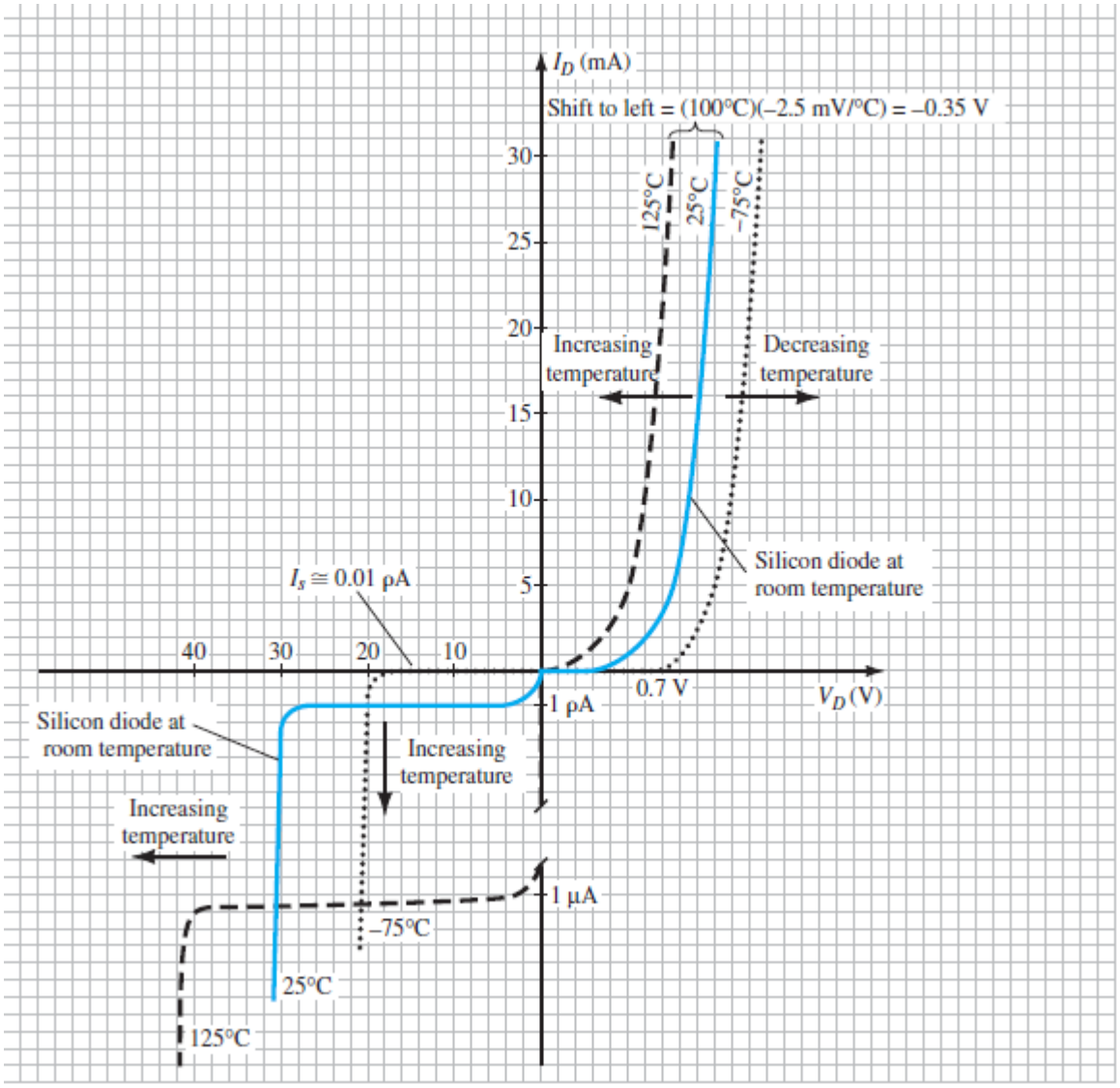
Tutorial 1

Chapter 1 Semiconductors and Diodes

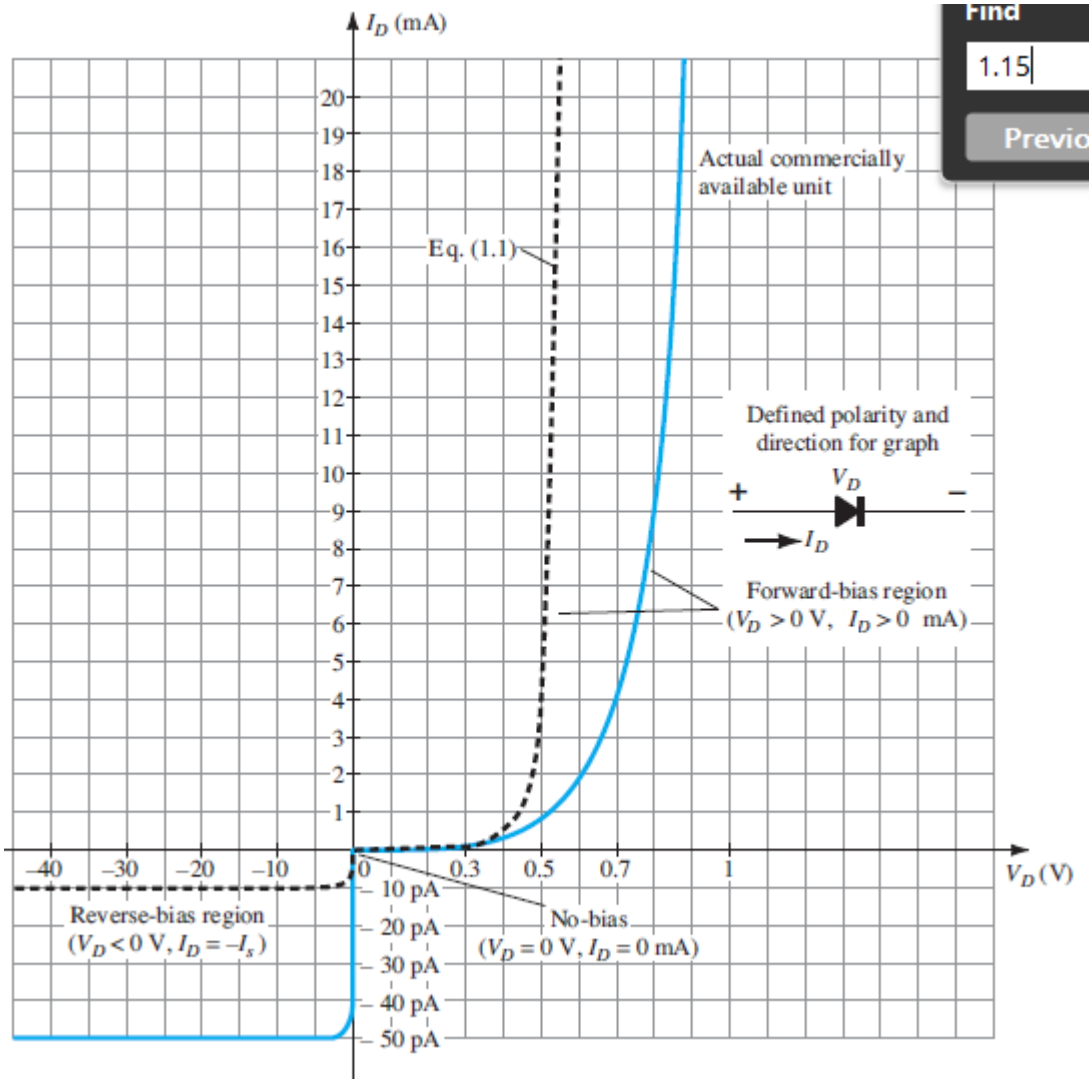
1. a. Determine the thermal voltage for a diode at a temperature of 20°C.
b. For the same diode of part (a), find the diode current using Eq. 1.2 if I_s _ 40 nA, n _ 2 (low value of V_D), and the applied bias voltage is 0.5 V.
c. Repeat for T _ 100°C (boiling point of water). Assume that I_s has increased to 5.0 mA.

2. Given a diode current of 6 mA, V_T _ 26 mV, n _ 1, and I_s _ 1 nA, find the applied voltage V_D.

3. Determine the forward voltage drop across the diode whose characteristics appear below at temperatures of -75°C, 25°C, 125°C and a current of 10 mA. For each temperature, determine the level of saturation current. Compare the extremes of each and comment on the ratio of the two.



4. a. Determine the static or dc resistance of the commercially available diode characteristics shown below at a forward current of 4 mA.
b. Repeat at a forward current of 15 mA and compare results.
c. Determine the static or dc resistance of the commercially available diode at a reverse voltage of -10 V. How does it compare to the value determined at a reverse voltage of -30 V?



5. a. Determine the dynamic (ac) resistance of the commercially available diode shown above, at a forward current of 10 mA using Eq. (1.5).

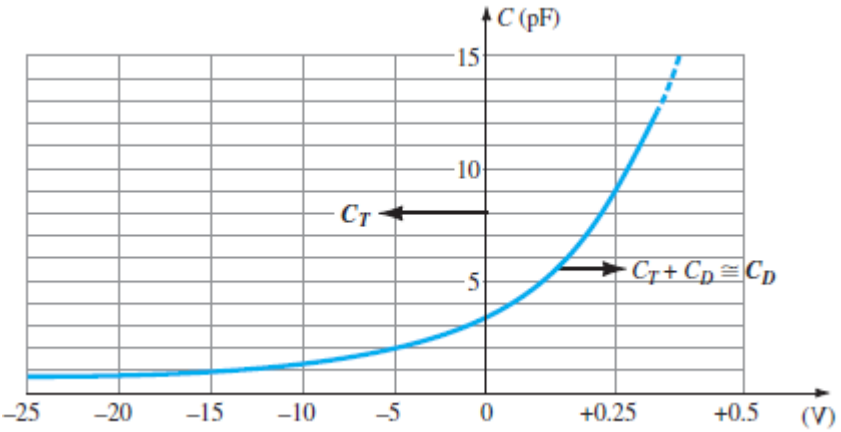
b. Determine the dynamic (ac) resistance of the diode shown above, at a forward current of 10 mA using Eq. (1.6).

c. Compare solutions of parts (a) and (b).

6. a. Referring to capacitance characteristics shown below , determine the transition capacitance at reverse-bias potentials of -25 V and -10 V. What is the ratio of the change in capacitance to the change in voltage?

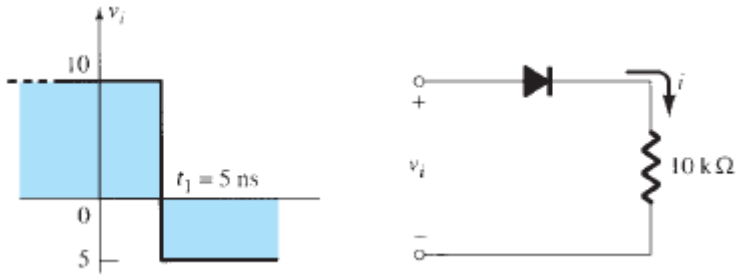
b. Repeat part (a) for reverse-bias potentials of -10 V and -1 V. Determine the ratio of the change in capacitance to the change in voltage.

c. How do the ratios determined in parts (a) and (b) compare? What does this tell you about which range may have more areas of practical application?

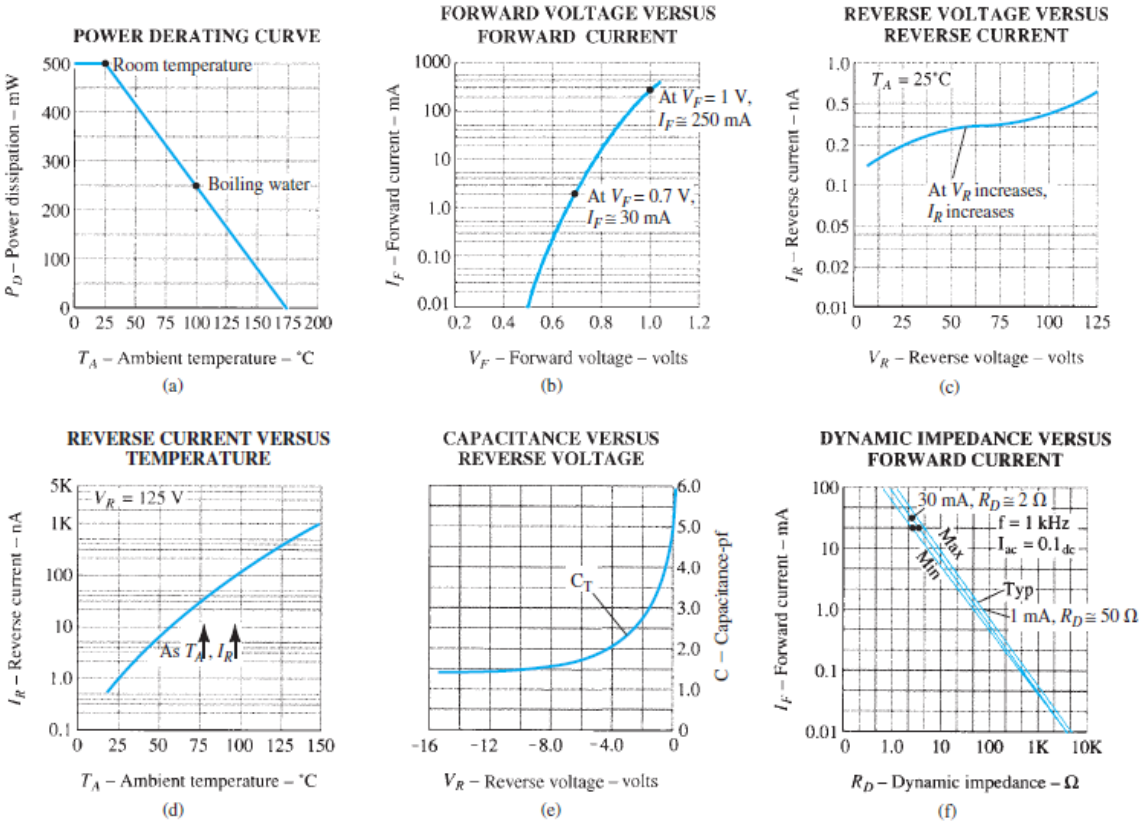


7. The no-bias transition capacitance of a silicon diode is 8 pF with V_K _ 0.7 V and n _ 1>2. What is the transition capacitance if the applied reverse bias potential is 5 V?

8. Sketch the waveform for i of the network shown below if $t_t = 2t_s$ and the total reverse recovery time is 9 ns.



9. Using the characteristics shown below, determine the maximum power dissipation levels for the diode at room temperature (25°C) and 100°C. Assuming that V_F remains fixed at 0.7 V, how has the maximum level of I_F changed between the two temperature levels?



10. Determine the dynamic impedance for the 24-V diode at *Iz* = 10 mA for the diode characteristics below. Note that it is a log scale.