Q- A solid cube of silver (density = 10.5 g/ cm^3) has a mass of 90.0 g.
(a) What is the resistance between opposite faces of the cube?

Volume of the cube will be = mass/density = 90.0/10.5 =8.57 cm^3.

Hence side of the cube L = $(8.57)^{\frac{1}{3}} = 2.05$ cm = 0.0205 m

Resistance of a conductor is given by

$$R = \frac{\rho L}{A}$$

Where ρ is the resistivity, L is the length and A is area of cross section. The resistivity of silver is $1.62*10^{-8}$ Ωm hence

$$R = \frac{\rho L}{A} = \frac{\rho L}{L^2} = \frac{\rho}{L} = \frac{1.62*10^{-8}}{0.0205} = 7.90*10^{-7}\,\Omega$$

(b) Assume each silver atom contributes one conduction electron. Find the average drift speed of electrons when a. potential difference of $1.00*10^{-5}$V is applied to opposite faces. The atomic number of silver is 47, and its molar mass is 107.87 g/mol.

With this applied voltage the current in the cube is given by

$$I = V/R = 1*10^{-5}/(7.90*10^{-7}) = 12.658 \text{ A}$$

And the current density

$$j = I/A = I/L^2 = 12.658/(0.0205)^2 = 30120 \text{ A/m}^2 \quad \text{-------- (1)}$$

Now the molar mass of silver is 107.87 gram/mol
Hence the number of moles in 10.5 gm i.e. 1 cm^3 will be

$$= 10.5/107.87 = 9.734*10^{-2} \text{ mole/cm}^3$$

Hence number of moles per m^3 will be = $9.734*10^4$ mole/m^3

And hence the number of atoms or conduction electrons per cubic meter will be

$$n = 9.734*10^4*6.023*10^{23} = 5.863*10^{28}$$

Now the drift velocity is given by

$$vd = j/(n*e)$$

Where n is the number of charge carriers per unit volume

Hence substituting the values we have

$$v_d = \frac{30120}{5.863*10^{28}*1.6*10^{-19}} = 3.21 * 10^{-6} \text{ m/s}$$