

Chapter 11 Review

- Rank the ionic bond strength for the following ionic formulas, 1 being strongest: Al_2S_3 NaCl MgCl_2 MgO
- Rank the lattice energy (ionic bond strength) for the following formulas, 1 being strongest: LiF KI NaCl NaI NaF
- Which of the following requires the lowest melting point?
 - CaF_2
 - KCl
 - NaCl
 - MgF_2
 - LiCl
- Classify each of the following molecules as polar covalent (PC), nonpolar covalent (NPC), ionic (I), or metallic (M).
 - CO_2
 - CH_3OH
 - O_2
 - NH_3
 - CH_2Cl_2
 - PCl_3
 - CO
 - SiCl_4
 - Fe
 - NaCl
- Ion–dipole forces always require
 - An ion and a water molecule
 - A cation and a water molecule
 - An anion and a polar molecule
 - An ion and a polar molecule.
 - A polar and a nonpolar molecule.
- Which of the following compounds is capable of dipole–dipole interactions?
 - CH_4
 - CO_2
 - H_2CO
 - SF_6
 - NH_4^+
- Which of the following compounds is capable of hydrogen bonding?
 - CH_3OCH_3
 - CH_3COCH_3
 - $\text{CH}_3\text{CH}_2\text{OH}$
 - H_2CO
 - CH_3F
- Based on their boiling points, which of the following compounds has the largest dipole–dipole interaction? (They are all covalent, variably polar, but without hydrogen-bonding.)
 - Propane (231 K)
 - Dimethyl ether (248 K)
 - Acetonitrile (355 K)
 - Methyl chloride (249 K)
 - Butane (135 K)

9. Indicate the strongest IMF in a sample of the following. Use LDF, DDF, HBF, IDF

- | | |
|---|---|
| a. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{SH}$ | g. $\text{CH}_3\text{CH}_2\text{NHCH}_2\text{CH}_3$ |
| b. $\text{P}(\text{CH}_3)_3$ | h. $\text{H}-\text{N}=\text{O}$ |
| c. K_3PO_4 in water | i. CCl_4 |
| d. $\text{C}_3\text{H}_7\text{OH}$ | j. CO |
| e. C_3H_8 | k. $\text{Zn}(\text{NO}_3)_2$ (aq) |
| f. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ | l. NH_3 |

10. Which of the following polar compounds is likely to have the highest boiling point?

- CH_3OCH_3
- $\text{CH}_3\text{CH}_2\text{OH}$
- $(\text{CH}_3)_2\text{CO}$
- H_2CO
- CO

11. Which of the following will have hydrogen bonding? (may be more than one)



12. Rank the following in terms of increasing boiling point, 1 being the lowest.



13. Which has a higher boiling, and why? (Both are $\text{C}_3\text{H}_8\text{O}$ isomers)



14. Rank the boiling points for the following, 1



15. Rank the melting points for the following, 1 being highest:



16. For F_2 , $\text{C}_3\text{H}_7\text{OH}$, and Na_2O , which of the following is true at room temperature?

- F_2 is a gas, $\text{C}_3\text{H}_7\text{OH}$ is a liquid, and Na_2O is a solid
- Na_2O is a gas, F_2 is a liquid, and $\text{C}_3\text{H}_7\text{OH}$ is a solid
- F_2 is a gas, Na_2O is a liquid, and $\text{C}_3\text{H}_7\text{OH}$ is a solid
- $\text{C}_3\text{H}_7\text{OH}$ is a gas, F_2 is a liquid, and Na_2O is a solid

17. For CO_2 , $\text{Zn}(\text{NO}_3)_2$, and $\text{C}_5\text{H}_{11}\text{NH}_2$, which of the following is true at room temperature?

- $\text{Zn}(\text{NO}_3)_2$ is a gas, CO_2 is a liquid, and $\text{C}_5\text{H}_{11}\text{NH}_2$ is a solid

- b. CO_2 is a gas, $\text{C}_5\text{H}_{11}\text{NH}_2$ is a liquid, and $\text{Zn}(\text{NO}_3)_2$ is a solid
- c. CO_2 is a gas, $\text{Zn}(\text{NO}_3)_2$ is a liquid, and $\text{C}_5\text{H}_{11}\text{NH}_2$ is a solid
- d. $\text{C}_5\text{H}_{11}\text{NH}_2$ is a gas, CO_2 is a liquid, and $\text{Zn}(\text{NO}_3)_2$ is a solid

18. The highest vapor pressure is observed for which of the following liquid/temperature combinations?

- a. C_6H_{14} at 275 K
- b. C_6H_{14} at 299 K
- c. C_5H_{12} at 299 K
- d. $\text{HOC}_4\text{H}_8\text{OH}$ at 299 K
- e. $\text{HOC}_4\text{H}_8\text{OH}$ at 275 K

19. Which of the following liquids would have the lowest vapor pressure, factoring in both the impact of the substance and the temperature?

- a. CH_3NH_2 at 25°C
- b. SiH_4 at 75°C
- c. SiH_4 at 25°C
- d. $\text{C}_3\text{H}_7\text{NH}_2$ at 25°C
- e. $\text{C}_3\text{H}_7\text{NH}_2$ at 75°C

20. Which of the following liquids would have the lowest viscosity, factoring in both the impact of the substance and the temperature?

- a. $\text{C}_3\text{H}_7\text{OH}$ at 25°C
- b. $\text{C}_3\text{H}_7\text{OH}$ at 75°C
- c. MgBr_2 at 25°C
- d. $\text{C}_5\text{H}_{11}\text{OH}$ at 25°C
- e. $\text{C}_5\text{H}_{11}\text{OH}$ at 75°C

21. CH_2F_2 has a boiling point of -52°C . CH_2Cl_2 has a boiling point of 40°C . Why is the boiling point of dichloromethane 92° higher than that of difluoromethane? Which of the following explains why dichloromethane has the higher boiling point?

- a. CH_2F_2 is more polar and thus must have stronger binding forces. With stronger intermolecular attraction, of course CH_2F_2 will have a lower boiling point.
- b. CH_2Cl_2 is ionic while CH_2F_2 is molecular.
- c. CH_2Cl_2 has hydrogen-bonding while CH_2F_2 does not.
- d. Dichloromethane (CH_2Cl_2) has a higher boiling point because it has stronger intermolecular attractions.

22. HCl (mw=36.5) has a boiling point of 190K. HBr (mw=80.9) has a boiling point of 206K. Which of the following statements is true?

- a. HBr is more polar.
- b. HCl has stronger intermolecular forces.
- c. HCl has stronger London dispersion forces
- d. Both molecules have hydrogen bonding.
- e. HBr has a higher boiling point because it has stronger intermolecular attractions, despite it having a smaller dipole moment. Evidently with its extra mass it has much stronger London dispersion attraction, enough so to overcome the dipole advantage of HCl .



23. Viscosity is a measure of a substance's
- a. Ability to resist changes in its surface area
 - b. Surface tension
 - c. Resistance to flow
 - d. Compressibility
 - e. Color

Heating Curves

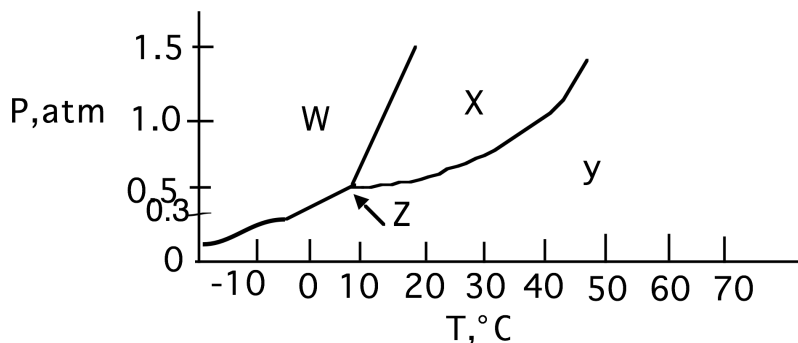
Substance	Specific Heat	Substance	Specific Heat
H ₂ O (s)	2.06 J/g °C	Aluminum (s)	0.900 J/g °C
H ₂ O (g)	2.02 J/g °C	Benzene (l)	1.74 J/g °C
H ₂ O (l)	4.18 J/g °C	Ethanol (l)	2.42 J/g °C

Substance	Heat of Fusion	Heat of Vaporization	Boiling Points	Melting Points
H ₂ O	6.01 kJ/mol	40.7 kJ/mol	373.2 K	273.2 K
Benzene (C ₆ H ₆)	10.59 kJ/mol	30.8 kJ/mol	353.2 K	278.6 K
Ethanol (C ₂ H ₆ O)	4.60 kJ/mol	43.5 kJ/mol	351.5 K	158.7 K
Acetone (C ₃ H ₆ O)	5.72 kJ/mol	29.1 kJ/mol	329.4 K	179 K

- How much heat is required to melt 25.0 g of ice at 0°C?
- How much heat is required to melt 25.0 g of Benzene at 278.6 K?
- How much heat is required to boil away 25.0 g of Ethanol at 351.5 K?
- How much heat is required to boil away 25.0 g of Acetone at 329.4 K?
- You have a sample of H₂O with a mass of 23.0 g at a temperature of -46.0 °C. How many kilojoules (kJ) of heat energy are necessary to:
 - heat the ice to 0°C?
 - melt the ice?
 - heat the water from 0°C to 100°C?
 - boil the water?
 - heat the steam from 100°C to 109°C?

6. How much heat is required to raise 23.0 g of ice at a temperature -46.0°C to 109°C ?
7. How much heat is required to change 25.0 g of liquid Ethanol that is at a temperature of 158.7 K to a gas at 351.5 K?

Phase Diagrams



- Which letter represents:
 - Gas Phase
 - Liquid
 - Solid
 - Triple Point
- What is the normal bp?
 - 20°C
 - 40°C
 - 65°C
 - 80°C
- What is the normal mp?
 - 12°C
 - 40°C
 - 80°C
- When a liquid originally at 20°C and 1 atm has pressure reduced, at what pressure will it vaporize?
- When a liquid originally at 20°C and 1 atm has pressure increased, at what pressure will it solidify?
- When solid at 1.0 atm is warmed, does it:
 - melt
 - or
 - sublime
- When solid at 0.3 atm is warmed, does it:
 - melt
 - or
 - sublime
- Suppose a solid is originally at 0.3 atm and 0°C . If it is first pressurized to 1.0 atm, and then subsequently heated to 60°C , what will happen to it?
 - It will sublime directly to gas
 - It will melt and end up as a liquid
 - It will first melt, and then boil, ending up as a gas
 - It will sublime to gas, then compress to a liquid and end up in the liquid phase
 - No phase change will happen. It will just stay solid.
- Suppose a solid is originally at 0.3 atm and 0°C . If it is first heated to 30°C , then pressurized to 1.0 atm, what will happen to it?
 - It will sublime directly to gas and stay a gas.
 - It will melt and end up as a liquid
 - It will first melt, and then boil, ending up as a gas

- d. It will sublime to gas first, then compress to a liquid and end up in the liquid phase
- e. No phase change will happen. It will just stay solid.