Unit 14 – AP Review **Name _____**

2022 FRQ #3 **Period _____**

3. Answer the following questions relating to the element aluminum, Al.

a) Write the complete ground-state electron configuration of an Al atom.

b) Based on principles of atomic structure, explain why the radius of the Al atom is larger than the radius of the Al^{3+} ion.

A student plans to combine solid aluminum with an aqueous solution of silver ions. The student determines the mass of solid $AgNO_3$ needed to prepare the solution with a specific concentration.

c) In the following table, briefly list the steps necessary to prepare 200.0 mL of an aqueous solution of $AgNO_3$ using only equipment selected from the choices given. Assume that all appropriate safety measures are already in place. Not all equipment or lines in the table may be needed.

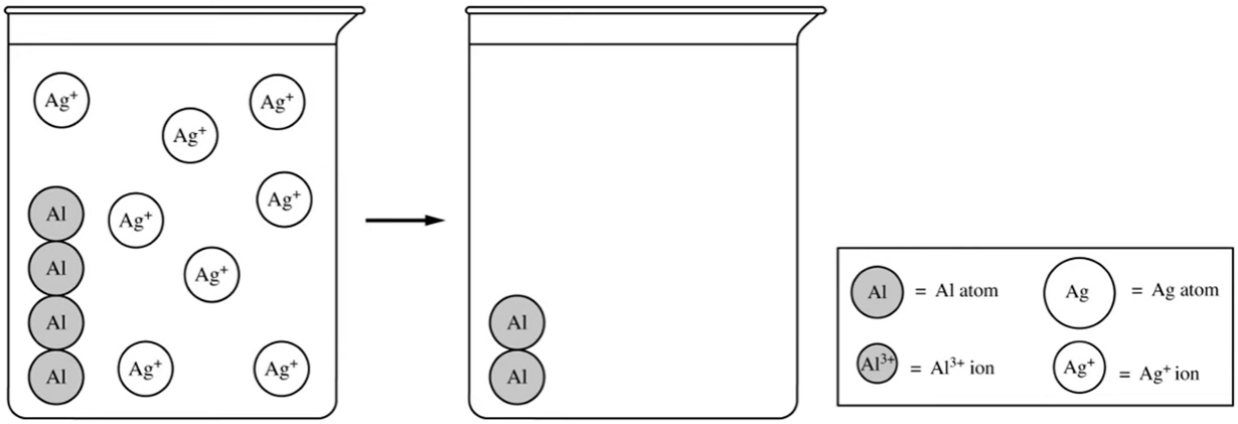
- Solid $AgNO_3$
- Distilled water
- Balance
- Weighing paper and scoop
- 200.00 mL volumetric flask
- 50.0 mL graduated cylinder
- 250 mL beakers
- Pipet

Step	Step Description
1.	Use weighing paper to measure the determined mass of solid $AgNO_3$ on a balance.
2.	

After preparing the solution, the student places some of the solution into a beaker and adds a sample of aluminum. The reaction represented by the following equation occurs.

$$Al_{(s)} + 3\ Ag^{+}_{(aq)} \rightarrow Al^{3+}_{(aq)} + 3\ Ag_{(s)}$$

d) The following diagram gives an incomplete particulate representation for the reaction. The beaker on the left represents the system before the mixture reacts. Complete the drawing on the right to represent the system after the reaction has occurred. Be sure to include 1) the correct type and number of particles based on the number shown on the left and 2) the relative spacing to depict the appropriate phases.



The student finds the standard reduction potentials given in the table, which are related to the reaction that occurs.

Half-Reaction	$E°$
$Ag^{+}(aq) + e^{-} \rightarrow Ag(s)$	0.80 V
$Al^{3+}(aq) + 3\,e^{-} \rightarrow Al(s)$	−1.66 V

e) Using the standard reduction potentials, calculate the value of E^0 for the reaction.

f) Based on the value of E^0, would the standard free energy change of the reaction under standard conditions, ΔG^0, be positive, negative, or zero? Justify your answer.

g) Once the reaction appears to stop progressing, would the change in free energy, ΔG, be positive, negative, or zero? Justify your answer.