In Figure P12.33 the battery symbol on the right hand side is upside down (the polarity is correct). And the right switch should be labeled $\bar{A}$.

1 mH. The switch (a thyristor) is switched on for 1 ms, and the period of the switching waveform is 3 ms. Calculate the average value of the load voltage and the power supplied by the battery.

12.28 The converter of Problem 12.27 is used to supply a separately excited DC motor with $R_a = 0.2\ \Omega$ and $L_a = 1$ mH. At the lowest speed of operation, the back-emf E_a is equal to 10 V. Calculate the average value of the load current and voltage for this condition if the switching period is 3 ms and the duty cycle is $\frac{1}{3}$.

12.29 A separately excited DC motor with $R_a = 0.33\ \Omega$ and $L_a = 15$ mH is controlled by a DC-DC converter in the range of 0 to 2,000 r/min. The DC supply is 220 V. If the load torque is constant and requires an average armature current of 25 A, calculate the range of duty cycles required if the motor armature constant is $K_a\phi = 0.00167$ V-s/r.

12.30 A separately excited DC motor is rated at 10 kW, 240 V, 1,000 r/min, and is supplied by a single-phase controlled bridge rectifier. The power supply is sinusoidal and rated at 240 V, 60 Hz. The motor armature resistance is 0.42 Ω, and the motor constant is $K_a = 2$ V-s/rad. Calculate the speed, power factor, and efficiency for SCR firing angles α of 0° and 20° if the load torque is constant. Assume that additional inductance is present to ensure continuous conduction.

12.31 A separately excited DC motor is rated at 10 kW, 300 V, 1,000 r/min, and is supplied by a three-phase controlled bridge rectifier. The power supply is sinusoidal and rated at 220 V, 60 Hz. The motor armature resistance is 0.2 Ω, and the motor constant is $K_a = 1.38$ V-s/rad. The motor delivers rated power at $\alpha = 0°$. Calculate the speed, power factor, and efficiency for a firing angle $\alpha = 30°$ if the load torque is constant. Assume that additional inductance is present to ensure continuous conduction.

12.32 Sketch the current through the load in the switched-mode power supply of Figure P12.32.

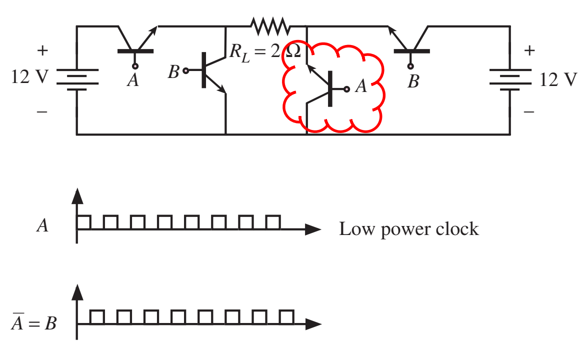

Figure P12.32

12.33 In the switched-mode power supply of Figure P12.33, sketch the load voltage signal, V_L.

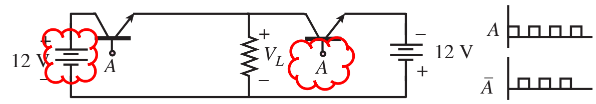

Figure P12.33

12.34 The switched mode power supply of Figure P12.34 will convert DC to three-phase AC. Sketch timing diagrams for the three low-power clock inputs to generate a balanced three-phase source. Also sketch the current in the neutral return wire. Assume the period of the cycle is normalized.

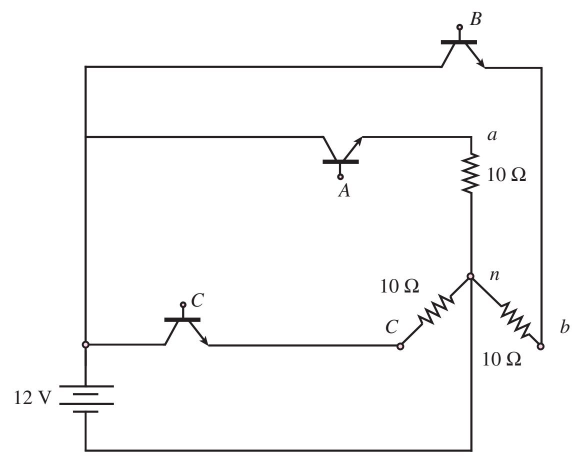

Figure P12.34

12.35 A DC-to-DC converter can also be thought of, and analyzed as, a DC transformer! Figure P12.35 shows a particular DC-to-DC converter configuration that converts the 1.2 V of a Ni-Cd battery cell to a desired 12 V DC supply. Using the usual transformer "reflecting theorems" (see Chapter 7), determine the power supplied by the 1.2 V source, and to the 10 Ω load.

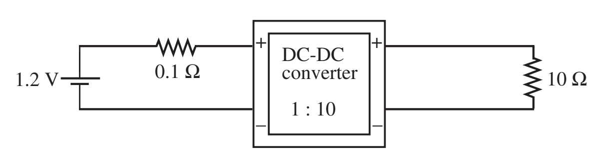

Figure P12.35

12.36 Shown in Figure P12.36 is a "charge pump" circuit for a switched-mode power supply (with all