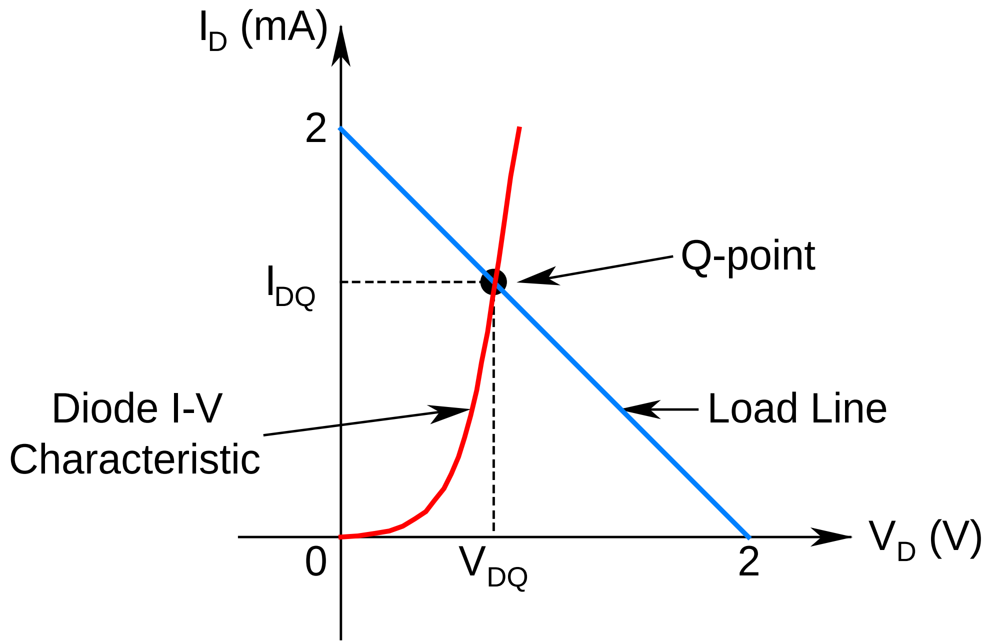
Finding the DC Operating Point

- Known as the ***Q-point*** (***quiescent point***)
- ***Defined by (I_D, V_D)***
- ***Two solution techniques***:
  - ➢ ***Graphical Method*** (***Using Load Line***)
  - ➢ ***Iterative Method*** (***Self-Consistent***)
- ***Graphical Method***:
  - ➢ ***Use diode I-V relation***: $I_D = I_0 \exp(V_D/V_T)$
  - ➢ ***Use Load Line equation***: $I_D = (2 - V_D)/(1\ \text{k}\Omega)$
  - ➢ ***Intersection point is the operating point***



Graphical Method

V_{DQ}, I_{DQ}: Quiescent values of V_D, I_D
= 0.7 V, 1.3 mA
(obtained from iterative method using I_0 = 3 fA)

DC Quiescent Power Dissipation
$= V_{DQ} \times I_{DQ} = 0.9$ mW

The two ***end points*** of the ***load line***:

1. $V_D = 0$: $I_D = 2/(1\ \text{k}) = 2$ mA

2. $I_D = 0$: $V_D = 2$ V

- ***Iterative Method***:
  - Also known as ***self-consistent analysis***
  - ***I-V relation*** and ***load line equation*** form a set of ***transcendental equations***
    - ***Analytical solution not possible***
    - Have to resort to ***numerical*** (***iterative***) analysis
  - ***Procedure***:
    - ***Choose V_D = 0.7 V*** and ***find I_D*** from ***load line equation***
    - ***Use this I_D*** to ***find V_D*** from ***I-V relation*** (***convert to ln form first***)
    - ***Repeat till convergence is achieved*** (pretty quick!)

Series Resistance Effect

- The two ***quasi-neutral regions*** (p and n) have their own ***bulk resistances***
- ***Denoted as*** r_p ***and*** r_n
- ***For small*** I_D, their ***effects are negligible***
- However, ***for large*** I_D, the ***potential dropped*** across them ***reduces*** the ***actual voltage*** appearing across the ***junction*** of the diode
- Known as the ***Series Resistance Effect***