1. Consider the NPN transistor circuit shown below. Given $V_{BE(on)} = 0.7V$, $V_{CE(sat)} = 0.2V$, $\beta = 100$.

![NPN Transistor Circuit](image1)

a) Find $I_B, I_C, I_E, V_C$ and $V_E$

b) What is the region of operation? Why?

c) Find the maximum value of $R_C$ so that it is the forward active region.

2. Consider the PNP transistor circuit below. Given $V_{EB(on)} = 0.7V$, $V_{EC(sat)} = 0.2V$, $\beta = 50$ and $R_L = 2.5k\Omega$.

![PNP Transistor Circuit](image2)
a) Find $I_B, I_C, I_E, V_C,$ and $V_E$.

b) What is the region of operation? Why?

c) What are the maximum and minimum values of $R_L$ so that the transistor remains in the forward active region.

3. Given $V_{BE(on)} = 0.7\, V$, $\beta = 100$, $r_0 \to \infty$, determine the voltage gain $A_v = \frac{v_{out}}{v_{in}}$. Assume $V_T = 25mV$. 