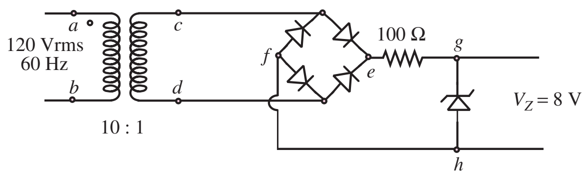

Figure P12.18

12.19 A power supply is shown in Figure P12.19. Sketch the signals V_{ab}, V_{cd}, V_{ef}, and I_Z.

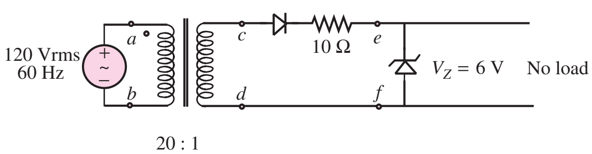

Figure P12.19

12.20 Figure P12.20 depicts a low-cost full-wave rectifier with a Zener diode voltage regulator. Sketch the voltages across terminals a-b, c-d, and e-f.

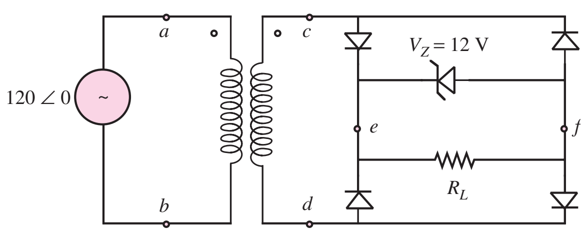

Figure P12.20

12.21 In the DC power supply shown in Figure P12.21, sketch the voltage across a-b, c-a, and d-e, assuming that R is so large as to make any ripple not noticeable.

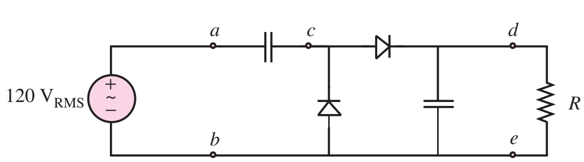

Figure P12.21

12.22 A DC power supply known as a *voltage doubler* is shown in Figure P12.22. It is assumed that the capacitors are large enough that the ripple is not significant in the output voltage. Sketch the signals V_{ab} and V_{cd}. Assume the input is at 60 Hz.

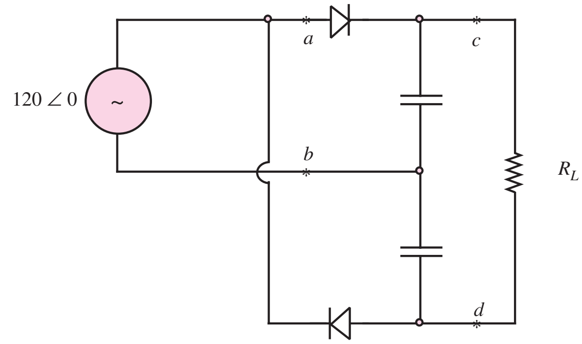

Figure P12.22

Section 12.6: Electric Motor Drives

12.23 The DC-DC converter of Figure 12.37 in the text, is used to control the speed of a DC motor. Let the supply voltage be 120 V and the armature resistance of the motor be 0.15 Ω. The motor back-emf constant is 0.05 V/(r/min), and the switching frequency is 250 Hz. Assume that the motor current is free of ripple and equal to 125 A at 120 r/min.

a. Determine the duty cycle of the converter, δ and the converter on time t_1.

b. Determine the power absorbed by the motor.

c. Determine the power generated by the supply.

12.24 The circuit of Figure 12.41 in the text, is used to provide regenerative braking in a traction motor. The motor constant is 0.3 V/(r/min), and the supply voltage is 600 V. The armature resistance is $R_a = 0.2$ Ω. The motor speed is 800 r/min and the motor current is 300 A.

a. Determine the duty cycle δ of the converter.

b. Determine the power fed back to the supply (battery).

12.25 For the two-quadrant converter of Figure 12.42 in the text, assume that thyristors S_1 and S_2 are turned on for time t_1 and off for time $T - t_1$ (T is the switching period). Derive an expression for the average output voltage in terms of the supply voltage V_S and the duty cycle δ.

12.26 A boost converter is powered by an ideal 100-V battery pack. The load voltage waveform consists of rectangular pulses with on time = 1 ms and period equal to 2.5 ms. Calculate the average and rms values of the converter supply voltage.

12.27 A buck converter connected to a 100-V battery pack supplies an RL load with $R = 0.5$ Ω and L =