ANSWER KEY.

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2.3 Structure of Ionic Solids

AP Chemistry | ANSWER KEY

Ionic radii (pm): Li^+ 76, Na^+ 102, K^+ 138, Ca^{2+} 100, F^- 133, Cl^- 181, Br^- 196, O^{2-} 140. Show your setup for calculations.

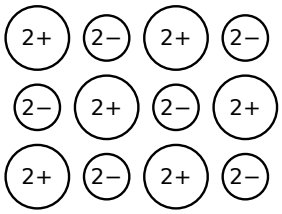
1. For each ionic compound, write the formulas of the two ions and the ratio of cations to anions.

(a) KBr (b) $CaCl_2$ (c) Al_2O_3

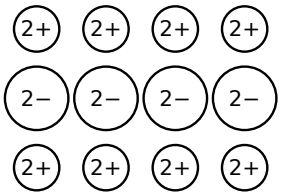
(a) K^+ and Br^-, 1 : 1 (b) Ca^{2+} and Cl^-, 1 : 2 (c) Al^{3+} and O^{2-}, 2 : 3

2. Which particle diagram best represents one layer of solid CaO? Explain why each of the other two diagrams is wrong.

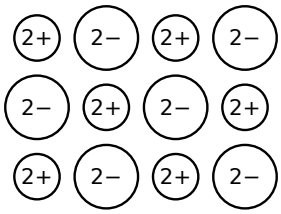
A



B



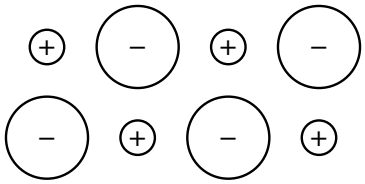
C



C. Each ion is surrounded by ions of the opposite charge, and Ca^{2+} (100 pm) is drawn smaller than O^{2-} (140 pm).

A has the sizes reversed. B puts like charges side by side in rows, which causes repulsion.

3. Draw a particle diagram of one layer of solid LiCl with at least 8 ions. Label the charges and draw the ions with the correct relative sizes.



Ions alternate, ratio 1 : 1, and Li^+ is drawn much smaller than Cl^-.

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4. Use Coulomb's law to estimate how many times stronger the attraction between ions is in CaO than in NaBr.

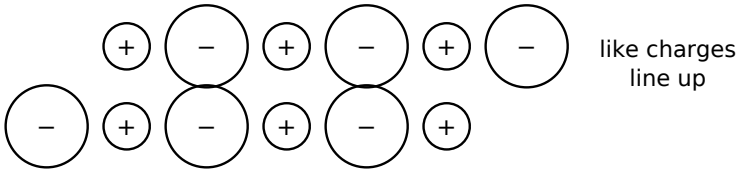
r(NaBr) = 102 pm + 196 pm = 298 pm; r(CaO) = 100 pm + 140 pm = 240 pm

F(CaO) / F(NaBr) = 4 × (298 pm / 240 pm)^2 = 4 × 1.54 = 6.17, so about 6.2 times stronger

5. Rank LiF, NaCl, and KBr from **highest** to **lowest** melting point. Justify your ranking.

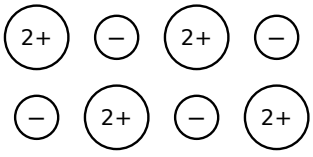
r: LiF = 209 pm, NaCl = 283 pm, KBr = 334 pm. LiF > NaCl > KBr. Same charges, so the smallest distance gives the strongest attraction and the highest melting point.

6. The diagram shows two layers of solid NaCl. A force pushes the top layer one ion to the right. Describe what happens and explain why salt crystals shatter.



After the shift, each ion sits next to an ion with the same charge. The like charges repel, so the layers push apart and the crystal splits.

7. A student drew this diagram of solid CaF_2. Identify two errors in the drawing.



(1) The ratio is 1 : 1, but CaF_2 needs two F^- for every Ca^{2+} (the drawing has a net charge of +4).

(2) Ca^{2+} is drawn larger than F^-, but F^- (133 pm) is larger than Ca^{2+} (100 pm).

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