

Revised August 2005



AP WORKED ANSWERS

1994, 9

Points 2, 2, 2, 2

(a) The ion has lost a whole shell of outer electrons (principal quantum number 4), making the outermost electron in the 3rd shell (a 3p electron) which is closer to the nucleus. The ion is significantly smaller.

(b) Ca^{2+} has a significantly higher charge density than K^+ (Ca^{2+} is smaller and double the charge) and therefore has a stronger attraction for oxide ions. As a result CaO has a higher lattice energy.

(c) (i) Same period and as result have the same number of electron shells. This means that there is no extra shielding on passing from Potassium to Calcium, but there is an extra proton. The increased nuclear charge coupled with no increased shielding means greater attraction between the nucleus and electrons and therefore a greater first ionization energy for Calcium when compared to Potassium.

(ii) Potassium's second electron is in a shell closer to the nucleus (principal quantum number 3) than the first (principal quantum number 4). It experiences less shielding from the nuclear charge and is therefore much more difficult to remove. Calcium's second electron is in the same shell as its first electron (principal quantum number 4) and therefore experiences the same amount of shielding as its first electron, and is not SIGNIFICANTLY more difficult to remove.

(d) The 3p outer electron in is in a slightly higher energy orbital than the 3s, and is being shielded by a full 3s orbital giving it a slightly lower ionization energy than expected.