

练习一.

1-8. 解: (1) $P = u i = \begin{cases} 0, & t < 0 \\ 3750 e^{-1000t} (1 - e^{-1000t}) \text{ W}, & t \geq 0. \end{cases}$

令 $t = 0.1 \text{ ms}$, $P \approx 322.90 \text{ W}$.

(2) $P \leq 3750 \times \frac{(e^{-1000t} + 1 - e^{-1000t})}{4} = 937.5 \text{ W}$, 当仅当 $e^{-1000t} = 1 - e^{-1000t}$ 取“=”.

即 $e^{-1000t_1} = \frac{1}{2}$ $t_1 = \frac{\ln 2}{1000} \text{ s}$. $P_{\max} = 937.5 \text{ W}$.

(3) 令 $P = 0$, 则 $e^{-1000t} = 0$ 或 $1 - e^{-1000t} = 0$. 即 $t \rightarrow \infty$ 或 $t = 0$ 时.

(4) $W = \int_0^{\infty} P dt = \int_0^{\infty} 3750 e^{-1000t} (1 - e^{-1000t}) dt$
 $= 3750 \left(\frac{e^{-1000t}}{-1000} - \frac{e^{-2000t}}{-2000} \right) \Big|_0^{\infty} = 1.875 \text{ J}.$

1-10. 解: (1) $E = U I t = 43200 \text{ J}$

(2) $T = \frac{E}{P} = 1.728 \times 10^5 \text{ s}$.

负载电流 $i = \frac{P}{U} \approx 20.83 \text{ mA}$.

1-14. 解: (1) $U_1 = 10 \text{ mV}$, $i_2 = 4 U_1 = 40 \text{ mA}$, $U_2 = -i_2 R_2 = -4 \text{ V}$

(2) $P_2 = i_2 U_2 = -160 \text{ mW}$.

(3) $P_1 = U_1 i_1 = \frac{U_1^2}{R_1} = 2 \mu \text{ W}$.

1-19. 解: 记电流 \leftarrow . 应用 KCL, 有 $i_1 - i_2 - i_3 = 0$, $i_3 = -2 \text{ A}$.

故 $U = i_3 R = -20 \text{ V}$.

1-27 解: (a) (1). 由 KCL, $i_2 - i_1 - i_4 = 0$, $i_4 - i_3 - i_6 = 0$, $i_2 - i_5 - i_6 = 0$.

由 KVL, $5i_3 - i_1 - 1 = 0$, ① $i_1 + 2i_2 - 2 = 0$, ②

$i_1 + 2i_2 - 5i_3 - 3 = 0$, ③, 由 ② ③ 得, $i_3 = -\frac{1}{5} \text{ A}$. 代入 ①

有 $i_1 = -2 \text{ A}$, $i_2 = 2 \text{ A}$. $\Rightarrow i_4 = 4 \text{ A}$, $i_5 = -\frac{11}{5} \text{ A}$, $i_6 = \frac{21}{5} \text{ A}$.

综上: 对 R_1 : $i_1 = -2 \text{ A}$, $P_1 = i_1^2 R_1 = 4 \text{ W}$. 对 R_2 , $i_2 = 2 \text{ A}$, $P_2 = i_2^2 R_2 = 8 \text{ W}$

对 R_3 , $i_3 = -\frac{1}{5} \text{ A}$, $P_3 = i_3^2 R_3 = \frac{1}{5} \text{ W}$.

(2) 由(1), $i_4 = 4A$, $i_5 = -\frac{11}{5}A$, $i_6 = \frac{21}{5}A$.

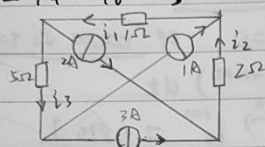
故 $P_4 = U_4 i_4 = 4W$, 提供; $P_5 = U_5 i_5 = \frac{22}{5}W$, 吸收.

$P_6 = U_6 i_6 = \frac{63}{5}W$, 提供

(3) $P_{吸收} = P_1 + P_2 + P_3 + P_5 = \frac{83}{5}W$. 故收支守恒.

$P_{提供} = P_4 + P_6 = \frac{83}{5}W$.

(b)



(4) 由KCL, $i_2 - 2 - 3 = 0$, $i_1 - 1 - i_2 = 0$

$i_3 - 1 - 3 = 0$,

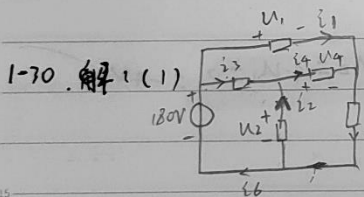
有 $i_1 = 6A$, $i_2 = 5A$, $i_3 = 4A$

计算电压: $U_{1A} = i_1 R_1 + i_3 R_3 = 26V$. $U_{2A} = i_2 R_2 + i_1 R_1 = 16V$

$U_{3A} = i_2 R_2 + i_1 R_1 + i_3 R_3 = 36V$.

故功率 $P_{1A} = U_{1A} i_{1A} = 26W$, $P_{2A} = U_{2A} i_{2A} = 32W$, $P_{3A} = U_{3A} i_{3A} = 108W$, 提供

验证: $P_{吸收} = i_1^2 R_1 + i_2^2 R_2 + i_3^2 R_3 = 166W = P_{1A} + P_{2A} + P_{3A}$.



1-30. 解: (1) $U_1 = i_1 R_1 = 100V$. 由KVL, $U_1 + U_5 - 180 = 0$.

有 $U_5 = 80V$, $i_5 = \frac{U_5}{R_5} = 10A$.

由KCL, $i_1 + i_4 - i_5 = 0$, $i_4 = 6A$.

进一步有 $U_4 = i_4 R_4 = 60V$, 再由KVL, $U_2 - U_4 - U_5 = 0$, $U_2 = 140V$.

于是 $i_2 = -\frac{U_2}{R_2} = -2A$.

(2) 解方程: 由KVL, $U_1 + U_5 - 180 = 0$ ①, $U_3 + U_2 - 180 = 0$ ②, $U_4 + U_5 - U_2 = 0$ ③

由KCL, $i_1 + i_4 = i_5$ ④, $i_3 + i_2 = i_4$ ⑤,

其中 $U_1 = 25i_1$, $U_2 = -70i_2$, $U_3 = 5i_3$, $U_4 = 10i_4$, $U_5 = 8i_5$.

联立得 $i_1 = 4A$. 正确.

A+