

Chang

- Helium atoms do not combine to form He_2 molecules, What is the strongest attractive force between He atoms?
- What is the molecular property related to the ease with which the electron density in a neutral atom or molecule can be distorted?
- Which one of the following substances will have both dispersion forces and dipole-dipole forces?
A. HCl B. BCl_3 C. Br_2 D. H_2 E. CO_2
- Which one of the following substances should exhibit hydrogen bonding in the liquid state?
A. PH_3 B. H_2 C. H_2S D. CH_4 E. NH_3
- Which two properties are more typical of molecular compounds than of ionic compounds?
A. They are gases or liquids at room temperature.
B. They have high melting points.
C. Solids do not conduct electricity, but liquids do.
D. Atoms share electrons.
- Which of the following substances should have the highest boiling point?
A. CH_4 B. Cl_2 C. Kr D. CH_3Cl E. N_2
- Which of the following would be expected to have the highest vapor pressure at room temperature?
A. ethanol, bp = 78°C B. methanol, bp = 65°C
C. water, bp = 100°C D. acetone, bp = 56°C
- Which of the following would be expected to have the lowest vapor pressure at room temperature?
A. ethanol, bp = 78°C B. methanol, bp = 65°C
C. water, bp = 100°C D. acetone, bp = 56°C
- Given the following liquids and their boiling points, which has the highest vapor pressure at its normal boiling point?
A. ethanol, bp = 78°C B. methanol, bp = 65°C
C. water, bp = 100°C D. benzene, bp = 80°C
E. The vapor pressure of each of the liquids at its normal boiling point would be the same.

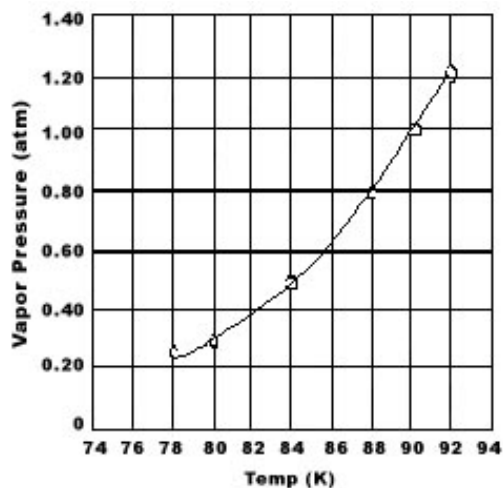
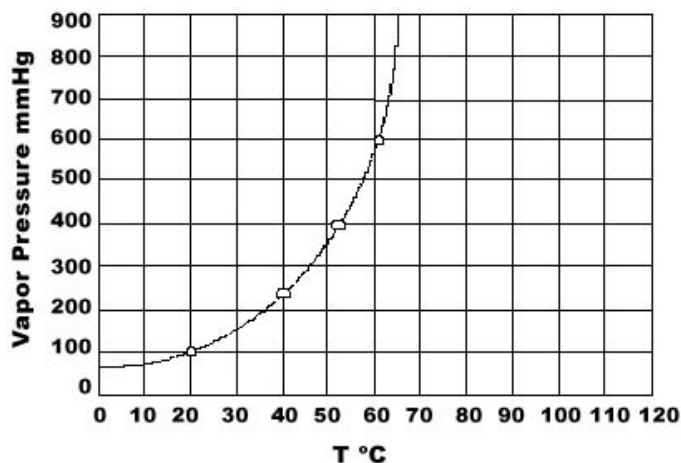
10. Choose the response that lists the member of each of the following pairs that has the higher boiling point.
- (I) H_2O or KI (II) HF or HI (III) Cl_2 or Br_2
11. Arrange the following in order of increasing boiling point: RbCl , CH_3Cl , CH_3OH , CH_4 .
- A. $\text{CH}_3\text{OH} < \text{CH}_3\text{Cl} < \text{RbCl} < \text{CH}_4$
B. $\text{CH}_3\text{OH} < \text{CH}_4 < \text{CH}_3\text{Cl} < \text{RbCl}$
C. $\text{RbCl} < \text{CH}_3\text{Cl} < \text{CH}_3\text{OH} < \text{CH}_4$
D. $\text{CH}_4 < \text{CH}_3\text{OH} < \text{CH}_3\text{Cl} < \text{RbCl}$
E. $\text{CH}_4 < \text{CH}_3\text{Cl} < \text{CH}_3\text{OH} < \text{RbCl}$
12. Krypton has a higher melting point than argon because of its
- A. hydrogen bonding. B. stronger dispersion forces.
C. permanent dipole moment. D. ionic bonds.
E. greater ionization energy.
13. Which one of the following substances should exhibit hydrogen bonding in the liquid state?
- A. PH_3 B. He C. H_2S D. CH_4 E. CH_3OH
F. SiH_4 G. CH_3NH_2 H. H_2
14. Octane, C_8H_{18} , boils at 125°C as compared to water, which boils at 100°C . This information suggests that the dispersion forces in nonpolar octane molecules are stronger than dispersion forces and hydrogen bonding in water. Explain
15. Which of the following that can form hydrogen bonds with water molecules?
- A. Na^+ B. CH_3COOH C. C_2H_6 D. CH_3NH_2
16. Which of the following atoms does not participate in hydrogen bonding?
- A. S B. O C. F D. N
17. Which of the following is not true with regard to water?
- A. Water has a high heat capacity.
B. Water has an unusually high boiling point.
C. Water can form hydrogen bonds.
D. Ice is more dense than liquid water.
E. Water is a polar molecule.
18. Which property of water allows a razor blade to float on it without sinking?
- A. viscosity B. surface tension C. density D. specific heat E. triple point
19. The triple point of iodine is at 0.12 atm and 115°C . Thus, liquid I_2

- A. is more dense than $I_2(s)$.
- B. cannot exist above $115^\circ C$.
- C. is liquid at room temperature.
- D. cannot have a vapor pressure less than 91 torr.

20. A liquid boils when its

- A. vapor pressure is exactly 1 atmosphere.
- B. vapor pressure is equal to, or greater than, the external pressure pushing on it.
- C. temperature is equal to 273 K (standard temperature).
- D. temperature is greater than room temperature.

21. Use the graph of vapor pressure to determine the normal boiling point of $CHCl_3$.



22. Use the graph of vapor pressure to determine the normal boiling point of O_2 .

23. Which one of the following elements would have the lowest melting point?

- A. Kr B. Br_2 C. S_8 D. Ca E. K

24. Which of the following gases would have the highest critical temperature?

- A. CH_4 B. O_2 C. CO_2 D. NH_3 E. Ne

25. Below are selected compounds and their boiling points. Identify which are polar

and which are nonpolar.

HCl	-84.9°C	F ₂	-188.1°C
Ar	-185.7°C	H ₂ S	-60.7°C

26. Identify the dominant (strongest) type of intermolecular force present in each of the following compounds.

- | | | | |
|------------------------|-------|------------------------|-------|
| a. RbCl(s) | _____ | b. H ₂ S(g) | _____ |
| c. NH ₃ (l) | _____ | d. Cl ₂ (l) | _____ |
| e. F ₂ (l) | _____ | f. HF(l) | _____ |
| g. SO ₂ (l) | _____ | h. He(l) | _____ |

27. Indicate all the types of intermolecular forces of attraction in the following compounds.

- | | | | |
|--------------------------------------|-------|--------------------------|-------|
| a. C ₂ H ₆ (g) | _____ | b. CHCl ₃ (l) | _____ |
| c. SF ₆ (g) | _____ | d. SF ₄ (g) | _____ |

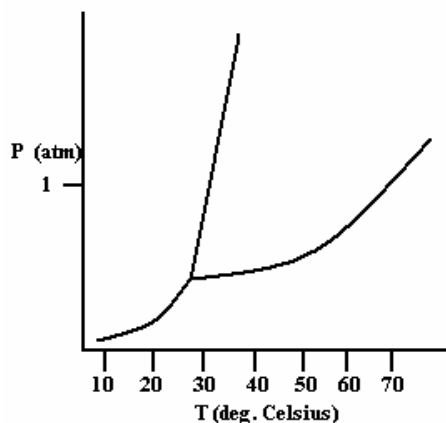
28. Circle the member of each pair that would have the stronger intermolecular forces of attraction.

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|--|---|--|
| a. H ₂ S or H ₂ Se | b. HF or HCl | c. CH ₄ or CH ₃ OH |
| d. NH ₃ or PH ₃ | e. SF ₄ or C ₁₀ H ₂₂ | |

29. The meniscus for water is curved upward at the edges (i.e., it is “concave up”). Explain this phenomenon in terms of cohesion and adhesion.

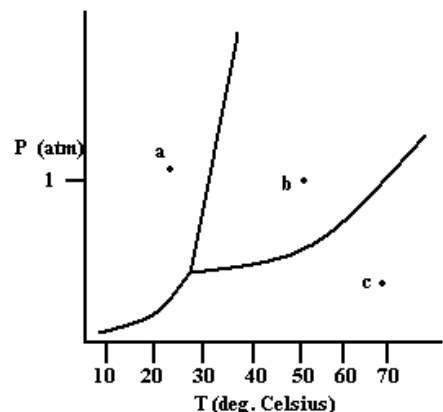
30. Which is expected to have a higher boiling point, C₈H₁₈ or C₄H₁₀ and why?

31. Ethanol and dimethyl ether have the same molecular formula, C₂H₆O. Ethanol boils at 78.4°C. Dimethyl ether boils at -23.7°C. Their structural formulas are, respectively, CH₃CH₂OH and CH₃OCH₃. Explain why the boiling point of the ether is so much lower than the boiling point of ethanol.



32. Using the following phase diagram of a certain substance, in what phase is the substance at 50°C and 1 atm pressure?

33. What phases exist at the points labeled a, b, and c?



Answers:

- | | | |
|--|--|-----------------------------|
| 1. dispersion forces (Van der Waal) | 2. polarizability. | 3. A |
| 4. E | 5. A and D | 6. D |
| 7. D | 8. C | 9. E |
| 10. KI, HF, and Br ₂
increase with mass | 11. E | 12. B dispersion forces |
| increase with increase in carbon chain and therefore the collective dispersion forces in octane is greater than the hydrogen bonding and dispersion forces in H ₂ O | 13. E and G | 14. True; dispersion forces |
| 15. B and D | 16. A | 17. D |
| 18. B | 19. D | 20. B |
| 21. 64°C | 22. 90K | 23. A |
| 24. D | 25. HCl polar F ₂ nonpolar Ar | |
| nonpolar H ₂ S polar | 26. a. ionic b. dipole-dipole c. hydrogen bonding d. dispersion | |
| dispersion e. dispersion f. hydrogen bonding g. dipole-dipole h. dispersion | | |
| 27. a. dispersion b. dipole-dipole and dispersion c. dispersion d. dipole-dipole and dispersion | | |
| 28. a. H ₂ Se b. HF c. CH ₃ OH d. NH ₃ e. C ₁₀ H ₂₂ | 29. Adhesion of water to | |
| glass is stronger than cohesion within water chain | 30. C ₈ H ₁₈ larger carbon | |
| forces, hydrogen bonding in particular, than ether, which is slightly polar but cannot form hydrogen bonds | 31. Ethanol is a polar molecule that has stronger attractive | |
| 32. Liquid | 33. a. solid b. liquid c. gas | |