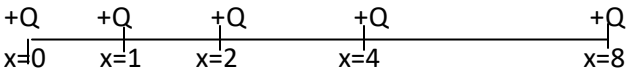
Numerical questions

1. Find the potential and field intensity at x=0 due to these set of charges shown in the figure below; x represents the distance from origin in x axis. Q is the magnitude of charge.



[Ans: $V = \frac{0.15Q^2}{\varepsilon_0}$, $E = \frac{0.1Q}{\varepsilon_0}$ **]**

2. Three equal charges each of magnitude 3.0 X 10^{-6} C are placed at three corners of a right angled triangle of sides 3 cm and 4 cm. Find the force on the charge at the apex corner if 4 cm side is the base of the triangle.
   [Ans: 112.3 N]

3. Three charges of magnitude +2.0 X 10^{-10} C, -8.0 X 10^{-10} C, +4.0 X 10^{-10} C are placed at three corners B, C, D respectively of a rectangle ABCD whose side AB = 5 cm and BC = 7 cm. Calculate the potential at corner A of the rectangle.
   [Ans: V_A = 3.73 V]

4. A parallel plate capacitor has plate area of 0.1m^2 and plate separation 0.015cm. The dielectric medium between the plates has relative permittivity 3. The capacitor retains a charge of 0.1μC when placed across voltage source. Find the flux density, electric field strength and voltage across the plates. Assume the permittivity of space as 8.854 x 10^{-12} F/m.
   [Ans: D = 0.98 C/m^2, E = 37.07 kV/m, V = 5.65 V]

5. Calculate the capacitance between two parallel plates of the area 0.4m^2 separated by a di-electric of 0.1 mm thick & of relative permittivity 5. If the voltage across the capacitor is 50 V, find the energy stored in the capacitor & the voltage gradient in the dielectric.
   [Ans: C = 177.1 nF, Energy stored = 2.22×10^{-4} J, Voltage gradient = 500 kV/m]

6. A capacitor is made of two plates with an area of 10 cm^2 separated by a mica sheet of 1 mm thickness. Find the capacitance taking ε_r = 6 for mica. If one of the plates is moved to provide an air gap of 0.25 mm thickness between the upper plate and mica, calculate the change in the value of capacitance.
   [Ans: C = 0.053 nF, New capacitance C' = 0.011 nF]