Topics 3.1 – 3.2: MCQ Practice

Data for the H–F Bond	
Bond Length	92 pm
Average Bond Energy	565 kJ/mol

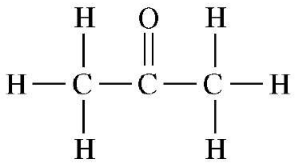
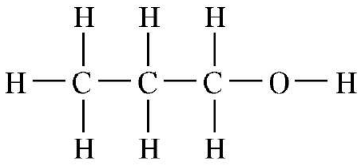
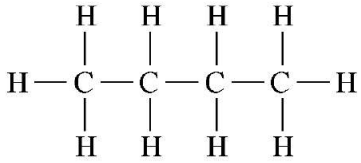
1. Data for the H–F bond are listed in the table above. Which of the following provides the correct predictions for both the average distance between HF molecules in a pure sample of HF(*l*) and the energy required to break the attractive forces between HF molecules?

	Average Distance between HF Molecules in a Pure Sample of HF(*l*)	Energy Required to Break the Attractive Forces Between HF Molecules
(A)	less than 92 pm	less than 565 kJ/mol
(B)	less than 92 pm	greater than 565 kJ/mol
(C)	greater than 92 pm	less than 565 kJ/mol
(D)	greater than 92 pm	greater than 565 kJ/mol

Properties of CCl_4	
Vapor Pressure at 293 K	90 torr
Boiling Point	350 K

2. Data for carbon tetrachloride, CCl_4, are listed in the table above. Which of the following provides the correct predictions for the properties of carbon tetrabromide, CBr_4?

	Vapor Pressure of CBr_4 at 293 K	Boiling Point of CBr_4
(A)	less than 90 torr	less than 350 K
(B)	less than 90 torr	greater than 350 K
(C)	greater than 90 torr	less than 350 K
(D)	greater than 90 torr	greater than 350 K

Name	Structural Formula	Molar Mass (g/mol)
Acetone		58.1
1-propanol		60.1
Butane		58.1

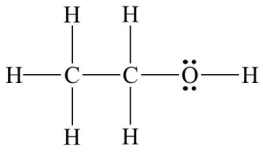
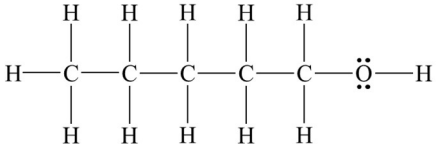
3. The table above shows the structural formulas and molar masses for three different compounds. Which of the following is a list of the compounds in order of increasing boiling points?

(A) Butane < 1-propanol < acetone

(B) Butane < acetone < 1-propanol

(C) 1-propanol < acetone < butane

(D) Acetone = butane < 1-propanol

Substance	Structural Formula	Boiling Point (K)
#1		351
#2		410

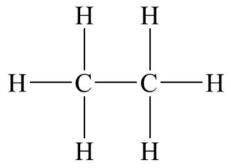
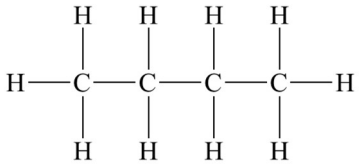
4. The structural formulas and boiling points for two different substances are shown above. Which of the following interparticle attractive forces are most responsible for the fact that Substance #2 has a higher boiling point than Substance #1?

(A) London dispersion forces

(B) Hydrogen bonds

(C) Dipole-dipole attractions

(D) Covalent bonds

Name	Ethane	Butane
Structural Formula		

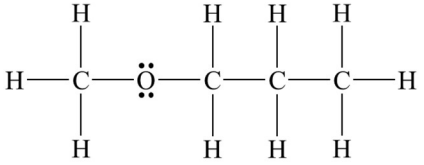
5. The structural formulas of two hydrocarbons are listed in the table above. Based on the information in the table, which compound has the higher boiling point, and why is that compound's boiling point higher?

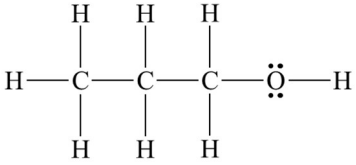
(A) Ethane, because its molecules are smaller and they can get closer to one another, resulting in stronger dispersion forces

(B) Ethane, because its molecules contain stronger covalent bonds, and more energy is required to break those bonds

(C) Butane, because its molecules contain more hydrogen atoms, resulting in more opportunities to form hydrogen bonding attractions between neighboring molecules

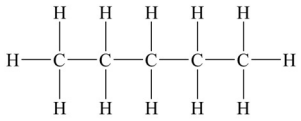
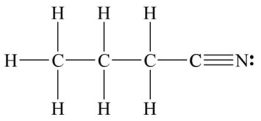
(D) Butane, because its molecules have more electrons, resulting in greater polarizability and stronger dispersion forces





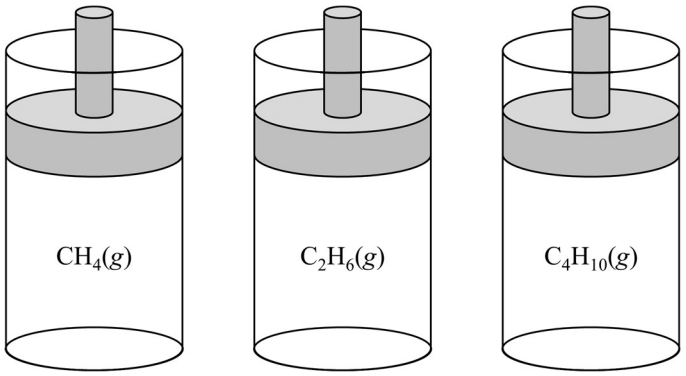
6. The structural formulas of $CH_3OCH_2CH_2CH_3$ and $CH_3CH_2CH_2OH$ are shown above. Which of the following identifies the substance with the higher boiling point and provides the best explanation for the higher boiling point?

	Substance with the Higher Boiling Point	Explanation for the Higher Boiling Point
(A)	$CH_3OCH_2CH_2CH_3$	The dipole-dipole forces present in $CH_3OCH_2CH_2CH_3(l)$ are stronger than the dipole-dipole forces present in $CH_3CH_2CH_2OH(l)$.
(B)	$CH_3OCH_2CH_2CH_3$	Hydrogen bonding attractions are present in $CH_3OCH_2CH_2CH_3(l)$ but are not present in $CH_3CH_2CH_2OH(l)$.
(C)	$CH_3CH_2CH_2OH$	Molecules of $CH_3CH_2CH_2OH$ have smaller electron clouds and are less polarizable than molecules of $CH_3OCH_2CH_2CH_3$.
(D)	$CH_3CH_2CH_2OH$	Hydrogen bonding attractions are present in $CH_3CH_2CH_2OH(l)$ but are not present in $CH_3OCH_2CH_2CH_3(l)$.

Substance	Structural Formula	Boiling Point (K)
#1		309
#2		391

7. The structural formulas and boiling points for two different substances are shown above. Each substance exists in the form of a liquid at 20°C. Which of the following identifies the substance with the higher vapor pressure at 20°C and provides the best explanation for the higher vapor pressure?

	Substance with the Higher Vapor Pressure at 20°C	Explanation for the Higher Vapor Pressure
(A)	Substance #1	Molecules of substance #1 have larger and more polarizable electron clouds than molecules of substance #2.
(B)	Substance #1	Substance #1 experiences only London dispersion forces, whereas substance #2 experiences both London dispersion forces and dipole-dipole attractions.
(C)	Substance #2	Molecules of substance #1 have larger and more polarizable electron clouds than molecules of substance #2.
(D)	Substance #2	Substance #1 experiences only London dispersion forces, whereas substance #2 experiences both London dispersion forces and dipole-dipole attractions.



8. Equimolar amounts of three different gases are placed in identical rigid vessels, each fitted with a movable piston. The pressure of each gas sample is increased by moving the piston downward while the temperature is maintained at 25°C. This process continues until condensation occurs. Which gas sample, if any, should condense at the lowest pressure value?

(A) CH_4 (B) C_2H_6 (C) C_4H_{10} (D) All the gases will condense at the same pressure.

9. Based on periodic trends and Coulomb's law, which of the following cations is most likely to have the strongest interactions with nearby water molecules in an aqueous solution?

(A) Na^+ (B) Rb^+ (C) Mg^{2+} (D) Sr^{2+}

Substance	X	Y	Z
Melting Point (°C)	240	1700	770
Electrical Conductivity In Solid Phase	None	None	None
Electrical Conductivity In Liquid Phase	None	None	High

10. Three different substances were studied in the laboratory, and the data in the table above were collected. Based on the data, which of the following most likely represents the type of bonding present in each substance?

	Substance X	Substance Y	Substance Z
(A)	Network covalent	Molecular	Metallic
(B)	Network covalent	Molecular	Ionic
(C)	Molecular	Network covalent	Metallic
(D)	Molecular	Network covalent	Ionic

11. A sample of a hard, solid binary compound at room temperature did not conduct electricity as a pure solid but became highly conductive when dissolved in water. Which of the following types of interactions is most likely found between the particles in the substance?

(A) Ionic bonds
(C) Covalent bonds
(B) Metallic bonds
(D) Hydrogen bonds

12. Which of the following could be the identity of a white crystalline solid that exhibits the following properties?

- It melts at 320°C.
- It does not conduct electricity as a solid.
- It conducts electricity in an aqueous solution.

(A) $C_6H_{12}O_6(s)$ (B) $NaOH(s)$ (C) $SiO_2(s)$ (D) $Pt(s)$