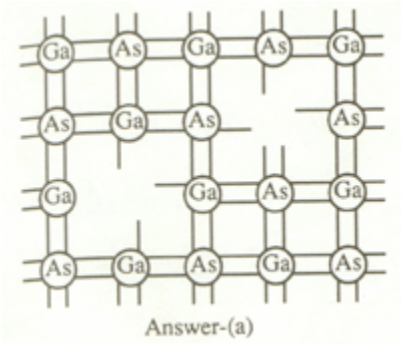
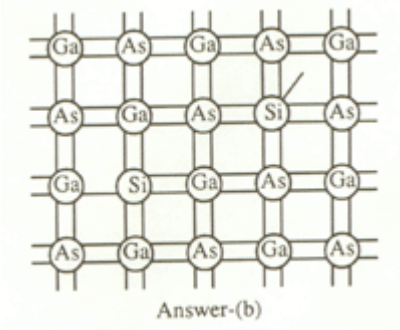
ECSE-2210 Microelectronics Technology
Homework 2 – Solution

1. a) The removal of the column III Ga atom with three valence electrons leaves five dangling bonds in the vicinity of the vacancy. The removal of the column V As atom with five valence electrons leaves three dangling bonds in the vicinity of the vacancy.

   b) When a Si atom with four valence electrons is inserted into the missing Ga site, there is one extra electron that does not fit snugly into the bonding pattern. Conversely, when Si atom is inserted into the missing As., there is one too few bonds to complete the bonding scheme. There is a hole in the bonding scheme.

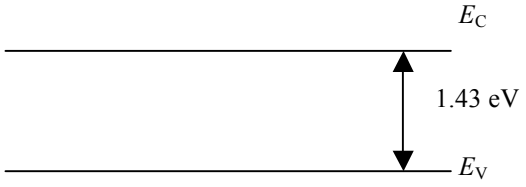




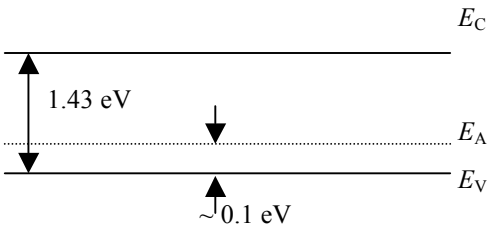
   c) n-type … The extra electron noted in part (b) is readily released yielding an increase in the electron concentration.

   d) p-type … The missing bond noted in part (b) is readily filled at room temperature yielding an increase in the hole concentration.

   e) The energy required to break one of the bonds is indicated as energy required to lift one electron from the valence band to the conduction band.



   f) Si As site → p-type



   Si on site → n-type