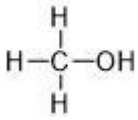
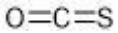
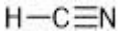
03. Which is the predominant intermolecular force in each of the following substances in the liquid state: London dispersion forces, dipole-dipole interactions or hydrogen bonding?

1. 
2. 
3. N_2
4. NH_3
5. 
6. 
7. $S{=}C{=}S$
8. Br—Cl
9. $I{-}CH_3$
10. 

04. Which of the following substance would be expected to exhibit hydrogen bonding in the liquid state?

1. $H_3C{-}CH_3$
2. H_2O_2
3. H_2O
4. H_2
5. $C_{33}H_{68}$
6. H_2S
7. NH_3
8. CO_2
9. $H_3C{-}CH_2{-}OH$

05. Which of the following represents a polar molecule?

1. CH_4
2. 
3. 
4. CO_2
5. 
6. 
7. NH_3
8. 
9. 

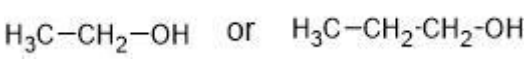
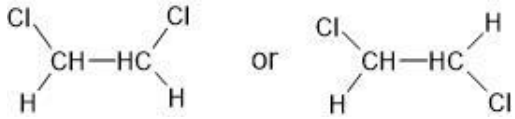
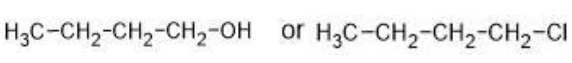
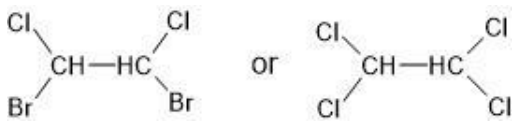
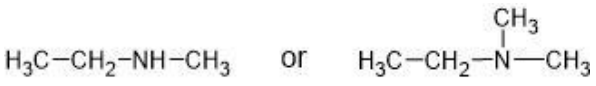
06. What is the strongest intermolecular force present for each of the following compounds?

1. CH_3OH
2. CCl_4
3. N_2
4. H_2S
5. CO_2
6. NH_3
7. PCl_3
8. SO_2
9. C_2H_6
10. CH_2O
11. BH_3
12. N_2H_2

07. Predict which compound in each pair have a higher melting point.

1. CS_2 or CCl_4
2. HI or KI
3. Cl_2 or F_2
4. $BeCl_2$ or $BaCl_2$
5. CO_2 or SiO_2
6. CH_4 or NH_3
7. $CHCl_3$ or CF_4
8. Na_2O or H_2O
9. CaF_2 or HF
10. BF_3 or P_4

08. Predict which compound in each of the following pairs has a higher boiling point.

1. CO_2 or SO_2
2. CCl_4 or CBr_4
3. Br_2 or ICl
4. N_2 or NO
5. He or Ne
6. HF or HBr
7. PH_3 or NH_3
8. CH_3Cl or $CHCl_3$
9. Ne or Ar
10. Kr or Xe
11. 
12. 
13. 
14. 
15. 

09. Explain, using intermolecular forces, what has happened when the sample of water has changed from liquid to gas.
10. Methane (CH_4) and water have the similar molecular masses. Why is methane a gas at room temperature while water is a liquid at room temperature?
11. Why does water (boiling point: 100 °C) have a higher boiling point temperature in comparison to H_2S (boiling point: -60 °C).
12. Consider two chemical compounds CH_3Cl (boiling point :249 K) and CH_3I (boiling point: 316 K). Give reasons why CH_3I have highest boiling point
13. Why does HF (boiling point: 19 °C) have a higher boiling point temperature in comparison to HCl (boiling point: -85 °C).

14. Write the following compounds in order of increasing melting points
    a) CaO, CH_3-CH_2-O-CH_2-CH_3, CH_3-CH_2-CH_2-CH_2-OH, KCl
    b) Si, CH_3OH, CH_3CH_3, NaCl

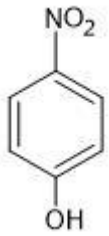
15. Write the following compounds in order of increasing boiling point
    a) Benzene (C_6H_6), NaCl, CHI_3, O_2
    b) C_2H_6, KF, BeCl, CH_3-COOH
    c) CO_2, CH_3OH, CH_3Br
    d) CH_3-CH_2-CH_2-CH_2-OH, HO-CH_2-CH_2-CH_2-OH, CH_3-CH_2-O-CH_2-CH_3
    e) CH_3 -CH_3, HO-CH_2-CH_2-OH, F-CH_2-CH_2-OH

16. Why does NH_3 have a higher boiling point temperature comparison to PH_3?

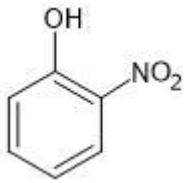
17. Explain the boiling point of KF, SiF_4, $AlBr_3$ and SiO_2, considering their bonding nature.

18. Write the compounds Br_2, NaI, Cl_2 and MgO in order of increasing boiling point.

19. Why *ortho*-nitrophenol has lower boiling point than *para*-nitrophenol?



ortho-nitrophenol

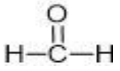


para-nitrophenol

20. Write the compounds H_2S, HF, H_2O, HBr and CH_3CH_2OH in order of increasing boiling points. Give reasons for your answer.

21. Explain the solubility of the substances in terms of Hydrogen bonding

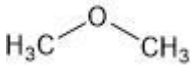
a) Mixing of H_2O and CH_3CH_2OH c) NH_3 dissolves in water

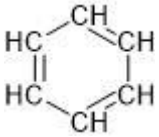
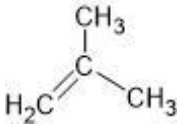
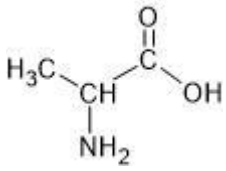
b)  dissolves in water

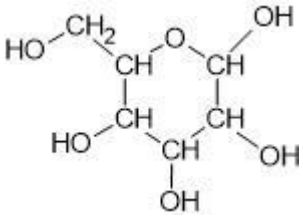
22. For each compound, would you expect greater solubility in Hexane (CH_3-CH_2- CH_2-CH_2-CH_2-CH_3) OR Water? Indicate the kind of intermolecular forces that occur between the solute and the solvent in which the molecule is most soluble.

1) KI 2) CaO 3) NaCl

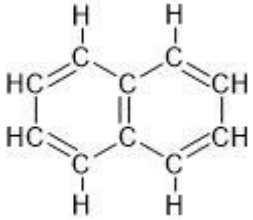
4) CCl_4 5) ZnS 6) $MgSO_4$

7) I_2 8) CH_3OH 9) 

10)  11)  12) 

13) 

Glucose

14) 

Naphthalene

23. Which compound is more volatile?

1) CH_4 2) NH_3 3) H_2O

4) HF 5) Ne

24. The order of decreasing boiling points of following compounds is shown correctly,

(A) H_2S (B) H_2O (C) CH_4 (D) H_2 (E) KBr

1) B > E > A > C > D 2) E > A > B > D > C (3) E > B > C > A > D

4) E > B > A > C > D 5) E > B > A > D > C

25. The order of increasing boiling points of compounds CO_2, SO_2, N_2, He and Ne is shown correctly,

1) He < Ne < N_2 < CO_2 < SO_2 2) Ne < He < N_2 < CO_2 < SO_2

3) He < Ne < CO_2 < N_2 < SO_2 4) Ne < He < CO_2 < SO_2 < N_2

5) He < Ne < N_2 < SO_2 < CO_2