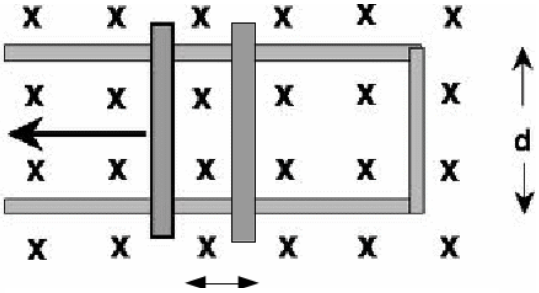
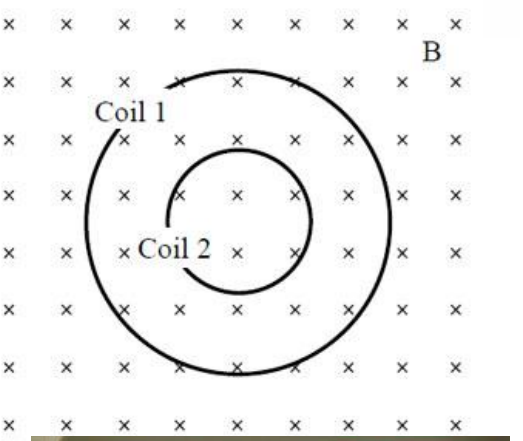
12 Electro-magnetic induction review questions

Induced emf

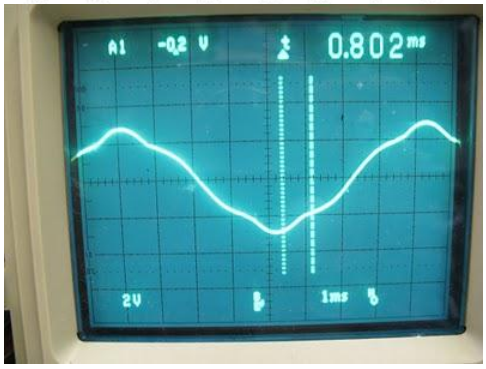


1. A wire is moved left to right through a magnetic field going into page as shown.
    a. State the direction of the induced electro-motive force.
    b. State the formula giving the size of this emf.
2. In the next diagram two coils of resistance wire of different diameters are in the same uniform magnetic field B. The magnitude of the magnetic field is increasing with time at a rate of $8Ts^{-1}$.
    a. State Lenz's law and use it to work out in which direction the current will flow.
    b. Calculate the size of the induced emf ignoring the magnetic effect of the induced current.
    c. State why the actual emf induced will be less than your answer in part b.

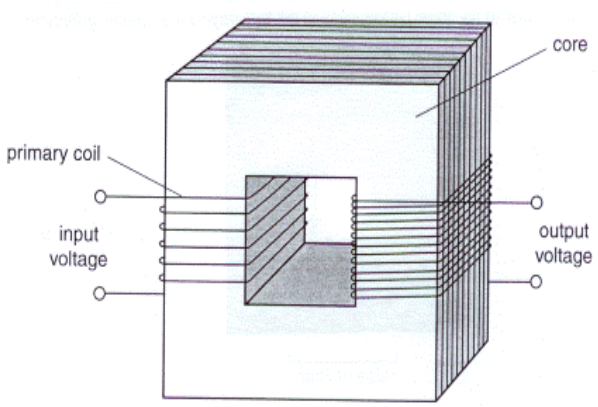


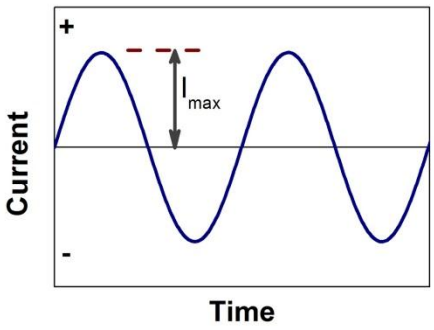
Alternating current

The trace opposite shows the induced emf of an AC generator peaking at 0.2V with a period of 64ms for a rotation.



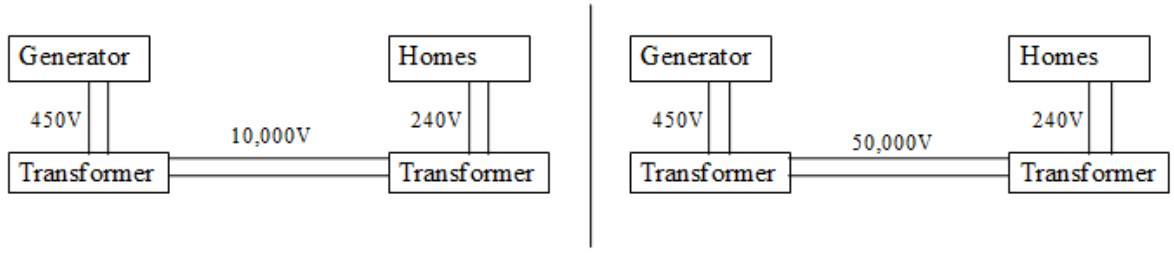
1. State the approximate rms value of the voltage.
2. Describe and quantify two differences in the trace is the generator was to rotate with a period of 32ms.
3. If the generator was connected to a 100 Ohmic resistor for this experiment calculate the power dissipated.
    a. At 64ms rotation period.
    b. At 32ms rotation period.
4. Describe how alternating current in a primary coil induces emf in a secondary coil of a transformer. State at what point in current's variation the induced voltage will be at its maximum.





Transmission of electrical power

1. This question gets you to compare these two power transmission systems:



The high voltage transmission lines in each system have a resistance of 1 Ohm. You can assume all other parts of the system to be "perfect". (in other words no power loss / 100% efficient).

(i) If the "Homes" are using 100 kW of electrical power what current is being drawn on the 240V circuit ?

(ii) What current is being drawn on (a) the 10,000V line and (b) the 50,000V line.

(iii) Given that the power loss is equal to I^2R for any circuit component calculate the power loss for

(a) The 10,000V line (b) The 50,000V line

(iv) What power must the generators provide (give your answers to 4 s.f)

(a) For the 10,000V line (b) For the 50,000V line

(v) What current must the two generators produce if their output voltage is 450V?

(vi) Why are very high voltage lines used for long distance power distribution?

2. Transformers are not "perfect". An alternating supply delivers a current of 0.025 A at 12 V to the primary coil of a transformer. A 20 Ω resistor is connected to the secondary coil. The current in the secondary circuit is 0.110 A.
    a. Calculate the power input.
    b. Calculate the power output.
    c. Calculate the efficiency.
3. For the same transformer as in question 2 the frequency of the supply is increased. The power input is kept constant. The current in the secondary coil falls to 0.105 A. Calculate the new efficiency of the transformer.
4. Outline why many people do not wish to live near to electricity sub-stations and power lines.