Homework 3

VE311 - Electronic Circuits Fall 2021

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3.1

(a) The equations

$$I_C = I_S\left(e^{\frac{qV_{BE}}{kT}} - 1\right)\left(1 + \frac{V_{CE}}{V_A}\right) = 2.049 \times 10^{-4}$$

$$gm = \frac{I_C}{kT/q} = 7.9 \times 10^{-3}$$

$$r_o = \frac{V_A}{I_C} = 2.44 \times 10^5$$

(b) The plot is attached here. The slope at $V_{BE} = 0.7V$ is about 7.84×10^{-6}, which is close to gm in

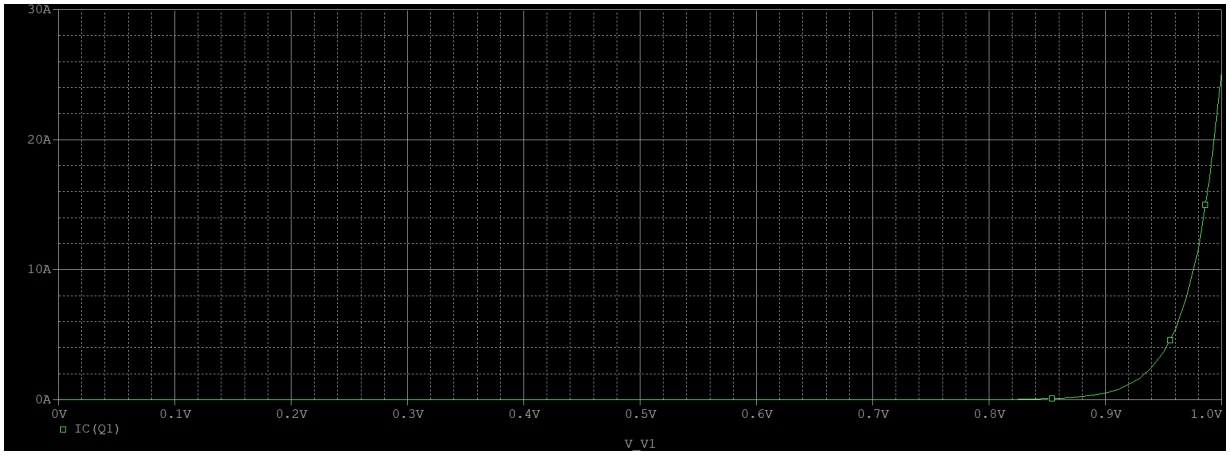

Figure 1: problem b

(a).
(c) The plot is attached here. The inverse at $V_{CE} = 2V$ is about 2.7×10^5, which is close to r_o in (a).

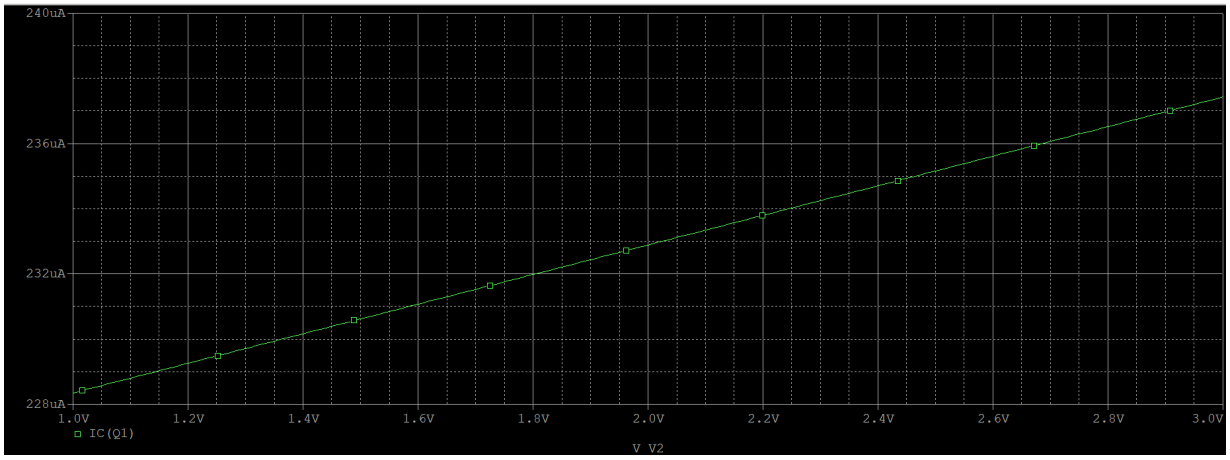

Figure 2: problem c

3.2

(a) DC analysis gives

$$I_C = I_S \left(e^{\frac{qV_{IN}}{kT}} - 1 \right) \left(1 + \frac{V_{OUT}}{V_A} \right)$$

$$V_{OUT} = V_{CC} - I_C R_C$$

we get

$$I_C = 2.049 \times 10^{-4}$$

and

$$r_o = \frac{V_A}{I_C} = 2.441 \times 10^5 \Omega$$

$$gm = \frac{I_C}{kT/q} = 7.879 \times 10^{-3}$$

$$A_v = -gm \left(r_o \| R_C \right) = -3.77 \times 10^1$$

(b) The plot is attached here. The slope at $V_{IN} = 0.7V$ is about -3.8×10^1, which is close the voltage

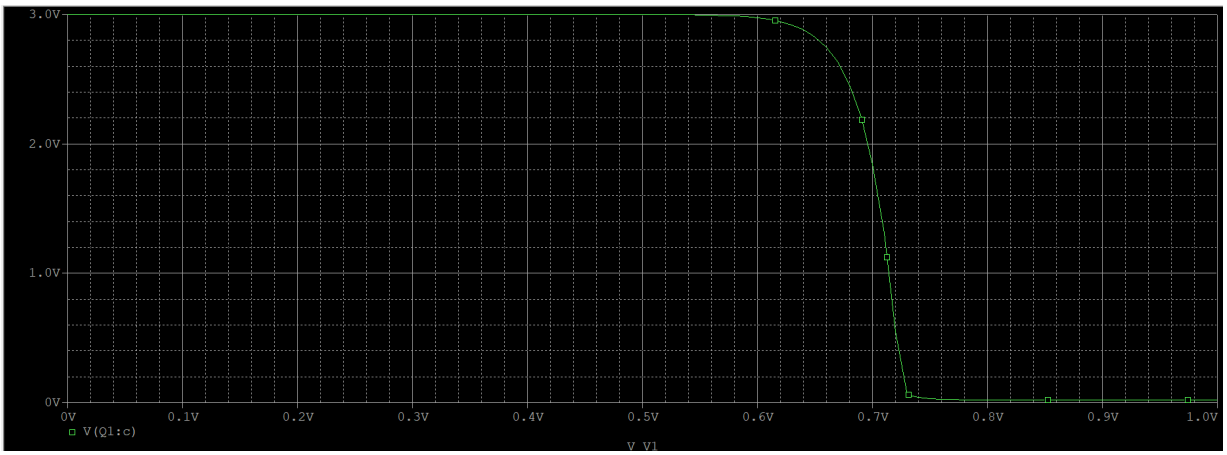

Figure 3: problem b

in (a).
(c) The plot is attached here. The result is about 3.9×10^1, which is close the voltage in (a).

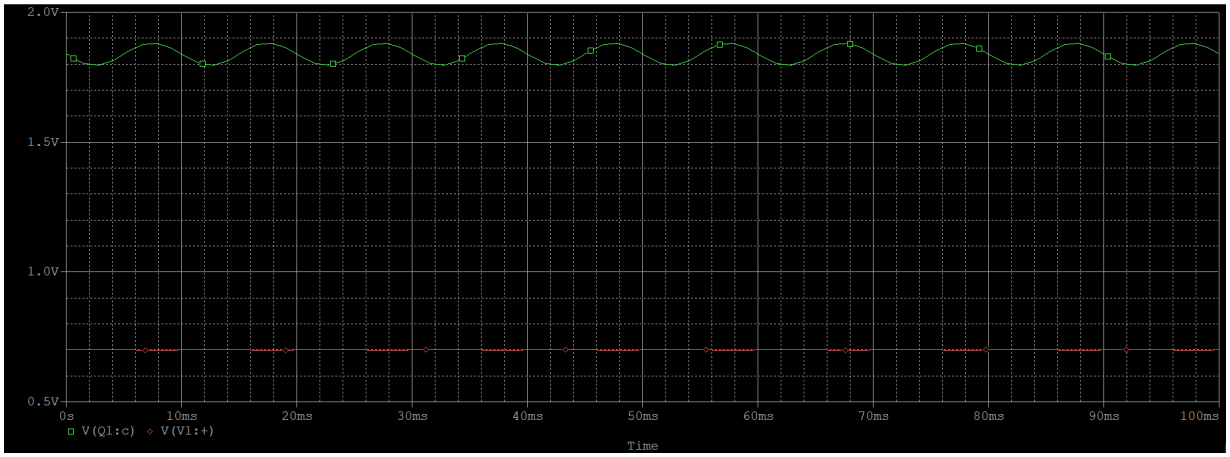

Figure 4: problem c