Topics 3.7 – 3.13: MCQ Practice

1. A student prepared an aqueous solution of Na_2SO_4 by dissolving 7.1 g of solid Na_2SO_4 (142 g/mol) in enough water to make 200.0 mL of solution. What is the molar concentration of the Na^+ ions present in this solution?

   (A) 0.050 *M*

   (B) 0.10 *M*

   (C) 0.25 *M*

   (D) 0.50 *M*

Step	Description
1	Add a certain quantity of stock solution to a 250.0 mL volumetric flask.
2	Add distilled water to the flask until the final volume of the solution is even with the calibration mark on the neck of the flask.
3	Seal the flask. Invert the flask several times to ensure that the solution is thoroughly mixed.

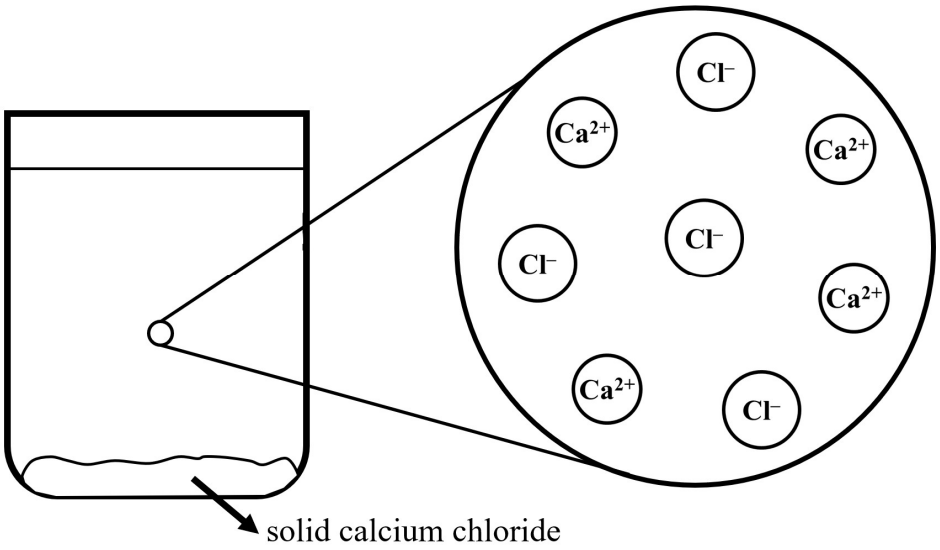
2. A student follows the outline of the general procedure shown above in order to prepare 250.0 mL of $CuSO_4(aq)$ in the laboratory. Which of the following quantities of stock solution used in Step #1 would result in the formation of 250.0 mL of 0.150 *M* $CuSO_4(aq)$?

   (A) 25.0 mL of 1.40 *M* $CuSO_4(aq)$

   (B) 50.0 mL of 0.750 *M* $CuSO_4(aq)$

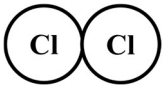
   (C) 75.0 mL of 0.600 *M* $CuSO_4(aq)$

   (D) 100.0 mL of 0.400 *M* $CuSO_4(aq)$



3. In a certain experiment, a student dissolves solid calcium chloride in water in a beaker at room temperature. Additional solid calcium chloride is added to the mixture in the beaker with continuous stirring until the maximum value for the solubility of calcium chloride is achieved. This is known as a saturated solution. A small amount of undissolved solid calcium chloride is present at the bottom of the beaker. The student drew the particle diagram shown above to show the particles in a representative sample of this saturated solution. Water molecules were intentionally omitted from the student's diagram.

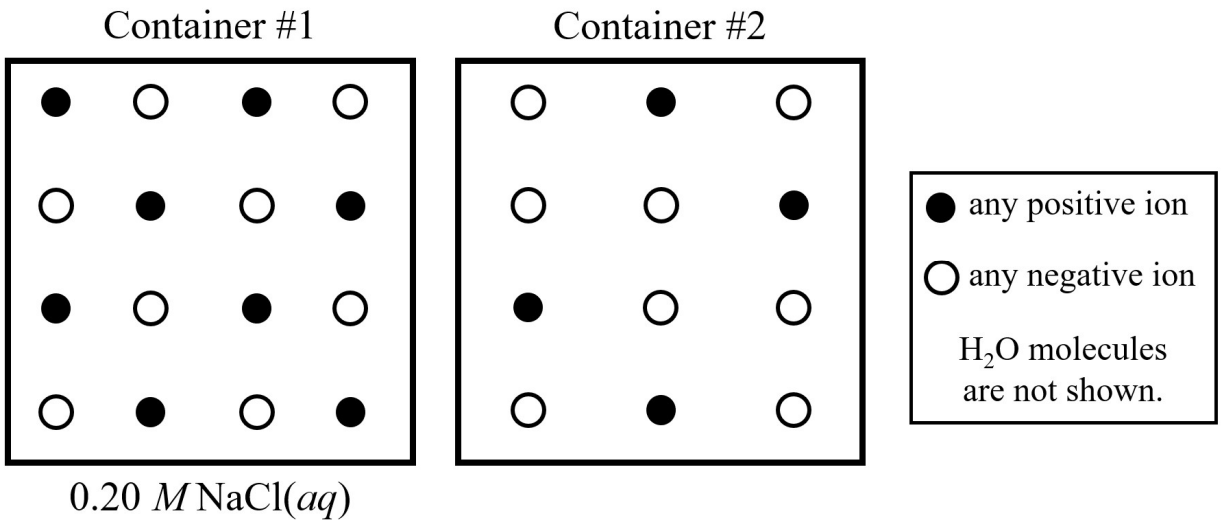
   Which of the following best identifies the error in the student's particle diagram?

   (A) Chloride should be represented as  particles instead of  particles.

   (B) Calcium should be represented as  particles instead of  particles.

   (C) The diagram should contain twice as many calcium particles as chloride particles.

   (D) The diagram should contain twice as many chloride particles as calcium particles.



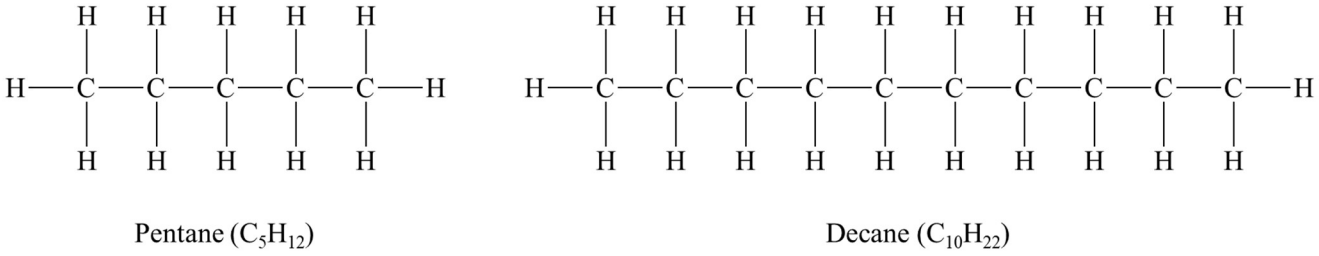
4. The two particle diagrams shown above represent equal volumes of solutions in two different containers. The solution represented in container #1 is 0.20 *M* NaCl(*aq*). Which of the following is most likely to represent the solution in container #2?

(A) 0.10 *M* NaCl(*aq*)

(B) 0.40 *M* NaCl(*aq*)

(C) 0.10 *M* $MgCl_2$(*aq*)

(D) 0.20 *M* $MgCl_2$(*aq*)



Pentane (C_5H_{12})

Decane ($C_{10}H_{22}$)

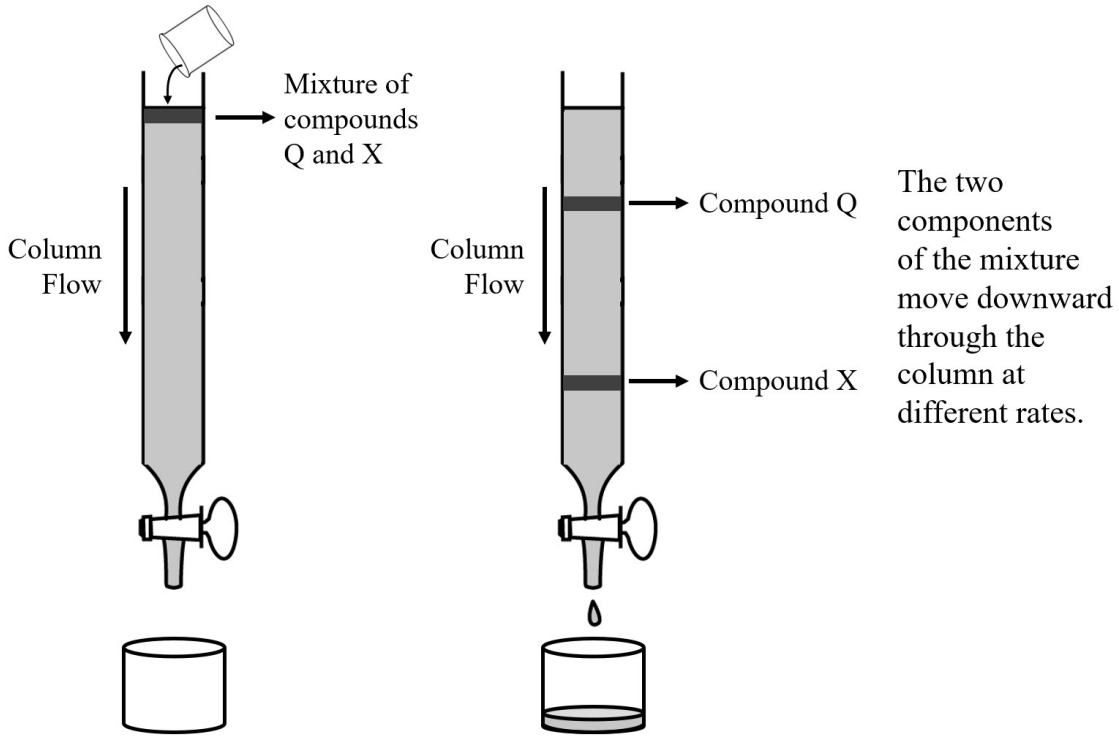
5. The structural formulas of pentane and decane are shown above. A mixture containing equal numbers of moles of pentane and decane was separated using distillation. Based on the diagrams shown above, which of the following identifies the substance that would be initially present in higher concentration in the distillate and correctly explains why that occurs?

(A) Pentane, because it has fewer C–C bonds to break

(B) Pentane, because it has a shorter carbon chain and weaker London dispersion forces

(C) Decane, because it has more C–C bonds to break

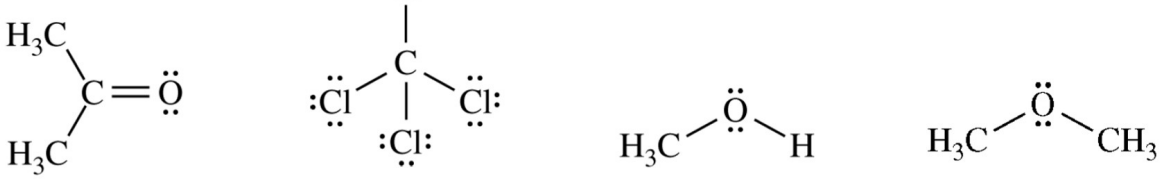
(D) Decane, because it has a longer carbon chain and stronger London dispersion forces



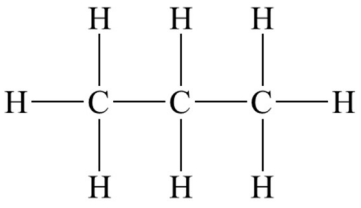
6. A chemist added a mixture of compounds Q and X at the top of a chromatography column filled with a nonpolar stationary phase. When water was poured through the column as the mobile phase, the components of the mixture moved at different rates through the column, as shown in the diagram above. Based on the results of this chromatography experiment, which of the following choices indicates correct comparisons of both solubility and polarity for compounds Q and X?

	Solubility in Water	Polarity
(A)	Q is more soluble in water than X.	Q is more polar than X.
(B)	Q is more soluble in water than X.	X is more polar than Q.
(C)	X is more soluble in water than Q.	Q is more polar than X.
(D)	X is more soluble in water than Q.	X is more polar than Q.

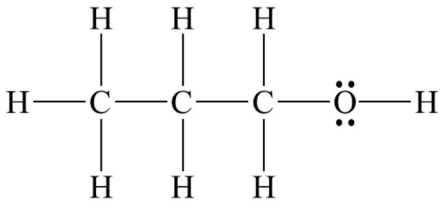
7. Which of the following molecules is least soluble in water?



(A) (B) (C) (D)



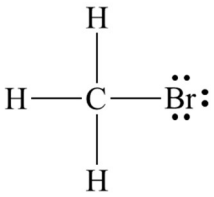
Propane (C_3H_8)



1-Propanol (C_3H_8O)

8. The structural formulas of propane and 1-propanol are shown above. Which of the following choices identifies the compound that is more soluble in water and identifies the strongest type of attractive forces that are formed between the molecules of the compound and molecules of water?

	Compound that is More Soluble in Water	Strongest Type of Attractive Forces Formed Between Molecules of the Compound and Molecules of Water
(A)	propane	London dispersion forces
(B)	propane	hydrogen bonding attractions
(C)	1-propanol	London dispersion forces
(D)	1-propanol	hydrogen bonding attractions



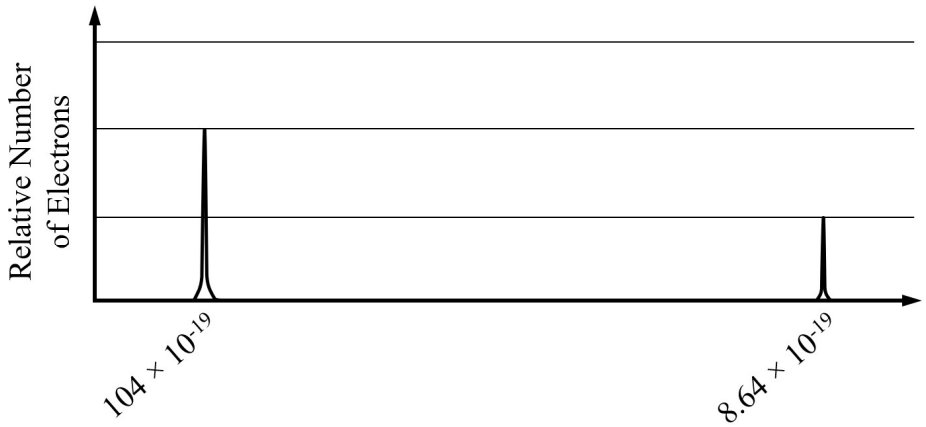
9. The structural formula of bromomethane, CH_3Br, is shown above. A pure sample of CH_3Br is analyzed using the technique of infrared spectroscopy. Which of the following correctly indicates the type of transitions associated with the absorption of infrared radiation by this sample?

(A) transitions in molecular vibrational levels

(B) transitions in molecular rotational levels

(C) transitions in electronic energy levels

(D) transitions in nuclear energy levels



10. The complete photoelectron spectrum of lithium (Li) in its ground state is represented above. Which of the following represents the wavelength, in meters, of electromagnetic radiation that is needed to remove an electron from the valence shell of an atom of Li?

(A) 1.9×10^{-8} m (B) 2.3×10^{-7} m (C) 1.3×10^{15} m (D) 1.6×10^{16} m

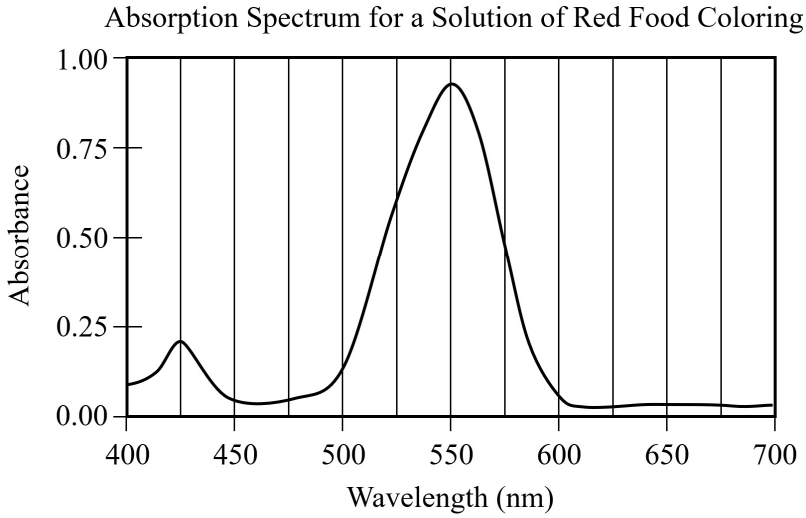
Sample Number	Blank	#1	#2	#3	#4	#5
Concentration of $NiCl_2(aq)$ (M)	0.00	0.100	0.120	0.140	0.160	0.180
Absorbance at 433 nm	0.00	0.53	0.64	0.74	0.85	0.87

11. A student is given the task of making a calibration curve for $NiCl_2(aq)$ for use in a spectrophotometry experiment. The absorbance of five different solutions of known concentration is measured, and the data is shown in the table above. Which of the following identifies the sample number (#1 through #5) that is most likely to be associated with an experimental error and provides an appropriate explanation of the error?

	Sample Number Associated with an Experimental Error	Explanation of the Error
(A)	#4	The cuvette into which the sample was placed had some water droplets inside it.
(B)	#4	The cuvette used for measuring the sample had not been wiped clean before being put in the spectrophotometer.
(C)	#5	The cuvette into which the sample was placed had some water droplets inside it.
(D)	#5	The cuvette used for measuring the sample had not been wiped clean before being put in the spectrophotometer.

Color	Wavelength Range (nm)
red	625 – 750
orange	590 – 625
yellow	565 – 590
green	500 – 565

Wavelength ranges for several colors in the visible portion of the electromagnetic spectrum are listed in the table above. A student performs a spectrophotometry experiment to determine the concentration of a red dye in a solution of red food coloring. The student measures the amount of light absorbed by a solution of the red food coloring over a range of wavelengths. The data are plotted in the graph shown below.



12. Which of the following indicates the best wavelength setting for the spectrophotometer in this experiment and explains why it is best?

(A) 550 nm, because the red dye will absorb significantly at this wavelength

(B) 550 nm, because this wavelength falls in the red region of the visible light spectrum

(C) 650 nm, because the red dye will absorb significantly at this wavelength

(D) 650 nm, because this wavelength falls in the red region of the visible light spectrum

Sample Number	Blank	#1	#2	#3	#4
Concentration of $K_2CrO_4(aq)$ (M)	0.00	0.025	0.050	0.16	0.20
Absorbance at 411 nm	0.00	0.12	0.24	?	0.95

13. A chemist prepared different solutions of $K_2CrO_4(aq)$ of known concentration and measured the absorbance of each solution at 411 nm using the same cuvette. Assuming that all lab equipment is functioning properly and that no experimental errors are made, what is the most likely value that should be recorded for the absorbance of the 0.16 M $K_2CrO_4(aq)$ solution?

(A) 0.48 (B) 0.60 (C) 0.77 (D) 0.91