

Review | Physics

Grade 10 Adv

Grade 12 General

Term 3

2023-2024

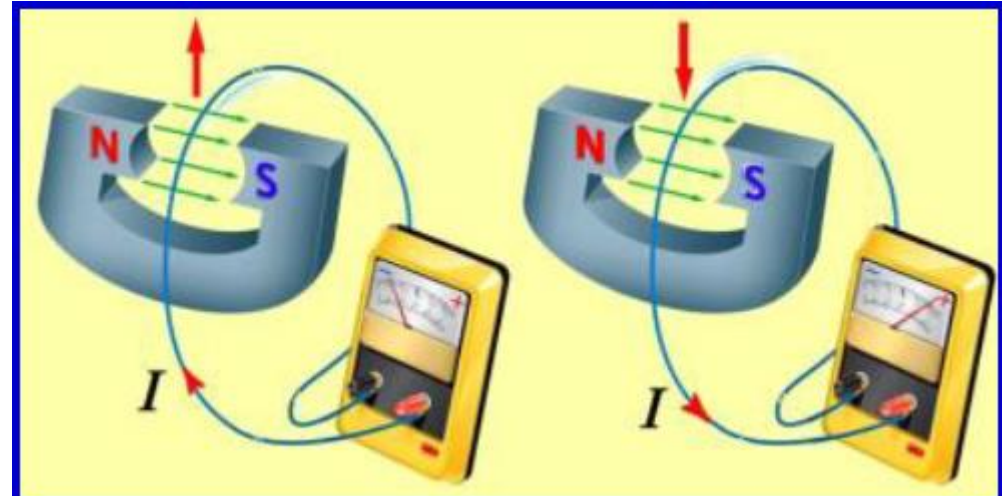
الحلول موجودة في نهاية الملف

Electromagnetic induction: The process of generating electrical current in a loop, caused by the relative movement between the wire and the magnetic field, that is, when the wire moves through the magnetic field or when the magnetic field moves through the wire

Faraday Experiment: Faraday put a part of a closed-loop wire within a magnetic field as shown in the figure, and studied the effect of wire movement in different directions on the generation of an inductive current in the electrical circuit

An induced current can be obtained in one of the following ways:

- 1- The relative movement of the conductor or magnet so that it cuts the lines of the magnetic field
- 2- Change in the magnetic flux that penetrates the coil



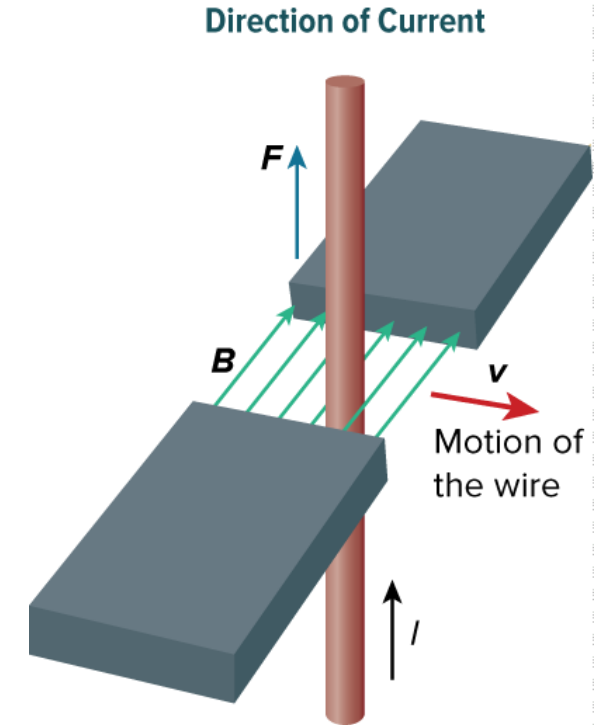
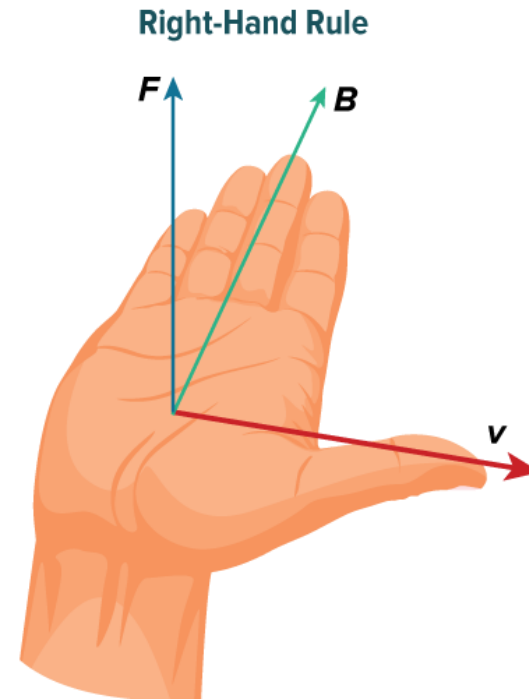
- When the wire is moved vertically or oblique along the magnetic field lines, the galvanometer indicator deflects Which indicates to the flow of current
- The current generation continues with the movement of the wire

The intensity of the current increases with increasing:

- 1- The strength of the magnetic field.
- 2- Increase the speed of the movement of the wire

to determine the direction of the induced current. By using the right-hand rule:

- Thumb points in the direction of the wire motion.
- The fingers points to the direction of the magnetic field.
- The palm of the hand points to the direction of the force which is the same of the direction of induced current



INDUCED ELECTROMOTIVE FORCE IN A

WIRE (EMF) is equal to the strength of the magnetic field times the length of the wire times the component of the velocity of the wire in the field that is perpendicular to the field

$$EMF = LBv \sin(\theta)$$

If an EMF generates a current in a wire that is part of a circuit with an effective resistance R , the current's magnitude can be determined by the following equation

$$I = \frac{EMF}{R}$$

Q1

What is the unit of electromotive force (EMF)?

Q2

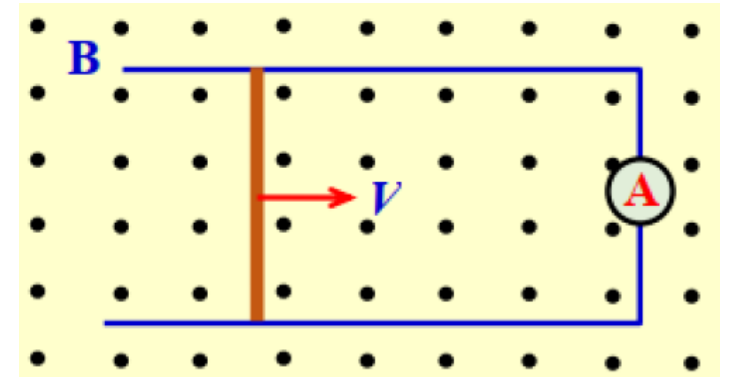
A straight wire that is **25 m** long, is mounted on an airplane flying at **125 m/s**. The wire moves in a perpendicular direction through Earth's magnetic field (**$B = 5 \times 10^{-2} \text{T}$**).

What EMF is induced in the wire

Q3-A

A straight wire, **0.20 m** long, moves at a constant speed of **7.0 m/s** perpendicular to a magnetic field of strength **$8.0 \times 10^{-2} \text{ T}$**

What EMF is induced in the wire



What is the direction of the induced current?

Q3-B

A straight wire, **0.20 m** long, moves at a constant speed of **7.0 m/s** perpendicular to a magnetic field of strength **$8.0 \times 10^{-2} \text{ T}$**

The wire is part of a circuit that has a resistance of **0.50Ω** . **What is the current through** the wire?

Q4

You move a straight wire that is **0.5 m** long at a speed of **20 m/s** vertically through a **0.4 T** magnetic field pointed in the horizontal direction

What EMF is induced in the wire

The wire is part of a circuit of total resistance of **6.0 Ω** . **What is the current in the circuit**

Q5

A straight wire segment in a circuit is **30.0 m** long and moves at **2.0 m/s** perpendicular to a magnetic field.

A **6.0 V** is induced. **What is the magnetic field magnitude?**

The induced current is **1.2 A** what is the total resistance of the circuit

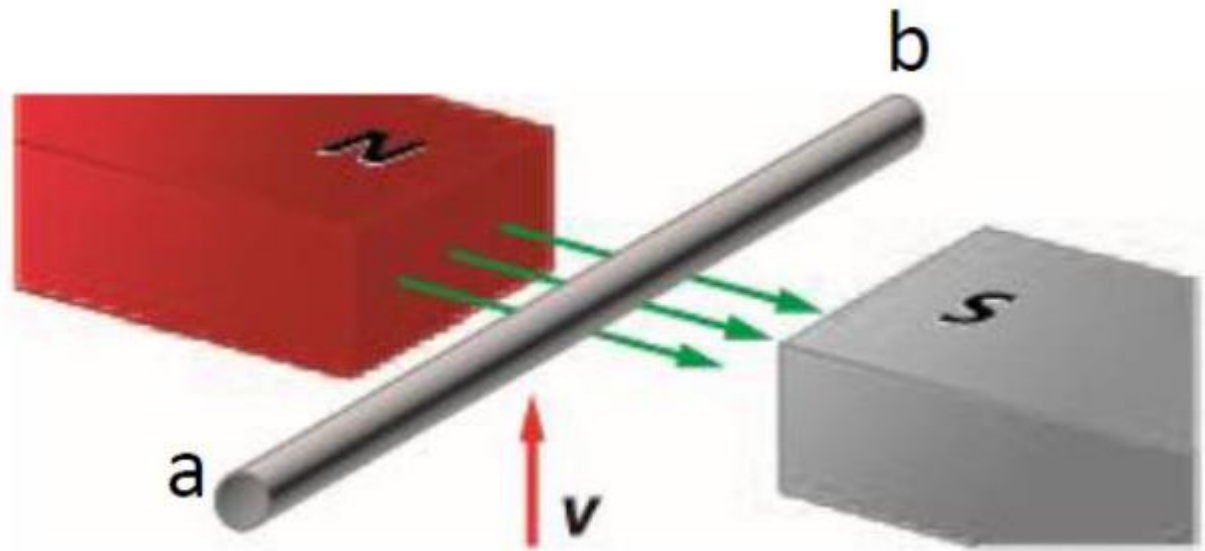
The wire is part of a circuit of total resistance of **6.0 Ω** . **What is the current in the circuit**

Q6

At what speed would a **0.20-m** length of wire have to move across **a 2.5-T** magnetic field to induce an EMF of **10 V**?

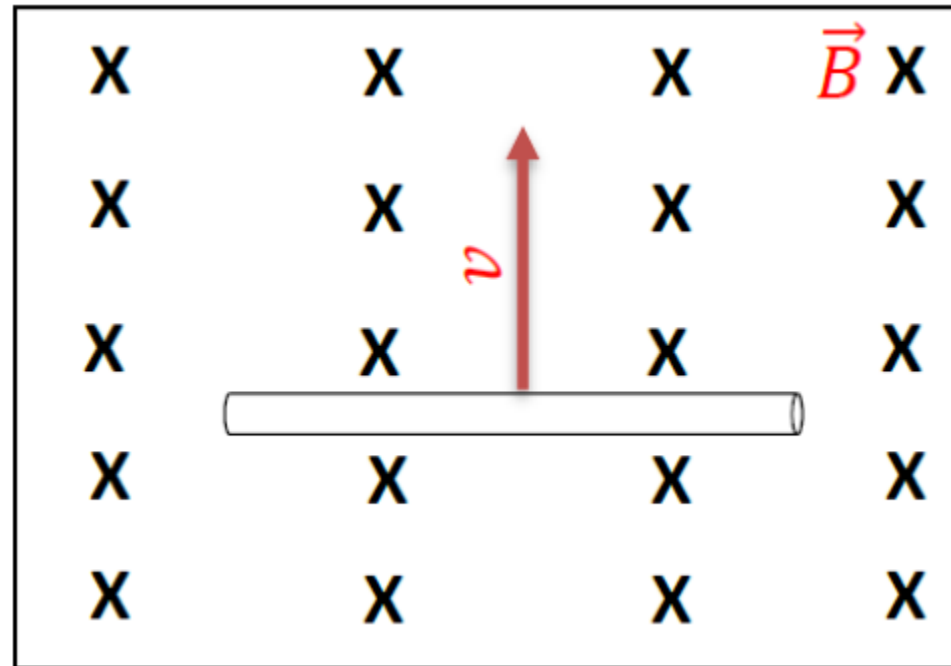
Q7

Determine the direction of the induced current in the wire shown in the figure?



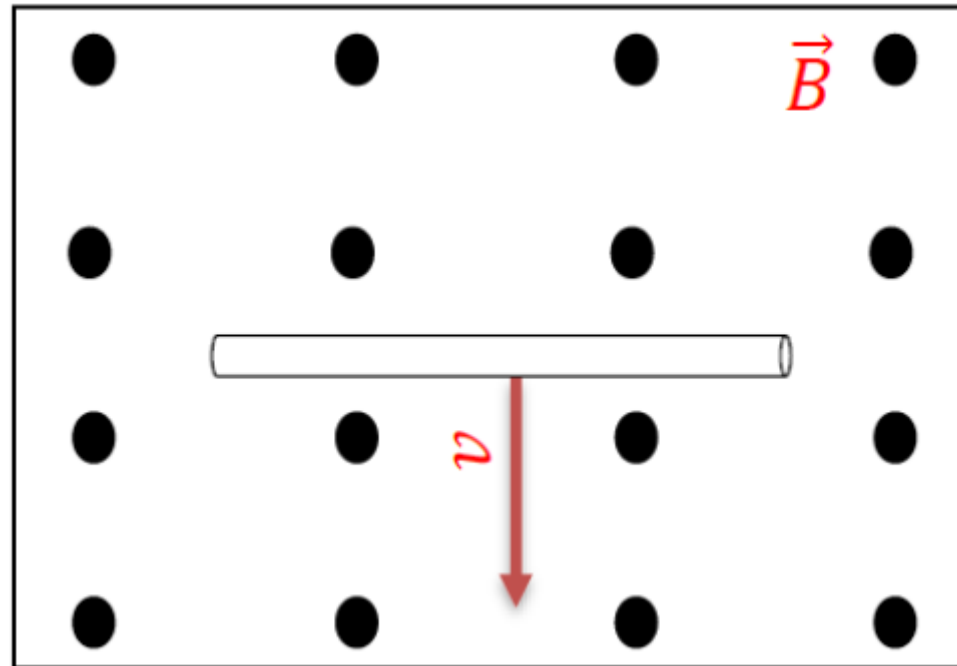
Q8

Determine the direction of the induced current in the wire shown in the figure?



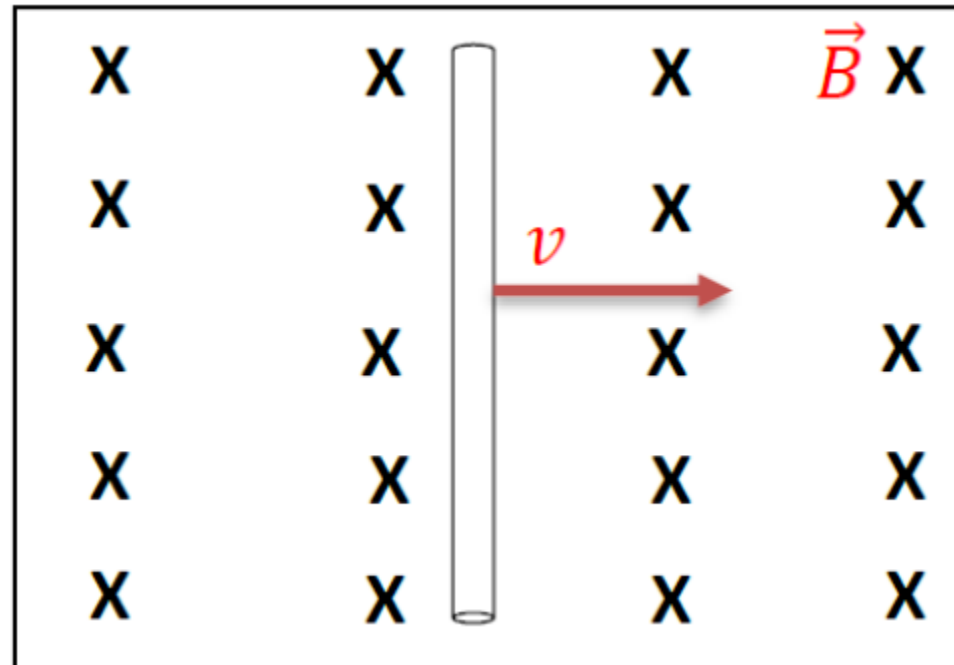
Q9

Determine the direction of the induced current in the wire shown in the figure?



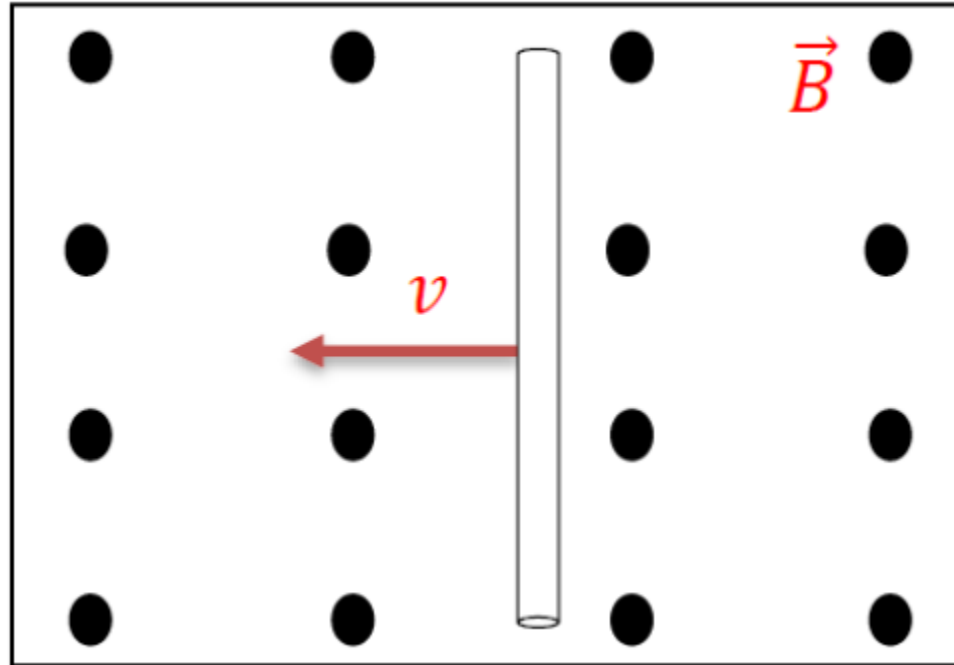
Q10

Determine the direction of the induced current in the wire shown in the figure?



Q11

Determine the direction of the induced current in the wire shown in the figure?



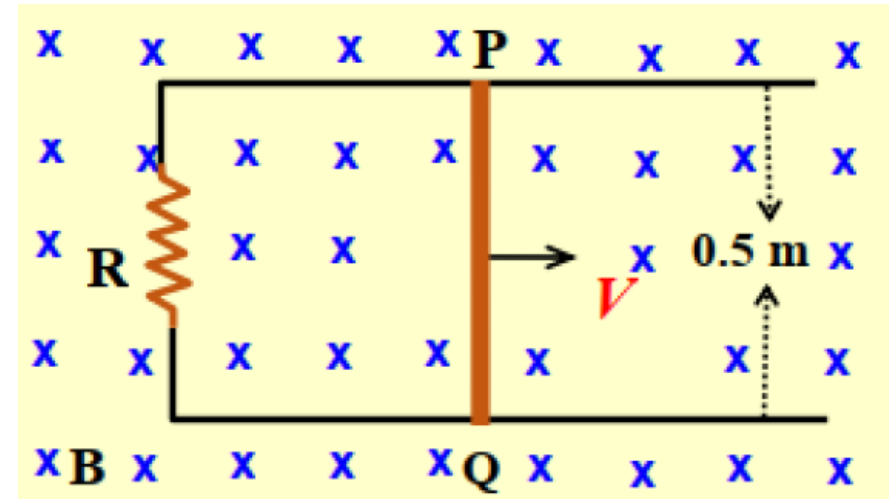
Q12

If the shown circuit is placed aside in a magnetic field, It has a uniform intensity of **0.15 T** and is directed to the inside of the page. If the conductor (**QP**) moves with a constant velocity to the right Its amount is (**2 m/s**) depending on the data on the figure.

answer the following:

1- Determine on the diagram the direction of the induced current passing through the resistor.

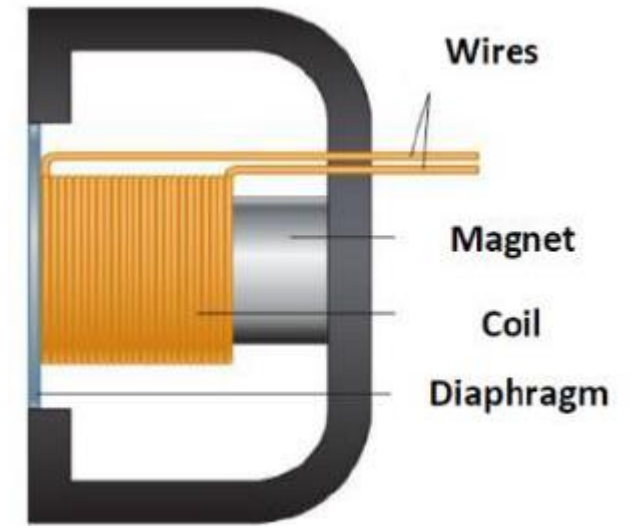
2- Calculate the magnitude of the electromotive force induced in Circuit



Induced EMF in microphone

Microphone is constructed like earbud, but it works in reverse

The microphone converts sound waves into electrical signals. The microphone's aluminum diaphragm is attached to a coil in a magnetic field. When sound waves vibrate the diaphragm, the coil moves. The current that is generated is proportional to the sound wave



Electric generator

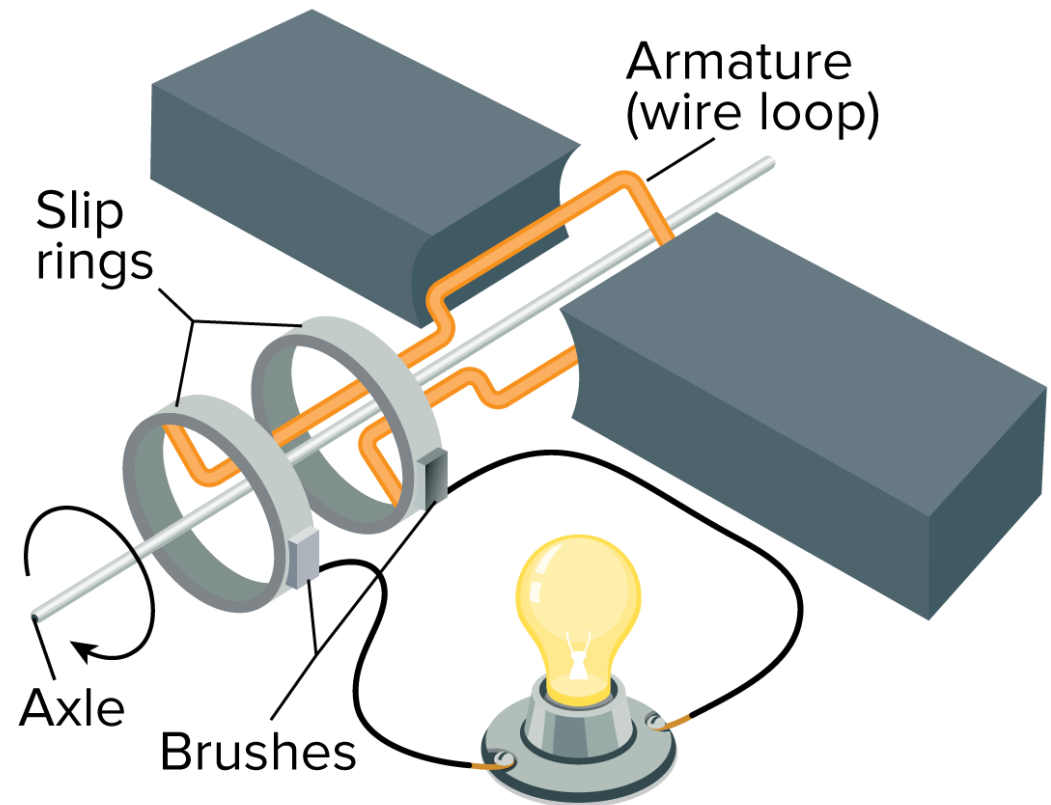
It is a device that converts mechanical energy to electrical energy

Types of Electric Generator

- 1- AC electric generator
- 2- DC electric generator

What are the components of the AC electric generator?

- Number of wire loops wound around an iron core (armature or rotor)
- Strong magnetic field.
- Two slip rings.
- Two brushes.
- Rotation axle



Compare between DC and AC generators

DC generator	AC generator
Charges move in a single direction. Current is in one direction because the wires of the armature connect to a circuit by means of a commutator.	Charges move in two direction. Current is in tow directions because the wires of the armature connect to a circuit by means of a slip ring device

How to calculate the average induced power by AC generator

$$P_{AC} = \frac{1}{2} P_{AC \max}$$

How to calculate the effective current produced by AC generator

$$I_{eff} = \left(\frac{\sqrt{2}}{2} \right) I_{max} = 0.7071 I_{max}$$

How to calculate the effective potential difference produced by AC generator

Effective voltage is commonly referred to as **RMS** (root mean square) voltage

$$V_{eff} = \left(\frac{\sqrt{2}}{2} \right) V_{max} = 0.7071 V_{max}$$

Q13:

A generator develops a maximum voltage of **120 V**

1- What is the effective voltage?

2- A **20-W** lightbulb is placed across the generator with an I_{max} of **0.40 A**. What is the effective current through the bulb?

3- What is the resistance of the lightbulb when it is working?

Q14

If the average power used over time by an electric light is **95 W**, **what is the peak power?**

Q15

The RMS voltage of an AC household outlet is **145 V**.

1- What is the maximum voltage across a lamp connected to the outlet?

2- If the RMS current through the lamp is **4.5 A**, what is the maximum current in the lamp?

Q16

An **AC generator** delivers a peak voltage of **550 V**.

1- What is the V_{eff} in a circuit placed across the generator?

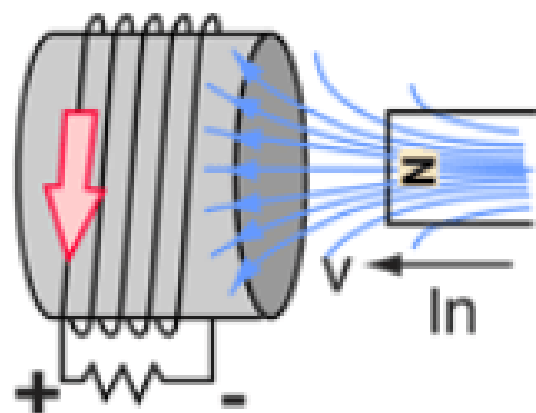
2- The resistance is $2 \times 10^2 \Omega$. What is the effective current?

Lenz's Law

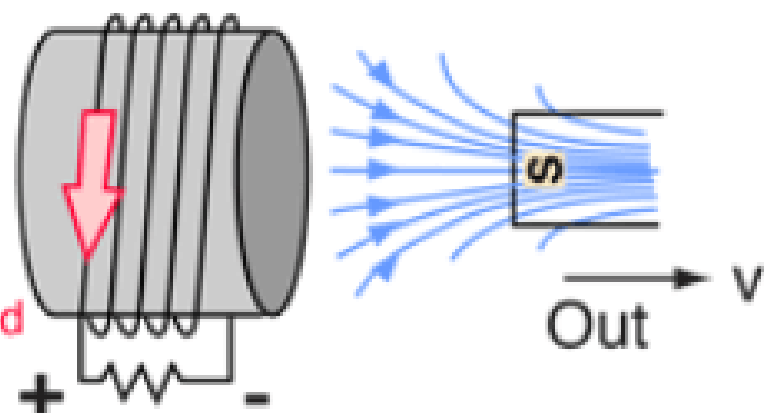
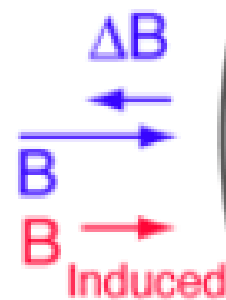
Lenz's law says that the magnetic field produced by the induced current is in the direction that is opposite the original field
In other words (the magnetic field produced in a coil by the induced current resists the change in the external field)

Note that the inductive magnetic effects reverse changes in the field, not the field itself

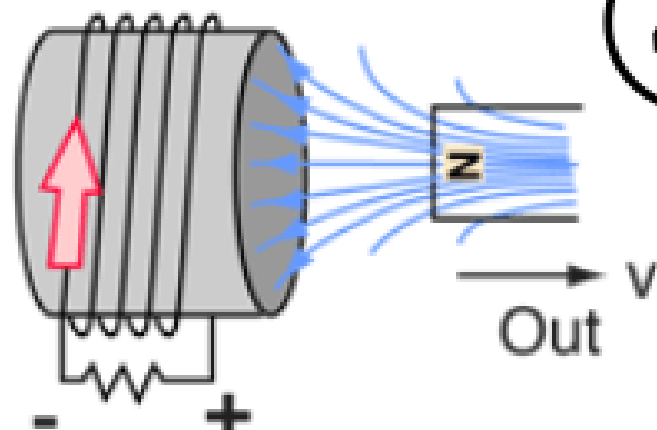
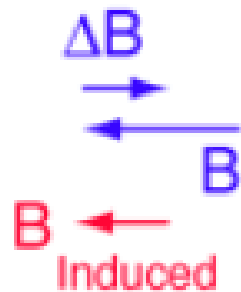
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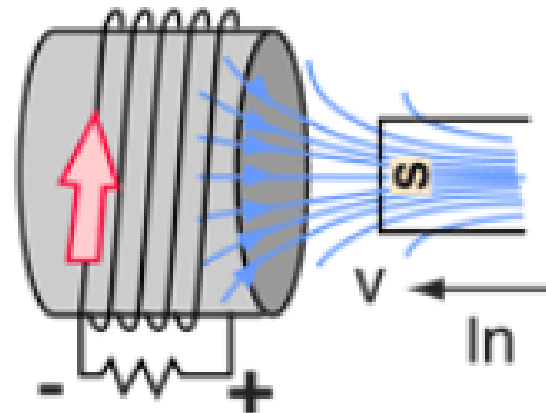
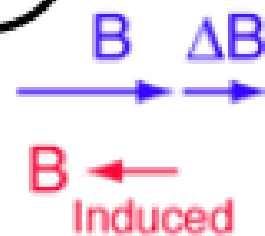
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2

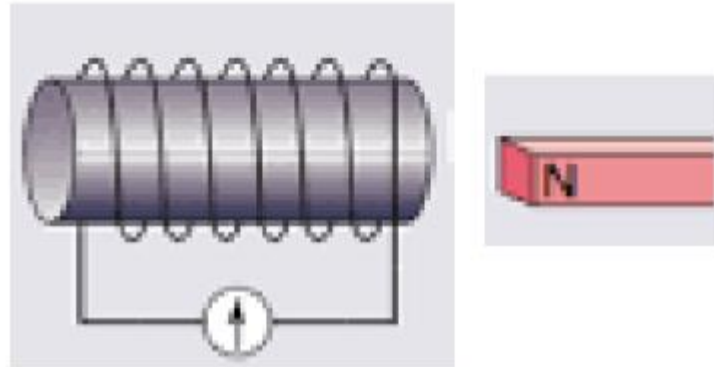


4



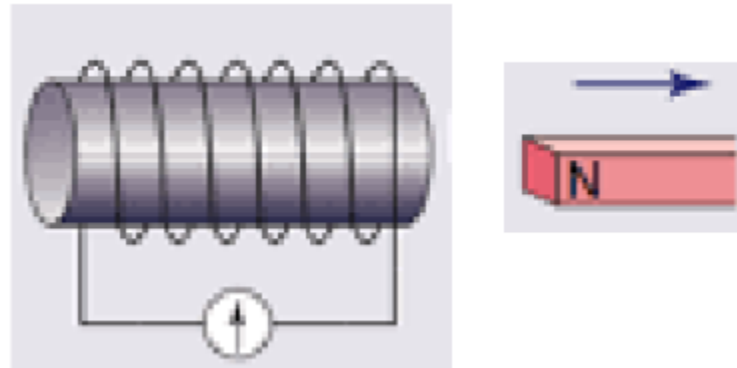
Q17

According to Lenz's law, **determine the direction of the induced current** and the induced magnetic field in the following cases shown in the figure



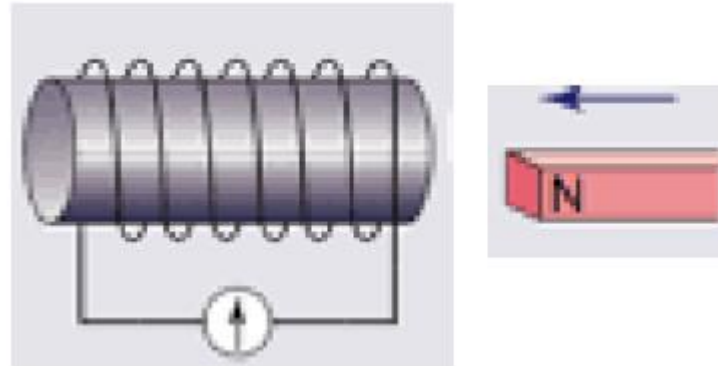
Q18

According to Lenz's law, **determine the direction of the induced current** and the induced magnetic field in the following cases shown in the figure



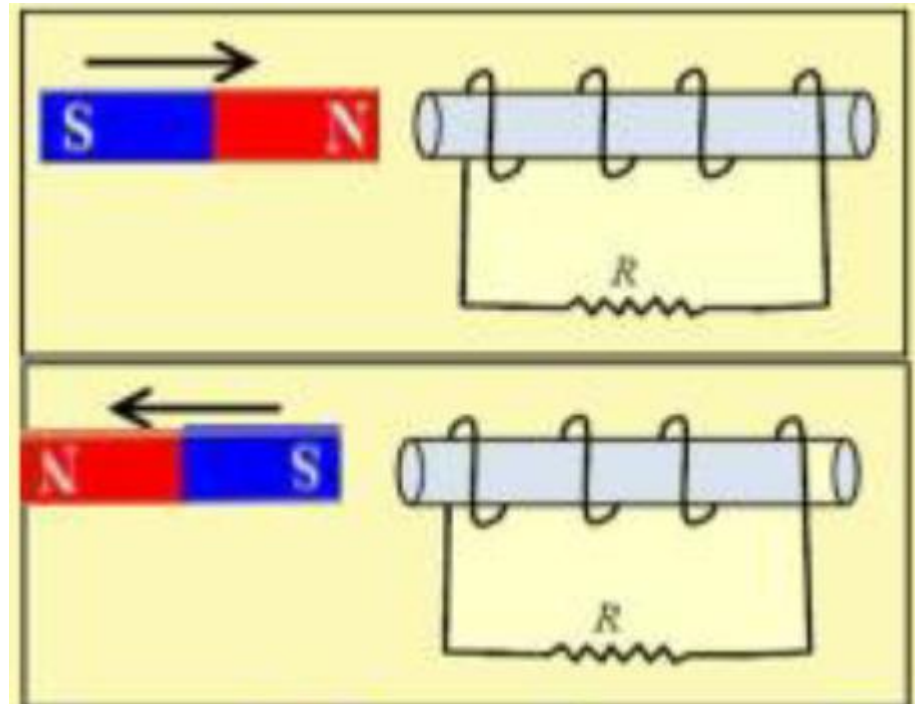
Q19

According to Lenz's law, **determine the direction of the induced current** and the induced magnetic field in the following cases shown in the figure



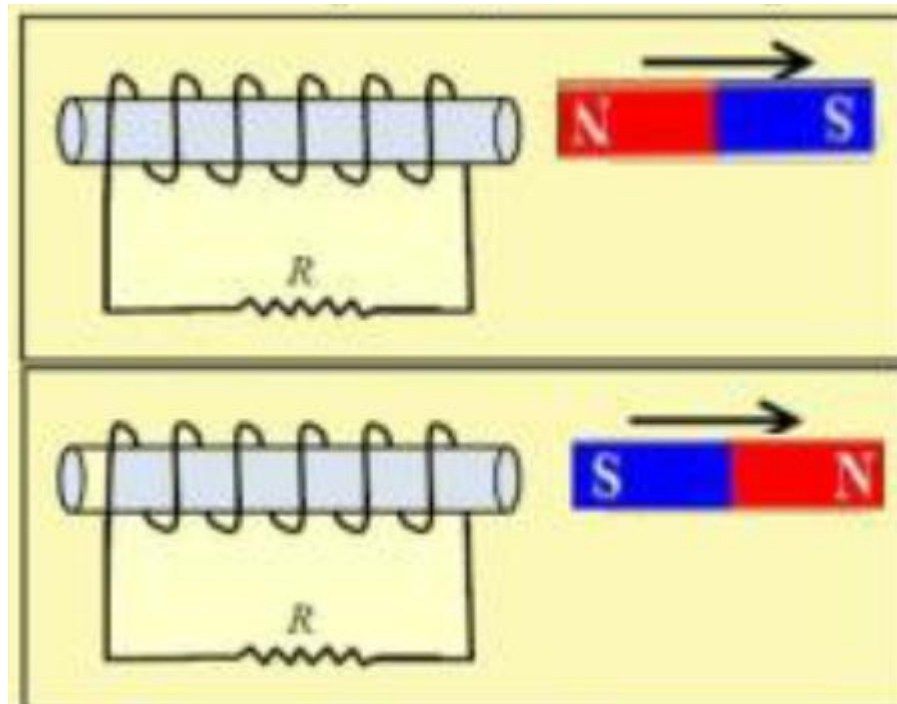
Q20

In each of the following cases, **determine the direction of the induced current** in the coil and resistor (R)



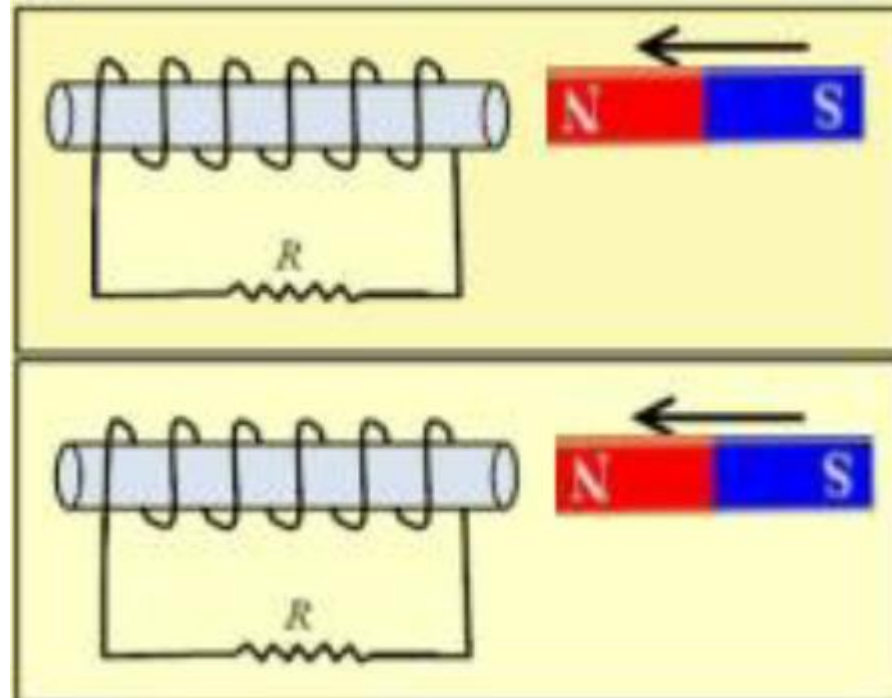
Q21

In each of the following cases, **determine the direction of the induced current** in the coil and resistor (R)



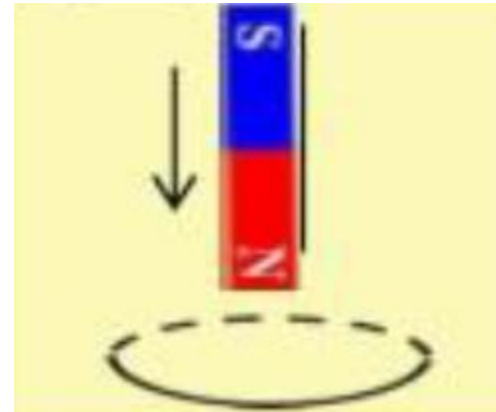
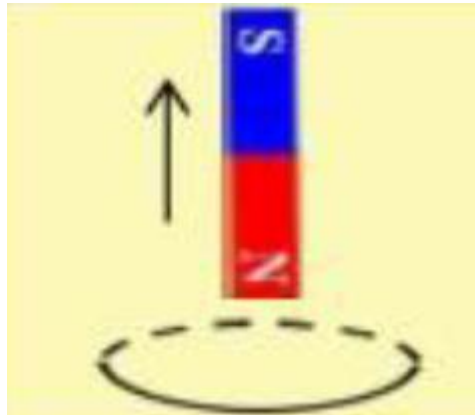
Q22

In each of the following cases, **determine the direction of the induced current** in the coil and resistor (R)



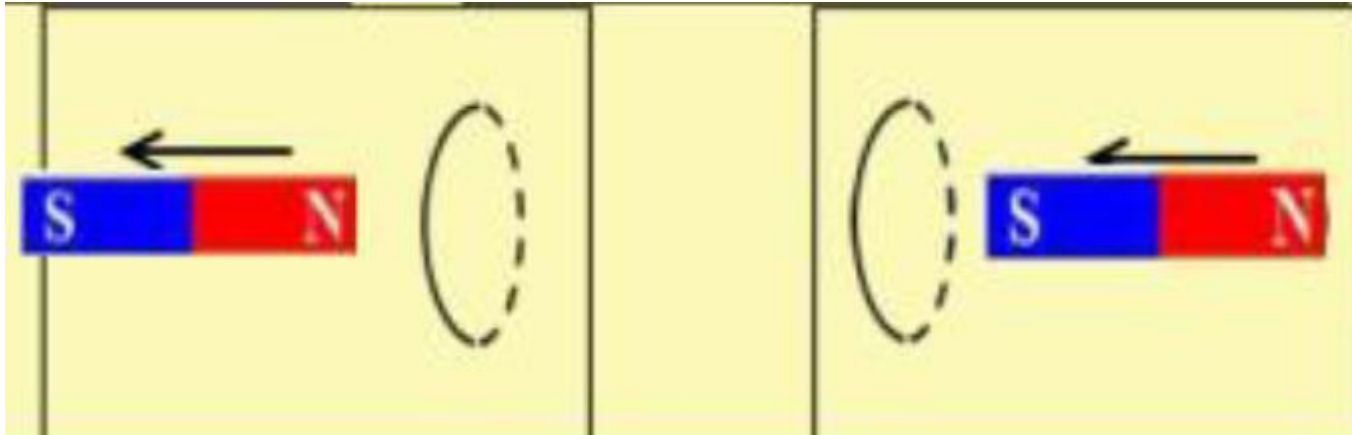
Q23

In each of the following cases, **determine the direction of the induced current** in the coil and resistor (R)



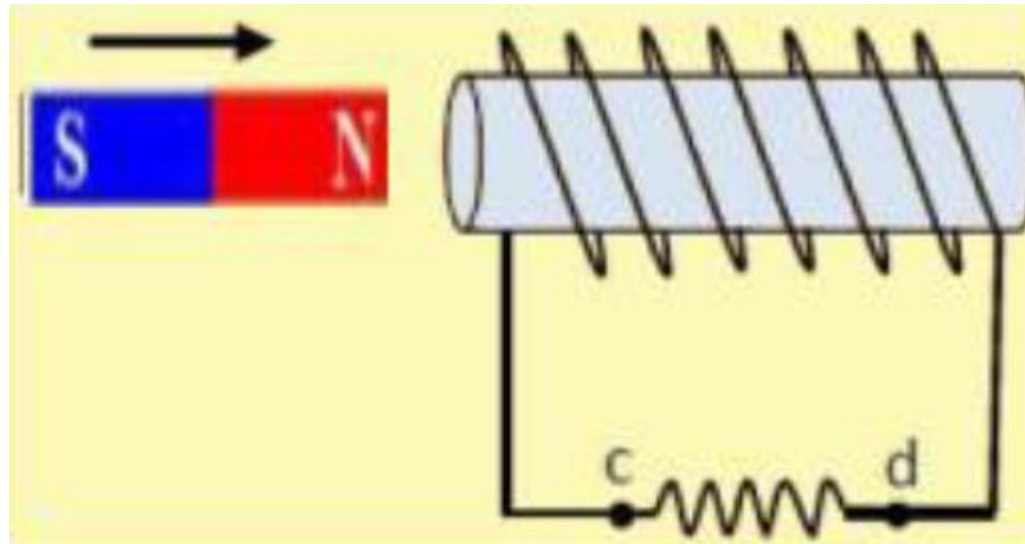
Q24

In each of the following cases, **determine the direction of the induced current** in the coil and resistor (R)



Q25

From the opposite figure **ideniify the dircction of the induced current** in resistance (cd) while the magnet is moving to the right



eddy currents.

eddy currents are generated in any piece of metal moving through a magnetic field.

the magnetic field they produce opposes the motion that caused the currents

the self-inductance.

It is the property of a wire either straight or in a coil to create an induced EMF that opposes the change in the potential difference across the wire

Transformers

Define transformers.

Transformers are devices that increase or decrease potential difference with relatively little waste of energy

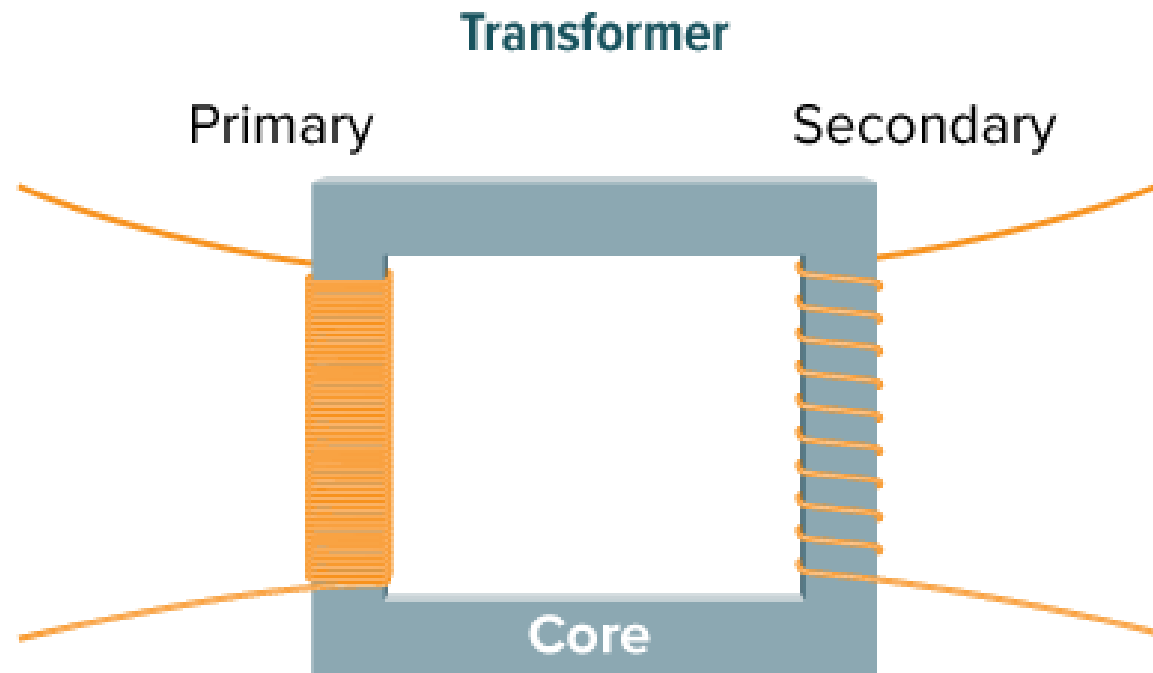
Note: Only alternating current can be sent through a transformer. Direct current cannot pass through a transformer

What is the principle of transformer work?

The transformer depends on mutual inductance where an EMF and current in one coil due to changing current in another coil.

What are the components of the transformers?

Primary coil	Which is connecting to the alternating current source
Secondary coil	Which is connecting to the devices (resistance)
Iron core	Which is carrying the changes in magnetic field from the primary coil to the secondary coil.



The coil connected to the source is called a **primary coil (P)** and the other is called a **secondary coil (S)**, as it is connected to a consumption circuit that has a resistance called the load resistance

Step-Up Transformer	Step-Down Transformer
$V_p < V_s$	$V_p > V_s$
$I_p > I_s$	$I_p < I_s$
$N_p < N_s$	$N_p > N_s$

Transformer Equation

The ratio of the current in the secondary coil to the current in the primary coil is equal to the ratio of the potential difference in the primary coil to the potential difference in the secondary coil, which is also equal to the ratio of the number of turns on the primary coil to the number of turns on the secondary coil.

$$\frac{I_s}{I_p} = \frac{V_p}{V_s} = \frac{N_p}{N_s}$$

Transformers are of two types:

* **The step-up transformer:** If the number of turns of the secondary winding is greater than the number of turns of the primary winding ($N_s > N_p$)

The transformer raises the potential difference and decreases the intensity of the current.

Step-down transformer: If the number of turns of the secondary winding is less than the number of turns of the primary winding ($N_s < N_p$)

The transformer reduces the voltage and raises the current

The ideal transformer

Note: The efficiency of the real transformer is between **95-98%** which is the ratio of the output power to the input power

Q27

A step-up transformer has a primary coil consisting of **200 turns** and a secondary coil consisting of **30 turns**. The primary coil is supplied with an effective DC voltage of **10.0 V**. **what is the voltage in the secondary circuit**

Q28

A step-down transformer has 7500 turns on its primary coil and 125 turns on its secondary coil. The potential difference across the primary circuit is 7.2 kV. What is the potential difference across the secondary circuit?

If the current in the secondary circuit is 36 A, what is the current in the primary circuit

MCQ

Q30

Which dimensional analysis is correct for the calculation of *EMF*

ما التحليل البعدي الصحيح لحساب *EMF*

A) $(N \cdot A \cdot m) (J)$

B) $(N/A \cdot m)(m)(m/s)$

C) $J \cdot C$

D) $(N \cdot m \cdot A/s)(1/m)(m/s)$

Q31

A **150 W** transformer has an input potential difference of **9.0 V** and an output current of **5.0 A**. What is the ratio of V_{output} to V_{input} ?

A) 1 to 3

C) 3 to 1

بممتاز محول **150 W** بفرق جهد دخل يبلغ **9.0 V** وتيار خرج يبلغ **5.0 A**. ما نسبة V_{output} to V_{input} ؟

B) 3 to 10

D) 10 to 3

Q32

A 15 cm length of wire is moving perpendicularly through a magnetic field of strength 1.4 T at the rate of 0.12 m/s. What is the EMF induced in the wire?

بتحرك سلك طوله 15 cm عموديا عبر مجال مغناطيسي مقداره 1.4 T بمعدل 0.12 m/s . ما مقدار EMF المستحثة في السلك

A) 0 V

B) 0.025 V

C) 0.018 V

D) 2.5 V

Q33

A transformer uses a **91 V** supply to operate a **13 V** device. If the transformer has **130 turns** on the primary coil and the device uses **1.9 A** of current from the transformer, **what is the current supplied to the primary coil?**

يستخدم محول مصدرا لجهد يبلغ **91 V** لتشغيل جهاز بالجهد **13 V** إذا كان المحول يحتوي على **130 لفة** على الملف الرئيسي ويستخدم الجهاز **1.9 A** من التيار من المحول، **فما التيار المزود للملف الرئيس؟**

A) 0.27 A

B) 4.8 A

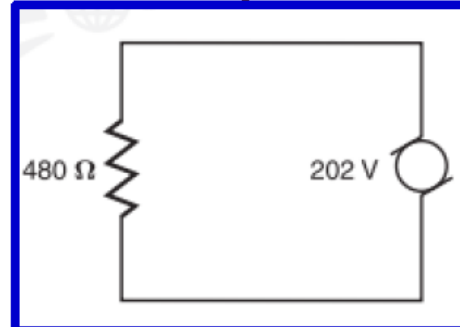
C) 0.70 A

D) 13.3 A

Q34

An AC generator that delivers a peak potential difference of 202 V is connected to an electric heater with a resistance of $4.80 \times 10^2\ \Omega$. What is the effective current in the heater?

يتصل مولد تيار متردد له أقصى فرق جهد يبلغ 202 V مع
سخان كهربائي مقاومته $4.80 \times 10^2\ \Omega$ ما شدة التيار
الفعال في السخان؟



A) 0.298 A

B) 1.68 A

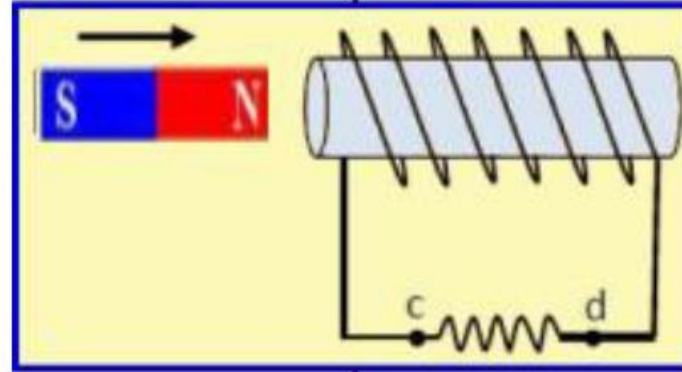
C) 2.38 A

D) 3.37 A

Q36

From the opposite figure **ideniify the dircction of the induced current** in resistance (cd) while the magnet is moving to the right

في الشكل المقابل، **حدد اتجاه التيار المستحث** في المقاومة (cd) عندما يتحرك المغناطيس إلى اليمين



A) From right to left

B) From left to right

C) up

D) No induced current formed

Q37

is (are) generated when a piece of metal moves through a magnetic field

يتم توليدها عندما تتحرك قطعة من المعدن عبر مجال
مغناطيسي

A) Eddy currents

التيارات الدوامية

B) Lenz's law

قانون لينز

C) Voltage drops

الهبوط بالجهد

D) EMF

القوة الدافعة الكهربائية الحثية

Q38

In a transformer, the primary coil has twice as many loops as the secondary coil. This is a _____ transformer

في المحول، يحتوي الملف الابتدائي على ضعف عدد الحلقات في الملف الثانوي. هذا محول هو

A) step-down

خافض

B) step-up

رافع

C) Reduction

التخفيض

D) Voltage

الجهد

Q39

An electric generator converts _____.

المولد الكهربائي يحول

A) Mechanical energy into electrical energy
الطاقة الميكانيكية إلى طاقة كهربائية

B) electrical energy into magnetic energy
الطاقة الكهربائية إلى طاقة مغناطيسية

C) magnetic energy into electrical energy
الطاقة المغناطيسية إلى طاقة كهربائية

D) magnetic energy into mechanical energy
الطاقة المغناطيسية إلى طاقة ميكانيكية

Good luck