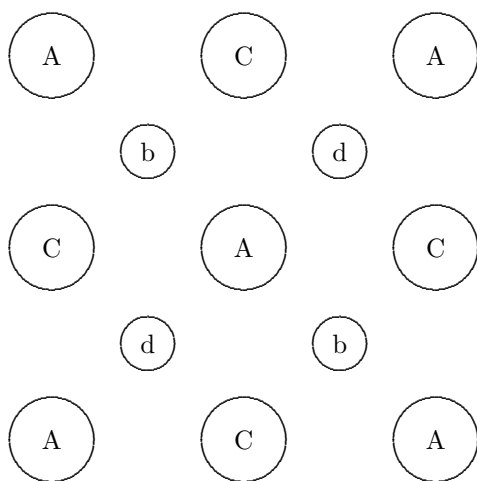


36. Each Arsenic atom is connected (by covalent bonding) to four Gallium atoms, and each Gallium atom is similarly connected to four Arsenic atoms. The “depth” of their very non-trivial lattice structure is, of course, not evident in a flattened-out representation such as shown for Silicon in Fig. 42-9. Still we try to convey some sense of this (in the  $[1, 0, 0]$  view shown below – for those who might be familiar with Miller indices) by using letters to indicate the depth: A for the closest atoms (to the observer), b for the next layer deep, C for further into the page, d for the last layer seen, and E (not shown) for the atoms that are at the deepest layer (and are behind the A’s) needed for our description of the structure. The capital letters are used for the Gallium atoms, and the small letters for the Arsenic. Consider the Arsenic atom (with the letter b) near the upper left; it has covalent bonds with the two A’s and the two C’s near it. Now consider the Arsenic atom (with the letter d) near the upper right; it has covalent bonds with the two C’s which are near it and with the two E’s (which are behind the A’s which are near it).



- (a) The 3p, 3d and 4s subshells of both Arsenic and Gallium are filled. They both have partially filled 4p subshells. An isolated, neutral Arsenic atom has three electrons in the 4p subshell, and an isolated, neutral Gallium atom has one electron in the 4p subshell. To supply the total of eight shared electrons (for the four bonds connected to each ion in the lattice), not only the electrons from 4p must be shared but also the electrons from 4s. The core of the Arsenic ion has charge  $q = +5e$  (due to the “loss” of the three 4p and two 4s electrons), and the charge of the Gallium ion has charge  $q = +3e$  (due to the “loss” of its single 4p and two 4s electrons).
- (b) As remarked in part (a), there are two electrons shared in each of the covalent bonds. This is the same situation that one finds for Silicon (see Fig. 42-9).