

## Intermolecular Forces, Liquids, Solids, Materials Sample Multiple Choice Questions

The number of sample questions does not reflect the number of questions that may appear on a test or exam.

1. Which ONE of the following pairings of molecule and intermolecular force is CORRECT?
  - A Ethene ( $\text{C}_2\text{H}_4$ ), dipole-dipole.
  - B  $\text{H}_2\text{S}$ , only London dispersion
  - C  $\text{CH}_3\text{CH}_2\text{NH}_2$ , hydrogen bonding
  - D  $\text{NCl}_3$ , only London dispersion
  - E  $\text{MgBr}_2$ , dipole-dipole
2. Which of the following substances exhibits only London dispersion forces?
  - A Potassium bromide ( $\text{KBr}$ ) dissolved in water ( $\text{H}_2\text{O}$ )
  - B Liquid bromine ( $\text{Br}_2$ )
  - C Boiling methanol ( $\text{CH}_3\text{OH}$ )
  - D Solid magnesium oxide ( $\text{MgO}$ )
  - E Solid gold ( $\text{Au}$ )
3. Ice is less dense than water. Why?
  - A Dispersion forces are lower in a solid than in a liquid.
  - B When water crystallizes into ice, ion-dipole forces are no longer effective.
  - C Hydrogen bonds are less effective in the solid state than in the liquid state, reducing intermolecular forces and lowering the density.
  - D Hydrogen bonding is optimized in the solid state when each water molecule is involved in a tetrahedral arrangement of hydrogen bonds, creating an open lattice.
  - E More dipole-dipole interactions can be formed for each water molecule in the liquid state.
4. At room temperature, which of the following compounds is most ordered?
  - A  $\text{NaCl}$
  - B  $\text{H}_2\text{O}$
  - C  $\text{CO}_2$
  - D  $\text{O}_2$
  - E polyethylene

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5. Which of the following mixtures will contain an example of an ion-dipole interaction?

- A HF and CO<sub>2</sub>
- B HCl and HF
- C NaCl and [PH<sub>4</sub>][BrO<sub>4</sub>]
- D NaCl and CCl<sub>4</sub>
- E H<sub>2</sub>O and [NH<sub>4</sub>][ClF<sub>4</sub>]

6. Which of the following compounds has the weakest intermolecular forces?

- A HBr
- B H<sub>2</sub>Te
- C HI
- D H<sub>2</sub>S
- E H<sub>2</sub>Se

7. Which of the following compounds will experience the strongest covalent bond?

- A Na<sub>2</sub>CO<sub>3</sub>
- B HNNH
- C HOOH
- D CO<sub>2</sub>
- E H<sub>2</sub>CCH<sub>2</sub>

8. Which of the following compounds exhibits the strongest London dispersion forces?

- A 3-methyl-1-pentene
- B 2-methylpentane
- C hexane
- D heptene
- E cyclopentane

9. What is the most appropriate classification for hydrogen bonding?

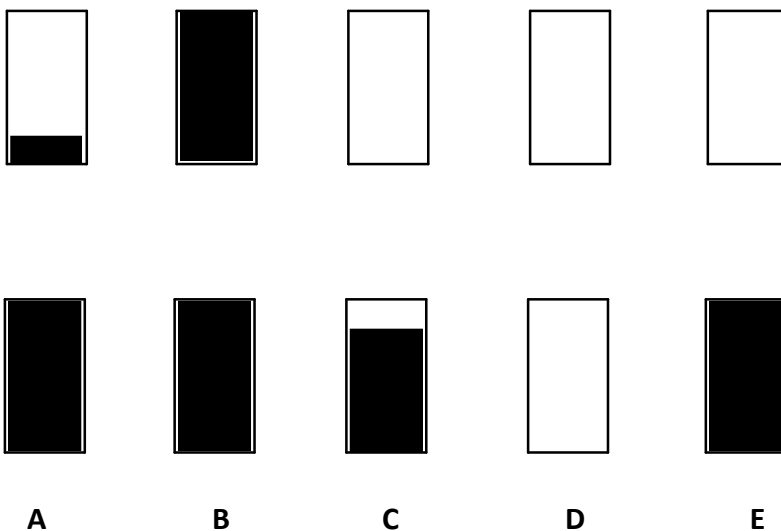
- A ionic
- B dipole-dipole
- C ion-dipole
- D dipole-induced dipole
- E induced dipole-induced dipole

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10. Which of the following compounds will experience the strongest intermolecular forces?

- A HNNH
- B H<sub>2</sub>O
- C H<sub>2</sub>CCH<sub>2</sub>
- D MgH<sub>2</sub>
- E CaO

11. Which of the following drawings represents the band structure of a p-type semiconductor?

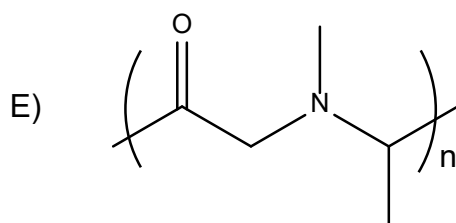
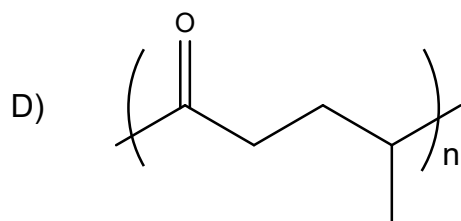
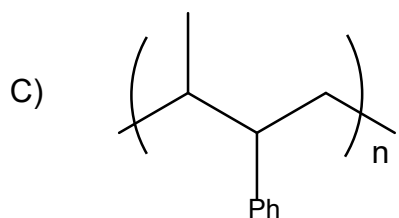
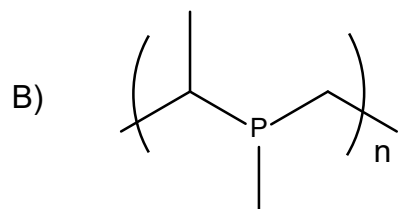
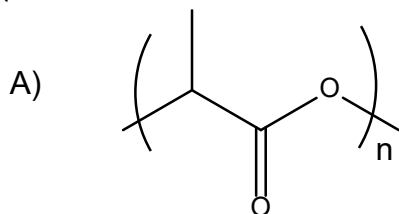


12. Which of the following statements is false?

- A The strength of an intermolecular attraction or repulsion is proportional to the distance between the molecules.
- B The strength of an intermolecular attraction or repulsion is proportional to the charges of the molecules involved.
- C The energy of an intermolecular attraction or repulsion is generally weaker than the energy for covalent bonds.
- D Compounds with greater intermolecular forces have higher boiling points.
- E Compounds with greater intermolecular forces have higher viscosity.

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13. Which of the following polymers can be formed by condensation polymerization?  
(NOTE Fall 2020– condensation polymerization is not examinable this year)



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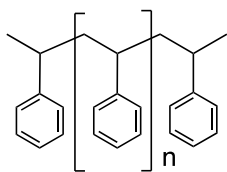
14. Which of the series below indicates the correct relationship for the boiling points of the shown compounds?
- A  $\text{H}_2\text{S} < \text{SiH}_4 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{H}_2\text{O}$
  - B  $\text{SiH}_4 < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{H}_2\text{S} < \text{H}_2\text{O}$
  - C  $\text{SiH}_4 < \text{H}_2\text{S} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{H}_2\text{O}$
  - D  $\text{H}_2\text{S} < \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{SiH}_4 < \text{H}_2\text{O}$
  - E  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3 < \text{H}_2\text{S} < \text{SiH}_4 < \text{H}_2\text{O}$
15. What is the strongest intermolecular force for  $\text{CaCl}_2$  in methanol?
- A Hydrogen bonding
  - B Dispersion force
  - C Dipole-dipole forces
  - D Ion dipole forces
  - E Ionic bond
16. Which of the following compounds exhibits the strongest intermolecular forces?
- A 2-hexanol
  - B 2,3-dimethyl-2-butanol
  - C pentane
  - D heptane
  - E 2-pentanol
17. If it takes 10 minutes to cook an egg in boiling water at sea level, how long would it take to cook an egg in boiling water on a mountain at an elevation of 2,500 meters?
- A The boiling point of water on top of the mountain is less than  $100^\circ\text{C}$  because of the lower atmospheric pressure and it will take longer to boil the egg.
  - B The boiling point of water on top of the mountain is greater than  $100^\circ\text{C}$  because of lower atmospheric pressure and it will take less time to boil the egg.
  - C The boiling point of water is always  $100^\circ\text{C}$  regardless of elevation so it would take the same amount of time to boil the egg.
  - D The boiling point of water on top of the mountain is less than  $100^\circ\text{C}$  because of the lower atmospheric pressure and it will take less time to boil the egg.
  - E The boiling point of water on top of the mountain is greater than  $100^\circ\text{C}$  because of lower atmospheric pressure and it will take longer to boil the egg.

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18. Why does the viscosity of a liquid increase when the temperature is lowered?
- A** At lower temperature the kinetic energy of the molecules in the liquid is higher making it possible for more intermolecular interactions to occur.
  - B** At lower temperatures the kinetic energy of the molecules in a liquid is lower and more intermolecular interactions can occur.
  - C** As the temperature is lowered the kinetic energy of the molecules in a liquid is constant but the strength of the intermolecular interactions increases.
  - D** At lower temperatures the movement of the molecules in the liquid increases leading to more collisions between the molecules.
  - E** There is no direct relationship between the temperature and the viscosity of a liquid.
19. The capillary action for a liquid in a glass tube leads to a concave surface when:
- A** The adhesive force is smaller than the cohesive force.
  - B** The adhesive force is non-existent.
  - C** The adhesive force is larger than the cohesive force.
  - D** The adhesive and cohesive forces are the same.
  - E** The liquid does not have cohesive forces.
20. A solid has a very high melting point, great hardness, poor electrical conduction, and does not dissolve in polar solvents. This is a(n) \_\_\_\_\_ solid.
- A** ionic
  - B** molecular
  - C** metallic
  - D** covalent network
  - E** metallic and covalent network
21. For which of the substances below is(are) the crystalline solid(s) a molecular solid?
- i)  $\text{SiO}_2$
  - ii)  $\text{KCl}$
  - iii)  $\text{CO}_2$
  - iv)  $\text{Co}$
  - v)  $\text{N}_2\text{O}$
- A** i only                      **B** iii only                      **C** iii and v only                      **D** i, iii, and v                      **E** iv only

## Intermolecular Forces, Liquids, Solids, Materials Sample Multiple Choice Questions

22. Which of the statements is correct with respect to the synthesis of the polymer shown in the structure below?



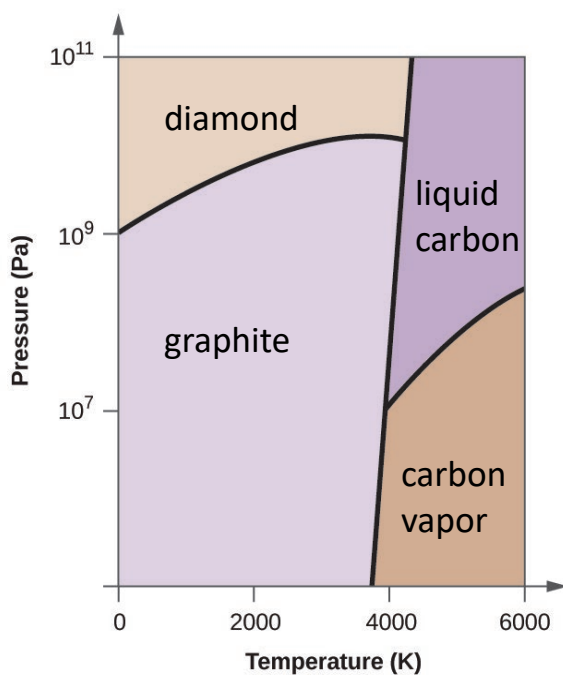
- A The monomer is an alcohol and the polymers is formed through an addition reaction.
- B The monomer is an alkyne and the polymer is formed through a condensation reaction.
- C The monomer is an alkene and the polymer is formed through an addition reaction
- D The monomers are an alkene and an alkyne, and the polymer is formed through a condensation reaction.
- E The monomer is an alkene and the polymer is formed through a condensation reaction.

23. Which one of the following substances will not have hydrogen bonding as one of its intermolecular forces?

- A 
$$\begin{array}{c} \text{O} \\ || \\ \text{CH}_3 - \text{C} - \text{CH}_3 \end{array}$$
- B 
$$\text{H} - \text{O} - \text{O} - \text{H}$$
- C 
$$\begin{array}{c} \text{H} \\ | \\ \text{CH}_3 - \text{C} - \text{O} - \text{H} \\ | \\ \text{H} \end{array}$$
- D 
$$\begin{array}{cc} \text{H} & \text{H} \\ & \diagdown \quad \diagup \\ & \text{N} - \text{N} \\ & \diagup \quad \diagdown \\ \text{H} & \text{H} \end{array}$$
- E 
$$\begin{array}{cc} & \text{H} \\ & | \\ \text{H} - & \text{C} - \text{N} \\ & | \quad \diagdown \\ & \text{H} \quad \text{H} \end{array}$$

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24. Based on the phase diagram for carbon (below), what are the transitions when (a) the pressure is kept constant at  $10^{10}$  Pa and the temperature is raised from 3200 K to 5800 K and (b) the pressure is kept constant at  $10^6$  Pa and the temperature is raised from 3000 K to 4500 K?



- A (a) no transition and (b) solid-to-liquid transitions  
B (a) solid-to-liquid and (b) liquid-to-gas transitions  
C (a) solid-to-solid and (b) gas-to-liquid transition  
D (a) solid-to-solid and (b) liquid-to-solid transition  
E (a) solid-to-liquid and (b) solid-to-gas transition
25. Considering intermolecular forces, which of the following liquids has the highest vapour pressure:

- A acetone  
B methanol  
C water  
D ethyl ether  
E ethanol



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Question	Answer
1	C
2	B
3	D
4	A
5	E
6	B
7	D
8	D
9	B
10	E
11	C
12	A
13	A
14	C
15	D
16	A
17	A
18	B
19	C
20	D
21	C
22	C
23	A
24	E
25	D