AP® CHEMISTRY
2015 SCORING GUIDELINES

Question 6

Compound	Melting Point (°C)
LiI	449
KI	686
LiF	845
NaF	993

A student learns that ionic compounds have significant covalent character when a cation has a polarizing effect on a large anion. As a result, the student hypothesizes that salts composed of small cations and large anions should have relatively low melting points.

(a) Select two compounds from the table and explain how the data support the student's hypothesis.

LiI and KI. LiI has a small cation and a large anion and KI has a large cation and the same large anion. The melting point of LiI (with its smaller cation) is lower than that of KI. **OR** LiI and LiF. LiI has a small cation and a large anion and LiF has the same small cation and a small anion. The melting point of LiI (with its larger anion) is lower than that of LiF. **OR** LiI and NaF. LiI has a small cation and a large anion and NaF has a relatively small cation and a small anion. The melting point of LiI (with its larger anion) is lower than that of NaF.	1 point is earned for choosing an appropriate pair of compounds (LiI/KI, LiI/LiF, or LiI/NaF). 1 point is earned for an explanation that supports the hypothesis.

(b) Identify a compound from the table that can be dissolved in water to produce a basic solution. Write the net ionic equation for the reaction that occurs to cause the solution to be basic.

Either LiF or NaF is acceptable. $F^- + H_2O \rightleftarrows HF + OH^-$	1 point is earned for choosing one of the correct compounds. 1 point is earned for writing a correct balanced equation.

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6. A student learns that ionic compounds have significant covalent character when a cation has a polarizing effect on a large anion. As a result, the student hypothesizes that salts composed of small cations and large anions should have relatively low melting points.

   (a) Select two compounds from the table and explain how the data support the student's hypothesis.

   (b) Identify a compound from the table that can be dissolved in water to produce a basic solution. Write the net ionic equation for the reaction that occurs to cause the solution to be basic.

a. LiI has a small cation and large anion.
LiF has a small cation and a small anion.
LiI has a relatively lower melting pt than LiF which supports the hypothesis

b. $NaF + H_2O \rightarrow NaOH + HF$

$F^-_{(aq)} + H_2O_{(l)} \rightleftharpoons OH^-_{(aq)} + HF_{(aq)}$

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6. A student learns that ionic compounds have significant covalent character when a cation has a polarizing effect on a large anion. As a result, the student hypothesizes that salts composed of small cations and large anions should have relatively low melting points.

   (a) Select two compounds from the table and explain how the data support the student's hypothesis.

   (b) Identify a compound from the table that can be dissolved in water to produce a basic solution. Write the net ionic equation for the reaction that occurs to cause the solution to be basic.

a) LiI supports the students hypothesis because Li^+ is a small anion because the effective nuclear charge pulls in the 1s orbital. I^- is a big anion because of all the levels of electrons shielding each other. It has a high boiling point

- KI supports the hypothesis for the same reasons, K^+ is small because of big effective nuclear charge and I^- is big cuz of shielding

b) NaF produces basic solution because of hydrolysis

$$F^-_{(aq)} + H_2O_{(l)} \rightarrow HF_{(aq)} + OH^-_{(aq)}$$

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6. A student learns that ionic compounds have significant covalent character when a cation has a polarizing effect on a large anion. As a result, the student hypothesizes that salts composed of small cations and large anions should have relatively low melting points.

   (a) Select two compounds from the table and explain how the data support the student's hypothesis.

   (b) Identify a compound from the table that can be dissolved in water to produce a basic solution. Write the net ionic equation for the reaction that occurs to cause the solution to be basic.

a) LiI, and KI have the lowest melting points. LiI has a melting point of 449°c and KI has a melting point of 686°c. LiI and KI have a small cation of Li^+ and K^+ and a large anion of I^- which belongs to the Halogen grap.

b) $NaF + H_2O \rightarrow NaOH + F_2$

$Na^+ + F^- + 2H^+ + O_2^- \rightarrow Na^+ OH^- 2F^-$

$F^- + H_2O \rightarrow OH^- + 2F^-$

AP® CHEMISTRY
2015 SCORING COMMENTARY

Question 6

Overview

Question 6 was designed to test the students' ability to identify evidence that supports a student hypothesis and explain their reasoning. This question also tested knowledge of salt hydrolysis and representation of this phenomenon. In part (a) students were given a data table of four compounds with corresponding melting points and asked to select two compounds that support a given hypothesis and explain their choice. In part (b) students were asked to identify a compound from the table that would produce a basic solution and then write the net ionic equation.

Sample: 6A
Score: 4

In part (a) 1 point was earned for selecting LiI and LiF as an appropriate pair of compounds. The second point was earned for a valid comparison of anion size to support the hypothesis. In part (b) 2 points were earned for identifying NaF as a basic salt and writing the correct net ionic equation.

Sample: 6B
Score: 3

In part (a) 1 point was earned for selecting LiI and KI as an appropriate pair of compounds. The second point was not earned because the response claims that both lithium ion and potassium ion are small cations, which are paired with large anions. In part (b) 2 points were earned for identifying NaF as a basic salt and writing the correct net ionic equation.

Sample: 6C
Score: 2

In part (a) 1 point was earned for selecting LiI and KI as an appropriate pair of compounds. The second point was not earned because the response claims that both lithium ion and potassium ion are small cations, which are paired with large anions. In part (b) 1 point was earned for identifying NaF as a basic salt. The second point was not earned for the net ionic equation with fluoride ion as a product instead of HF.