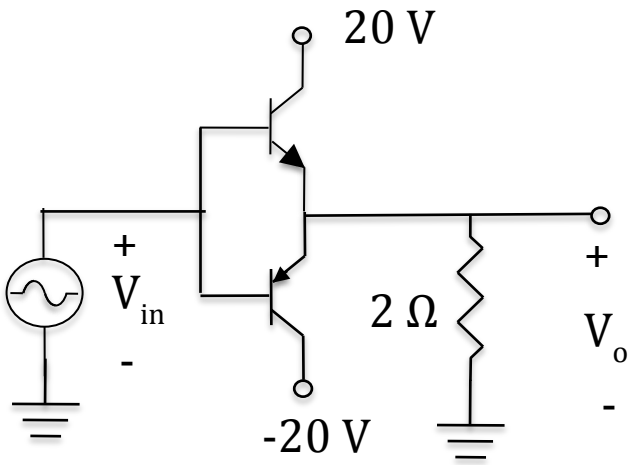
Problem #4: Spring 2014 PhD Qualifying Exam

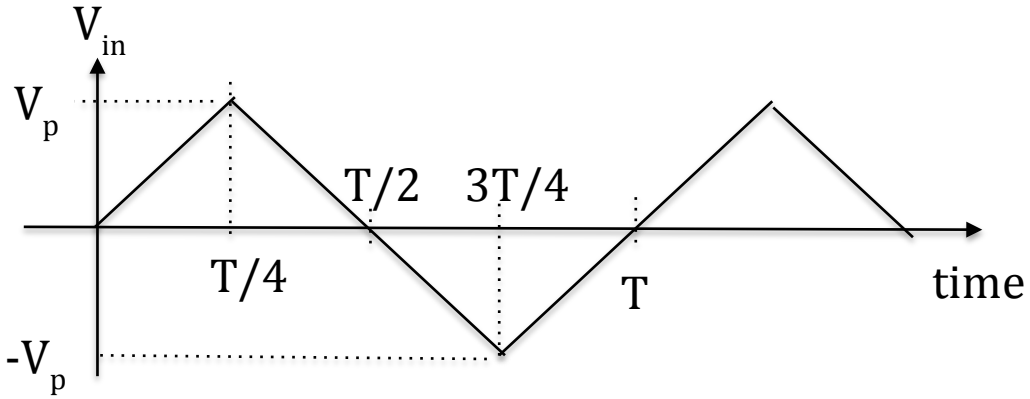
Electronics

A power amplifier is shown below along with an input triangular wave of variable amplitude V_p ($0 < V_p < 20$ V) The transistor specifications are given in the box beside the circuit schematic. Cross-over distortion can be ignored. $R_{\theta ja}$ is the junction to ambient thermal resistance.



Si BJT Specifications

Beta = 100
$R_{\theta ja}$ = 5 °C/W = junction-to-ambient thermal resistance
V_A = 100 V (Early voltage)



1. (0.5 points)
   What should be voltage rating of the transistors? Include a 50% factor of safety.

2. (0.5 points)
   What should be the current rating of the transistors? Include a 50% factor of safety.

3. (2 point)
   What is the maximum average power dissipated in a transistor?

4. (0.5 point)
   What is the maximum efficiency of the circuit? Maximum efficiency is the ratio of the average power delivered to the load at maximum signal swing divided by the average power provided by the bias supplies (the two 20 V supplies).

5. (0.5 point)
   What is the maximum junction temperature reached in the transistors? Assume an ambient temperature of 35 °C.