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# Problems and Solutions

*in Mathematics, Physics and Applied Sciences*

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## Maximum Gain of a Resistor Loaded Transistor

Did you know that the maximum possible voltage gain for a resistor loaded, single stage, common emitter amplifier is about 38 times the supply voltage?

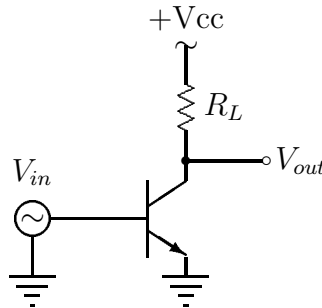


Figure 1: Class A amplifier

Consider the amplifier in Figure 1. The voltage gain is given by

$$A_V = \frac{V_{out}}{V_{in}} = g_m R_L = \frac{R_L}{r'_e} = \frac{I_E R_L}{.026} \quad (1)$$

where  $r'_e = .026/I_E$  is the emitter diffusion resistance. Then the maximum gain for a given  $R_L$  occurs when the collector current is greatest, *i.e.* near saturation where  $I_E = V_{cc}/R_L$ . Hence,

$$A_{V(max)} = 38 I_{E(max)} R_L = 38 V_{cc} \quad (2)$$