Average value   Square   wave

                                   Algebraic sum of
                                   area under the curve
            Avg   value = ————————————————————————
                                   length   of   curve

$$\text{Avg value} = \frac{(10)(1ms) + (-10)(1ms)}{2\ ms}$$

$$= 0$$

$T = 2ms$

$$\text{Avg} = \frac{(20)(1ms) + (-5)(1ms)}{2}$$

$$= \frac{20 - 5}{2}$$

$$= \boxed{7.5v}$$

Sine Wave

$$\int_0^\pi A_m \sin \alpha \cdot d\alpha = -A_m \cos \alpha \Big/_0^\pi$$

$$\boxed{= 2A_m}$$

$$Avg = \frac{(2A_m) + (-2A_m)}{2\pi}$$

if $A_m = 10$; $2A_m = 20$

Half wave

$$Avg = \frac{2A_m + 0}{2\pi} = \frac{A_m}{\pi}$$

$v(t)$ **full wave**

Am

$0 \quad \pi \quad 2\pi \quad t$

$$Avg = \frac{2Am}{\pi}$$

Effectional value, rms value

$$P_{DC} = I_{DC}^2 \, R$$

Switch 2 is closed

as Switch 1 is open

$$i(t) = I_m \sin \omega t$$

$$P_{ac} = i^2(t) \, R$$

$$= (I_m \sin \omega t)^2 \, R = I_m^2 \sin^2 \omega t \, R$$

under what condition $P_{DC} = P_{ac}$

$$I_{DC}^2 \, \cancel{R} = I_m^2 \sin^2 \omega t \, \cancel{R}$$

$$\sin^2 \omega t = \frac{1}{2}(1 - \cos 2\omega t)$$

$$I_{DC}^2 = I_m^2 \frac{1}{2}(1 - \cos 2\omega t) = \frac{1}{2} I_m^2 - \frac{1}{2} I_m^2 \cos 2\omega t$$

$$I_{DC}^2 = \frac{1}{2} I_m^2 \qquad I_m^2 = \frac{I_{DC}^2}{2}$$

$$I_m^2 = 2I_{DC}^2$$

$$I_m = \sqrt{2}\ I_{DC}$$

$$I_{rms} = \frac{I_m}{\sqrt{2}} = 0.707\ I_m$$

$$I_m = \sqrt{2}\ I_{rms}$$

$i(t)$

$$I_{rms} = (0.707)(10) = 7.07A$$

$$I_m = \sqrt{2}\ I_{ms} = 1.414\ I_{ms}$$

$$V_{rms} = V_m (0.707)$$

$$V_m = \frac{V_{rms}}{0.707} = \sqrt{2}\ V_{rms}$$

The effective value or rms value of
any signal $f(t)$

$$f_{rms} = \sqrt{\frac{\int_0^T f^2(t)\,dt}{T}} = \sqrt{\frac{\text{area under square}}{\text{of signal}}\Big/\text{Period of signal}}$$

find the average value at rms value

$$\text{Avg} = \frac{(3)(4) + (-1)(4)}{8} = 1 \text{ v}$$

$$V_{rms} = \sqrt{\frac{(4)(9) + (4)(9)}{8}} = 2.236 \text{ v}$$