Name:	**Dr JBO**
Student ID Number:	**Model Answer**
Section:	01A / 01B
Lecturer:	Dr. Jamaludin Bin Omar

EEEB273 - Quiz 2
SEMESTER 1, ACADEMIC YEAR 2018/2019
Date: 3 July 2018 Time: 15 minutes

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Question:

Study **Figure 1** carefully. Assume V_{BE}**(on) = 0.7 V** and $V_A = \infty$ for all BJTs in the circuit. β for Q_1 and Q_2 is ∞, but β for Q_3 and Q_4 is **30**. For R_C **= 2 kΩ,** R_1 **= 2.7 kΩ,** and $v_{B1} = v_{B2}$ **= 0 V**, **determine** the value of V_{CE1}. Show your solution clearly. [10 marks]

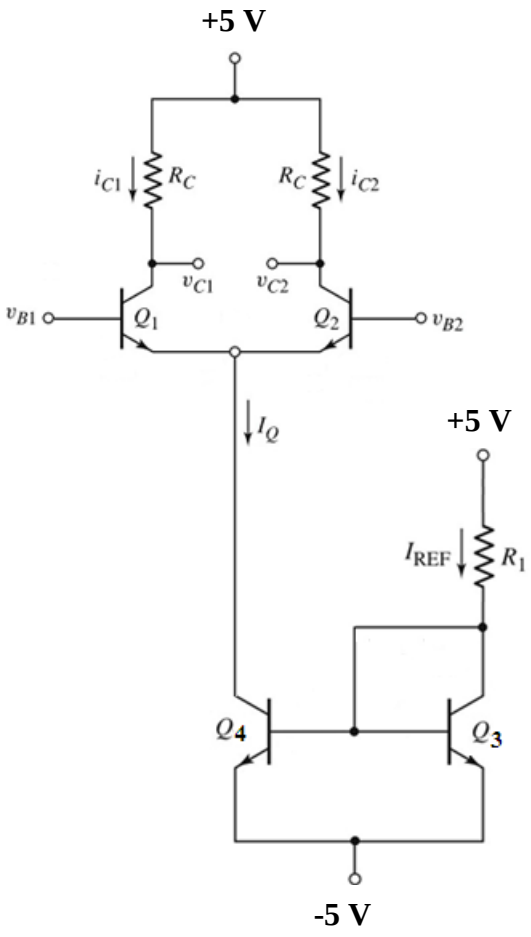

Figure 1

2TCS:

I_{REF} $= (V^+ - V_{BE3}(\text{on}) - V^-) / (R_1)$ **[1]**
$= (5-0.7-(-5)) / (2.7k) = 3.444$ mA **[1]**

I_Q $= I_{REF} / (1+2/\beta)$ **[1]**
$= (3.444m)/(1 + 2/30) = 3.2288$ mA **[1]**

Diff amp:

When $v_{B1} = v_{B2} = 0$ V and β for Q_1 and Q_2 is ∞:

I_Q $= i_{C1} + i_{C2}$ **[1]**
i_{C1} $= i_{C2} = I_Q / 2$
$= (3.2288m) / 2 = 1.6144$ mA **[1]**

V_{CE1} $= v_{C1} - V_{E1}$ **[1]**
V_{E1} $= v_{B1} - V_{BE1}(\text{on}) = 0 - 0.7 = -0.7$ V **[1]**
v_{C1} $= 5 - i_{C1} R_C$
$= 5 - (1.6144m)(2k) = 1.7712$ V **[1]**
V_{CE1} $= 1.7712 - (-0.7) = 2.4712$ V **[1]**

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

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Question:

Study **Figure 1** carefully. Assume V_{BE}**(on) = 0.7 V** and $V_A = \infty$ for all BJTs in the circuit. β for Q_1 and Q_2 is ∞, but β for Q_3 and Q_4 is **40**. For R_C **= 2 kΩ,** R_1 **= 2.8 kΩ,** and $v_{B1} = v_{B2}$ **= 0 V**, **determine** the value of V_{CE2}. Show your solution clearly. [10 marks]

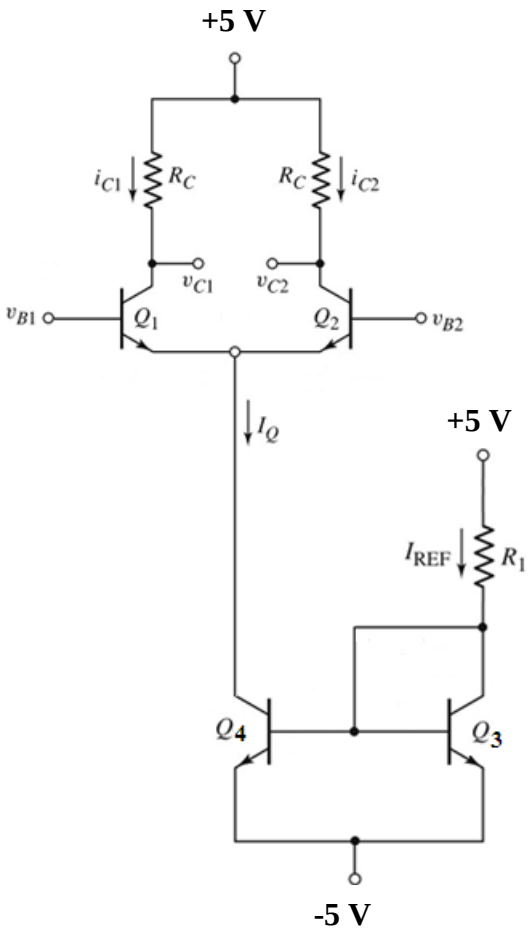

Figure 1

2TCS:

I_{REF} = $(V^+ - V_{BE3}(\text{on}) - V^-) / (R_1)$ **[1]**
= (5-0.7-(-5)) / (2.8k) = 3.3214 mA **[1]**

I_Q = $I_{REF} / (1+2/\beta)$ **[1]**
= (3.3214m)/(1 + 2/40) = 3.1632 mA **[1]**

Diff amp:

When $v_{B1} = v_{B2}$ = 0 V and β for Q_1 and Q_2 is ∞:

I_Q = $i_{C1} + i_{C2}$ **[1]**
i_{C2} = i_{C1} = $I_Q / 2$
= (3.1632m) / 2 = 1.5816 mA **[1]**

V_{CE2} = $v_{C2} - V_{E2}$ **[1]**
V_{E2} = $v_{B2} - V_{BE2}(\text{on})$ = 0 – 0.7 = -0.7 V **[1]**
v_{C2} = $5 - i_{C2} R_C$
= 5 – (1.5816m)(2k) = 1.8368 V **[1]**
V_{CE2} = 1.8368 – (-0.7) = 2.5368 V **[1]**

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

Answer:

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Question:

Study **Figure 1** carefully. Assume V_{BE}**(on) = 0.7 V** and $V_A = \infty$ for all BJTs in the circuit. β for Q_1 and Q_2 is ∞, but β for Q_3 and Q_4 is **40**. For R_C **= 2.5 kΩ,** R_1 **= 3 kΩ,** and $v_{B1} = v_{B2}$ **= 0 V**, **determine** the value of V_{CE1}. Show your solution clearly. [10 marks]

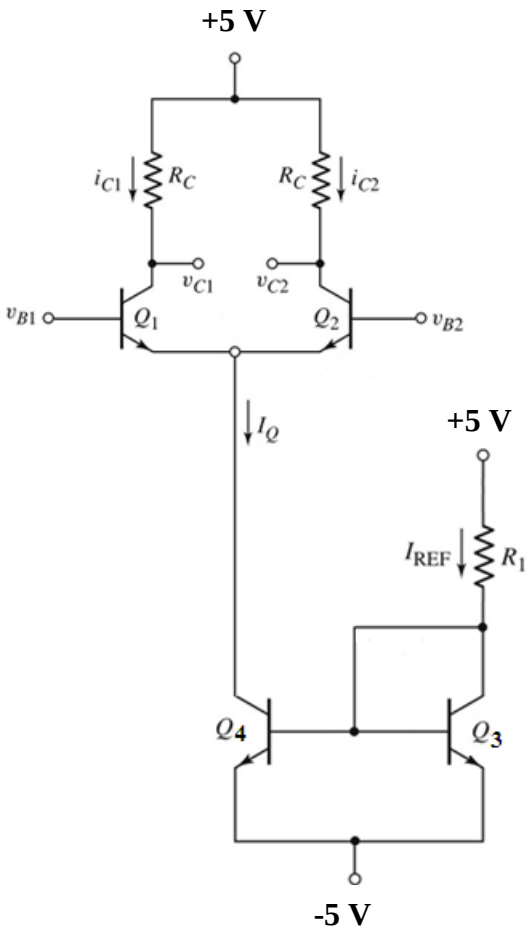

Figure 1

2TCS:

I_{REF} = $(V^+ - V_{BE3}(\text{on}) - V^-) / (R_1)$ **[1]**
= (5-0.7-(-5)) / (3k) = **3.1 mA** **[1]**

I_Q = $I_{REF} / (1+2/\beta)$ **[1]**
= (3.1m)/(1 + 2/40) = **2.9523 mA** **[1]**

Diff amp:

When $v_{B1} = v_{B2}$ = 0 V and β for Q_1 and Q_2 is ∞:

I_Q = $i_{C1} + i_{C2}$ **[1]**
i_{C1} = i_{C2} = $I_Q / 2$
= (2.9523m) / 2 = **1.4762 mA** **[1]**

V_{CE1} = $v_{C1} - V_{E1}$ **[1]**
V_{E1} = $v_{B1} - V_{BE1}(\text{on})$ = 0 – 0.7 = **-0.7 V** **[1]**
v_{C1} = $5 - i_{C1} R_C$
= 5 – (1.4762m)(2.5k) = **1.3095 V** **[1]**
V_{CE1} = 1.3095 – (-0.7) = **2.0095V** **[1]**

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

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Study **Figure 1** carefully. Assume V_{BE}**(on) = 0.7 V** and $V_A = \infty$ for all BJTs in the circuit. β for Q_1 and Q_2 is ∞, but β for Q_3 and Q_4 is **30**. For R_C **= 2.5 kΩ,** R_1 **= 2.9 kΩ,** and $v_{B1} = v_{B2}$ **= 0 V**, **determine** the value of V_{CE2}. Show your solution clearly. [10 marks]

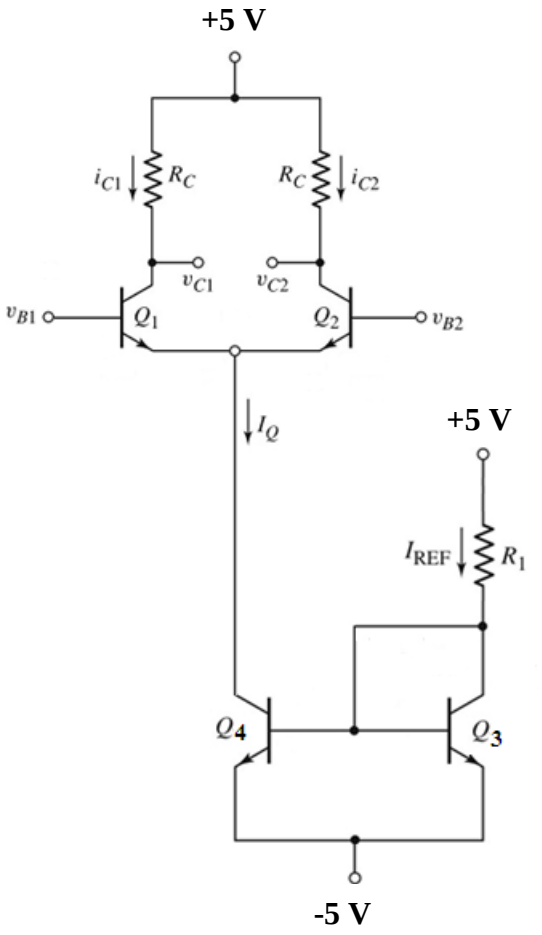

Figure 1

2TCS:

I_{REF} $= (V^+ - V_{BE3}(\text{on}) - V^-) / (R_1)$ **[1]**
$= (5-0.7-(-5)) / (2.9k)$ $= 3.2069$ mA **[1]**

I_Q $= I_{REF} / (1+2/\beta)$ **[1]**
$= (3.2069m)/(1 + 2/30)$ $= 3.0064$ mA **[1]**

Diff amp:

When $v_{B1} = v_{B2} = 0$ V and β for Q_1 and Q_2 is ∞:

I_Q $= i_{C1} + i_{C2}$ **[1]**
i_{C2} $= i_{C1}$ $= I_Q / 2$
$= (3.0064m) / 2$ $= 1.5032$ mA **[1]**

V_{CE2} $= v_{C2} - V_{E2}$ **[1]**
V_{E2} $= v_{B2} - V_{BE2}(\text{on}) = 0 - 0.7$ $= -0.7$ V **[1]**
v_{C2} $= 5 - i_{C2} R_C$
$= 5 - (1.5032m)(2.5k)$ $= 1.242$ V **[1]**
V_{CE2} $= 1.242 - (-0.7)$ $= 1.942$ V **[1]**

$$g_m = \frac{I_{CQ}}{V_T}$$

$$r_o = \frac{V_A}{I_{CQ}}$$

Answer: