應用電子學(一) Quiz 4

姓名： **學號：** **Date:2019.05.23**

1. (30 points) Please find the Q point values, (V_{CE}, I_C), in Figure 1.

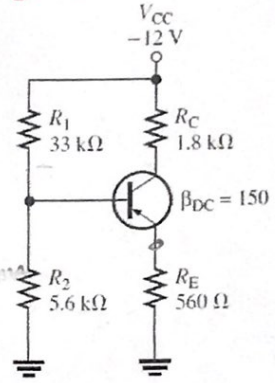

Figure 2

$$V_S = V_{CC}\frac{R_2}{R_1+R_2} = (-12V)\cdot\frac{5.6k\Omega}{5.6k\Omega+33k\Omega} = -1.74\ V$$

$$R_S = \frac{R_1R_2}{R_1+R_2} = \frac{(5.6k\Omega)(33k\Omega)}{5.6k\Omega+33k\Omega} = 4.787\ k\Omega$$

$$I_C = \frac{V_{CC}-V_S}{R_C+\frac{R_S}{\beta}} = \frac{-12V-(-1.74V)}{1.8k\Omega+\frac{4.787k\Omega}{150}} = -5.6\ (mA)$$

$I_E \approx I_C$ $V_{EQ} = I_E R_E = -5.6(mA)\cdot 560 = -3.13\ V$

$V_{CQ} = V_{CC} - I_C R_C = -12V - (-5.6mA)\cdot(1.8k\Omega) = +1.92\ V$

$V_{CEQ} = V_{CQ} - V_{EQ} = +1.92 - (-3.13) = 1.21$

2. (30 points) Refer to Figure 3. The DC emitter current $I_E = 2.63mA$, and the $\beta_{ac} = 70$. Please find the following ac values for this amplifier.
   (a) $R_{in(base)}$
   (b) $R_{in(tot)}$
   (c) A_v
   (d) A_i
   (e) A_p

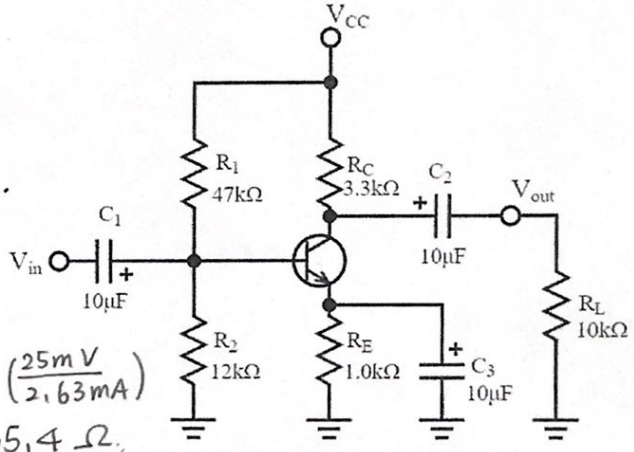

Figure 3

(a) $R_{in(base)} = \beta_{ac} r'e = \beta_{ac}\left(\frac{25mV}{I_E}\right) = 70\left(\frac{25mV}{2.63mA}\right)$

$= 665.4\ \Omega$

(b) $R_{in(tot)} = R_1 // R_2 // R_{in(base)} = \frac{1}{\frac{1}{47k\Omega}+\frac{1}{12k\Omega}+\frac{1}{665.4}} = 622\ \Omega$

(c) $A_V = \frac{R_C // R_L}{r'e} = \frac{\frac{1}{\frac{1}{3.3k\Omega}+\frac{1}{10k\Omega}}}{\left(\frac{25mV}{2.63mA}\right)} = 261$

(d) $A_i = \beta_{ac} = 70$

(e) $A_p = A_V \cdot A_i = 261 \times 70 = 18270$

應用電子學(一) Quiz 5

姓名： **學號：** 100 **Date:2019.06.06**

1. (50 points) For the circuits in Figure 1, determine the following:
   (a) Q_1 and Q_2 dc terminal voltages $(V_{B1}, V_{B2}, V_{C1}, V_{C2}, V_{E1}, V_{E2})$.
   (b) Overall β_{ac}.
   (c) r_e' for each transistor.
   (d) Total input resistance.

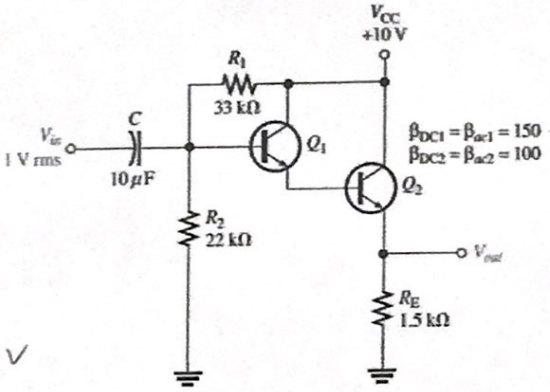

Figure 1

(a) $V_{C1} = 10\ V$ ✓ $\quad V_{C2} = 10\ V$ ✓

$V_{B1} = V_{CC}\left(\frac{R_2}{R_1+R_2}\right)$

$= 10\ V\left(\frac{22\ k\Omega}{33k\Omega+22k\Omega}\right)$

$= 4\ V$ ✓

$V_{E1} = V_{B1} - V_{BE} = 4 - 0.7 = 3.3\ V$ ✓

$V_{B2} = V_{E1} = 3.3\ V$

$V_{E2} = V_{B2} - V_{BE} = 3.3V - 0.7V$

$= 2.6V$ ✓

(b) $\beta_{ac(tot)} = \beta_{ac1}\beta_{ac2} = 150 \times 100 = 15000$ ✓

(c) $I_{E1} = \frac{V_{E1} - V_{BE}}{\beta_{ac2} R_E} = \frac{3.3 - 0.7}{100 \times 1.5k\Omega} = \frac{2.6V}{150\ k\Omega} = 0.0173\ mA$

$r_{e1}' = \frac{25\ mV}{I_{E1}} = \frac{25mV}{0.0173mA} = 1445\ \Omega$ ✓

(d) $R_{in} = R_1 \| R_2 \| R_{in(base1)}$

$= R_1 \| R_2 \| \beta_{ac1}\beta_{ac2} R_E$

$= 33\ k\Omega \| 22\ k\Omega \| 15000 \times 1.5k\Omega$

$= 13.192\ k\Omega$ ✓

$I_{E2} = \frac{V_{E2}}{R_E} = \frac{2.6V}{1.5k\Omega} = 1.73\ mA$

$r_{e1}' = \frac{25mV}{I_{E2}} = \frac{25mV}{1.73mA} = 14.45\ \Omega$ ✓

2. (50 points) Determine the approximate input resistance seen by the signal source for the amplifier of Figure 2 if $\beta_{ac} = 100$. (Find Q-point first).

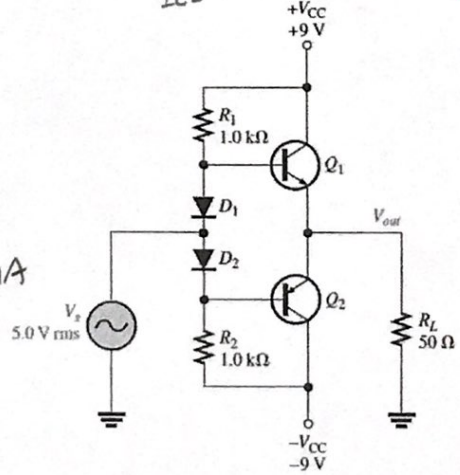

Figure 2

$V_{B1} = 0 + 0.7 = 0.7V$

$V_{B2} = 0 - 0.7 = -0.7V$

$I_{CQ} = \frac{V_{CC} - (-V_{CC}) - 1.4V}{R_1 + R_2} = \frac{9 - (-9) - 1.4}{1k\Omega + 1k\Omega} = 8.3\ mA$

$I_{CQ} \approx I_E = 8.3\ mA$ ✓

$r_e' = \frac{25mA}{8.3mA} = 3\Omega$ ✓

$V_E = 0 \quad V_{CEQ_1} = 9 \quad V_{CEQ_2} = -9$

$R_{in} = R_1 \| R_2 \| \beta_{ac}(R_L + r_e')$

$= 1k\Omega \| 1k\Omega \| 100 \times (50 + 3\Omega)$

$= 456.89\ \Omega$ ✓