EM Induction & Transformers

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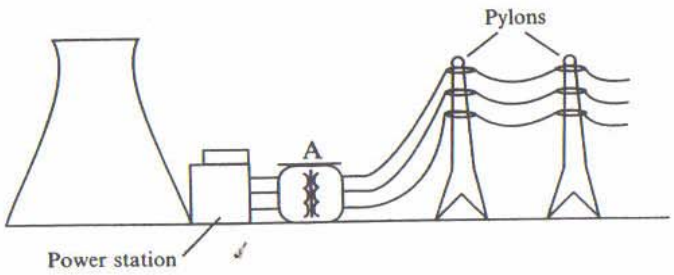
(b) The diagram shows part of the transmission system for carrying electricity from power station to consumers.

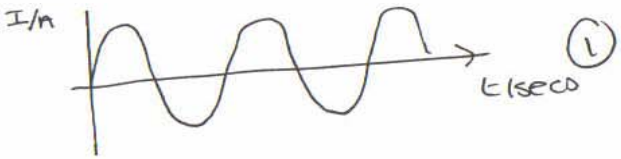
(1)



(i) Name the device labelled A (step up transformer)

(ii) An a.c. generator produces the electricity in the power station.

Explain what a.c. (alternating current) means.
You may illustrate your answer with a diagram.



(1)

The current change direction (1)
(electrons flow one way & then the other) repeatedly [2]
(1)
if no diagram.

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[Turn over

(iii) Describe **fully** why an a.c. generator **and** device A are used in the electricity transmission system.

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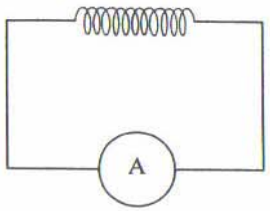
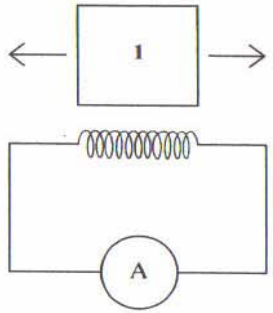
transformer steps up the voltage ①
in order to decrease the current ①
making system more efficient ①

transformers can only operate from ① a.c (to produce changing magnetic field) [4]

(d) A coil of wire is connected to a sensitive ammeter.



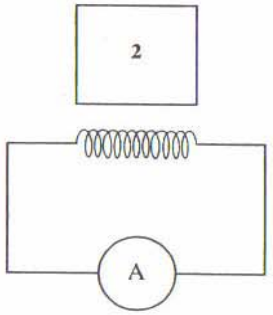
(i) When box **1** is moving beside the coil, a current is induced in the coil.



Suggest what device box **1** contains.

magnet or current carrying conductor (not e-magnet on its own)

(ii) When box **2** sits stationary beside the coil, a current is induced in the coil.



Suggest what box **2** contains.

conductor with a.c / spinning magnet [1]

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Marks	Remark

(e) A power station generates electricity for a large factory 30 km away.

The station sends out 3 MJ of electrical energy every second on the overhead transmission wires at a voltage of 33 000 V. The factory receives 2.94 MJ of electrical energy every second.

(i) Calculate the efficiency of the electrical transmission system. **Show clearly your working out.**

$$\text{eff} = \frac{\text{energy o/p}}{\text{energy i/p}} \quad (1)$$

$$= \frac{2.94}{3.0} \quad (1)$$

$$= 0.98$$

Efficiency = 0.98 or 98% (1) [3]

(ii) State **one** reason why the transmission system is not 100% efficient.

ohmic losses / heat losses

[1]

(iii) Suggest **one** change which would allow the electricity to be carried more efficiently over these transmission wires.

smaller current / thicker cables

or step up transformer [1]

(iv) One of the two transformers in this transmission system has 5500 turns on the primary coil and 500 turns on the secondary coil.

If the primary voltage is 33 000 V, calculate the secondary voltage.

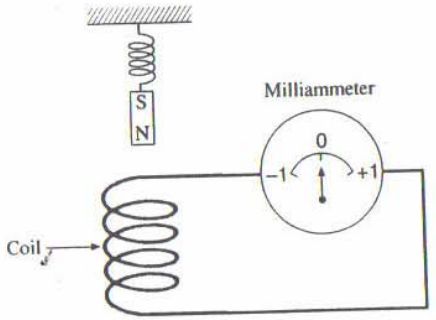
$$\frac{N_p}{N_s} = \frac{V_p}{V_s} \quad (1)$$

$$\frac{5500}{50} = \frac{33000}{x} \quad (1)$$

$$x = 3000\ \text{V}$$

Secondary voltage = 3000 (1) V [3]

8 Frank attaches a magnet to a spring and allows it to oscillate within a coil. (2)



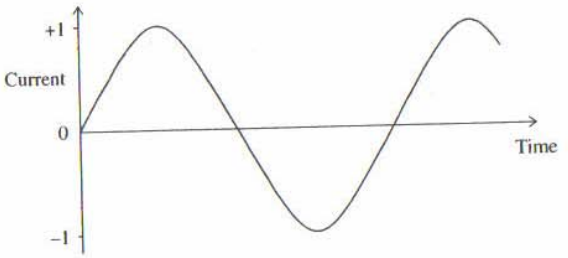
(a) (i) The magnet enters the coil. The maximum reading on the milliammeter is +1 mA.
Explain why a current is induced in the coil.

coil experiences changing magnetic field [1]

(ii) What size of current is induced when the magnet is stationary inside the coil?

zero [1]

(b) As the magnet oscillates, the readings on the milliammeter are recorded.
A graph of current against time is plotted.

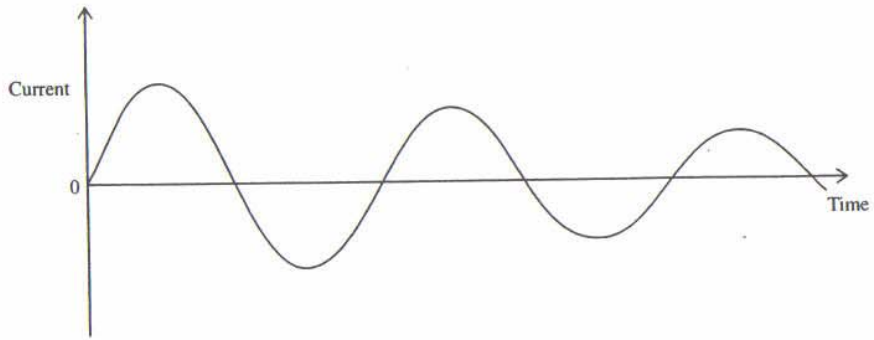


Frank says that the output is **a.c.**
Use the graph to explain what is meant by a.c.

(1) (1)
current changes direction repeatedly

[2]

(c) After a period of time the readings produce the following graph.



Describe the motion of the magnet over this period of time.

magnet is slowing down.

[1]

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7 At a power station the main transformer is supplied from a 25 kV generator.

(3) (a) How much energy is transferred from the generator for each coulomb of charge?

$1V = 1J/C$

Energy = 25000 J [1]

(b) The main transformer steps up the voltage to 275 kV before sending it out to the grid.

Describe fully the purpose of stepping up the voltage.

(higher voltage) reduces current in cables ∴ ①

less heat (ohmic) losses ①

[2]

(c) In what other part of the electricity transmission system must transformers be used?

end of grid → consumers

[1]

(d) Why must these other transformers be used?

Voltages must be reduced for consumer appliances. [1]

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