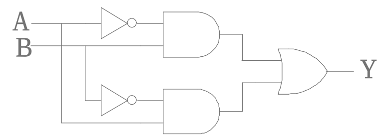
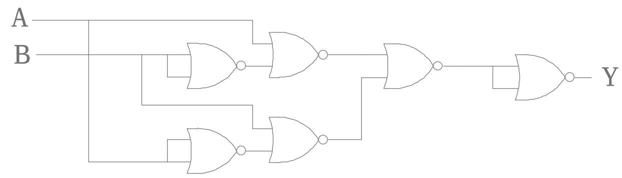
1.

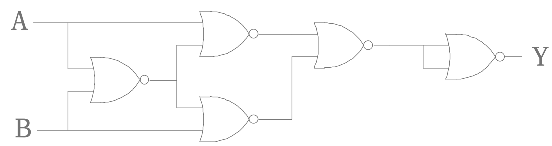
1a.



1b.
(STRAIGHTFORWARD CONVERSION OF 1a.)



1b.
(ANOTHER SOLUTION: USES ONE LESS GATE)



2a. Since the base current flows through the resistor, its value must be Ib= (8- 0.7)/10k = 0.73 mA. The collector current is therefore Ic = 99Ib = **72.27 mA.**

b. The emitter current is the sum of the base current and the collector current. Ie = (99+1)Ib = 100 Ib = **73 mA**.

c. The power dissipated in the transistor is the sum of the power delivered to the collector and the power delivered to the base: Pwr = VcIc + VbIb = 8(72.27) + 0.7(0.73) = **578.671 mW**.

3. If Ve is the emitter voltage, the base current will be Ib = (8-[Ve+0.7]) /10k. Since the emitter current is 100 times the base current, we have 100 x (8-[Ve+0.7]) /10k = Ve/100. Solving for Ve, we find Ve= 3.65 V. The emitter current is therefore 3.65/100 = 36.5 mA. The collector current is Ic=Ie-Ib or Ic = Ie-Ic/99. Therefore Ic = Ie/(1+1/99) = 36.5(1+1/99) = **36.135 mA**.

b. The power dissipated by the transistor is Vce Ic + Vbe Ib = (8-3.65)V x 36.135mA + 0.7V x (36.135/99) = **157.44 mW**.

4. A quarter-wave line inverts the impedance of its load. Looking into the quarter-wave line, the impedance is therefore 50^2 /100= 25. A half-wave line leaves terminating impedance unchanged. Looking into the half-wave line, the impedance is therefore -j25. Since these impedances are in parallel, Zin is given by Zin **= [1/25 - 1/(j25)]^-1.**

5a. At low frequencies, the capacitor becomes an open circuit and the circuit becomes a simple follower with voltage gain = **1**.

b. At high frequencies, the capacitor becomes a short circuit. Since the current in the resistors will be equal, we have (Vout - Vin)/10k = Vin/10k or Vout/Vin = **2**.

c. For an arbitrary frequency, we must include the capacitor: (Vout-Vin)/10k = Vin/(10k+1/(j 2pi f C), which is easily solved for Vout/Vin.

6a. The power into the speaker is the mean square voltage divided by resistance. Therefore <V^2> = 4 x 32. For a sine wave, the mean square voltage is half the square of the peak voltage, so Vpk^2 = 2 x 4 x 32 and Vpk = 16 V. Since the circuit consists of voltage followers, the voltage on the speaker will be essentially identical to Vin: a sine wave symmetric around zero volts. Therefore the peak-to-peak input voltage is 2 x 16 = **32Vpp**.

b. The power dissipated by the transistors is the difference between the power supplied by the power supplies and the power delivered to the speaker. The average current through the two transistors is the same as the average current flowing to the speaker. Since the peak voltage is 16, the peak current is 16/R = 16/4 = 4A. The top transistor provides the positive current loops and the bottom transistor provides the negative current loops. The average power delivered to the amplifier is therefore 30V times the average of the absolute value of the current sine wave. The average value of |sin(x)| is easily computed to be 2/pi, so the average power delivered to the amplifier is 30 x 4 x 2/pi =76.39W. The power dissipated by the transistors is therefore 76.39 - 32 = **44.39 W**.

7. The three stages (3dB attenuator, amplifier, and 4 dB attenuator have) noise figues of 3db, 8 dB, and 4 db, respectively. The noise figure of the cascade if therefore given by F1 + (F2-1)/G1 + (F3-1)/(G1 G2) = 10^.3 +([10^.8] -1)/ (10^.-3) + ([10^.4] -1)/([10^-.3][10^.6]) = 13.35 = **11.25 dB**.

8. The gain is 16 (10^12/10). Therefore the effective collecting area of the receiving antenna is 11.5 square meters: 16x 3^2/(4pi), where 3 is the wavelength in meters. At a distance of 10^4 meters, the flux from the transmitting antenna will be 16 x 1 /(4pi[10^4]^2) = 1.27E-8 watts per square meter. Multiplying the flux times the collecting area, we find that the maximum power available from the receiving antenna will be **0.146 microwatts**

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