a) $I_E$, $V_E$ and $V_B$

DC bias analysis. Either go over the loop with base and emitter and solve for $I_B$ and $I_E$ or by shifting the base resistor to the emitter side

$I_E = [9-0.7] / [1 + 100/(\beta + 1)]$

For $\beta = 40$, $I_E = 2.41 \text{ mA}$; $V_E = 2.41 \text{ V}$; $V_B = 3.11 \text{ V}$
For $\beta = 200$, $I_E = 5.54 \text{ mA}$; $V_E = 5.54 \text{ V}$; $V_B = 6.24 \text{ V}$

b) $R_{in}$

Note: The circuit is exactly same as the ones in 5.63 with $r_o$ replaced by $R_E (=1k)$

$R_{in} = 100 \text{ K}/[(\beta + 1)(r_e + (1//1)); r_e = V_T/I_E$

For $\beta = 40$, $r_e = 10.37 \Omega$; $R_{in} = 17.3 \text{ K}\Omega$.
For $\beta = 200$, $r_e = 4.51 \Omega$; $R_{in} = 50.3 \text{ K}\Omega$.

c) $v_o/v_{sig}$

$v_o/v_{sig} = v_o/v_b \cdot v_b/v_{sig} = \{R_{in}/(R_{in} + R_{sig})\} \cdot \{(1//1)/[(1//1)+r_e]\}$

Again, for $\beta = 40$,
$\beta = 200$, $v_o/v_{sig} = 0.621 \text{ V/\text{V}}, v_o/v_{sig} = 0.827 \text{ V/\text{V}}$. 
\[ I_E = \left[ 5 - 0.7 \right] / \left[ 3.3 + (100/101) \right] \]
\[ I_E = 1 \text{ mA}. \]
\[ r_e = 0.025/0.001 = 25 \ \Omega \]

\[ R_{in} = (\beta + 1) \left[ r_e + (3.3/1) \right] \]
\[ R_{in} = 80 \ \text{K}\Omega. \]

\[ V_{o/v_{sig}} = v_o/v_{h} \ast v_{o/v_{sig}} = \left\{ R_{in}/(R_{in} + R_{sig}) \right\} \ast \left\{ (3.3/1) / [(3.3/1)+r_e] \right\} \]
\[ V_{o/v_{sig}} = 0.430 \ \text{V/V}. \]

\[ i_{o/in} = [v_o/R_L] / [v_{sig}(R_{sig} + R_{in})] = [v_o/v_{sig}] * [(R_{sig} + R_{in})/R_L] \]
\[ i_{o/in} = 77.4 \ \text{A/A}. \]

\[ R_{out} = 3.3 / (r_e + 100/101) \]
\[ R_{out} = 0.776 \ \text{K}\Omega. \]
\[
R_{\text{out}} = r_o / \left[ r_e + 10k / (\beta + 1) \right] \\
r_o = V_A / I_C = 50.5 \text{ K} ; \quad r_e = 0.01 \text{ K} ; \\
R_{\text{out}} = 108 \text{ } \Omega.
\]

\[
R_{\text{in}} = (\beta + 1) * \left[ r_e + r_o / R_L \right] \\
v_o / v_{\text{sig}} = v_o / v_b * v_b / v_{\text{sig}} = \left\{ \frac{R_{\text{in}}}{(R_{\text{in}} + R_{\text{sig}})} \right\} * \left\{ \frac{r_o / R_L}{[(r_o / R_L) + r_e]} \right\}
\]

Case 1: for \( R_L = \infty \)
\[
R_{\text{in}} = 5101 \text{ K}\Omega \\
v_o / v_{\text{sig}} = 0.998 \text{ V/V}.
\]

Case 2: \( R_L = 1K \)
\[
R_{\text{in}} = 100 \text{ K} \\
v_o / v_{\text{sig}} = 0.899 \text{ V/V}.
\]

Note: From the answer to case 1, one can find the one for case 2, in another method with \( R_L = 1 \text{ K}\Omega \), \( v_o / v_{\text{sig}} = 0.998 \left[ \frac{R_L}{(R_L + R_{\text{out}})} \right] = 0.899 \).

Largest negative output signal voltage (i.e., min output signal voltage) is when the transistor goes to cut off.
\[
v_o (\text{min}) = -2.5 \text{ mA} * 1 \text{ K} = -2.5 \text{ V}.
\]

Largest positive signal voltage happens when \( V_B = 3 + 0.4 \text{ V} \) i.e., \( V_E = 2.7 \text{ V} \)
But \( V_E \) already has a DC bias component, which is
\[
V_E (\text{DC}) = \left[ -10 \text{ K} * (2.5/101) \right] - 0.7 = -0.95 \text{ V} \\
\text{So } v_o (\text{max}) = 2.7 - (-0.95) = 3.65 \text{ V}.
\]
Overall open circuit gain is given as 0.99 (G_vo). Since r_o is large, eqn 5.147 becomes

\[ G_{vo} = \frac{R_B}{R_B + R_{sig}} = 0.99 \]
\[ R_B = 990 \, \text{K}\Omega \]

From eqn 5.149, \( R_{out} = r_e + \left[ \frac{R_{sig}}{R_B}(\beta + 1) \right] \)
When \( R_{sig} = 10 \, \text{K} \), \( R_{out} = 200 \, \Omega \)
When \( R_{sig} = 20 \, \text{K} \), \( R_{out} = 300 \, \Omega \)

This will give us two equations, solving which we get

\[ \beta = 96 \, ; \, r_e = 98 \, \Omega \, ; \]
For \( R_{sig} = 30 \, \text{K}\Omega \) and \( R_L = 1 \, \text{K}\Omega \)

From equation 5.145 (or from small signal analysis), for large \( r_o \)

\[ G_v = \left\{ \frac{R_B}{R_{sig} + R_B} \right\} \ast \left\{ \frac{R_L}{\left[ \frac{R_{sig}}{R_B}(\beta + 1) + r_e + R_L \right]} \right\} \]
\[ G_v = 0.7 \, \text{V/V} \]