# Solutions to Tutorial Sheet-10

**1.** $V_2 = \frac{N_2}{N_1} \times V_1 = \frac{1}{12} \times 220 = 18.33\,\mathbf{V}$; $V_m = V_2 \times \sqrt{2} = 18.33 \times \sqrt{2} = 25.93\,\mathbf{V}$; $V_{dc} = \frac{V_m}{\pi} = \frac{25.92}{\pi} = \mathbf{8.25V}$;
$PIV = V_m = \mathbf{25.93V}$

**2.** (a) $V_2 = \frac{N_2}{N_1} V_1 = \frac{1}{10} \times 220 = 22\text{ V}$; $\therefore\ V_m = V_2 \times \sqrt{2} = 22 \times \sqrt{2} = 31.1\text{ V}$; $I_m = \frac{V_m}{R_L + r_f} = \frac{31.1}{510} \approx 61\text{ mA}$;

$\therefore\ I_{dc} = \frac{I_m}{\pi} = \mathbf{19.4\,mA}$

(b) $\eta = \frac{40.6}{1 + r_f / R_L}\% = \frac{40.6}{1 + 10/500}\% = \mathbf{39.8\ \%}$

(c) $PIV = V_m - V_T = 31.1 - 0.7 = \mathbf{30.4V}$

**3.** $N_1 : N_2 = 1000 : 50 = 20 : 1$, $V_{in} = 220$ V, $R_L = 1$ kΩ

$V_2 = \frac{N_2}{N_1} V_1 = \frac{50}{1000} \times 220 = 11\text{ V}$; $V_m = V_2 \times \sqrt{2} = 15.5\text{ V}$

(a) $\therefore\ PIV = 2V_m = \mathbf{31V}$; (b) $V_{dc} = \frac{2V_m}{\pi} = \frac{2 \times 31}{\pi} = \mathbf{9.9V}$; (c) $I_{dc} = \frac{V_{dc}}{R_2} = \frac{99}{1000} = \mathbf{9.9\ mA}$

**4.** $V_{dc} = \frac{2(V_m - 2V_T)}{\pi}$; $\therefore\ V_m = \frac{\pi}{2} V_{dc} + 2V_T = \frac{\pi}{2}(15) + (0.7) = 24.95\text{ V}$; $V_2 = \frac{V_m}{\sqrt{2}} = 17.64\text{ V}$;

$\therefore\ \frac{N_1}{N_2} = \frac{V_1}{V_2} = \frac{220}{17.64} \approx 12.4$; $\therefore\ N_1 : N_2 \approx \mathbf{12{:}1}$

**5.** (a) $PIV = V_m - 2V_T = 20 - 0 = \mathbf{20V}$

(b) $I_m = (V_m - 2V_T)/(R_L + R_S + 2r_f) = \frac{20}{970 + 10 + 20} = 20\text{ mA}$; $I_{dc} = \frac{2I_m}{\pi} = \frac{2 \times 20}{\pi}\text{ mA} = \mathbf{12.7\ mA}$

(c) $P_{dc} = I_{dc}^2 R_L = (12.7)^2 (970)\ \mu\text{W} = \mathbf{156.5\ mW}$

(d) $\eta = \frac{81.2}{1 + 2r_f / R_L}\% = \frac{81.2}{1 + 20/970}\% = \mathbf{79.56\,\%}$

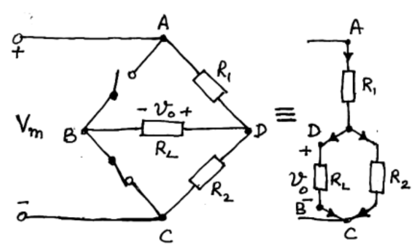
**6.** $V_m = 220 \times \sqrt{2} = \mathbf{331\,V}$; $V_{dc} = \frac{V_m}{\pi} = \mathbf{105.4\,V}$

**7.** (a) $I_{\max} = \frac{P_{\max}}{V_T} = \frac{14\text{ mW}}{0.7\text{ V}} = \mathbf{20\ mA}$

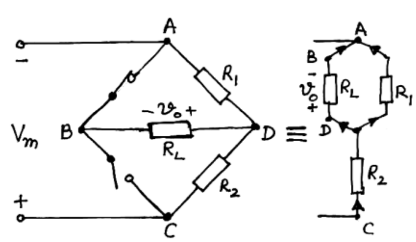
(b) $R_L = 5.6\text{ k}\Omega \,||\, 47\text{ k}\Omega = 5\text{ k}\Omega$; $I_{\max} = \frac{V_m - V_T}{R_L} = \frac{150\text{ V} - 0.7\text{ V}}{5\text{ k}\Omega} = \mathbf{29.86\,mA}$

(c) $I_D = \frac{I_{\max}}{2} = \mathbf{14.93\,mA}$; (**d**) Yes; (**e**) $I_D = \mathbf{29.86\,mA} > I_{\max} = 20\text{ mA}$

**8.**




(a) For positive half-cycle.

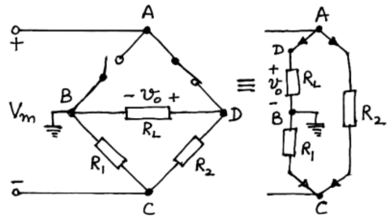



(b) For negative half-cycle.

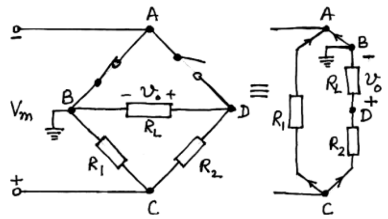
(a) $V_{o(\max)} = V_{DB(\max)} = V_m \frac{(R_L \parallel R_2)}{R_1 + (R_L \parallel R_2)} = (150\text{ V}) \times \frac{1.1\text{ k}\Omega}{2.2\text{ k}\Omega + 1.1\text{ k}\Omega} = \mathbf{50\ V}$

(b) $V_{o(\max)} = V_{DB(\max)} = V_m \frac{(R_L \parallel R_1)}{R_2 + (R_L \parallel R_1)} = (150\text{ V}) \times \frac{1.1\text{ k}\Omega}{2.2\text{ k}\Omega + 1.1\text{ k}\Omega} = \mathbf{50\ V}$; and $V_{dc} = \frac{2V_m}{\pi} = \mathbf{31.8\,V}$

**9.**




(a) For positive half-cycle.

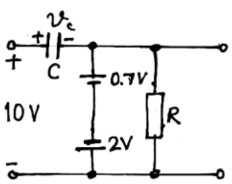



(b) For negative half-cycle.

$$V_m = \frac{V_{pp}}{2} = \frac{200\ \text{V}}{2} = 100\ \text{V}$$

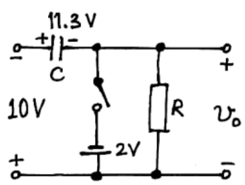
(a) $V_{o(\max)} = V_{DB(\max)} = V_m \dfrac{R_L}{R_L + R_1} = (100\ \text{V}) \times \dfrac{2.2\ \text{k}\Omega}{2.2\ \text{k}\Omega + 2.2\ \text{k}\Omega} = \mathbf{50\ V}$

(b) $V_{o(\max)} = V_{DB(\max)} = V_m \dfrac{R_L}{R_L + R_2} = (100\ \text{V}) \times \dfrac{2.2\ \text{k}\Omega}{2.2\ \text{k}\Omega + 2.2\ \text{k}\Omega} = \mathbf{50\ V}$; and $V_{dc} = \dfrac{2V_m}{\pi} = \mathbf{31.8\ V}$



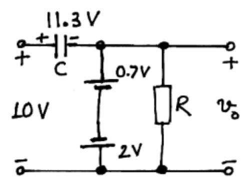

(***a***) Charging of capacitor during first positive half-cycle.

$v_C$ = – 0.7 V+ 2 V + 10 V




(***b***) Circuit during negative half-cycle.

$v_o$ = -10 V – 11.3 V




(***c***) Circuit during positive half-cycle.

$v_o$ = -2 V + 0.7 V