Solutions aux problèmes et exercices proposés dans le volume de Hambley 7th Edition

Chapitre 1

E1.6 (a) $p_a(t) = v_a(t)i_a(t) = 20t^2$

$$w_a = \int_0^{10} p_a(t)dt = \int_0^{10} 20t^2 dt = \left.\frac{20t^3}{3}\right|_0^{10} = \frac{20t^3}{3} = 6667 \text{ J}$$

(b) Notice that the references are opposite to the passive sign convention. Thus we have:

$$p_b(t) = -v_b(t)i_b(t) = 20t - 200$$

$$w_b = \int_0^{10} p_b(t)dt = \int_0^{10} (20t - 200)dt = 10t^2 - 200t\Big|_0^{10} = -1000 \text{ J}$$

E1.12 $P = V^2/R \Rightarrow R = V^2/P = 144\ \Omega \Rightarrow I = V/R = 120/144 = 0.833\ A$

E1.13 $P = V^2/R \Rightarrow V = \sqrt{PR} = \sqrt{0.25 \times 1000} = 15.8\ \text{V}$

$I = V/R = 15.8/1000 = 15.8\ \text{mA}$

P1.21* (a) $P = -v_a i_a$ = 30 W Energy is being absorbed by the element.

(b) $P = v_b i_b$ = 30 W Energy is being absorbed by the element.

(c) $P = -v_{DE} i_{ED}$ = -60 W Energy is being supplied by the element.

P1.29 The power that can be delivered by the cell is $p = vi = 0.12$ W. In 75 hours, the energy delivered is $W = pT = 9$ Whr $= 0.009$ kWhr. Thus the unit cost of the energy is $Cost = (0.50)/(0.009) = 55.56$ \$/kWhr which is 463 times the typical cost of energy from electric utilities.

T1.4 (a) Applying KVL, we have $-V_s + v_1 + v_2 = 0$. Substituting values given in the problem and solving we find $v_1 = 8$ V.

(b) Then applying Ohm's law, we have $i = v_1 / R_1 = 8/4 = 2$ A.

(c) Again applying Ohm's law, we have $R_2 = v_2 / i = 4/2 = 2\ \Omega$.

Chapitre 2

E2.1 (a) R_2, R_3, and R_4 are in parallel. Furthermore R_1 is in series with the combination of the other resistors. Thus we have:

$$R_{eq} = R_1 + \frac{1}{1/R_2 + 1/R_3 + 1/R_4} = 3\,\Omega$$

(b) R_3 and R_4 are in parallel. Furthermore, R_2 is in series with the combination of R_3, and R_4. Finally R_1 is in parallel with the combination of the other resistors. Thus we have:

$$R_{eq} = \frac{1}{1/R_1 + 1/[R_2 + 1/(1/R_3 + 1/R_4)]} = 5\,\Omega$$

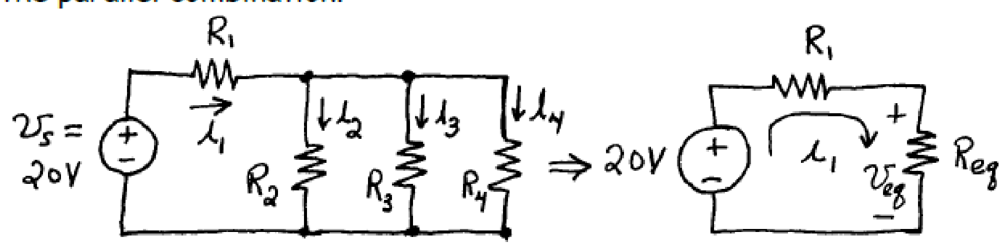
(c) R_1 and R_2 are in parallel. Furthermore, R_3, and R_4 are in parallel. Finally, the two parallel combinations are in series.

$$R_{eq} = \frac{1}{1/R_1 + 1/R_2} + \frac{1}{1/R_3 + 1/R_4} = 52.1\,\Omega$$

(d) R_1 and R_2 are in series. Furthermore, R_3 is in parallel with the series combination of R_1 and R_2.

$$R_{eq} = \frac{1}{1/R_3 + 1/(R_1 + R_2)} = 1.5\ \mathrm{k}\Omega$$

E2.2 (a) First we combine R_2, R_3, and R_4 in parallel. Then R_1 is in series with the parallel combination.

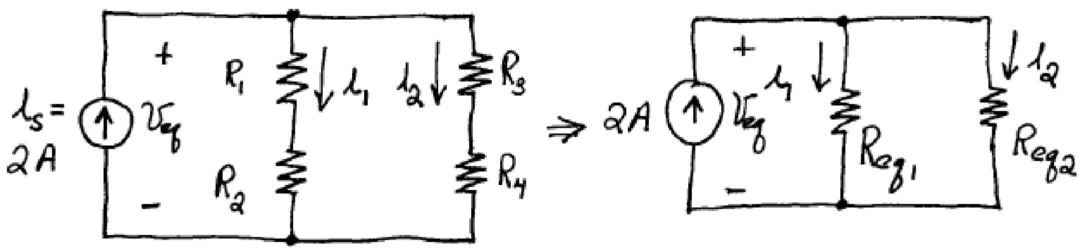


$$R_{eq} = \frac{1}{1/R_2 + 1/R_3 + 1/R_4} = 9.231\,\Omega \qquad i_1 = \frac{20\ \text{V}}{R_1 + R_{eq}} = \frac{20}{10 + 9.231} = 1.04\ A$$

$$v_{eq} = R_{eq} i_1 = 9.600\ \text{V} \qquad i_2 = v_{eq}/R_2 = 0.480\ A \qquad i_3 = v_{eq}/R_3 = 0.320\ A$$

$$i_4 = v_{eq}/R_4 = 0.240\ A$$

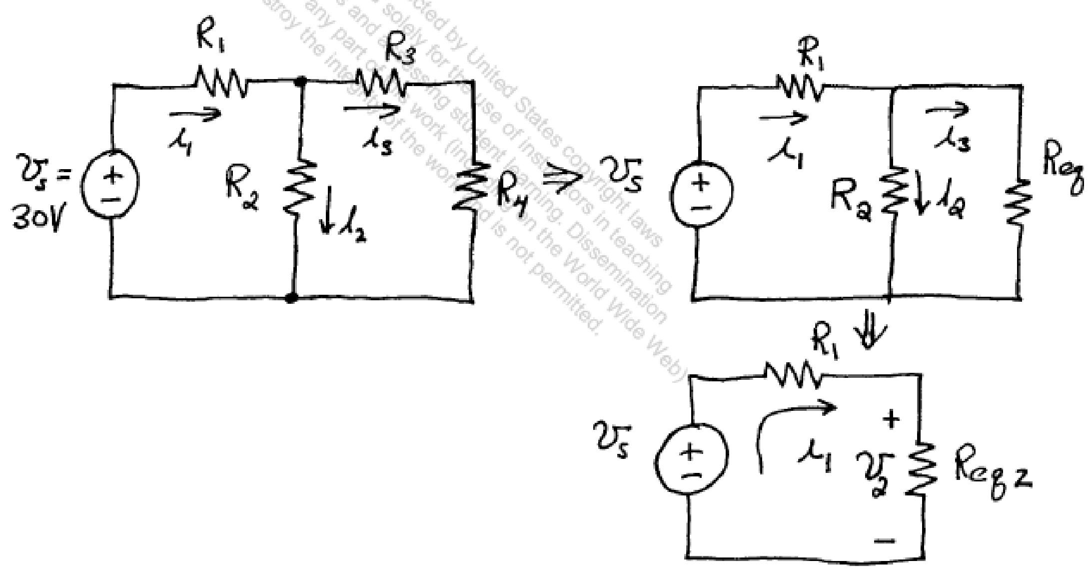
(b) R_1 and R_2 are in series. Furthermore, R_3, and R_4 are in series. Finally, the two series combinations are in parallel.



$$R_{eq1} = R_1 + R_2 = 20\,\Omega \quad R_{eq2} = R_3 + R_4 = 20\,\Omega \quad R_{eq} = \frac{1}{1/R_{eq1} + 1/R_{eq2}} = 10\,\Omega$$

$$v_{eq} = 2 \times R_{eq} = 20\text{ V} \quad i_1 = v_{eq}/R_{eq1} = 1\text{ A} \quad i_2 = v_{eq}/R_{eq2} = 1\text{ A}$$

(c) R_3, and R_4 are in series. The combination of R_3 and R_4 is in parallel with R_2. Finally the combination of R_2, R_3, and R_4 is in series with R_1.



$$R_{eq1} = R_3 + R_4 = 40\,\Omega \quad R_{eq2} = \frac{1}{1/R_{eq1} + 1/R_2} = 20\,\Omega \quad i_1 = \frac{v_s}{R_1 + R_{eq2}} = 1\text{ A}$$

$$v_2 = i_1 R_{eq2} = 20\text{ V} \quad i_2 = v_2/R_2 = 0.5\text{ A} \quad i_3 = v_2/R_{eq1} = 0.5\text{ A}$$

E2.3 (a) $v_1 = v_s \dfrac{R_1}{R_1 + R_2 + R_3 + R_4} = 10\text{ V}$. $v_2 = v_s \dfrac{R_2}{R_1 + R_2 + R_3 + R_4} = 20\text{ V}$.

Similarly, we find $v_3 = 30\text{ V}$ and $v_4 = 60\text{ V}$.

(b) First combine R_2 and R_3 in parallel: $R_{eq} = 1/(1/R_2 + 1/R_3) = 2.917\ \Omega$.

Then we have $v_1 = v_s \dfrac{R_1}{R_1 + R_{eq} + R_4} = 6.05\ \text{V}$. Similarly, we find

$v_2 = v_s \dfrac{R_{eq}}{R_1 + R_{eq} + R_4} = 5.88\ \text{V}$ and $v_4 = 8.07\ \text{V}$.

E2.4 (a) First combine R_1 and R_2 in series: $R_{eq} = R_1 + R_2 = 30\ \Omega$. Then we have $i_1 = i_s \dfrac{R_3}{R_3 + R_{eq}} = \dfrac{15}{15+30} = 1\ A$ and $i_3 = i_s \dfrac{R_{eq}}{R_3 + R_{eq}} = \dfrac{30}{15+30} = 2\ A$.

(b) The current division principle applies to two resistances in parallel. Therefore, to determine i_1, first combine R_2 and R_3 in parallel: $R_{eq} = 1/(1/R_2 + 1/R_3) = 5\ \Omega$. Then we have $i_1 = i_s \dfrac{R_{eq}}{R_1 + R_{eq}} = \dfrac{5}{10+5} = 1\ A$.

Similarly, $i_2 = 1$ A and $i_3 = 1$ A.

P2.1* (a) $R_{eq} = 20\ \Omega$ (b) $R_{eq} = 23\ \Omega$

P2.2* We have $4 + \dfrac{1}{1/20 + 1/R_x} = 8$ which yields $R_x = 5\ \Omega$.

Chapitre 5

E5.1 (a) We are given $v(t) = 150\cos(200\pi t - 30^\circ)$. The angular frequency is the coefficient of t so we have $\omega = 200\pi$ radian/s. Then

$$f = \omega / 2\pi = 100 \text{ Hz} \qquad T = 1/f = 10 \text{ ms}$$

$$V_{rms} = V_m/\sqrt{2} = 150/\sqrt{2} = 106.1 \text{ V}$$

Furthermore, $v(t)$ attains a positive peak when the argument of the cosine function is zero. Thus keeping in mind that ωt has units of radians, the positive peak occurs when

$$\omega t_{max} = 30 \times \frac{\pi}{180} \quad \Rightarrow \quad t_{max} = 0.8333 \text{ ms}$$

(b) $P_{avg} = V_{rms}^2 / R = 225$ W

(c) A plot of $v(t)$ is shown in Figure 5.4 in the book.

E5.3 $\omega = 2\pi f \cong 377$ radian/s $\qquad T = 1/f \cong 16.67$ ms $\qquad V_m = V_{rms}\sqrt{2} \cong 155.6$ V

The period corresponds to 360° therefore 5 ms corresponds to a phase angle of $(5/16.67)\times 360^\circ = 108^\circ$. Thus the voltage is

$$v(t) = 155.6\cos(377t - 108^\circ)$$

P5.5* Sinusoidal voltages can be expressed in the form $v(t) = V_m\cos(\omega t + \theta)$. The peak voltage is $V_m = \sqrt{2}V_{rms} = \sqrt{2}\times 20 = 28.28$ V. The frequency is $f = 1/T =$ 10 kHz and the angular frequency is $\omega = 2\pi f = 2\pi 10^4$ radians/s. The phase corresponding to a time interval of $\Delta t =$ 20 μs is $\theta = (\Delta t/T)\times 360^\circ = 72^\circ$. Thus we have $v(t) = 28.28\cos(2\pi 10^4 t - 72^\circ)$ V.

P5.11*

$$V_{rms} = \sqrt{\frac{i}{T}\int_0^T v^2(t)dt} = \sqrt{\frac{1}{2}\int_0^1 25dt} = 3.536 \text{ V}$$

P5.13*

$$I_{rms} = \sqrt{\frac{1}{T}\int_0^T i^2(t)dt} = \sqrt{\frac{1}{4}\left(\int_0^2 4dt + \int_2^4 1dt\right)} = 1.581 \text{ A}$$

T5.1

$$I_{rms} = \sqrt{\frac{1}{T}\int_0^T i^2(t)dt} = \sqrt{\frac{1}{3}\int_0^2 (3t)^2 dt} = \sqrt{t^3\Big|_0^2} = \sqrt{8} = 2.828 \text{ A}$$

$$P = I_{rms}^2 R = 8(50) = 400 \text{ W}$$

Chapitre 9

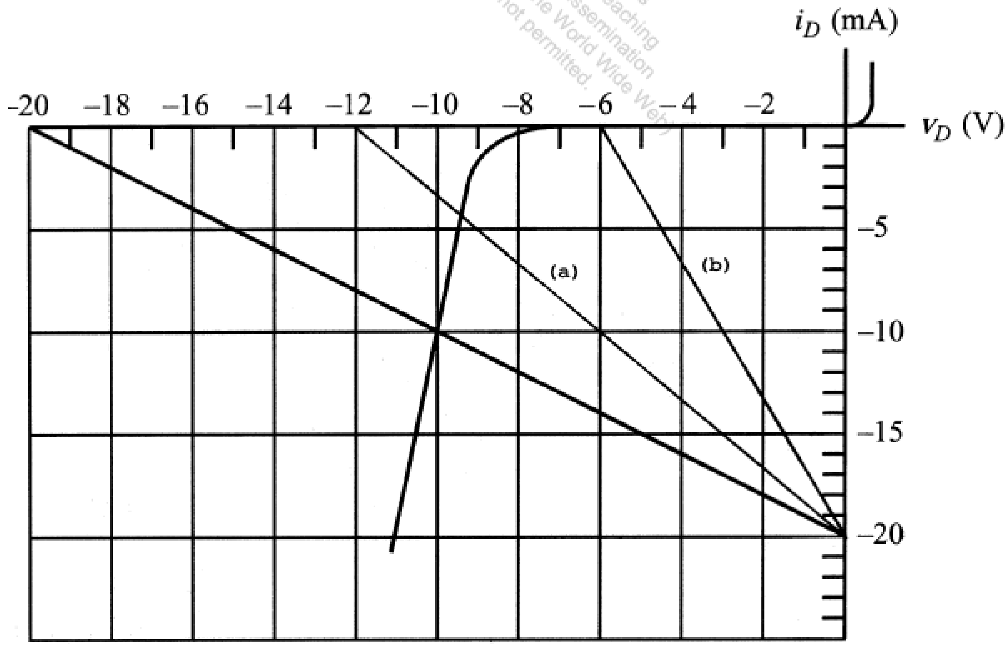
Attention cette solution est une solution avancée. La droite de charge ne fait pas partie de la matière de l'APP1.

E9.4 Following the methods of Example 10.4 in the book, we determine that:

(a) For $R_L = 1200\ \Omega$, $R_T = 600\ \Omega$, and $V_T = 12$ V.

(b) For $R_L = 400\ \Omega$, $R_T = 300\ \Omega$, and $V_T = 6$ V.

The corresponding load lines are:



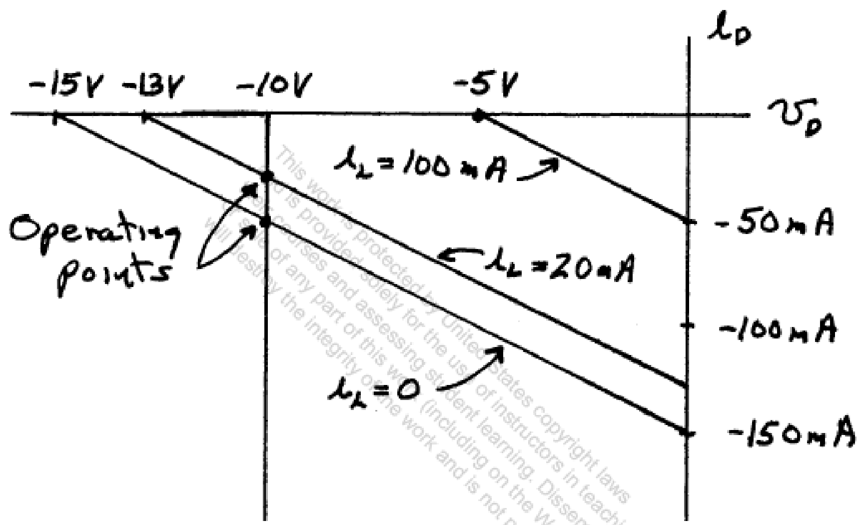
At the intersections of the load lines with the diode characteristic we find (a) $v_L = -v_D \cong 9.4$ V ; (b) $v_L = -v_D \cong 6.0$ V .

Attention, ce problème est aussi un problème avancé. Vous devriez être en mesure de résoudre, de façon plus simple, ce problème.

E9.5 Writing a KVL equation for the loop consisting of the source, the resistor, and the load, we obtain:

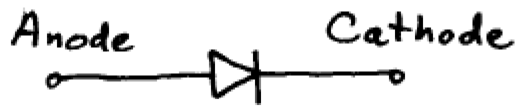
$$15 = 100(i_L - i_D) - v_D$$

The corresponding load lines for the three specified values of i_L are shown:

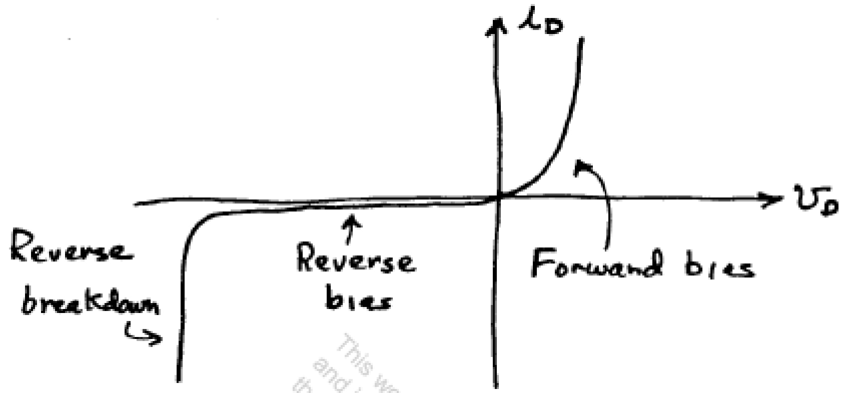


At the intersections of the load lines with the diode characteristic, we find (a) $v_o = -v_D = 10$ V; (b) $v_o = -v_D = 10$ V; (c) $v_o = -v_D = 5$ V. Notice that the regulator is effective only for values of load current up to 50 mA.

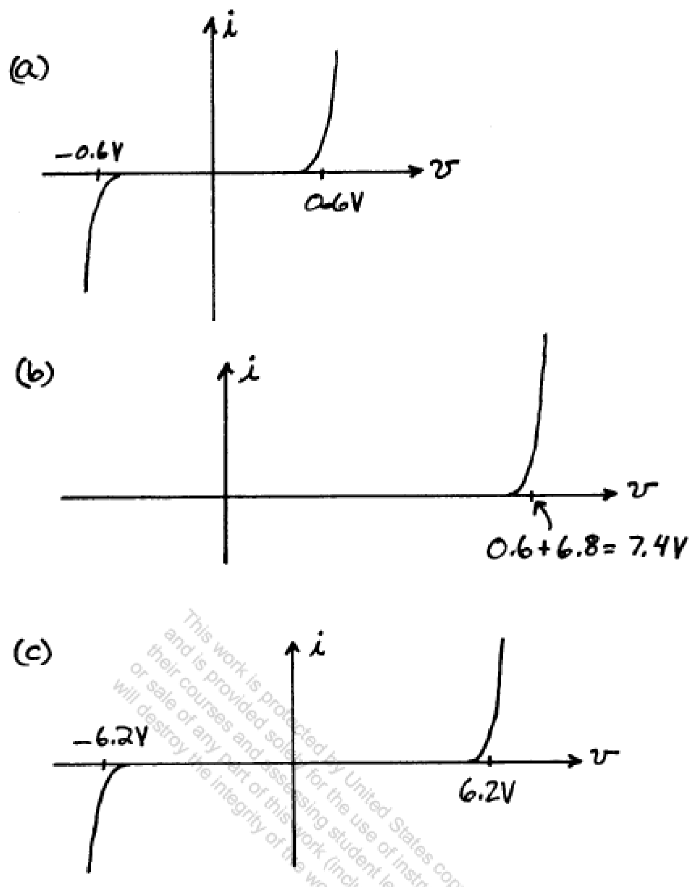
P9.1


Anode
Cathode

P9.2


i_D
v_D
Reverse breakdown
Reverse bias
Forward bias

P9.6*


(a)
i
v
−0.6V
0.6V
(b)
i
v
0.6+6.8= 7.4V
(c)
i
v
−6.2V
6.2V

P9.25 A Zener diode is a diode intended for operation in the reverse breakdown region. It is typically used to provide a source of constant voltage. The volt-ampere characteristic of an ideal 5.8-V Zener diode is: