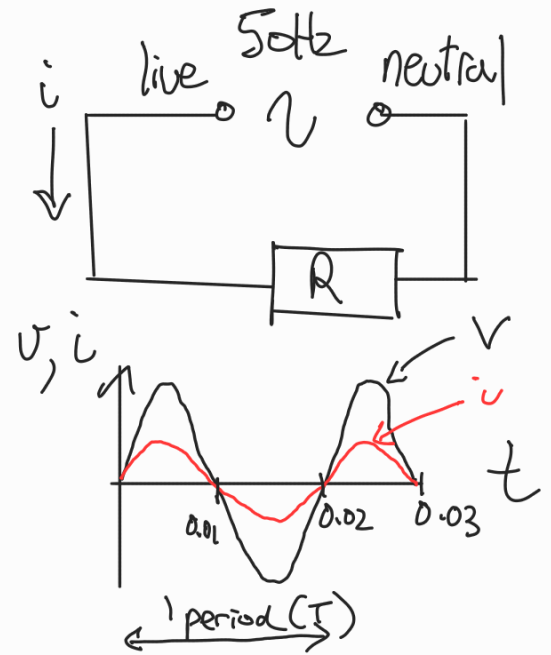
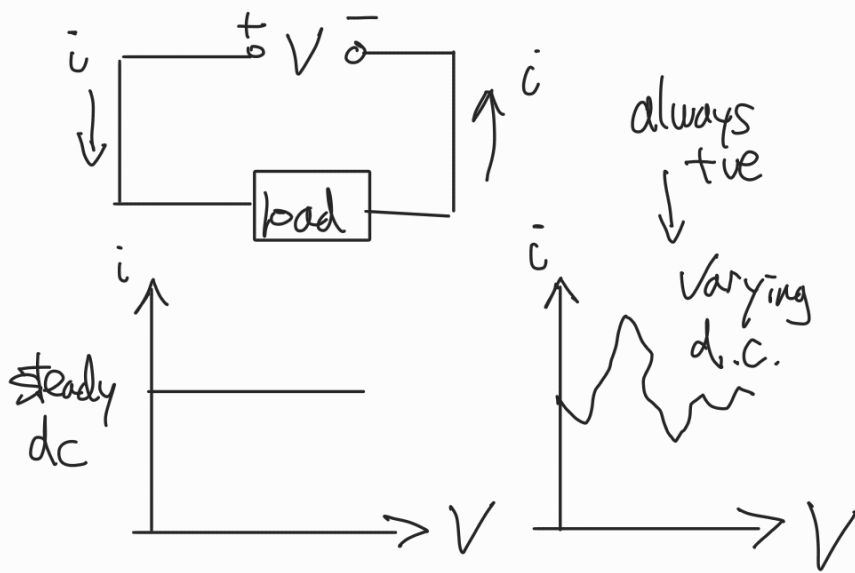
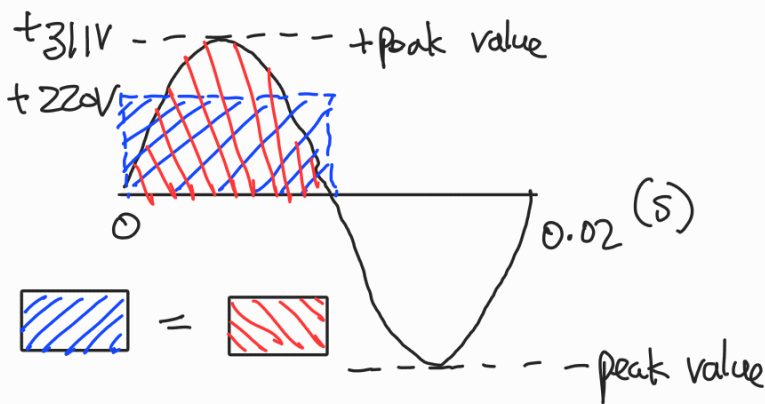


4.3 Ac and Domestic Electricity

Direct and alternating current



Mains Current (Hz)



$$f : 50Hz \quad \left. \begin{array}{l} f = \frac{1}{T} \\ T : 0.02 \end{array} \right\}$$

peak value : ± 311

average power voltage value : $\pm 220V$
(r.m.s.)

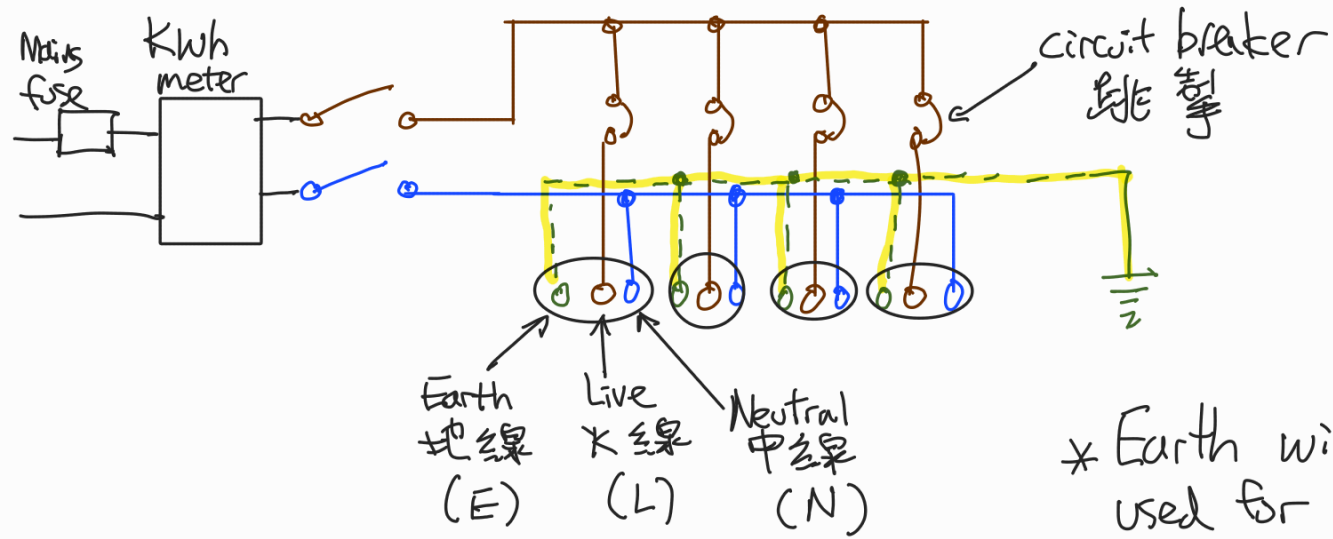
Power Ratings $W = IV$

e.g. hair dryer $\left. \begin{array}{l} 1000W \\ 220V \end{array} \right\} W = I_{ac} V_{ac} \quad I = \frac{1000W}{220V} \quad (A)$

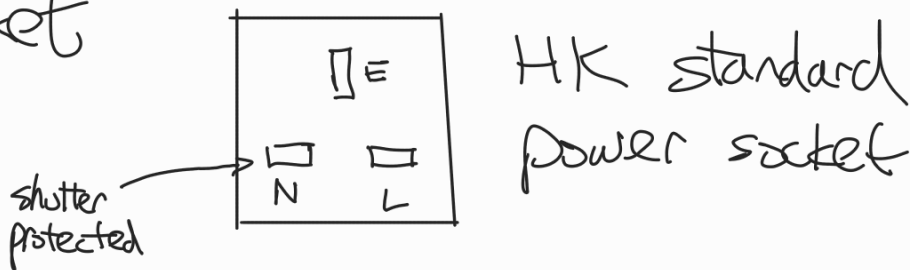
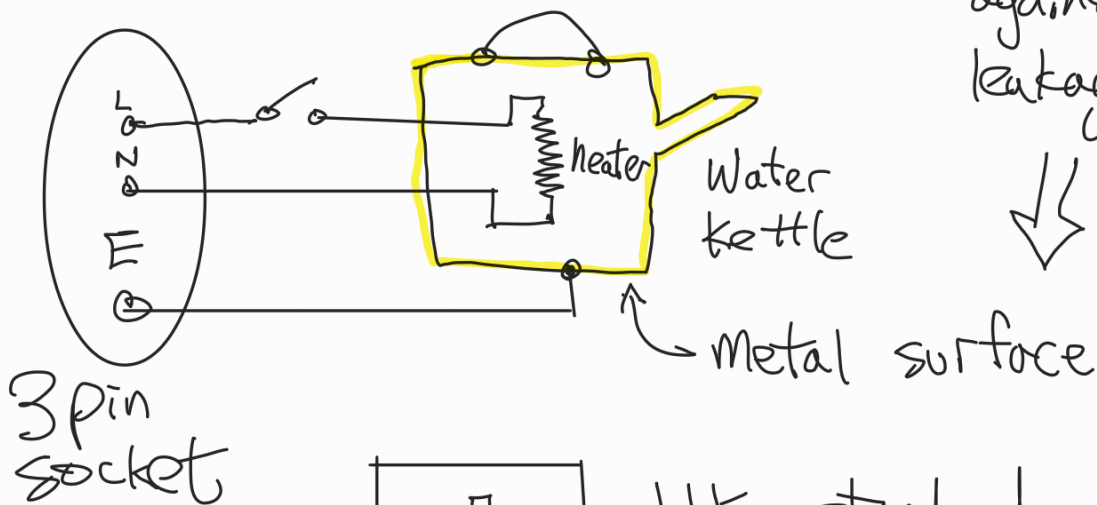
Energy Consumption

1 unit = 1 kWh = 1000 Wh $\Rightarrow$ 80¢
 $\uparrow \quad \quad \uparrow$
 1 kW hair dryer used for 1 hr

House hold Wiring



* Earth wire is used for protection against electricity leakage



- Overcurrent protection :
1. Fuse protection in power socket and devices. (e.g. 5A, 13A fuse)
 2. Circuit Breaker breaks the circuit when over current (e.g. 15A, 20A, 30A)

Residual Current Circuit Breaker (RCCB) - Detect leakage current between L and E, cut of electricity when occurs.

漏电保护装置

More About Mains a.c.

$$V = V_0 \sin \omega t$$

↑
can find the instantaneous value at any t

$$I = I_0 \sin \omega t$$

$$\omega = 2\pi f = \frac{2\pi}{T}$$

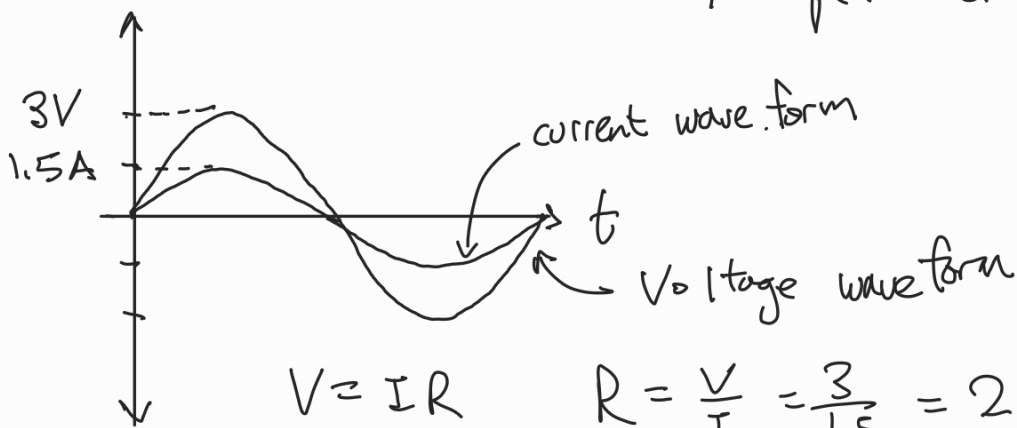
V_0 : peak Voltage (311 V for HK system)

I_0 : peak current

ω : how fast a.c. varies

f : frequency of waveform (50Hz, HK)

T : period of waveform (0.02s, HK)



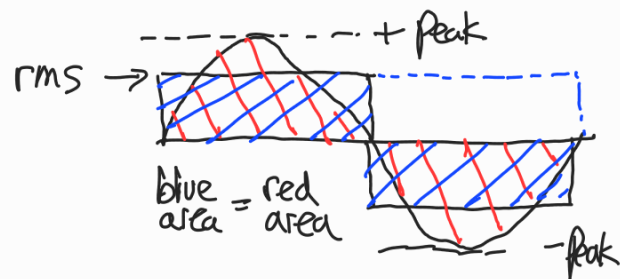
$$P = \frac{V^2}{R} = I^2 R = VI$$

for a.c

$$P = \frac{(V_0 \sin \omega t)^2}{R} = P_0 \sin^2 \omega t$$

↑
instantaneous power

↑
peak power



$$\text{Average Power } \langle P \rangle = V_{\text{rms}} \times I_{\text{rms}}$$

$$= \frac{(V_{\text{rms}})^2}{R} = (I_{\text{rms}})^2 R$$

What is rms ?

$$I_{\text{rms}} = \sqrt{\langle I^2 \rangle}$$

↑ root ↑ Mean ↑ square value

$$V_{\text{rms}} = \sqrt{\langle V^2 \rangle}$$

Relationship between peak value and rms value

$$V_{rms} = \sqrt{\langle V^2 \rangle} = \frac{1}{\sqrt{2}} V_0$$

(220V) $\quad \quad \quad = (0.707) \times (311)$

$$I_{rms} = \sqrt{\langle I^2 \rangle} = \frac{1}{\sqrt{2}} I_0$$

