SAMPLE MULTIPLE CHOICE UNIT 3 **Names** Key

1) A student performed an analysis to determine the amount of $AgNO_3(aq)$ in a solution. Excess $NaCl(aq)$ was added to the solution, and the $Ag^+(aq)$ precipitated as $AgCl(s)$. The precipitate was collected by gravity filtration and dried in an oven. Three trials were performed, and in each case, according to the instructor, the mass of precipitate recovered was 5 percent higher than the actual mass of $AgCl(s)$ that should have formed. Which of the following could account for the error?

$$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$$

A) The pores in the filter paper were too large.
B) Not all of the precipitate was transferred to the filter paper.
C) The $NaCl(aq)$ solution was too concentrated.
D) The precipitate was not rinsed with deionized water before drying.

Not washed

2) When a student adds 30.0 mL of 1.00 *M* HCl to 0.56 g of powdered Fe, a reaction occurs according to the equation below. When the reaction is complete at 273 K and 1.0 atm, which of the following is true?

A) HCl is in excess, and 0.100 mol of HCl remains unreacted.
B) HCl is in excess, and 0.020 mol of HCl remains unreacted.
C) 0.015 mol of $FeCl_2$ has been produced.
D) 0.22 L of H_2 has been produced.

LR

$$Fe(s) + 2\,HCl(aq) \rightarrow FeCl_2(aq) + H_2(g)$$

0.010 mol | 0.030 mol | 0 | 0
−0.010 | −0.020 | +0.010 | +0.010
0 | 0.010 | 0.010 | 0.010

$30.0\,mL\,HCl \times \frac{1.00\,mol}{1000\,mL} = 0.030\,mol\,HCl$

$0.56\,g\,Fe \times \frac{1\,mol}{56\,g} = 0.010\,mol\,Fe \times \frac{1\,mol\,H_2}{1\,mol\,Fe} \times \frac{22.4\,L\,H_2}{1\,mol} = 0.22\,L\,H_2$

3) A 0.30 mole sample of $NaNO_2$ (s) and a 0.10 mole sample of $Al(NO_2)_3$ (s) are dissolved in water and diluted to 300mL. What is the concentration of NO_2^- in the solution?

A) 0.50M B) 2.0M C) 0.30M D) 1.0M

0.300 L

$0.30\,mol\,NO_2^-$ $0.30\,mol\,NO_2^-$

$\frac{0.30+0.30\,mol}{0.30\,L} = \frac{0.60\,mol}{0.30\,L} = 2\,M$

$$BaCl_{2(aq)} + 2AgNO_{3(aq)} \rightarrow Ba(NO_3)_{2(aq)} + 2AgCl_{(s)}$$

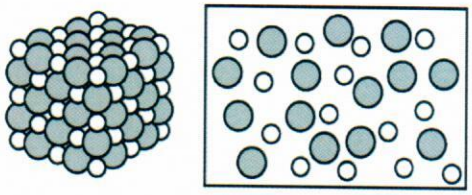
4) How many moles of AgCl are produced when 30.mL of 0.10M barium chloride is added to 20.mL of 0.20M silver nitrate?

A) 0.010 B) 0.0040 C) 0.0050 D) 0.0060

$30.0\,mL\,BaCl_2 \times \frac{0.10\,mol\,BaCl_2}{1000\,mL} \times \frac{2\,mol\,AgCl}{1\,mol\,BaCl_2} = 0.0060\,mol\,AgCl$

LR $20.0\,mL\,AgNO_3 \times \frac{0.20\,mol\,AgNO_3}{1000\,mL} \times \frac{2\,mol\,AgCl}{2\,mol\,AgNO_3} = 0.0040\,mol\,AgCl$

5) Based on the diagram, which of the following best helps to explain why $MgO(s)$ is not able to conduct electricity, but $MgO(l)$ is a good conductor of electricity?



Solid MgO Liquid MgO

A) $MgO(s)$ does not contain free electrons, but $MgO(l)$ contains free electrons that can flow.
B) $MgO(s)$ contains no water, but $MgO(l)$ contains water that can conduct electricity.
C) $MgO(s)$ consists of separate Mg^{2+} ions and O^{2-} ions, but $MgO(l)$ contains MgO molecules that can conduct electricity.
D) $MgO(s)$ consists of separate Mg^{2+} ions and O^{2-} ions held in a fixed lattice, but in $MgO(l)$ the ions are free to move and conduct electricity.

Questions 6-8 refer to the following information. $Cu(s) + 4\ HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2\ NO_2(g) + 2\ H_2O(l)$

Each student in a class placed a 2.00 g sample of a mixture of Cu and Al in a beaker and placed the beaker in a fume hood. The students slowly poured 15.0 mL of 15.8 *M* $HNO_3(aq)$ into their beakers. The reaction between the copper in the mixture and the $HNO_3(aq)$ is represented by the equation above. The students observed that a brown gas was released from the beakers and that the solutions turned blue, indicating the formation of $Cu^{2+}(aq)$.
The solutions were then diluted with distilled water to known volumes.

6) Which of the following is true about the reaction?
A) It is a Brønsted-Lowry acid-base reaction, because the solution is neutral at the end.
B) It is a Brønsted-Lowry acid-base reaction, because $HNO_3(aq)$ is a strong acid.
C) It is a redox reaction, because $Cu(s)$ is oxidized and $H^+(aq)$ is reduced.
D) It is a redox reaction, because $Cu(s)$ is oxidized and the nitrogen atom in $NO_3^-(aq)$ is reduced.

7) To determine the number of moles of Cu in the sample of the mixture, the students measured the absorbance of known concentrations of $Cu(NO_3)_2(aq)$ using a spectrophotometer. A cuvette filled with some of the solution produced from the sample of the mixture was also tested. The data recorded by one student are shown in the table. On the basis of the data provided, which of the following is a possible error that the student made?

$[Cu^{2+}]$	Absorbance
0.025	0.059
0.050	0.235
0.100	0.117
0.200	0.468
Unknown (from sample of mixture)	0.330

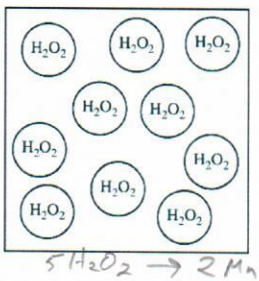
A) The $Cu(NO_3)_2(aq)$ from the sample of the mixture was not diluted properly.
B) The spectrophotometer was calibrated with tap water instead of distilled water.
C) The student labeled the cuvettes incorrectly, reversing the labels on two of the solutions of known concentration.
D) The spectrophotometer was originally set to an inappropriate wavelength, causing the absorbance to vary unpredictably.

8) The students determined that the reaction produced 0.010 mol of $Cu(NO_3)_2$. Based on the measurement, what was the percent of Cu by mass in the original 2.00 g sample of the mixture?
A) 16% B) 32% C) 64% D) 96%

$0.010\ mol\ Cu(NO_3)_2 \rightarrow 0.010\ mol\ Cu \times \frac{64\ g\ Cu}{1\ mol} = \frac{0.64\ g\ Cu}{2.00\ g\ sample} \times 100 = 32\%$

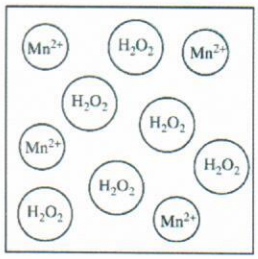
From 1:1

9) A particle view of a sample of $H_2O_2(aq)$ is shown. The $H_2O_2(aq)$ is titrated with $KMnO_4(aq)$, as represented by the equation below.
$2\ MnO_4^-(aq) + 5\ H_2O_2(aq) + 6\ H^+(aq) \rightarrow 2\ Mn^{2+}(aq) + 5\ O_2(g) + 8\ H_2O(l)$
Which of the following particle views best represents the mixture when the titration is halfway to the equivalence point? (H_2O molecules and H^+ ions are not shown.)



$10 \rightarrow 5$

$5\ H_2O_2 \rightarrow 2\ Mn^{+2}$

A)


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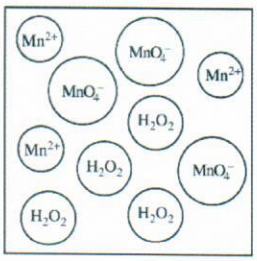
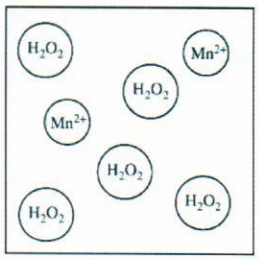
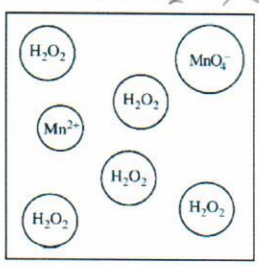


C)


D)


$5\ H_2O_2 \times \frac{2\ Mn^{+2}}{5\ H_2O_2} = 2\ Mn^{+2}$