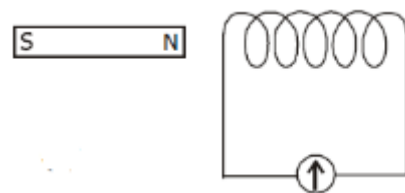


## Exam Questions

1. [2003] Explain the term *emf*
2. [2008][2004][2002][2002 OL][2004 OL][2007 OL][2008 OL] What is electromagnetic induction?

3. [2008 OL]  
A magnet and a coil can be used to produce electricity.  
How would you demonstrate this?

4. [2005 OL]
  - (i) A coil of wire is connected to a sensitive galvanometer as shown in the diagram.  
What is observed when the magnet is moved towards the coil?
  - (ii) Explain why this occurs.
  - (iii) Describe what happens when the speed of the magnet is increased.

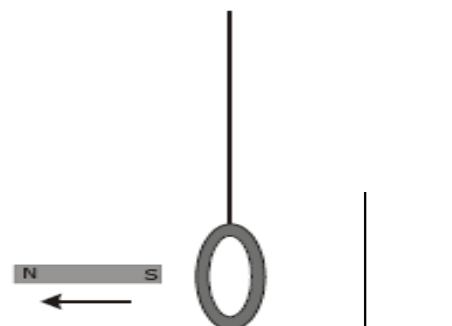


5. [2010 OL]
  - (i) Draw a sketch of the apparatus Michael Faraday used to generate electricity.
  - (ii) What name is given to the generation of electricity discovered by Michael Faraday?
  - (iii) What energy conversions take place in Faraday's experiment?
  - (iv) How does Faraday's experiment show that a changing magnetic field is required to generate electricity?

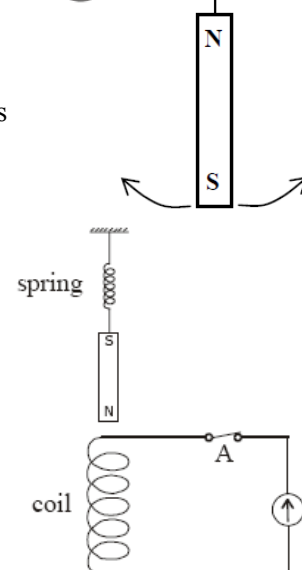
6. [2007][2005][2010] State Faraday's law of electromagnetic induction.
7. [2002] State Lenz's law of electromagnetic induction.
8. [2008][2003]  
State the laws of electromagnetic induction.
9. [2004][2002 OL] Describe an experiment to demonstrate electromagnetic induction.
10. [2007] Describe an experiment to demonstrate Faraday's law.

### Lenz Law

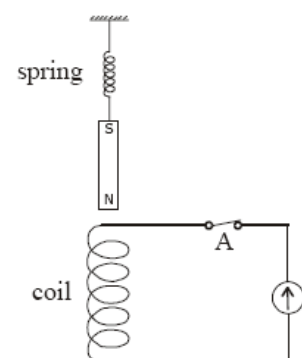
11. [2004]
  - (i) A light aluminium ring is suspended from a long thread as shown in the diagram.  
When a strong magnet is moved away from it, the ring follows the magnet.  
Explain why.
  - (ii) What would happen if the magnet were moved towards the ring?



12. [2008]
  - (i) A bar magnet is attached to a string and allowed to swing as shown in the diagram.  
A copper sheet is then placed underneath the magnet. Explain why the amplitude of the swings decreases rapidly.
  - (ii) What is the main energy conversion that takes place as the magnet slows down?



13. [2003]
  - (i) A small magnet is attached to a spring as shown in the diagram.  
The magnet is set oscillating up and down. Describe the current flowing in the circuit.
  - (ii) If the switch at A is open, the magnet will take longer to come to rest. Explain why.



## Magnetic flux and Faraday's Law

14. [2006][2005]  
Define magnetic flux.
15. [2006]  
A coil has 5000 turns.  
What is the emf induced in the coil when the magnetic flux cutting the coil changes by  $8 \times 10^{-4}$  Wb in 0.1 s?
16. [2009]  
What is the average emf induced in a coil of 20 turns when the magnetic flux cutting it decreases from 2.3 Wb to 1.4 Wb in 0.4 s?

17. [2008]

- (i) A metal loop of wire in the shape of a square of side 5 cm enters a magnetic field of flux density 8 T.

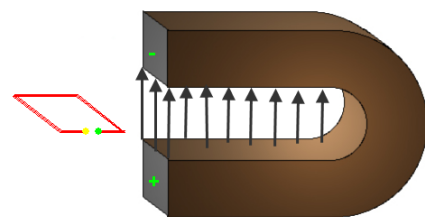
The loop is perpendicular to the field and is travelling at a speed of  $5 \text{ m s}^{-1}$ .

How long does it take the loop to completely enter the field?

- (ii) What is the magnetic flux cutting the loop when it is completely in the magnetic field?

- (iii) What is the average emf induced in the loop as it enters the magnetic field?

{the diagram wasn't in the original question but it may be useful here to help picture the situation}

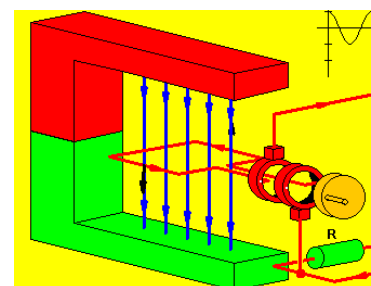


18. [2005]

- (i) A square coil of side 5 cm lies perpendicular to a magnetic field of flux density 4.0 T. The coil consists of 200 turns of wire. What is the magnetic flux cutting the coil?

- (ii) The coil is rotated through an angle of  $90^\circ$  in 0.2 seconds. Calculate the magnitude of the average e.m.f. induced in the coil while it is being rotated.

{the diagram wasn't in the original question but it may be useful here to help picture the situation}



19. [2006]

Read the following passage and answer the accompanying questions.

The growth of rock music in the 1960s was accompanied by a switch from acoustic guitars to electric guitars. The operation of each of these guitars is radically different.

The frequency of oscillation of the strings in both guitars can be adjusted by changing their tension. In the acoustic guitar the sound depends on the resonance produced in the hollow body of the instrument by the vibrations of the string. The electric guitar is a solid instrument and resonance does not occur.

Small bar magnets are placed under the steel strings of an electric guitar, as shown. Each magnet is placed inside a coil and it magnetises the steel guitar string immediately above it. When the string vibrates the magnetic flux cutting the coil changes, an emf is induced causing a varying current to flow in the coil. The signal is amplified and sent to a set of speakers.

Jimi Hendrix refined the electric guitar as an electronic instrument. He showed that further control over the music could be achieved by having coils of different turns.

(Adapted from Europhysics News (2001) Vol. 32 No. 4)

- (a) Why must the strings in the electric guitar be made of steel?  
(b) Why does the current produced in a coil of the electric guitar vary?  
(c) What is the effect on the sound produced when the number of turns in a coil is increased?

20. [2006][2010] The peak voltage of the mains electricity is 325 V. Calculate the rms voltage of the mains.

21. [2004] Sketch a voltage-time graph of the 230 V supply.

22. [2008 OL] Electricity produced in a generating station is a.c. What is meant by a.c.?

23. [2006]

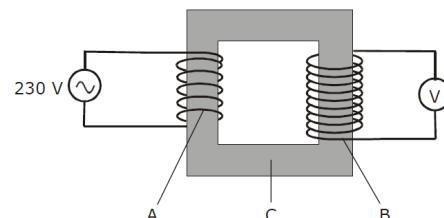
Sketch a graph to show the relationship between current and time for

- (i) alternating current  
(ii) direct current.

24. [2003 OL] What is a diode?
25. [2003 OL] Give an example of a device that contains a rectifier.
26. [2004 OL][2005 OL] Name a device that is based on electromagnetic induction.

### Transformers

27. [2003 OL]  
What is a transformer used for?
28. [2002 OL][2007 OL]  
The transformer is a device based on the principle of electromagnetic induction.  
Name two devices that use transformers.
29. [2007 OL][2004 OL] [2002 OL]  
Name the parts of the transformer labelled A, B and C in the diagram.



30. [2002 OL]  
How is the iron core in a transformer designed to make the transformer more efficient?
31. [2002 OL]  
The efficiency of a transformer is 90%. What does this mean?
32. [2003 OL]  
State one energy conversion that takes place in an electrical generator.
33. [2002 OL]  
The mains electricity supply (230 V) is connected to the input coil of a transformer which has 400 turns. The output coil has 100 turns. What is the reading on the voltmeter?
34. [2004 OL]  
The input coil of a transformer has 400 turns of wire and is connected to a 230 V a.c. supply while the output coil has 1200 turns. What is the voltage across the output coil?
35. [2007 OL]  
The input voltage is 230 V. The input coil has 4600 turns and the output coil has 120 turns. Calculate the output voltage.

### Self-Induction

36. [2007]  
(i) A resistor is connected in series with an ammeter and an ac power supply. A current flows in the circuit. The resistor is then replaced with a coil. The resistance of the circuit does not change.  
What is the effect on the current flowing in the circuit?  
(ii) Justify your answer
37. [2002]  
(i) In an experiment, a coil was connected in series with an ammeter and an a.c. power supply as shown in the diagram. Explain why the current was reduced when an iron core was inserted in the coil.  
(ii) Give an application of the principle shown by this experiment.

