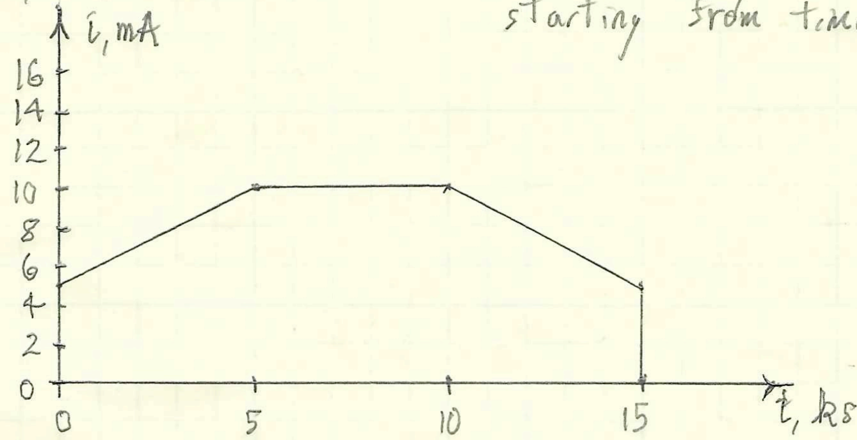
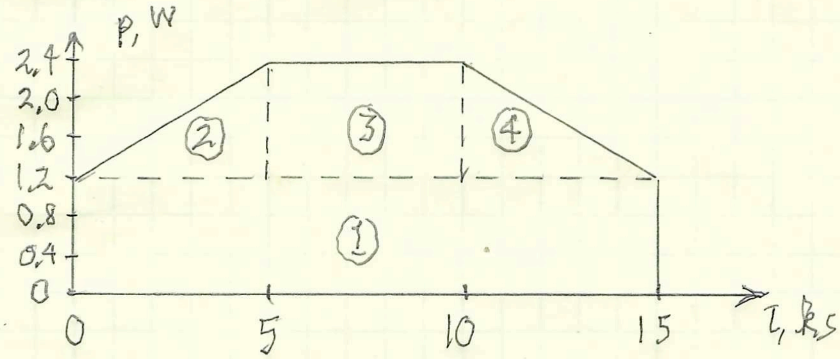
1) 1.28) $V = 240\,V$

Take "initially" in description to mean starting from time $t = 0$.

a)



b) $p(t) = v(t)\,i(t) = 240\,i(t)$. Obtain same shape as above, but different vertical scale.



c) E = area under the power curve in (b). This is the same as the area of the rectangles 1 and 3 and the triangles 2 and 4.

Area 1 $= (15\times10^3\,s)(1.2\,J/s) = 18\,kJ$

Area 3 $= (5\times10^3\,s)(1.2\,J/s) = 6\,kJ$

Area 2 + 4 $= 2\times\frac{1}{2}(5\times10^3\,s)(1.2\,J/s) = 6\,kJ$

Total area $= (18+6+6)\,kJ = \underline{\underline{30\,kJ}}$

2) 1.33) Power for the elements, employing the passive sign convention and the given powers and currents, is:

$p_a = -v_a i_a = -0.918\text{ W} = -v_a(-0.051\text{A})$

$p_b = v_b i_b = -0.81\text{ W} = v_b(0.045\text{ A})$

$p_c = v_c i_c = -0.012\text{ W} = v_c(-0.006\text{ A})$

$p_d = -v_d i_d = 0.4\text{ W} = -v_d(-0.02\text{ A})$

$p_e = -v_e i_e = 0.224\text{ W} = -v_e(-0.014\text{ A})$

$p_f = v_f i_f = 1.116\text{ W} = v_f(0.031\text{ A})$

a) Need to show sum of all powers is zero.

$\Rightarrow -0.918 - 0.81 - 0.012 + 0.4 + 0.224 + 1.116 = 0$ checks!

b) Absorbed/consumed power is positive; delivered power is negative.

$\Rightarrow$ Elements d, e, and f are absorbing power.

c) $v_a = -(0.918/-0.051) = \underline{\underline{-18\text{V}}}$

$v_b = -0.81/0.045 = \underline{\underline{-18\text{V}}}$

$v_c = -0.012/-0.006 = \underline{\underline{2\text{V}}}$

$v_d = -(0.4/-0.02) = \underline{\underline{20\text{V}}}$

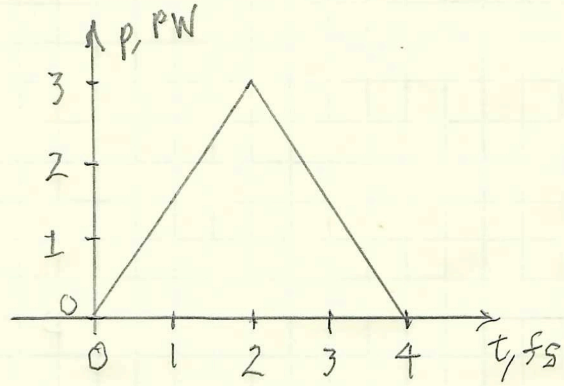
$v_e = -(0.224/-0.014) = \underline{\underline{16\text{V}}}$

$v_f = 1.116/0.031 = \underline{\underline{36\text{V}}}$

3) $3\text{ PW} = 3\times10^{15}\text{ W}$

Pulse varies linearly from 0 to 3 PW over 2 fs (2×10^{-15} s) and then back down to zero over the next 2 fs.

Power vs. time:



a) $\text{Energy} = \int p(t)\,dt$

Area under curve is area of a triangle $= \frac{1}{2}(\text{base})(\text{height})$

$$E = \frac{1}{2}\left(4\times10^{-15}\text{ s}\right)\left(3\times10^{15}\ \underbrace{\text{J/s}}_{\text{W}}\right) = \underline{\underline{6\text{ J}}}$$

b) Assume power of LED lightbulb is constant.

$$E_{LED} = (\text{time})(\text{Power}) = (\text{time})(20\text{ J/s}) = 6\text{ J}$$

$$\Rightarrow \text{illumination time} = \frac{6\text{ J}}{20\text{ J/s}} = \underline{\underline{0.3\text{ s}}}$$