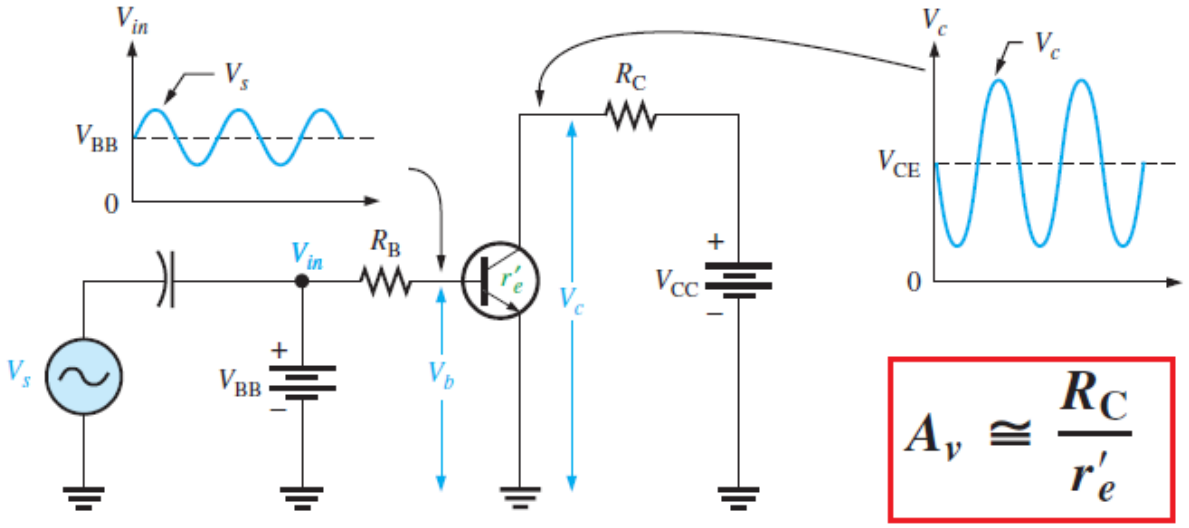
4-4 BJT as an Amplifier

- **Voltage amplification**: a transistor amplifies current because the collector current is equal to the base current multiplied by the Current gain, β.

- The following is the basic transistor amplifier circuit with ac source voltage *Vs* which is superimposed on the dc bias voltage V_{BB} by capacitive coupling.

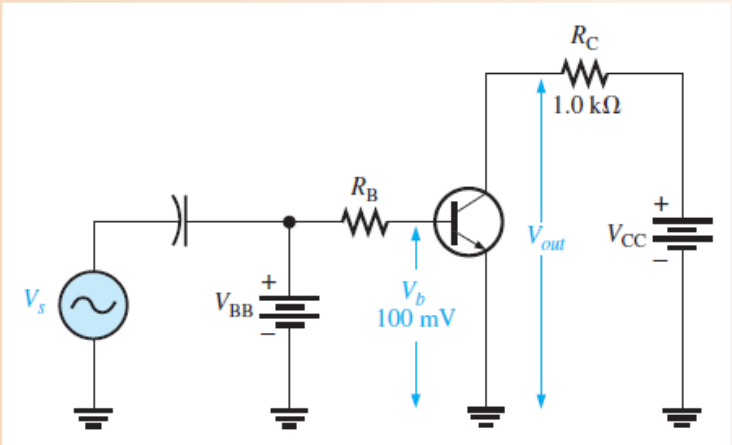


$$A_v \cong \frac{R_C}{r'_e}$$

EXAMPLE 4–9

Determine the voltage gain and the ac output voltage in Figure 4–22 if $r'_e = 50\ \Omega$.

▶ FIGURE 4–22



Solution

The voltage gain is

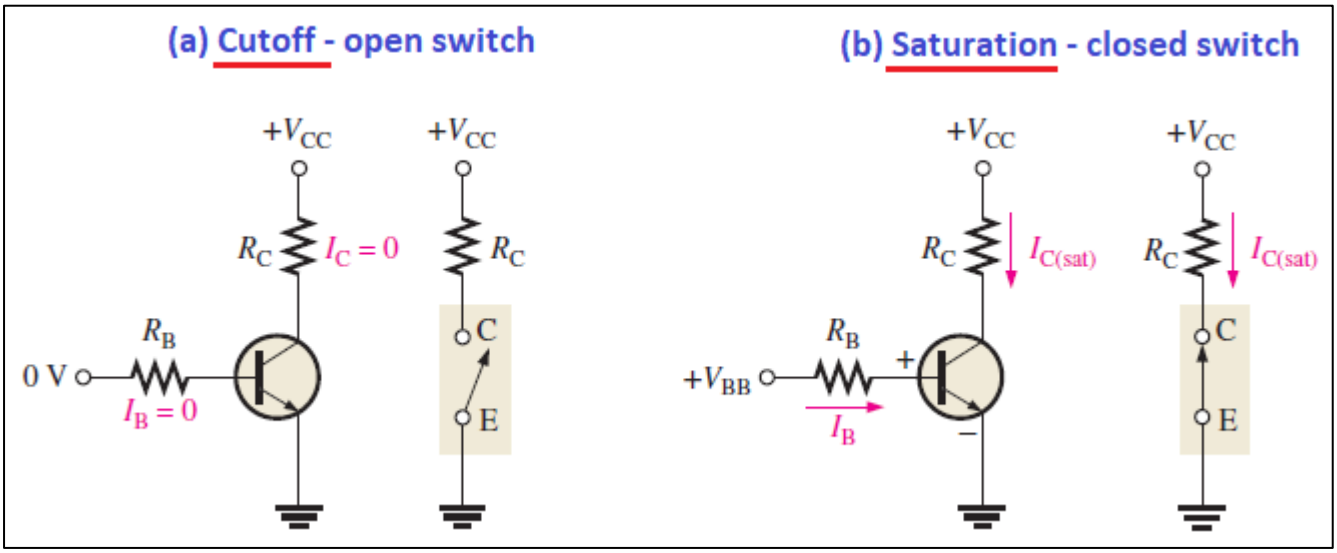
$$A_v \cong \frac{R_C}{r'_e} = \frac{1.0\ \text{k}\Omega}{50\ \Omega} = \mathbf{20}$$

Therefore, the ac output voltage is

$$V_{out} = A_v V_b = (20)(100\ \text{mV}) = \mathbf{2\ V\ rms}$$

4-5: the BJT as a Switch

- When used as an electronic switch, a BJT is normally operated alternately in **cutoff** and **saturation**.



- **In part (a):** the transistor is in the cutoff region because the base-emitter junction reversed biased.
  Ideally ➔ an open between collector and emitter.

- **In part (b),** the transistor is in the saturation region because the base emitter junction and the base-collector junction are forward-biased and the base current is made large enough to cause the collector current to reach its saturation value.
  Ideally ➔ a short between collector and emitter

■ ***Conditions in Cutoff***

$$V_{CE(cutoff)} = V_{CC}$$

■ ***Conditions in Saturation***

$$I_{C(sat)} = \frac{V_{CC} - V_{CE(sat)}}{R_C}$$

■ The minimum value of base current needed to produce saturation

$$I_{B(min)} = \frac{I_{C(sat)}}{\beta_{DC}}$$