1. It is given that $V_1 = 30\,\text{V}$, $R_1 = 1.5\,\text{k}\,\Omega$, $R_2 = 3\,\text{k}\,\Omega$, and $R_3 = 1\,\text{k}\,\Omega$. (An alternate version of the problem had $V_1 = 15\,\text{V}$, $R_1 = 3\,\text{k}\,\Omega$, $R_2 = 1.5\,\text{k}\,\Omega$, and $R_3 = 1\,\text{k}\,\Omega$.)
   (a) Solve for the Thévenin voltage $V_S$ and Thévenin resistance $R_S$ seen by the diode.

   
   ![Circuit Diagram]

   $$V_S = V_1 \frac{R_1}{R_1 + R_2} = 10\,\text{V} \quad R_S = R_1 || R_2 + R_3 = 2\,\text{k}\,\Omega$$

   (b) Draw the load line for the diode on the characteristics given and estimate the diode voltage and current at the Q point.

   ![Load Line Diagram]

   $\approx (3\,\text{V}, 3.5\,\text{mA})$

2. (a) A diode is biased at a constant current. If the temperature changes in constant increments $\Delta T$, describe the mathematical variation of the diode voltage. *Answer:* It changes by an additive amount, i.e. you add or subtract something each time the temperature increases by $\Delta T$.
   (b) If the temperature of a diode changes in constant increments $\Delta T$, describe the mathematical variation of the saturation current of the diode. *Answer:* It changes by a multiplicative factor, i.e. you multiply by something each time the temperature increases by $\Delta T$.
   (c) Represent the total voltage across a diode by $v_D = V_D + v_d$ and the total current through the diode by $i_D = I_D + i_d$, where $V_D$ and $I_D$ are the Q-point values and $v_d$ and $i_d$ are small-signal changes about the Q point. In deriving the small-signal model of the diode, what is the basic mathematical step that is used to relate $i_d$ to $v_d$? *Answer:* You solve for the slope or derivative of the $i_D$ versus $v_D$ curve at the Q point and set this equal to the ratio $i_d/v_d$. Although not part of the answer, this slope is the reciprocal of the small-signal resistance $r_d$. 
