$$V_T = \frac{KT}{q}$$

3.15 $T = \frac{V_T q}{K} =$ 289.86 °K

$V_T = \frac{K(218.15)}{q} =$ 0.019 V

$V_T = \frac{K(273.15)}{q} =$ 0.024 V

$V_T = \frac{K(398.15)}{q} =$ 0.034 V

3.27 0.9 V $I_D = 100\,\mu A$ $T = 308.15$ K

~~$V_T = 25.9$ mV~~ $V_T = \frac{KT}{q} = 0.0267$ V

a) $I_D = 200\,\mu A$, $T = ?$

$I_D = I_S\left(e^{\frac{V_D}{V_T}} - 1\right) = I_S\left(e^{\frac{V_D}{KT/q}} - 1\right) = I_S e^{\frac{qV_D}{KT}} - I_S$

$\ln(I_d) = \ln(I_S)\left(\frac{qV_D}{KT}\right) \rightarrow T = \frac{\ln(I_S)\left(\frac{qV_D}{K}\right)}{\ln(I_d)}$

$I_S = 0.3\,aA$ $T = \frac{\ln(0.3aA)(1.6E-19)(0.9)}{\ln(200\mu A)(1.38E-23)}$

T = 305.7 K

b) $I = 50\,\mu A$, $T = ?$

$T = \frac{qV_D}{K\ln\left(\frac{I_D}{I_S} + 1\right)}$

T = 318.6 K

3.59 $I_S = 0.1\,fA$ $T = 300\,K$

a) $I_D = 100\,\mu A$, $V_x = ?$, $r_D = ?$

$V_D = \frac{TK\ln\left(\frac{I_D}{I_S}+1\right)}{q} = 0.71\,V$ $V_T = \frac{KT}{q} = 0.026\,V$

$r_D = \frac{V_T}{I_D} = \boxed{260\,\Omega}$ $V_x = V_D - V_T = 0.71 - 0.026 = \boxed{0.684\,V}$

b) $I_D = 2.5\,mA$, $V_x = ?$, $r_D = ?$

$V_D = 0.798\,V$ $V_T = 0.026\,V$

$r_D = \boxed{10.4\,\Omega}$ $V_x = \boxed{0.774\,V}$

c) $I_D = 25\,mA$, $V_x = ?$, $r_D = ?$

$V_D = 0.86\,V$

$r_D = \boxed{1.04\,\Omega}$ $V_x = \boxed{0.834\,V}$

3.64 d) $I_S = 0.1\,fA$