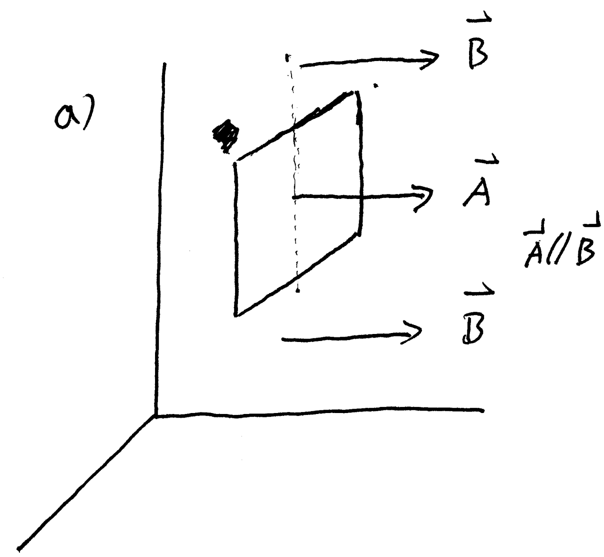
e.g. 29-2.

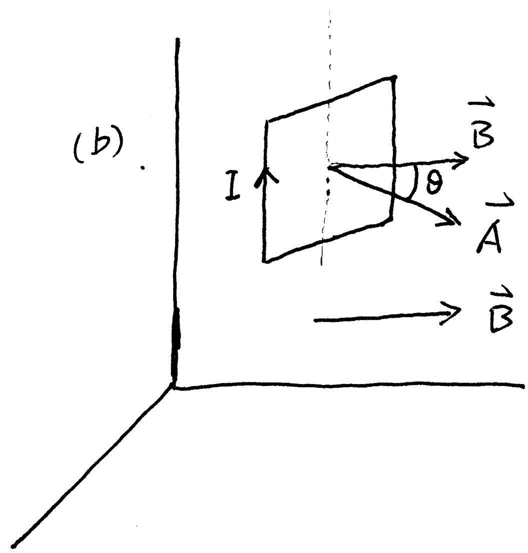
a). $\vec{A} \parallel \vec{B}$, $\theta = 0$

$$\Phi_B = \vec{A} \cdot \vec{B}$$
$$= AB$$
$$= (0.05)^2 \times 0.16$$
$$= 4.0 \times 10^{-4} \text{ wb}.$$



b). $\theta = 30^\circ$

$$\Phi_B = AB\cos\theta$$
$$= (0.05)^2 \times 0.16 \times \cos 30^\circ$$
$$= 3.5 \times 10^{-4} \text{ wb}.$$



c). from b) to a).

$$\Delta\Phi_B = 4.0 \times 10^{-4} - 3.5 \times 10^{-4}$$
$$= 5.0 \times 10^{-5} \text{ wb}$$

$$|\varepsilon| = \frac{\Delta\Phi_B}{\Delta t} = \frac{5.0 \times 10^{-5}}{0.14} = 3.6 \times 10^{-4} \text{ V}$$

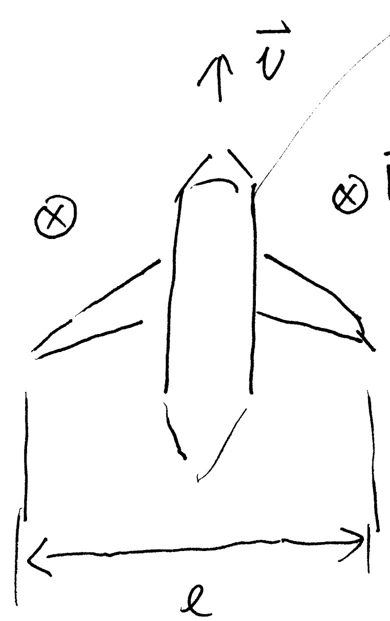
$$I = \frac{\varepsilon}{R} = \frac{3.6 \times 10^{-4}}{0.012} = 0.030 \text{ A}.$$

Cause of induction: from b) to a). Φ_B increases.

Result: I produce a field to reduce Φ_B, (opposite to the original $\vec{B}$-field) e.g. 29-6

$v = 1000\ km/h = 280\ m/s$

$B = 5 \times 10^{-5}\ T$, $\ell = 70\ m$



The emf:

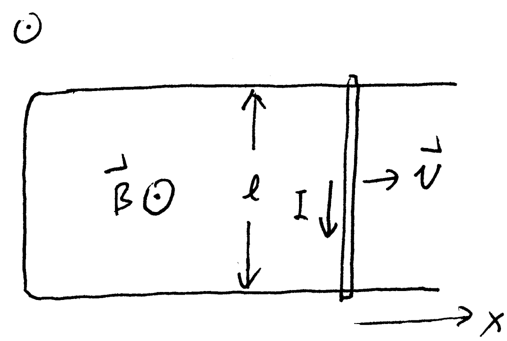
$$\mathcal{E} = B\ell v$$

$$= 5 \times 10^{-5} \times 70 \times 280$$

$$\approx 1\ V$$

e.g. 29-8.

a) when the rod moves, a current I is induced. $I = \dfrac{\ell v B}{R}$



This current experiences a magnetic force. since it is in the field $\vec{B}$.

$$\vec{F} = I\vec{\ell} \times \vec{B}$$

$$F = I\ell B = \left(\frac{\ell v B}{R}\right)\ell B = \frac{B^2\ell^2 v}{R}.$$

b). $dW = F dx$. — work for displacement dx.

$$P = \frac{dW}{dt} = F \cdot \frac{dx}{dt} = F \cdot v. = \frac{B^2\ell^2 v^2}{R}$$ — power.

e.g. 29-9 An ac generator

$f = 60\ Hz$, $B = 0.15\ T$

$\omega = 2\pi f = 377\ (rad/s)$.

$A = 2.0 \times 10^{-2}\ m^2$,

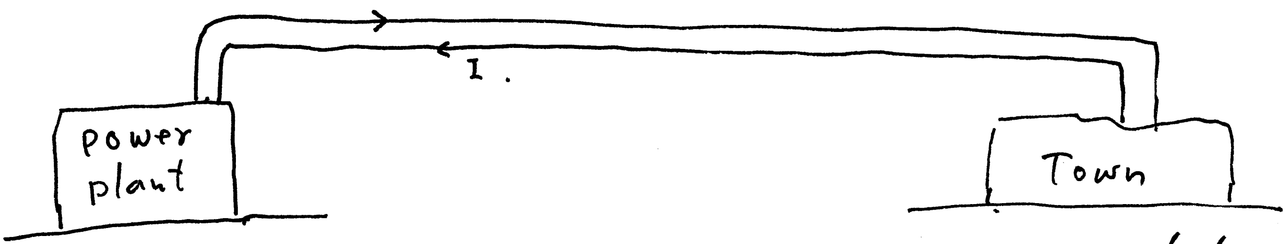
$\mathcal{E}_0 = 170V$. (peak emf.)

$$\mathcal{E} = NBA \sin(\omega t) \cdot \omega = \mathcal{E}_0 \sin(\omega t)$$

$$\mathcal{E}_0 = NBA\omega$$

$$N = \frac{\mathcal{E}_0}{BA\omega} = \frac{170}{0.15 \times 2.0 \times 10^{-2} \times 377} = 150 \text{ (turns)}$$

e.g. 29-13. I Transmission lines $R = 0.4\,\Omega$.



power needed:

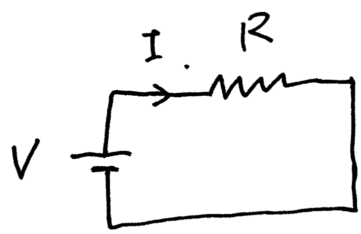
$P_T = 120$ KW.

want: Power loss in the transmission lines.

· power: $P = IV = I^2R = \frac{V^2}{R}$.

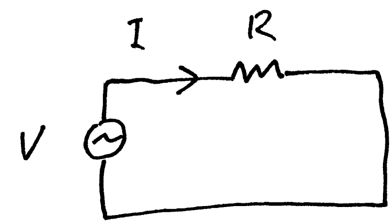
which one should be used?

what does it mean?



DC.

OR



AC.

V, I — RMS values.

power consummed by R: $P = IV = \frac{V^2}{R} = I^2R$.

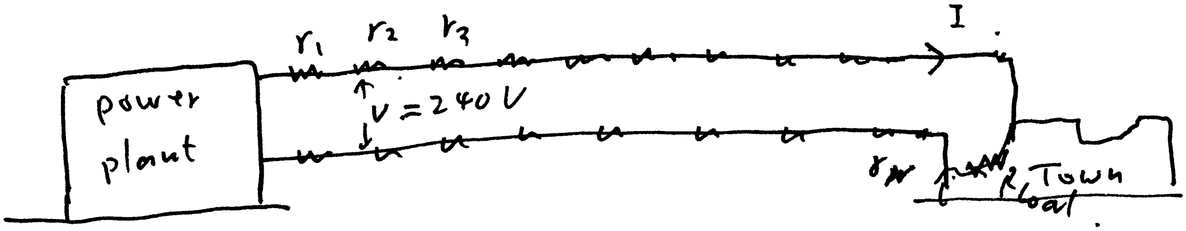
(The wire is perfect conductor).

I — current through R.

R — voltage across R.

In the example, the wire is not a perfect conductor.

The resistance of the wire is continuously distributed throughout the wire. $R = r_1 + r_2 + r_3 + \dots + r_N$.



a) $V = 240$ is NOT the voltage across R.

but the voltage across R_{Load}. (The Town)

useful power $P_T = IV$ (consummed by R_{Load})

$$I = \frac{P}{V} = \frac{120000}{240} = 500\,A.$$

That's the current through R_{load} as well as R.

Power commume by R (wasted):

$$P_R = I^2 R.$$

$$= (500)^2 \times 0.4\,\Omega = 100\,kW.$$

(almost as much as P_T!)

b) $V = 24{,}000\ V$.

$P_T = IV$.

$I = \dfrac{P_T}{V} = \dfrac{120\,000}{24\,000} = 5.0\ A$.

$P_e = I^2 R = (5)^2 \cdot 0.4 = 10\ W$.

(very little)

usually there is an efficiency in the tranformer, e.g. 99%.

so there is an additional loss in the transformer, but not too much.