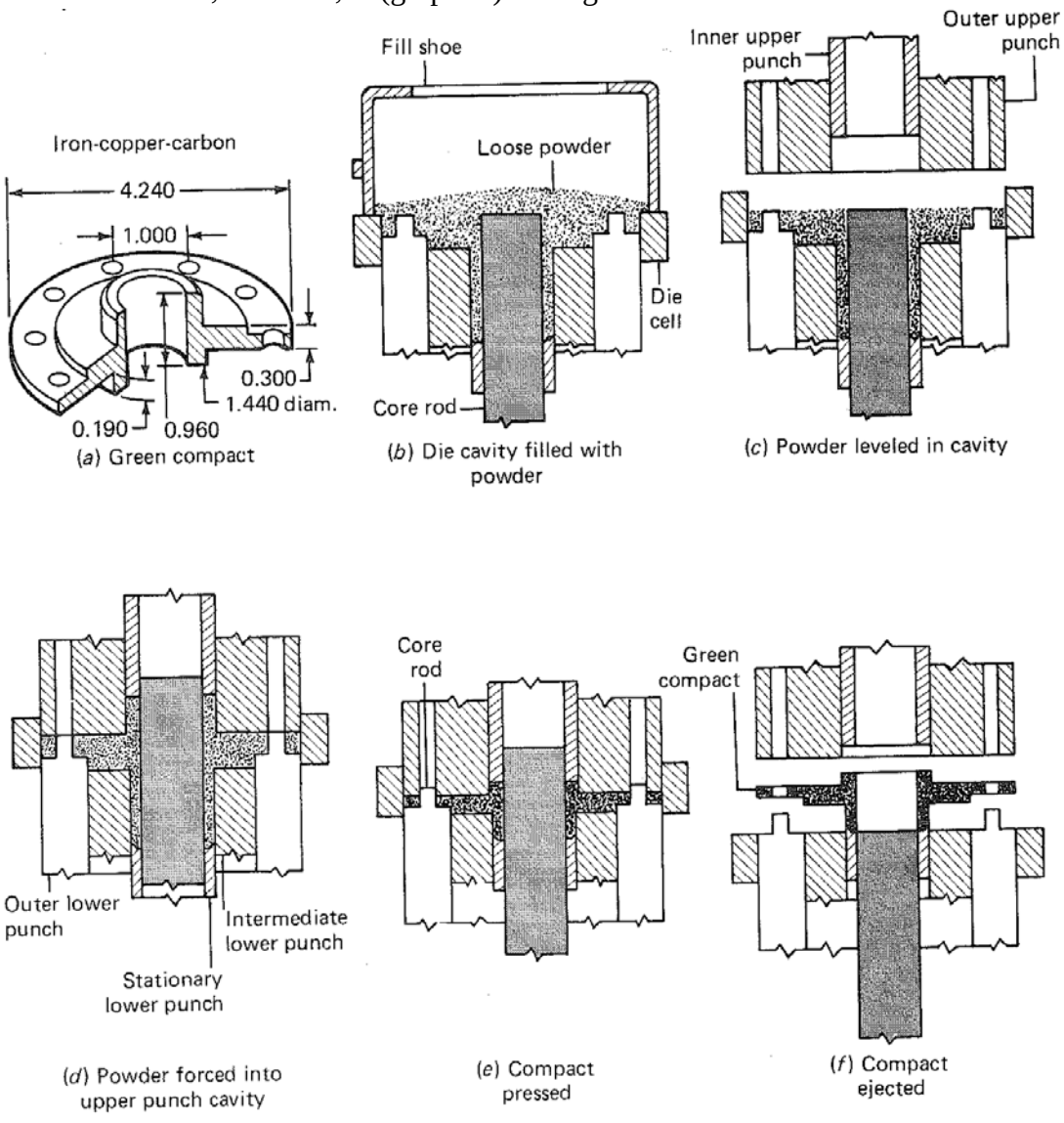
Question 1:

The density of polystyrene is 1.05 g/cm^3. Calculate the volume of air space in the walls of an expanded polystyrene foam cup of 50 kg/m^3 density.

Question 2:

(i) The green compact shown in the accompanied figure (part a) has a hub of 0.960 in height and a flange of 0.300 in thickness. Calculate the position of the lower punches for filling the die cavity (figure b) if the density of loose powder is 38% and the density of the green compact is 78% of theoretical density.

(ii) The green compact shown in the accompanied figure (part a) is sintered to 96% of the theoretical density. The composition is Fe-8Cu-2C. Calculate (1) the theoretical density and (2) shrinkage of the 0.960-in dimension. (Hint: the densities of the constituent elements are Fe: 7.87; Cu: 8.96; C (graphite): 2.25 g/cm^3.



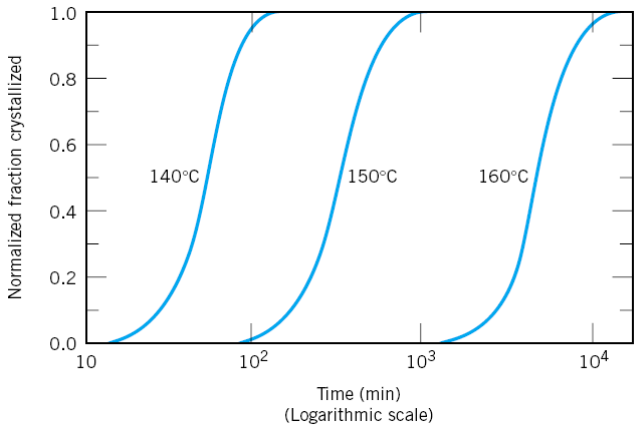
Question 3:

The time dependence of crystallization can be described by Avrami equation:

$$1 - y = \exp\left(-kt^n\right)$$

Where, y is the fraction crystallized, k and n are time-independent constants whose values depend on the crystallizing system. Using the accompanied figure, determine *k* and *n*.

Plot of normalized fraction crystallized versus the logarithm of time for polypropylene at constant temperatures of 140°C, 150°C, and 160°C.



Question 4:

An extruder has a barrel diameter = 5.0 inch and length = 12 ft. The extruder screw rotates at 50 rev/min; it has channel depth = 0.30 in and flight angle = 17.7°. The plastic melt has a shear viscosity = 100 x 10^{-4} lb- sec/in^2. Find: (a) the extruder characteristic, (b) the values of Q and p at the operating point, given that the die characteristic is Q_x = 0.00150 p.

Question 5:

(i) A rotational molding operation is to be used to mold a hollow playing ball out of polyethylene. The ball will be 1.5 ft in diameter and its wall thickness should be 1/16 in. What weight of PE powder should be loaded into the mold in order to meet these specifications? The specific gravity of the PE grade is 0.95.

(ii) The extrusion die for a polyethylene parison used in blow molding has a mean diameter = 16.0 mm. The size of the ring opening in the die = 1.5 mm. The mean diameter of the parison is observed to swell to a size of 20.5 mm after exiting the die orifice. If the diameter of the blow molded container is to be 100 mm, determine (a) the corresponding wall thickness of the container and (b) the wall thickness of the parison.

Question 6:

The foreman in the injection molding department says that a polyethylene part produced in one of the operations has greater shrinkage than the calculations indicate it should have. The important dimension of the part is specified as 112.5 ±0.25 mm. However, the actual molded part measures 112.02 mm. (a) As a first step, the corresponding mold cavity dimension should be checked. Compute the correct value of the mold dimension, given that the shrinkage value for polyethylene is 0.025 (from Table 13.1 of Groover's text). (b) What adjustments in process parameters could be made to reduce the amount of shrinkage.