ELEN20005 FOUNDATIONS OF ELECTRICAL NETWORKS
Semester 1 Exam, 2019
Numerical Answers

Question 1

(a).

$$\begin{aligned} 0 &= \frac{v_1}{R_2} + \frac{v_1 - v_3}{R_1} + \frac{v_2 - v_3}{R_3} - i_s \\ 0 &= \frac{v_3 - v_1}{R_1} + \frac{v_3}{R_4} + \frac{v_3 - v_2}{R_3} \\ 0 &= -v_1 + \frac{v_x}{2} + v_2 \\ v_x &= v_3 - v_1 \end{aligned}$$

(b) Supplies 15 W (c) 332K

Question 2

(a) $v_C(0^-) = 50\ V$ (b) $v_C(0^+) = 50\ V$ (c) $v_C(t) = 25(1 + e^{-t})\ V$
(d) $v_C(\infty) = 25\ V$, after 4.6 s.

Question 4

(a) $\mathbf{V} = 2.17\underline{/77.5^\circ}\ V$, $Z_T = 217\underline{/77.5^\circ}\ \Omega$.
(b) $i_C(t) = 1.1\cos(1000t + 167^\circ)\ mA$, $i_L(t) = 10.8\cos(1000t - 12.5^\circ)\ mA$
$i_R(t) = 2.2\cos(1000t + 77.5^\circ)\ mA$, $v(t) = 2.17\cos(1000t + 77.5^\circ)\ V$

Question 5

(a) Load A: $P = 10\ kW$, $Q = 4.83\ kVAR$, $AP = 11.1\ kVA$, $\theta = 25.8^\circ$.
Load B: $P = 12\ kW$, $Q = -9.0\ kVAR$, $AP = 15\ kVA$, $\theta = -36.8^\circ$.
Source: $P = 22\ kW$, $Q = -4.2\ kVAR$, $AP = 22.4\ kVA$, $\theta = -10.8^\circ$.
$I_{Arms} = 11.1\ Arms$, $I_{Brms} = 15\ Arms$.
(b) $R = 81.1\ \Omega$, $X = 38.9\ \Omega$.

Question 6

(b) $\mathbf{V}_1 = 791\underline{/18.4^\circ}\ V$, $\mathbf{I}_1 = 0.354\underline{/-45^\circ}\ A$.
(c) $\mathbf{V}_2 = 79.1\underline{/18.4^\circ}\ V$, $\mathbf{I}_2 = 3.54\underline{/-45^\circ}\ A$, $P = 62.7\ W$.

Question 7

$i = 0\ A$ as the diode is OFF.

Question 8

(a) $Z = AB\overline{C}$
(b) X has 'No promises' from $t = 5\ ns$ to $t = 21\ ns$.
Y has 'No promises' from $t = 5\ ns$ to $t = 25\ ns$.
Z has 'No promises' from $t = 10\ ns$ to $t = 46\ ns$.
(c) contamination delay $= 10\ ns$, propagation delay $= 46\ ns$.

Question 9

(a) $\mathbf{V}_L = \dfrac{jV_t 2\pi f L}{R + j2\pi f L}$

(b) $H_L(f) = \dfrac{j2\pi^2 f}{5000 + j2\pi^2 f}$

(c) $V_L(t) = 98.7\cos(10\pi t + 88.7°) + 394\cos(40\pi t + 85.5°)\ mV.$