1. **Calculate** the number of electrons formed in an electron avalanche which has traveled a distance of 1.5cm in the uniform field gap between two parallel plates provided that in air at the given field the values of the ionization and the attachment coefficient are α=7.4 , μ=5 , η=2.4 The electron avalanche has started by an electron flash of 100 electrons.

2. **Calculate** the value of secondary ionization coefficient that fulfills Towensed criterion of breakdown in a uniform gap of 2 cm width, which stressed by a uniform field corresponding to α=8.

3. **State** Townsend criterion of breakdown in gases. In a certain gas at low pressure, if the first ionization coefficient (cm^{-1}) is related to E (volt/cm) by the expression $\alpha=(E/200)^{4.35}*10^{-6}$ and if the second Townsend coefficient has a value of 10^{-4}, **Calculate** the electrode spacing necessary to produce breakdown and the breakdown voltage assuming that E is constant at 8 kV/cm.

4. If the breakdown voltage of two parallel plates separated by a gap of 0.1cm is 4500V, **Calculate** the total secondary coefficient of ionization γ if the gap is air at a pressure 760 torr and temperature of 25 ^{o}C. Take A=15cm^{-1} and B=365.

5. If the voltage of two parallel plates separated by air gap of 0.002 m is 9 Kv just before the transition to self sustaining current. **Calculate** The total secondary ionization coefficient γ at NTP (P=1 atm. = 101.3 Kpa). The A and B values are 11253.7 $(m.Kpa)^{-1}$, 273840 (v/m.Kpa) respectively.

6. For a certain gas the first Townsend coefficient of ionization is given by the standard equation with A=15 $(cm)^{-1}$ and B=365. If the secondary ionization coefficient is equal to 10^{-4}, **Calculate** the minimum breakdown voltage and the minimum value of the pressure distance product.

7. For a certain gas, if A=15 $(cm.torr)^{-1}$ and B=365 (v/cm.torr). E/P is kept constant to be 350 V/cm.torr and P is kept constant to be 5 torr. **Calculate**:
   a) The First Townsend's ionization coefficient α
   b) The mean free path λ.
   c) The ionization potential.
   d) The maximum ionization efficiency.
   e) If $\gamma=10^{-4}$ calculate the minimum breakdown voltage and the corresponding value of the pressure-distance product.

8. For the current growth equation of Townsend's Criterion for breakdown in Gases with second ionization process;
   a) **Mention** the Townsend's Criterion for breakdown in Gases?
   b) **What** are the drawbacks of Townsend's Criterion for breakdown in Gases?
   c) **Define** Townsend's first and second ionization coefficients?
   d) **Mention** the condition for breakdown in a Townsend discharge?
   e) **Define** Paschen's law for breakdown in Gases?
   f) **Mention** how you account the breakdown voltage as a function in "p x d "?
   g) **Mention** how you account the minimum voltage for breakdown under a given "p x d " condition?

9. **Write** a short notes on each of the following:
   a) Photo ionization Process.
   b) Photoemission Process.
   c) Electron attachment.
   d) Self sustained discharge.
   e) Electronegative gases.
   f) Non self sustained discharge.
   g) The various factors which affect breakdown of gases.

10. **Why** is the breakdown strength higher in electronegative gases compared to that in other gases?

11. **Mention** the Townsend's criterion for breakdown in electronegative gases?

12. **Explain** with drawing the streamer theory of breakdown in gases?