P_ 1.13 a) $P = +vi = -12(30) = -360$

The power flow is thus from B to A, and car A has the "dead" battery.

b) $w = \int_0^t p\,dx = \int_0^t 360\,dx = 360t = 360 \times 60$

$= 21.6\,kJ$

P_ 1.15 a) $p = vi = 30e^{-500t} - 30e^{-1500t} - 40e^{-1000t}$

$+ 50e^{-2000t} - 10e^{-3000t}$

$p(1ms) = 3.1\,mW$

b) $w(t) = \int_0^t p(x)\,dx$

$= \int_0^t \left(30e^{-500x} - 30e^{-1500x} - 40e^{-1000x} + 50e^{-2000x} - 10e^{-3000x}\right) dx$

$= 21.67 - 60e^{-500t} + 20e^{-1500t}$

$+ 40e^{-1000t} - 25e^{-2000t} + 3.33e^{-3000t}$ μJ

$W(1ms) = 1.24\,\mu J$

c) $W_{total} = 21.67\,\mu J$

P- 1.21 a) $p = vi$

$$= 400\times10^3 t^2 e^{-800t} + 700t e^{-800t} + 0.25 e^{-800t}$$

$$= e^{-800t}\left[400{,}000t^2 + 700t + 0.25\right]$$

$$\frac{dp}{dt} = e^{-800t}\left[800{,}000t + 700\right]$$

$$+ (-800) e^{-800t}\left[400{,}000t^2 + 700t + 0.25\right]$$

$$= \left(3{,}200{,}000t^2 - 2400t - 5\right)\left(-100 e^{-800t}\right)$$

$$\therefore \quad \frac{dp}{dt} = 0 \implies 3{,}200{,}000t^2 - 2400t - 5 = 0$$

So P_{max} occurs at $t = 1.68$ ms.

b) $$P_{max} = e^{-800(0.00168)}\left[400{,}000(0.00168)^2 + 700(0.00168) + 0.25\right] = 666 \text{ mW}$$

c) $$w = \int_0^t p(x)\,dx$$

$$= \int_0^t 4\times10^5 x^2 e^{-800x}\,dx + \int_0^t 700x\, e^{-800x}\,dx + \int_0^t 0.25 e^{-800x}\,dx$$

$$= \frac{4\times10^5 e^{-800x}}{-512\times10^6}\left[64\times10^4 x^2 + 1600x + 2\right]\Big|_0^t +$$

$$\frac{700 e^{-800x}}{64\times10^4}\left[-800x - 1\right]\Big|_0^t + 0.25\,\frac{e^{-800x}}{-800}\Big|_0^t.$$

when $t = \infty$, all upper limits go to zero. Thus,

$$w = \frac{4\times10^5(2)}{512\times10^6} + \frac{700}{64\times10^4} + \frac{0.25}{800} = 2.97 \text{ mJ}$$

P- 2.6 The interconnection is valid because it does not violate KCL or KVL.

$i_\Delta = -25\ A$; $6i_\Delta = -150V$

$-200 + 50 - (-150) = 0$

P- 2.9 The interconnection is valid because it does not violate KCL or KVL.

$P_{V-sources} = (100 - 60)(5) = 200W$

P- 2.12 (a) $v_o = 8i_a + 14i_a + 18i_a = 40(20) = 800V$

$800 = 10\,i_o$

$i_o = \frac{800}{10} = 80\ A$

b) $i_g = i_a + i_o = 20 + 80 = 100\,A$

c) P_g (delivered) $= 100(800) = 80{,}000\,W$

$= 80\,KW$