Theatre of Science IGCSE Physics: Magnetism 1: Magnets!

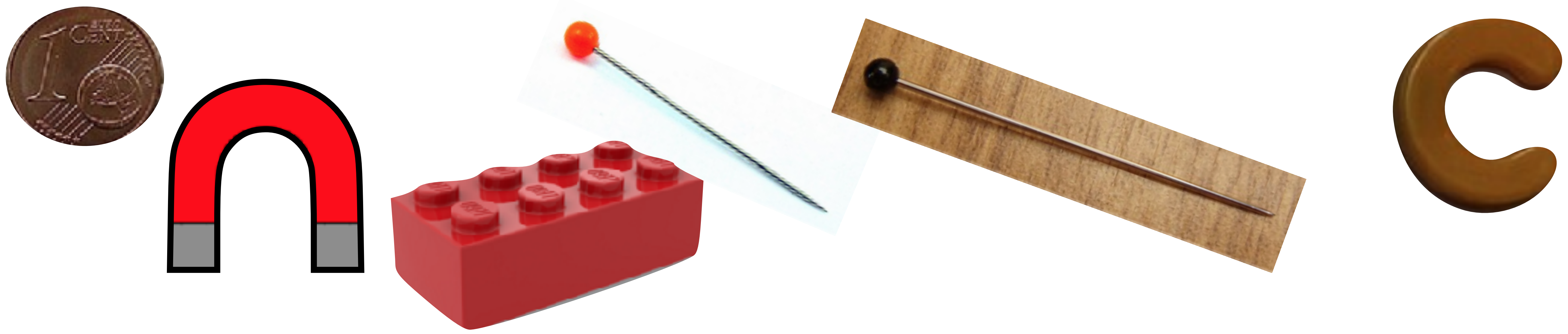
To join in bring:
As many different magnets as you have easily to hand! Bowl of water, a few leaves, some pins or needles, few Lego bricks or other small plastic items, coins.

Today's lesson will cover the following spec points:

(Cambridge) Describe the forces between magnetic poles and between magnets and magnetic materials, including the use of the terms north pole (N pole), south pole (S pole), attraction and repulsion, magnetised and unmagnetised
Describe induced magnetism
State the difference between magnetic and nonmagnetic materials
Describe a magnetic field as a region in which a magnetic pole experiences a force
Draw pattern & direction of magnetic field lines around a bar magnet
Know that the relative strength of a magnetic field is represented by the spacing of the magnetic field lines
Describe the plotting of magnetic field lines with a compass or iron filings and the use of a compass to determine the direction of the magnetic field

(Pearson) know that magnets repel and attract other magnets and attract magnetic substances
understand the term 'magnetic field line'
know that magnetism is induced in some materials when they are placed in a magnetic field
practical: investigate the magnetic field pattern for a permanent bar magnet and between two bar magnets
describe how to use two permanent magnets to produce a uniform magnetic field pattern

If you have some of the 'to join in bring' items with you, sort them into three categories: magnets, magnetic things, and things that aren't magnetic.



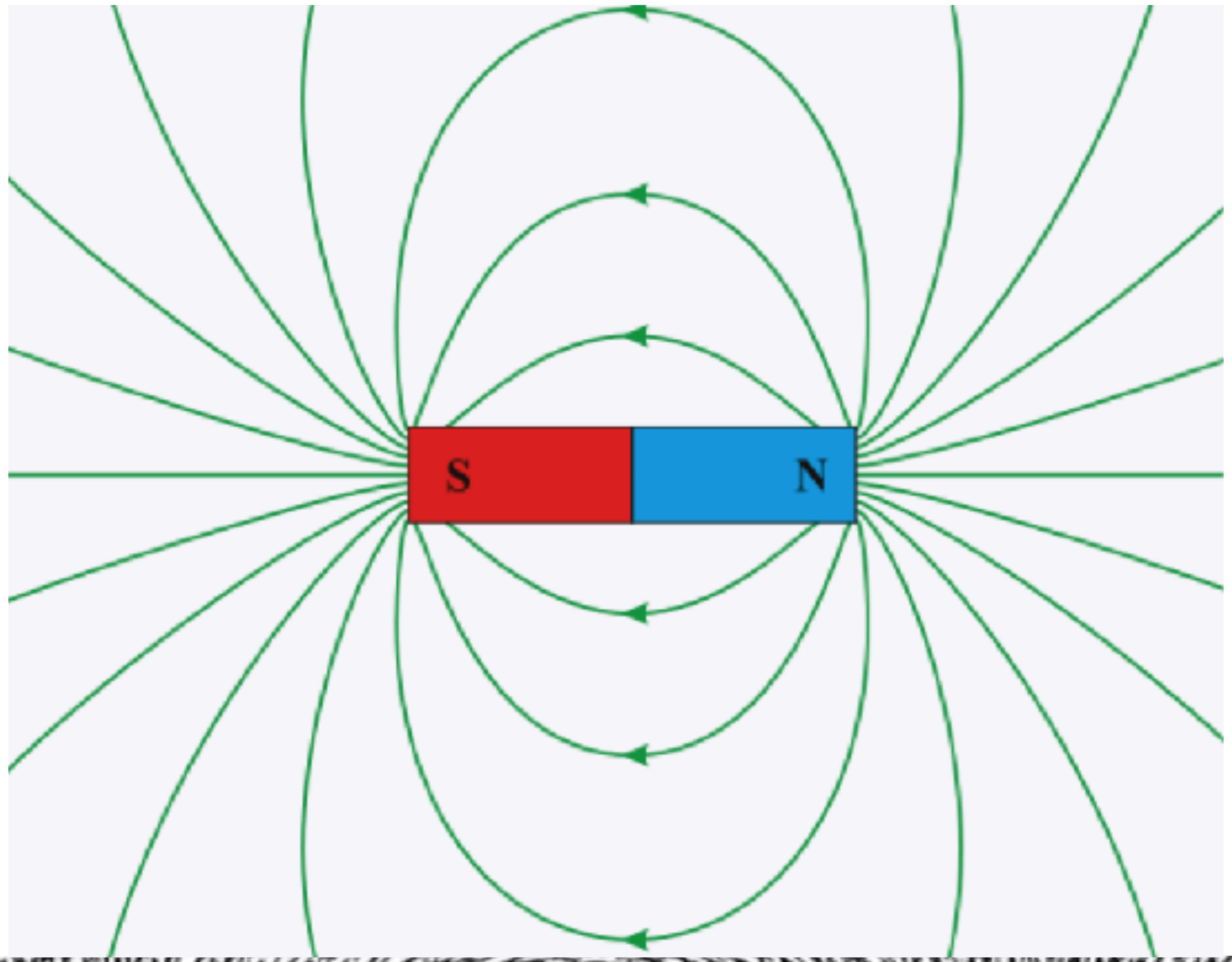
You might not have found that very difficult. The important and more challenging job is can you say HOW you knew? You 'just knew'! But what was it about the behaviour of the items that clued you in?

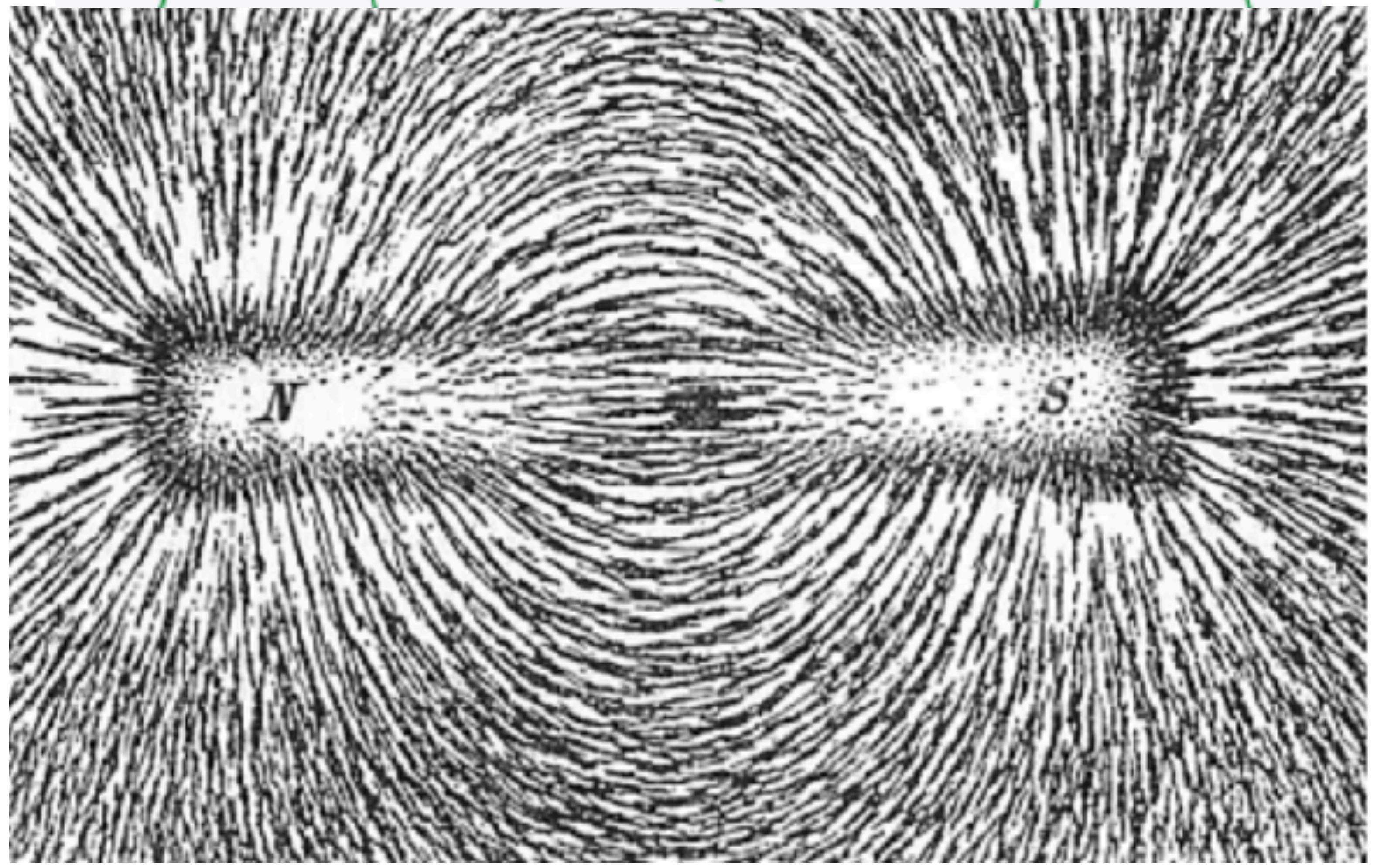
Magnets | **Induced Magnets** | **Non-magnetic materials**

Where is the magnetic field strongest? (Write ’S’)

And weakest? (Write ‘W’)

Label a magnetic field line.

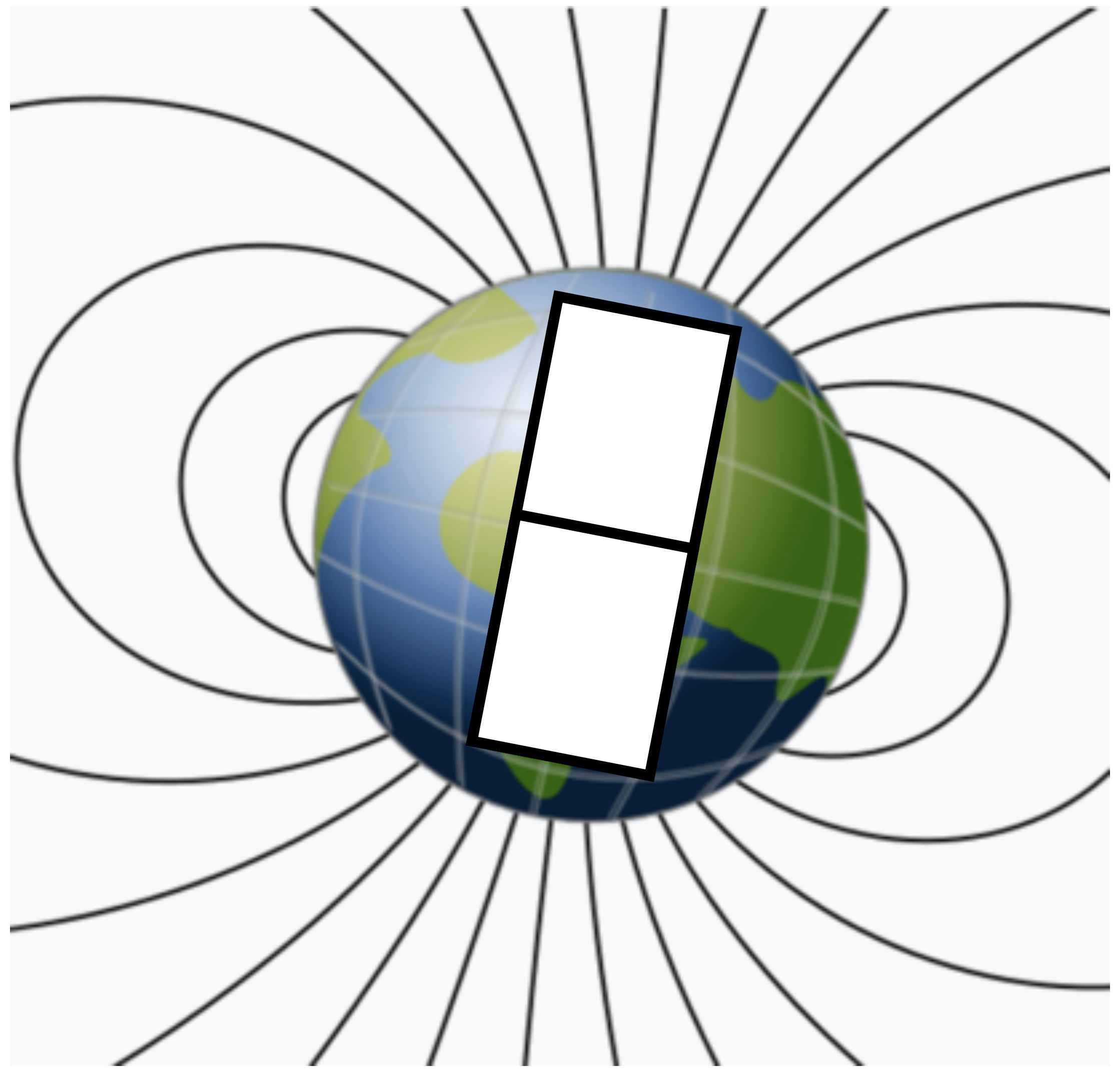




Using iron filings to see magnetic field lines

A uniform magnetic field is one where the magnetic field lines are parallel (all lined up next to each other). How could you arrange magnets to make that happen? Imagine you’ve got as many as you like and sketch some ideas here:

A compass needle is a tiny magnet. The north pole of the magnet points north. Anything strange about that?!



Explain by labelling the magnet on this diagram!

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Theatre of Science IGCSE Physics: Magnetism 2: Magnets!

To join in bring:
Large bowl, jug of water, 5p plastic bag or thin plastic packaging. (Something static-y!)

Today's lesson will cover the following spec points:

Cambridge: State that the direction of an electric field at a point is the direction of the force on a positive charge at that point
Describe simple electric field patterns, including the direction of the field: (a) around a point charge (b) around a charged conducting sphere (c) between two oppositely charged parallel conducting plates (end effects will not be examined)

State the differences between the properties of temporary magnets (made of soft iron) and the properties of permanent magnets (made of steel)

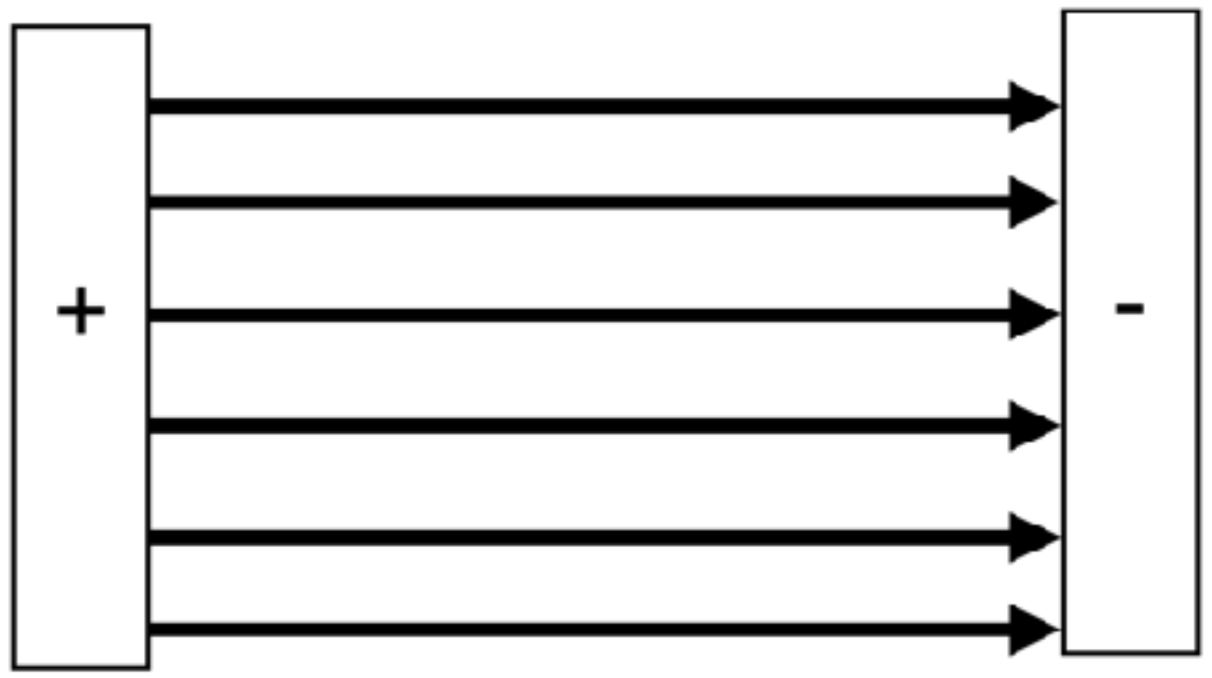
Describe an electric field as a region in which an electric charge experiences a force

Describe the uses of permanent magnets and electromagnets

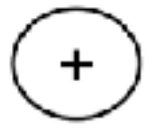
Pearson: know that an electric current in a conductor produces a magnetic field around it
describe the construction of electromagnets
draw magnetic field patterns for a straight wire, a flat circular coil and a solenoid when each is carrying a current

Describe the uses of permanent magnets and electromagnets

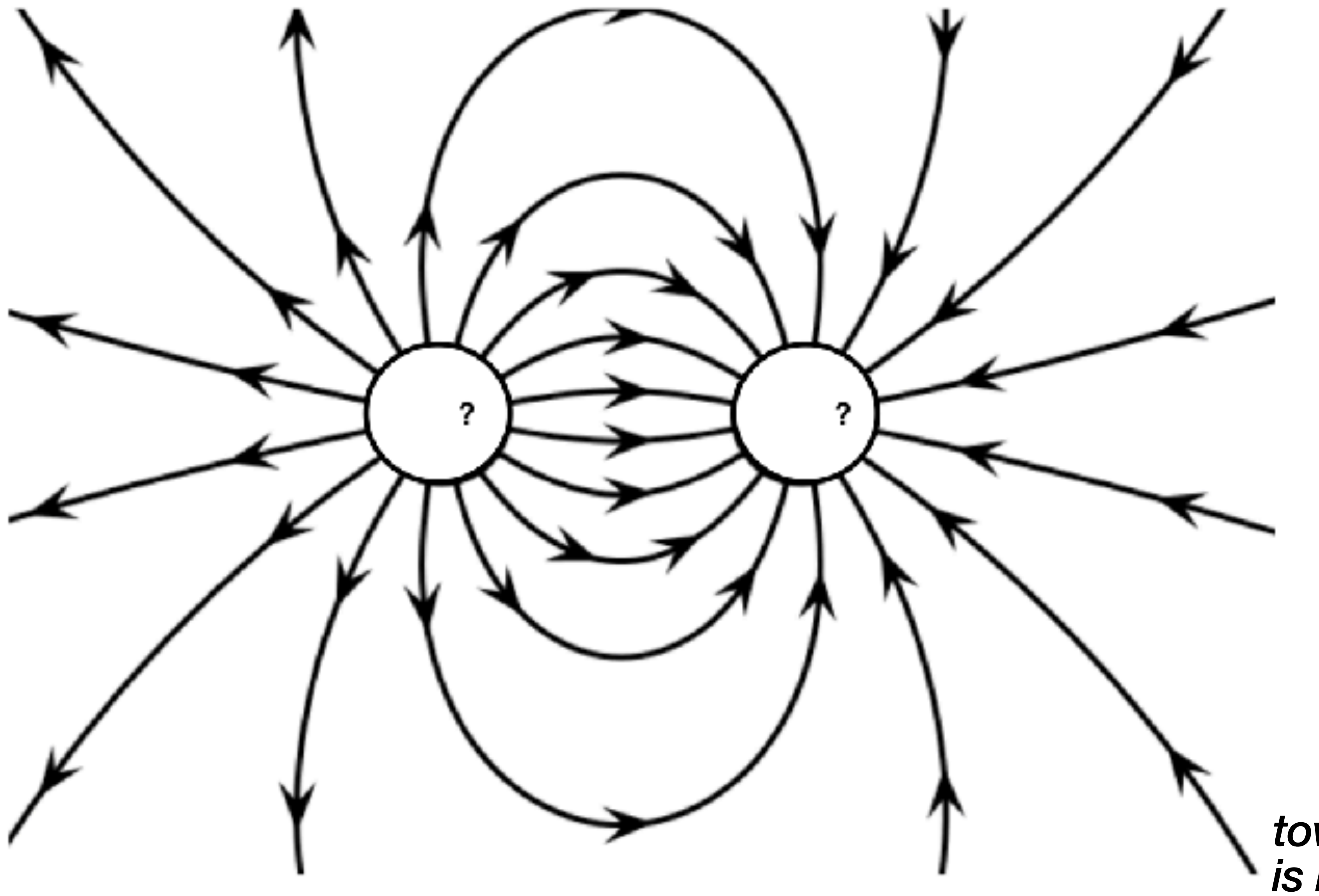
Electric Field Lines go from positive to negative



So what do the fields lines look like around a positive charge?!



And a negative charge?



Why is Jurassic Park on the cover of this lesson?!

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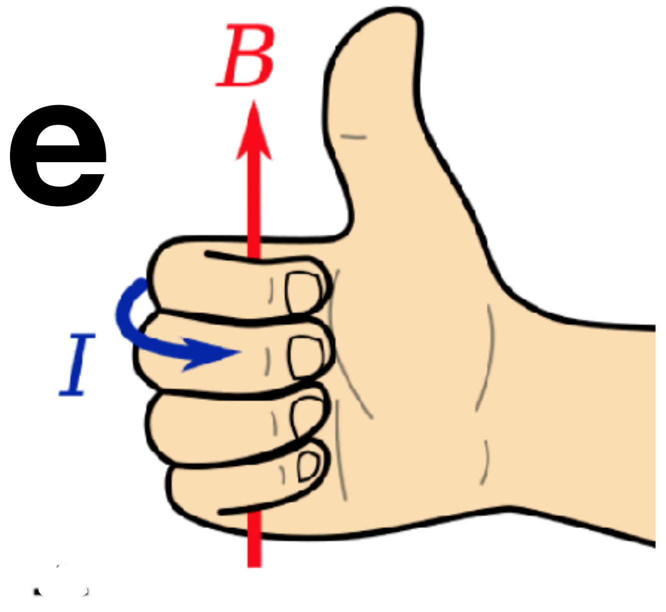
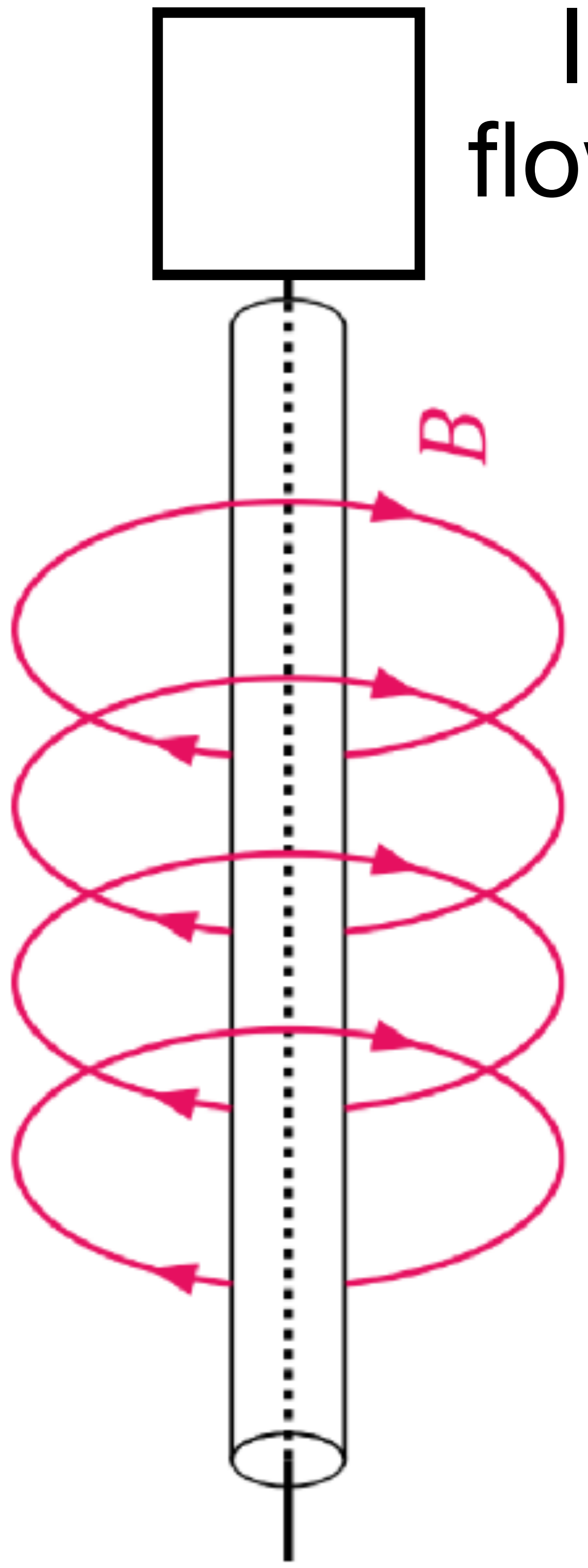
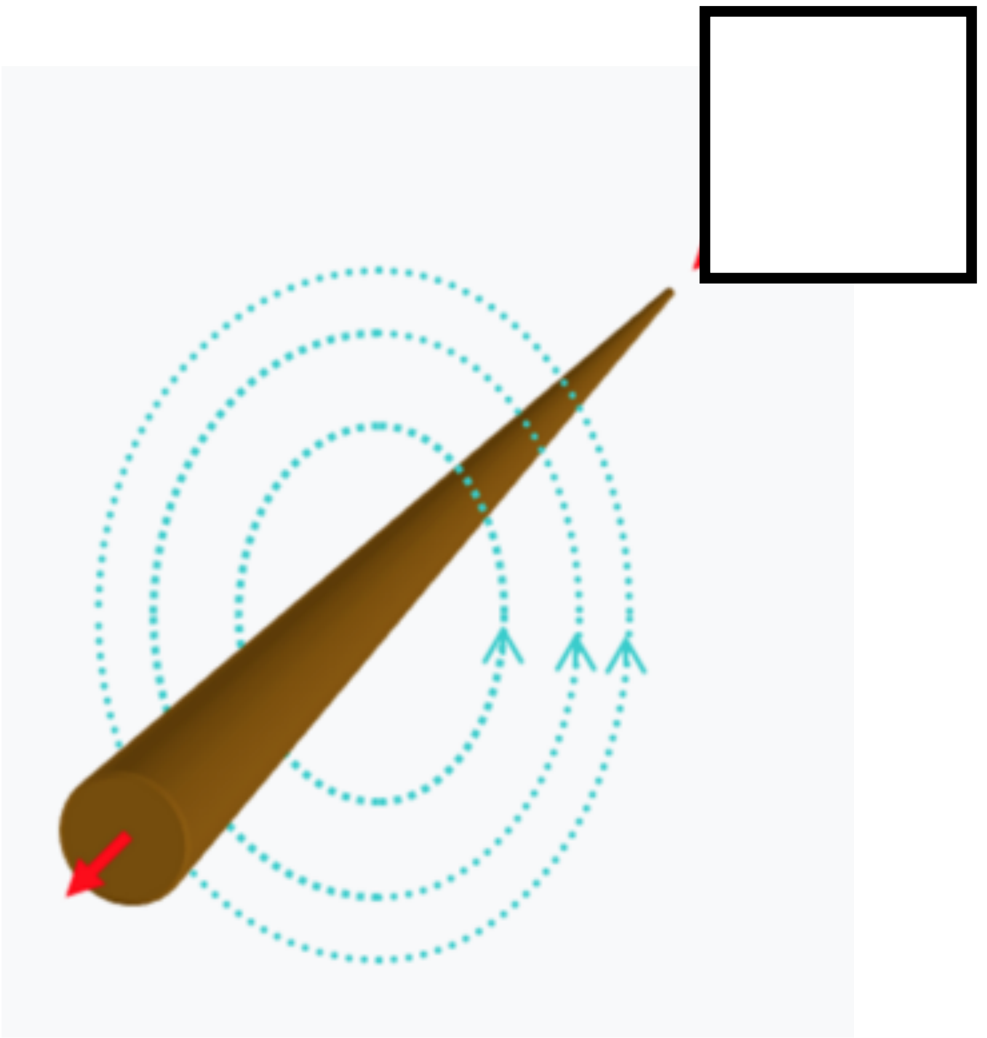
Using the right hand thumb rule

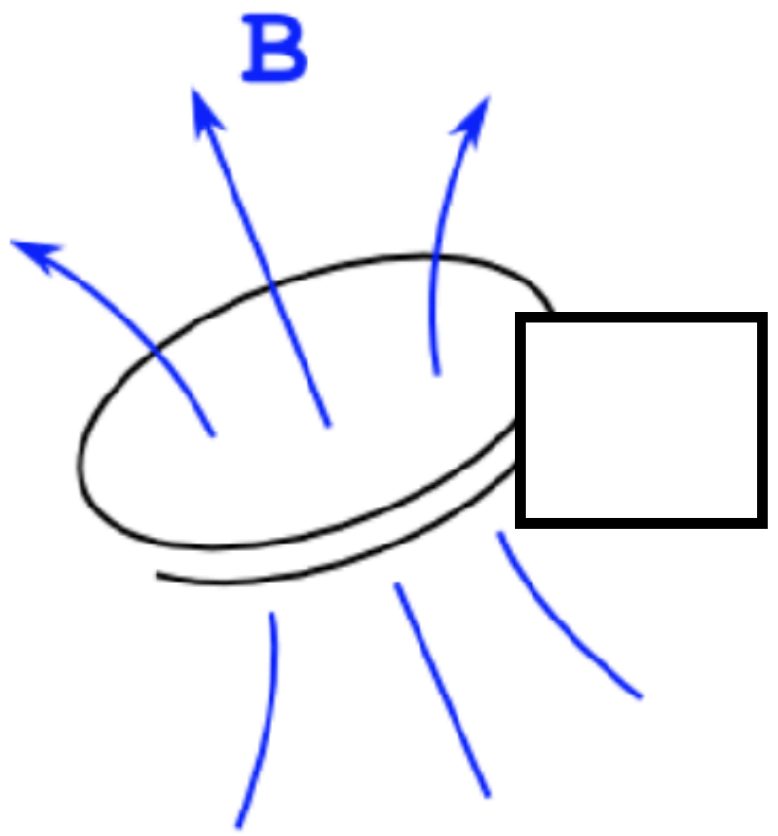


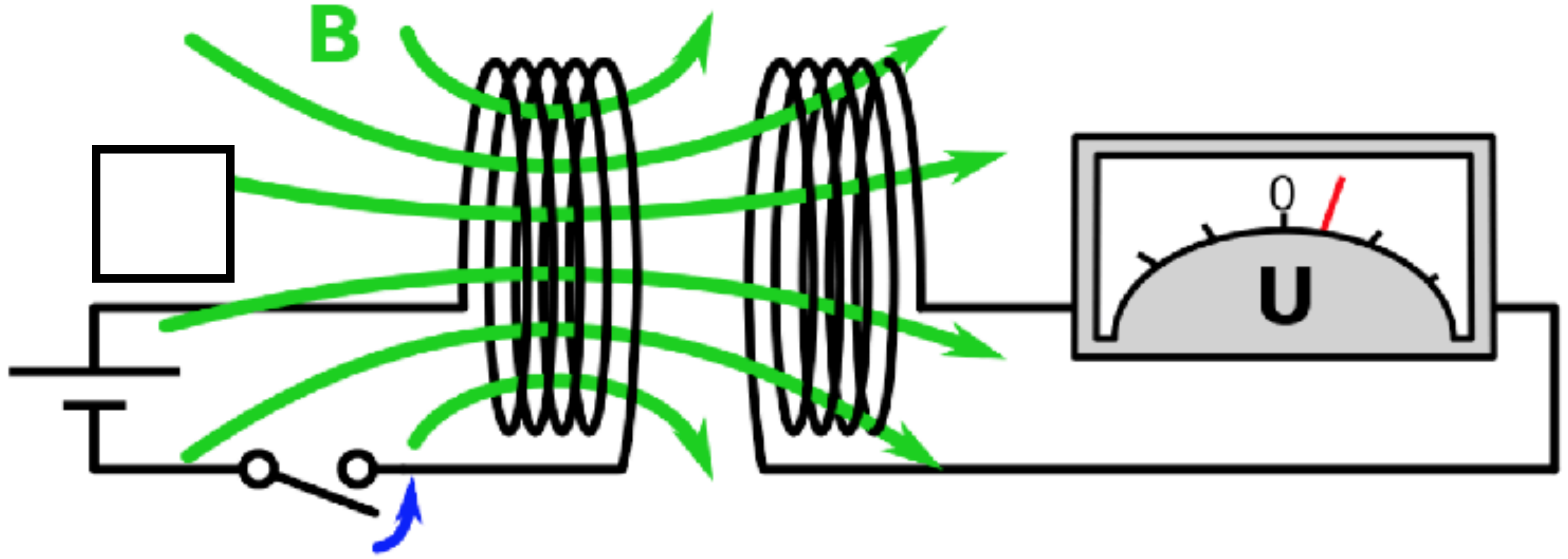
B is the magnetic field
I is the current

I've covered up the direction the current is flowing in these diagrams with a square. Draw arrows in the squares to complete them!

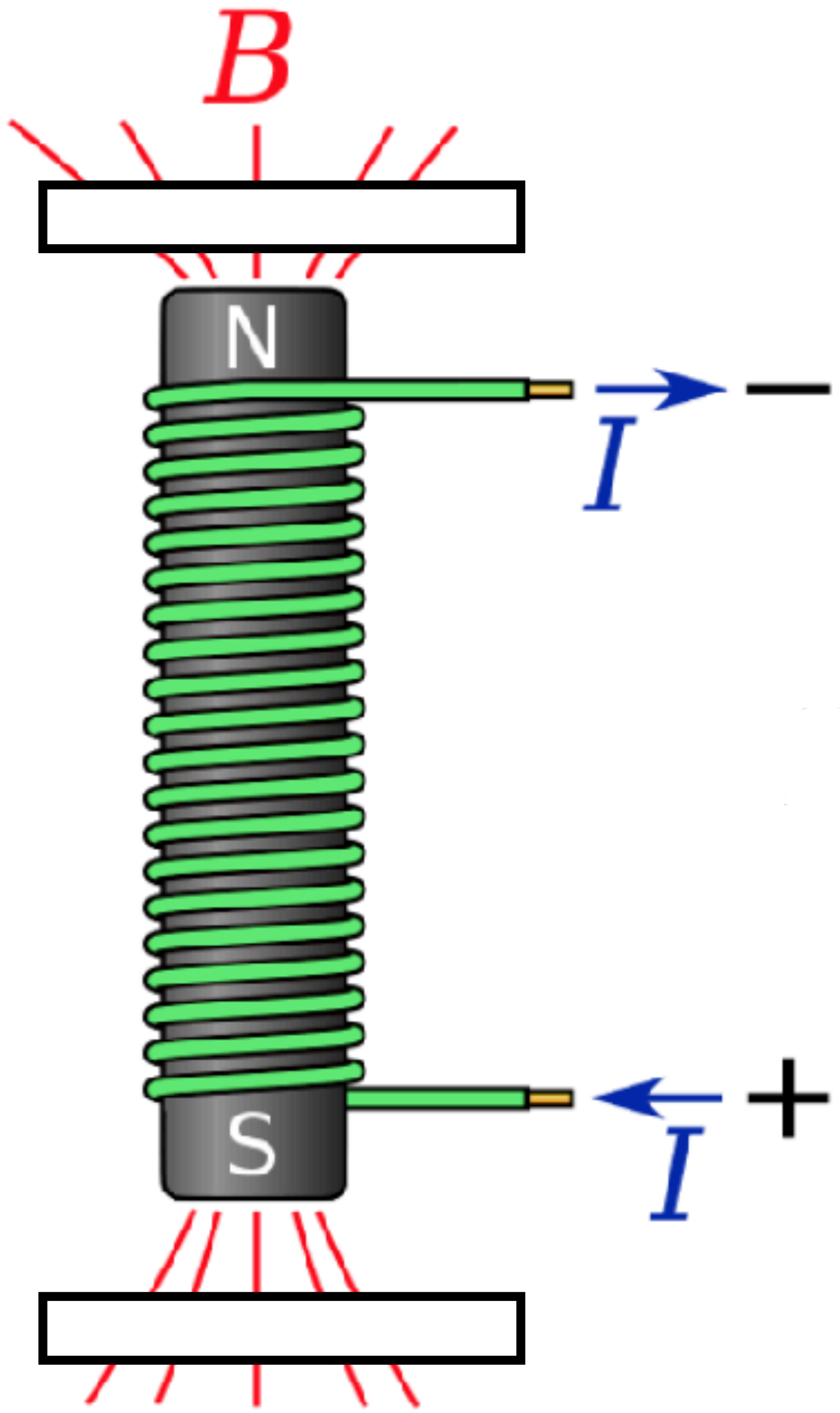


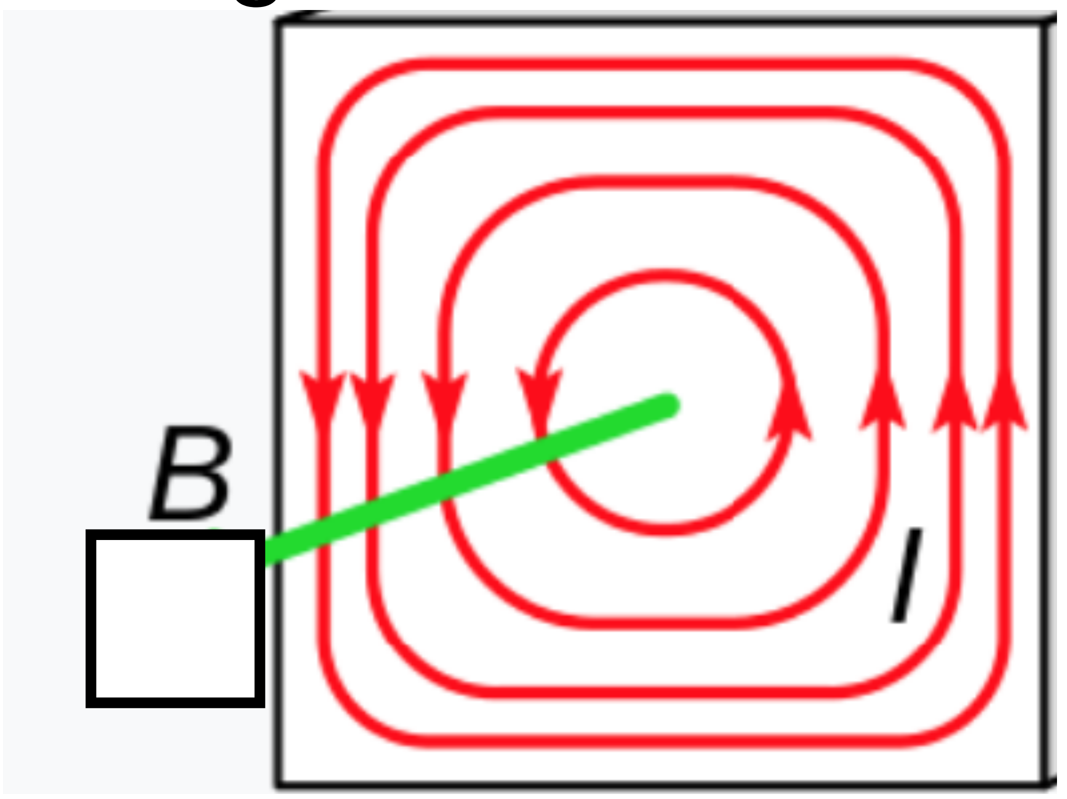


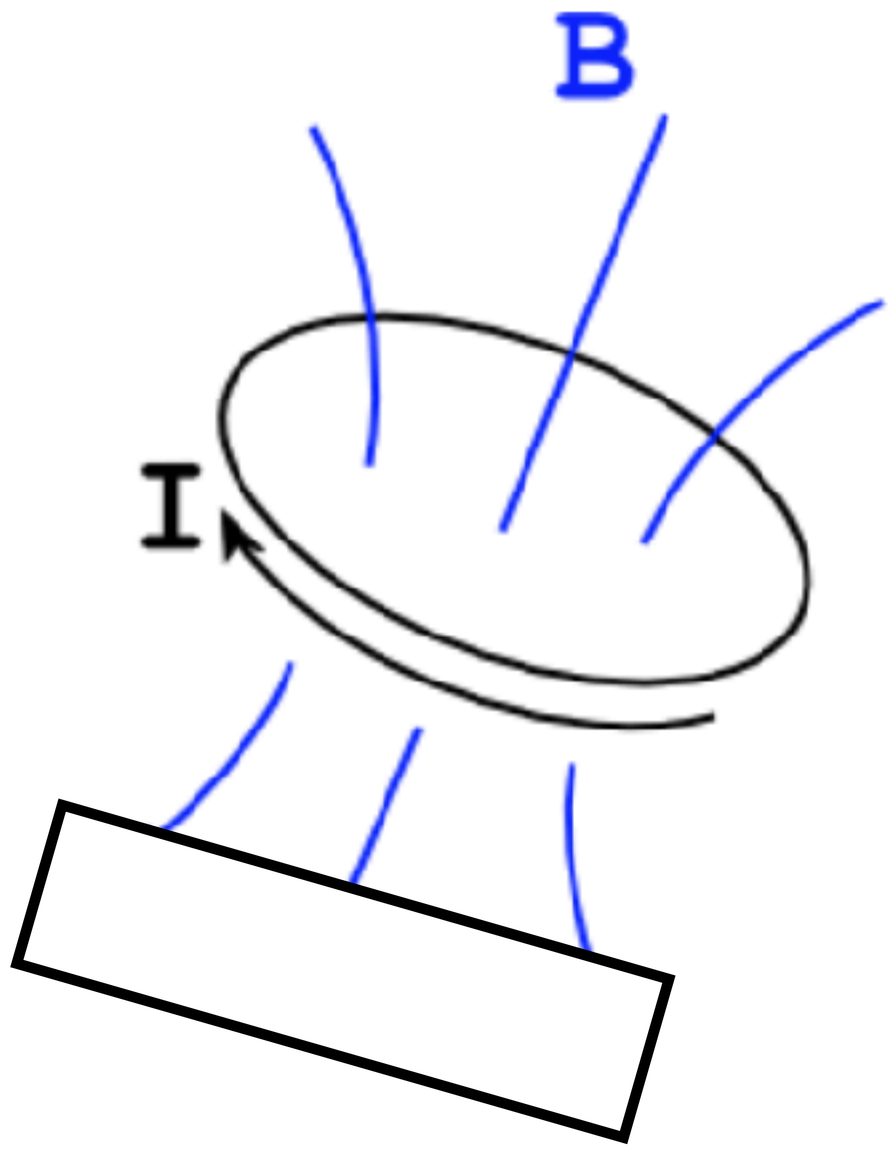




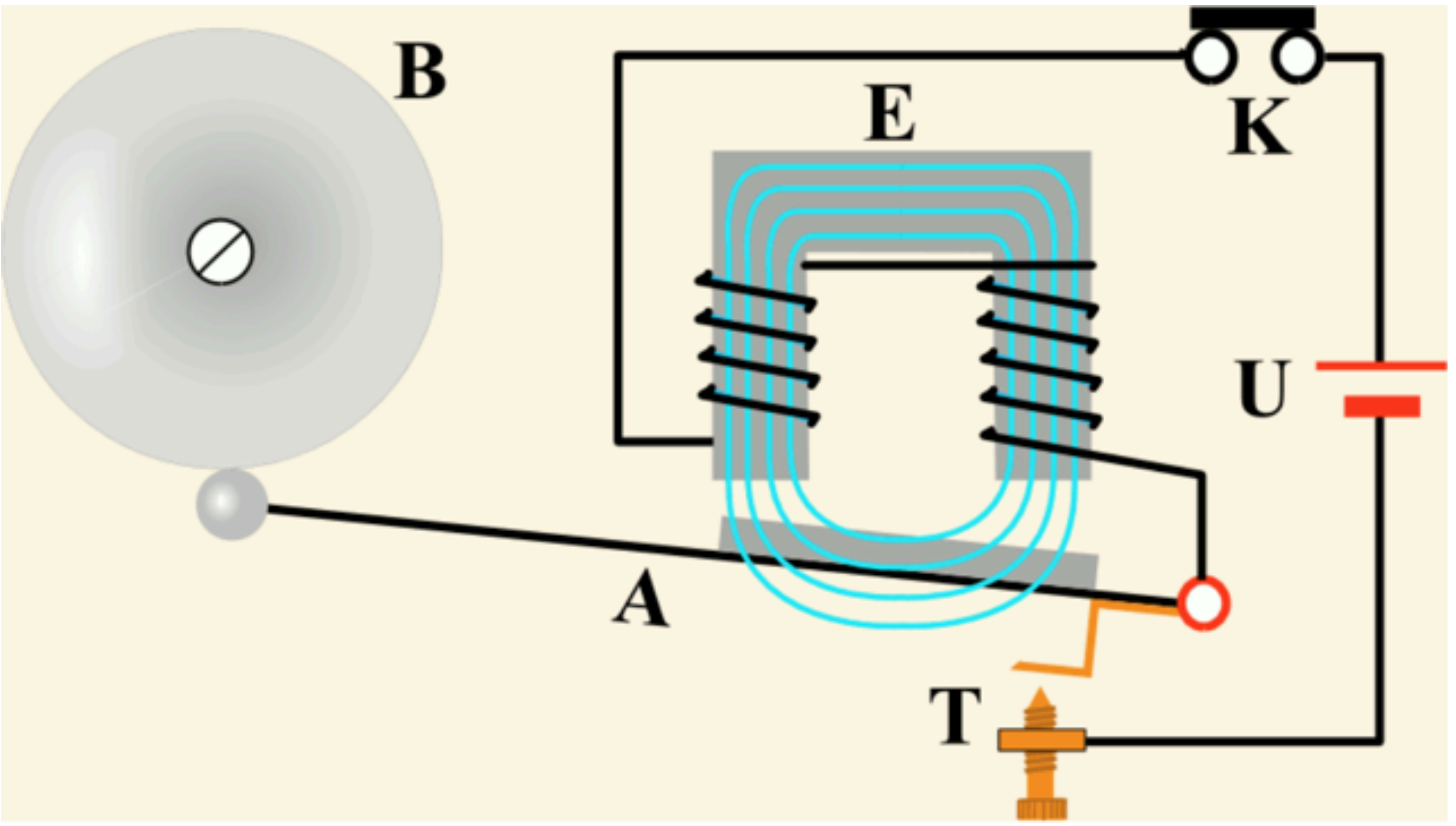
...And draw arrows in these squares to show what direction the magnetic field is going in.

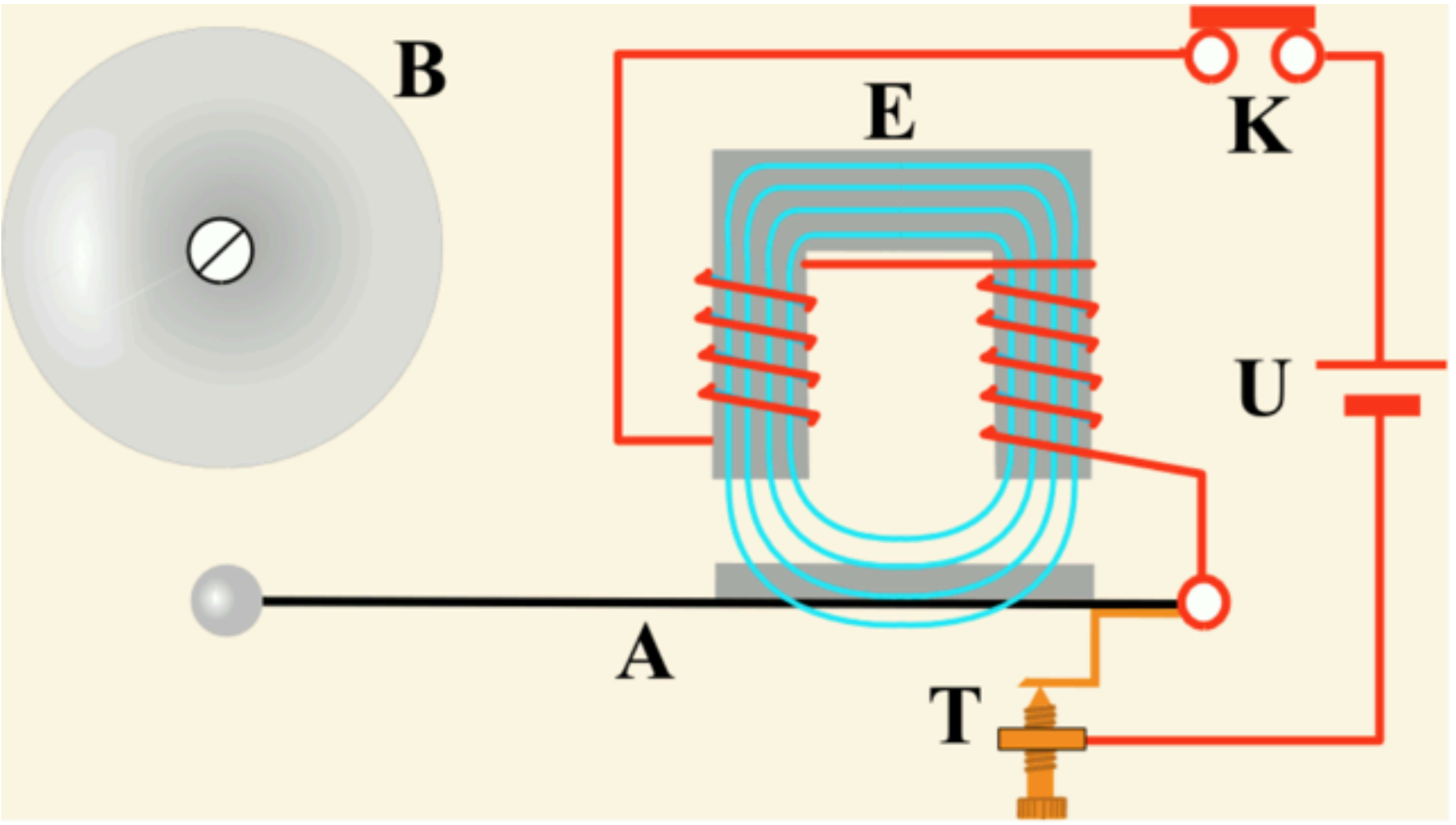


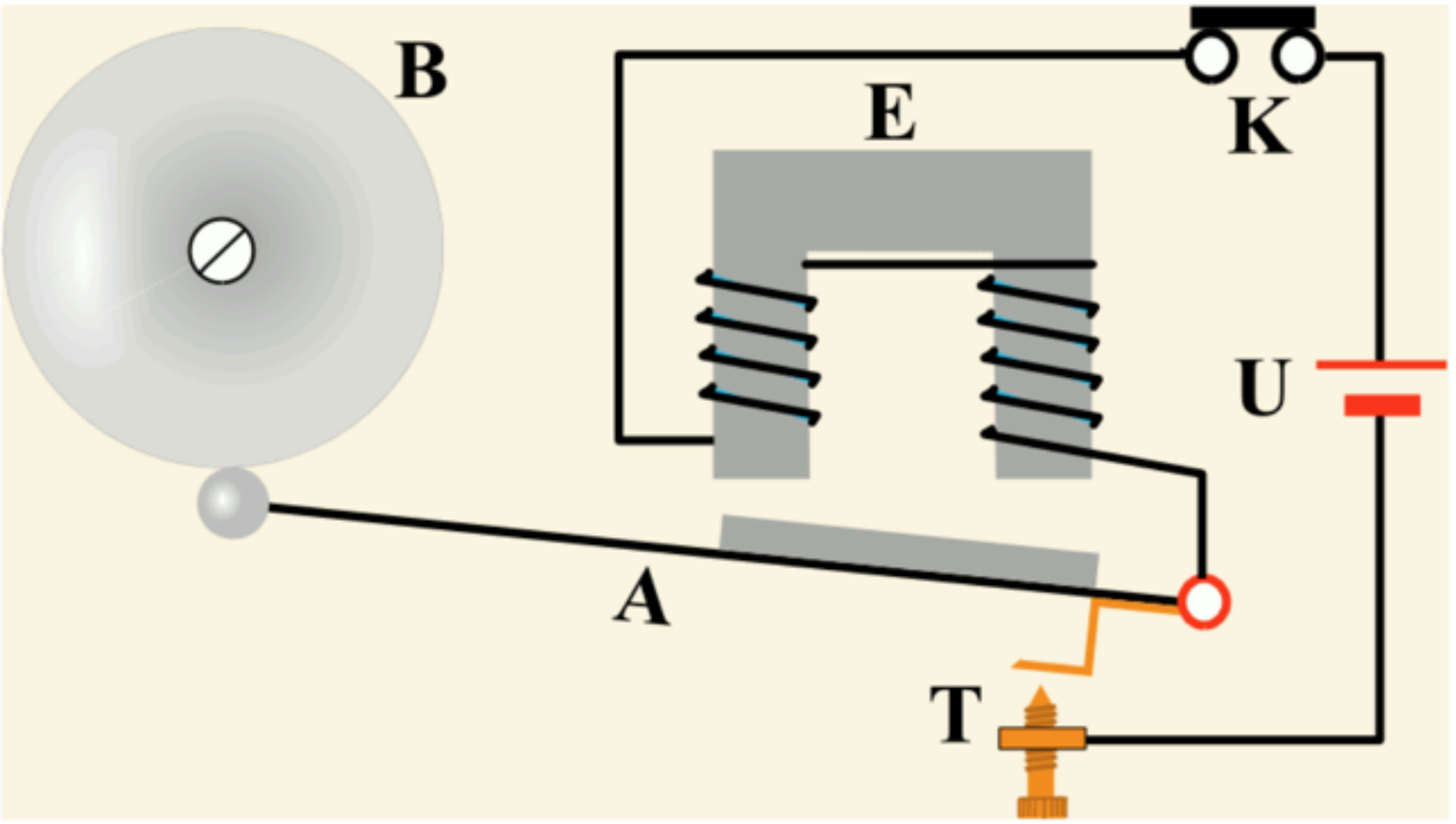


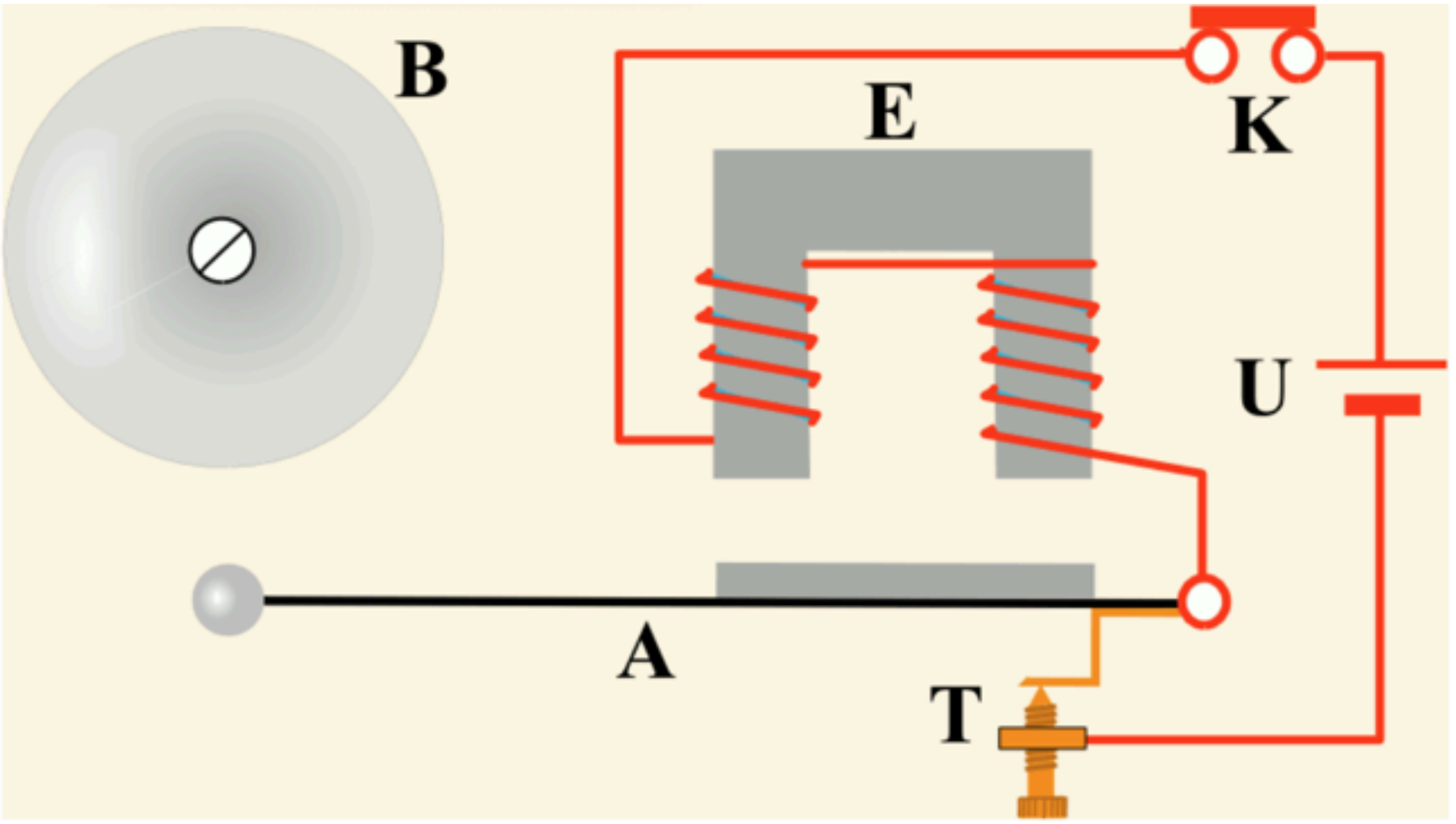


This bell is using an electromagnet. Study the diagrams; can you see how it works and put the pictures in order?









Theatre of Science IGCSE Physics: Magnetism 3: The Motor Effect

You might want to bring a toy with a motor if you have one to hand! Bubble machine / electronics kit etc. Just for looking at.

Today's lesson will cover the following spec points:

Cambridge: Describe an experiment to show that a force acts on a current-carrying conductor in a magnetic field, including the effect of reversing: (a) the current (b) the direction of the field

Recall & use the relative directions of force, magnetic field & current

Determine the direction of the force on beams of charged particles in a magnetic field

Pearson: know that there is a force on a charged particle when it moves in a magnetic field as long as its motion is not parallel to the field

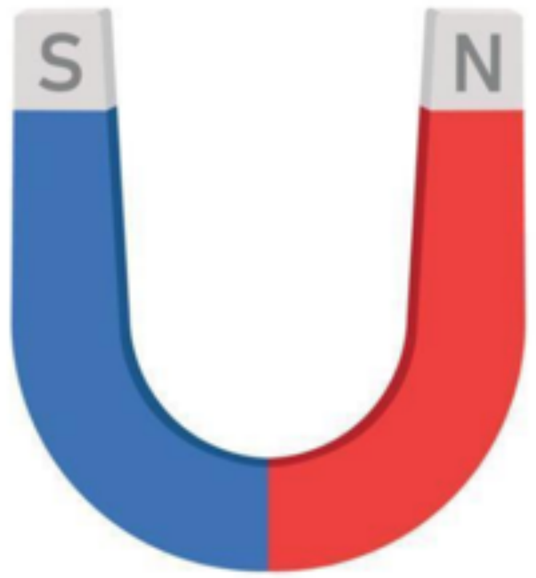
understand why a force is exerted on a current-carrying wire in a magnetic field and how this effect is applied in simple d.c. electric motors and loudspeakers

use the left-hand rule to predict the direction of the resulting force when a wire carries a current perpendicular to a magnetic field

describe how the force on a current-carrying conductor in a magnetic field changes with the magnitude and direction of the field and current

A conductor - like a wire - with a current flowing through it experiences a force when it's placed in a magnetic field! How could you set up these objects to prove this?

Cell

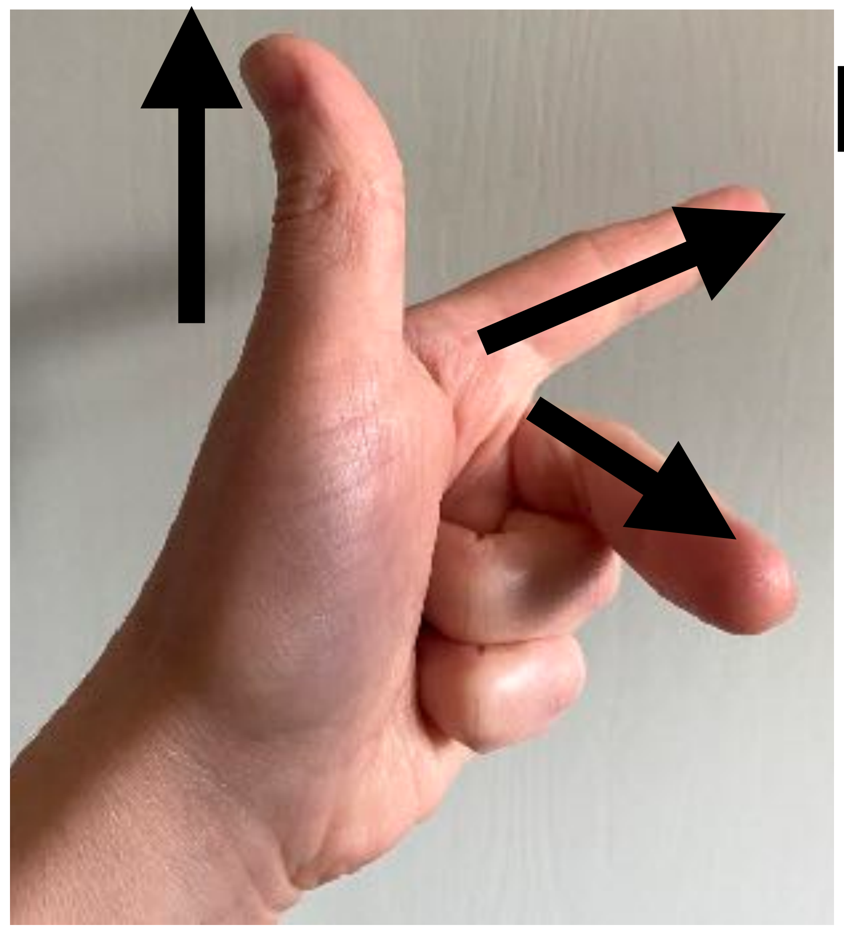


Magnet

Copper wire

Any health and safety issues you'd have to watch out for?

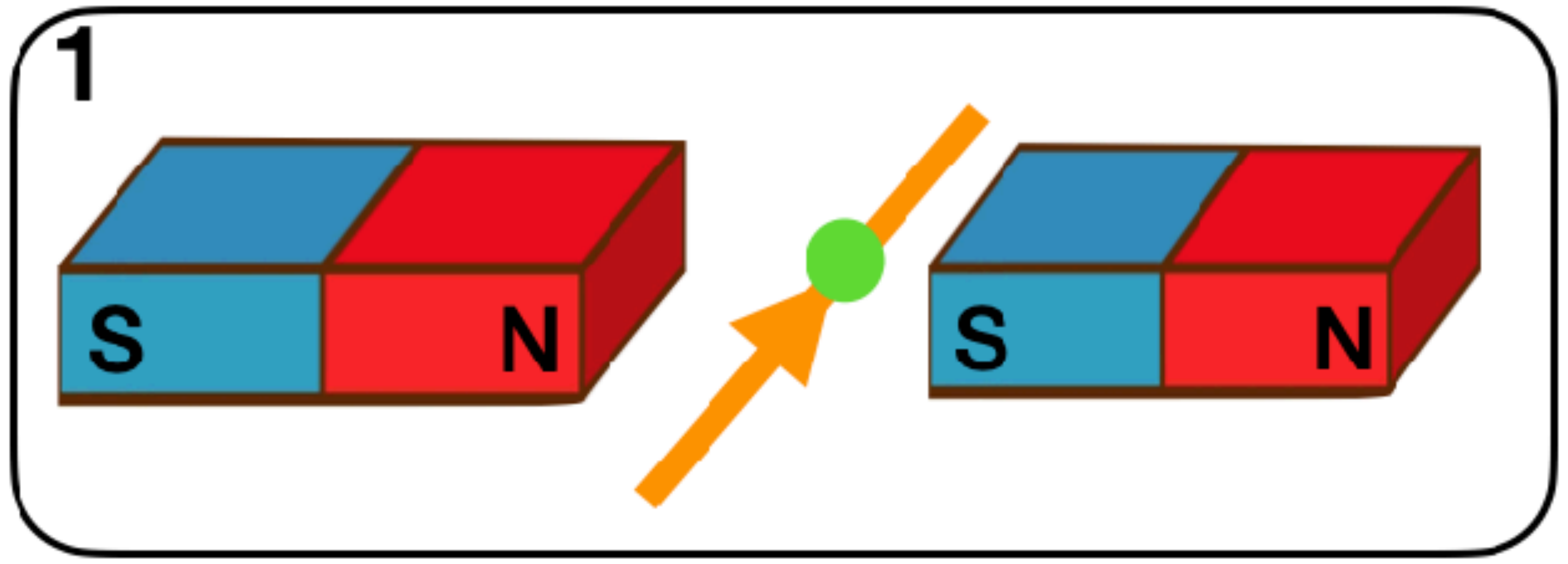
Direction of force

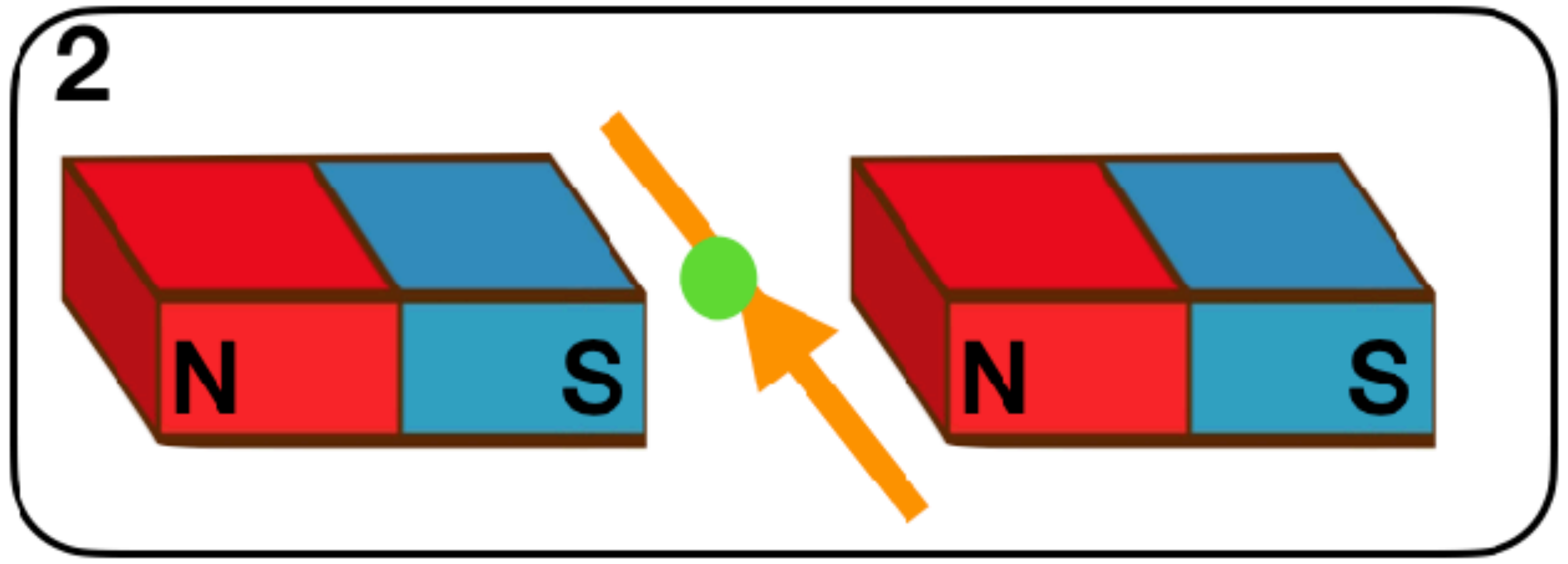


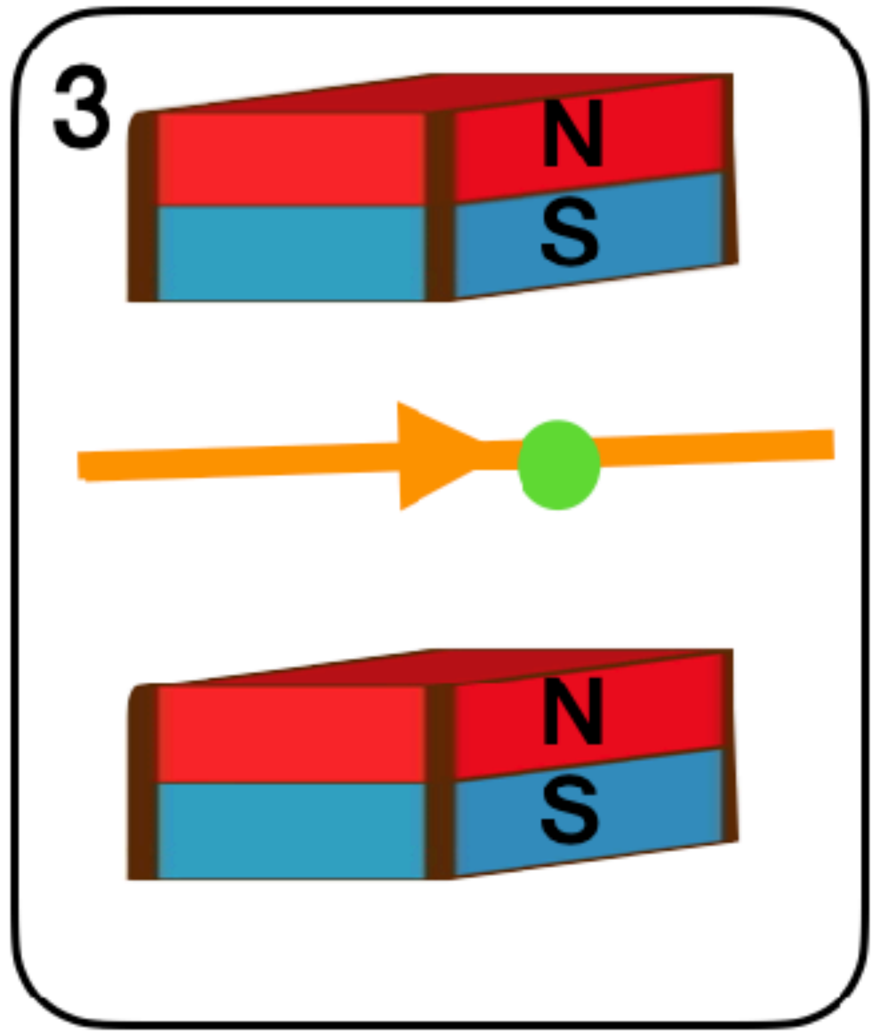
First finger field

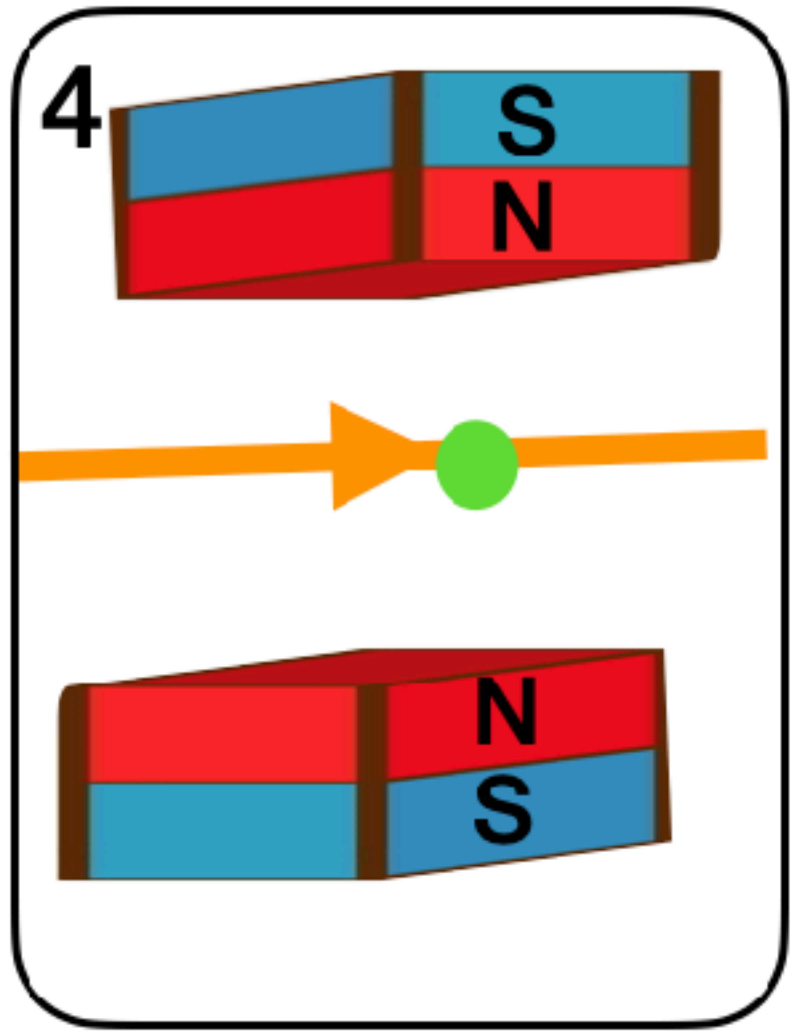
Second finger current

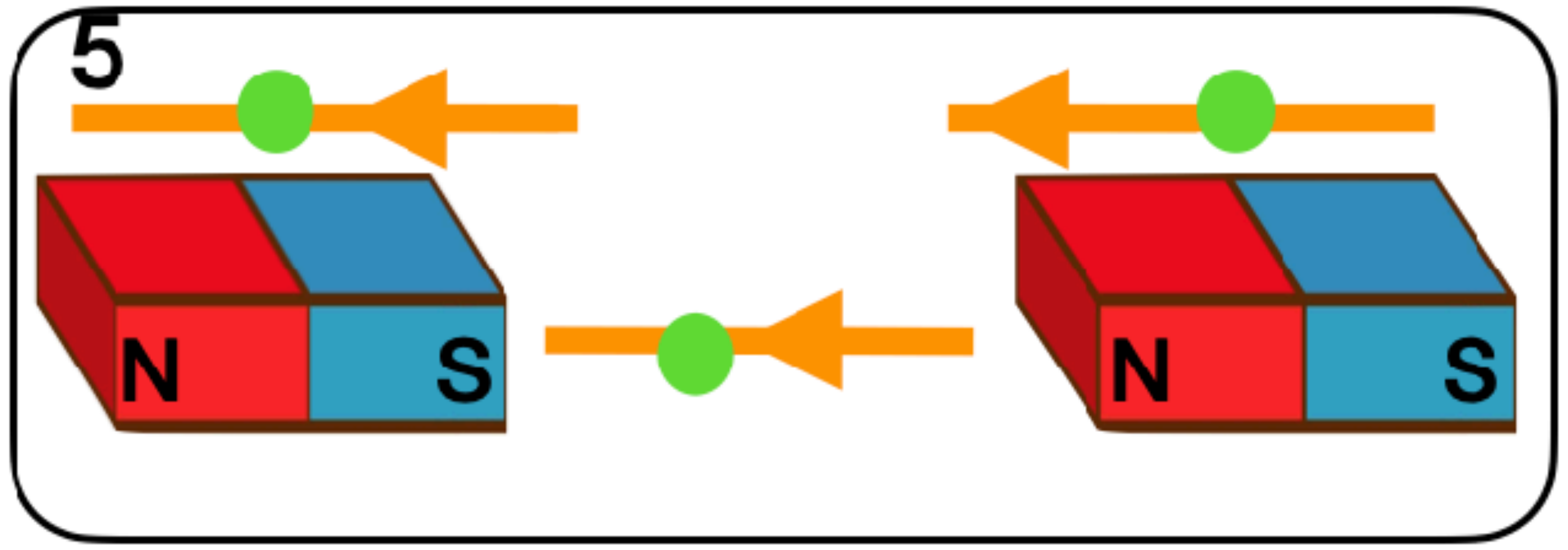
Which direction would the green dot move in each case? Draw an arrow and/or write a word.











Theatre of Science IGCSE Physics: Magnetism 4: a.c Generators

Bring: Play doh or blu tack, a knife (not a sharp one!)

Today's lesson will cover the following spec points:

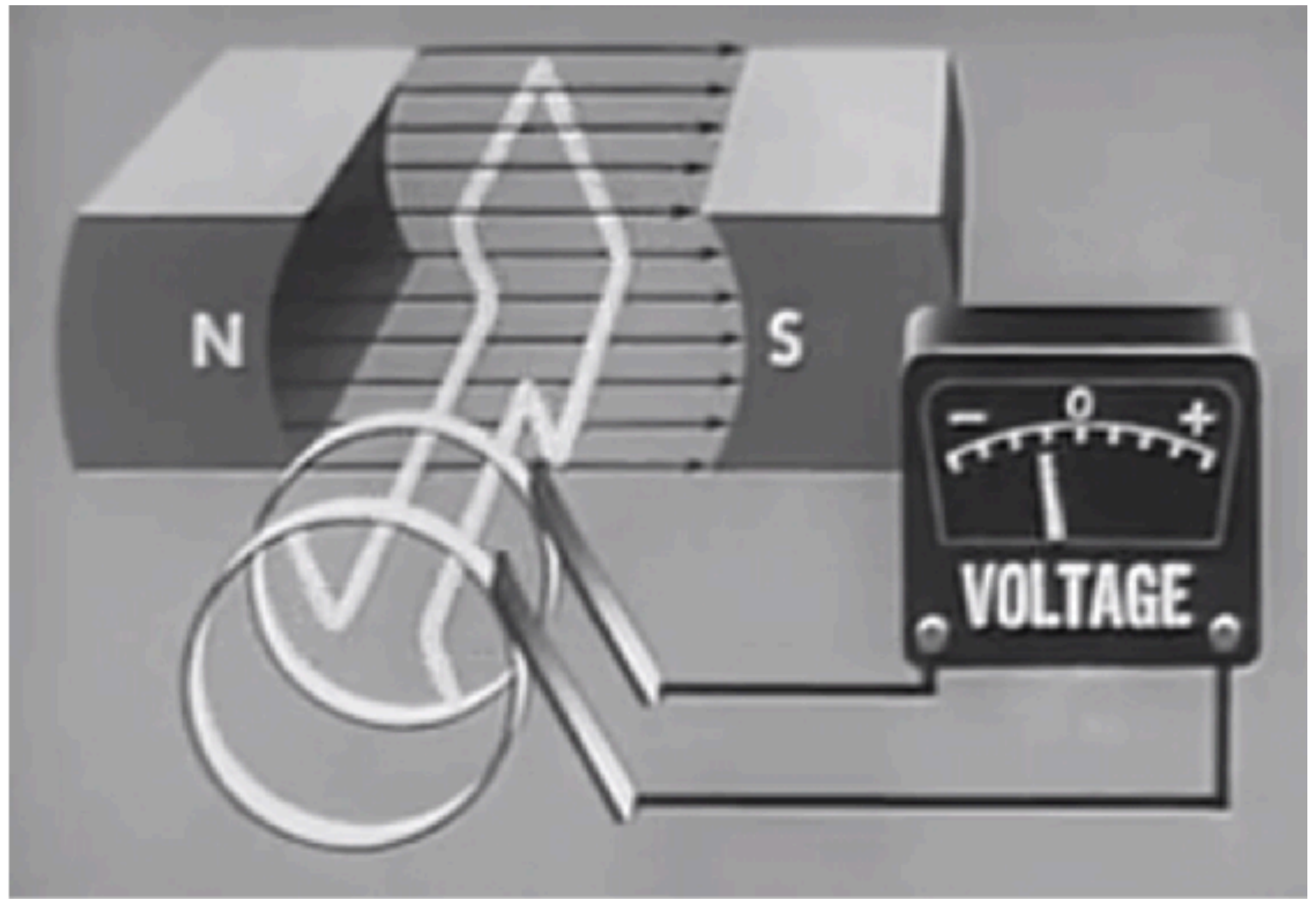
Cambridge: Describe a simple form of a.c. generator (rotating coil or rotating magnet) and the use of slip rings and brushes where needed 2 Sketch and interpret graphs of e.m.f. against time for simple a.c. generators and relate the position of the generator coil to the peaks, troughs and zeros of the e.m.f.

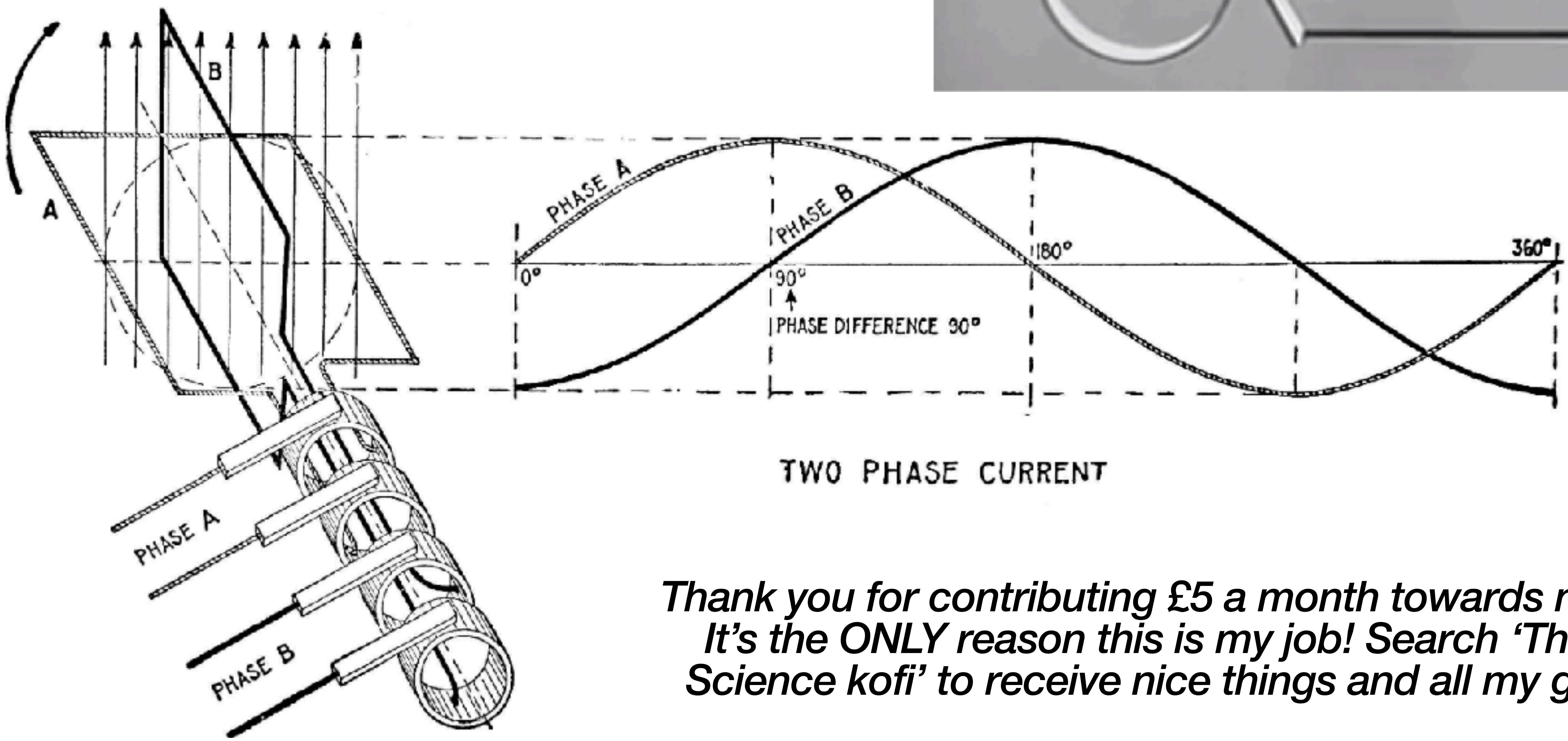
Pearson: know that a voltage is induced in a conductor or a coil when it moves through a magnetic field or when a magnetic field changes through it and describe the factors that affect the size of the induced voltage

Describe the generation of electricity by the rotation of a magnet within a coil of wire and of a coil of wire within a magnetic field, and describe the factors that affect the size of the induced voltage

Label the:
Slip rings
Brushes
Armature
Output
Input

Which one is a trick and you can't label it because it doesn't exist?





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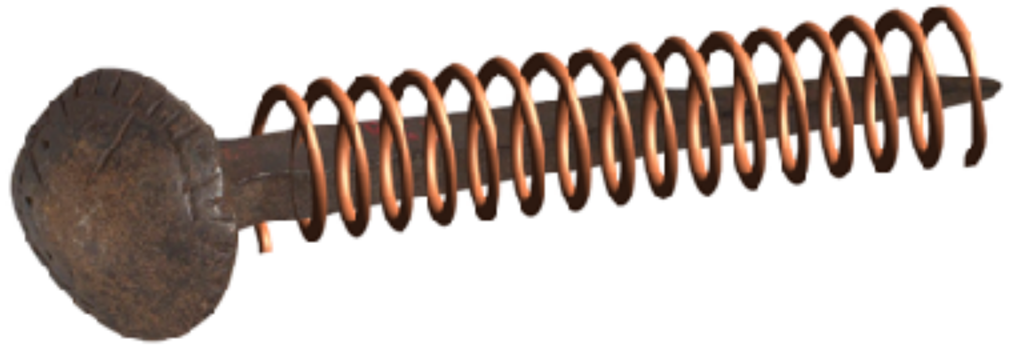
Is there a potential difference across the wire?

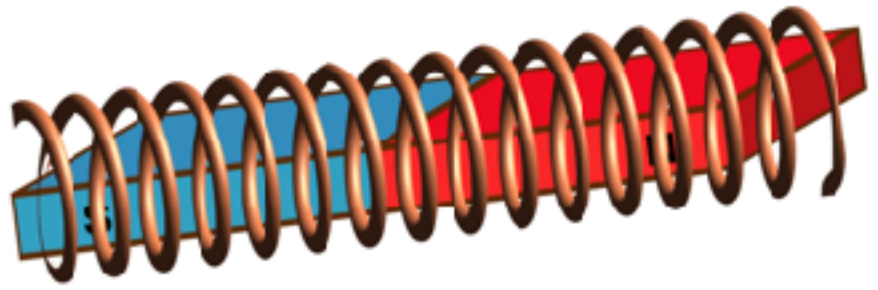
Is current flowing?



Wire wrapped round an iron nail which is staying still.

Is there a potential difference across the wire?

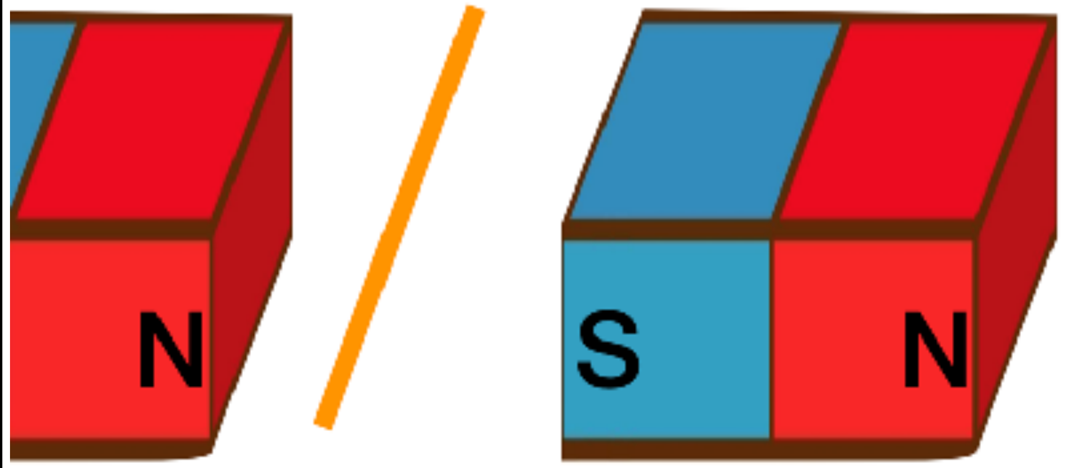
Is current flowing?



Wire wrapped round a magnet which is moving to and fro.

Is there a potential difference across the wire?

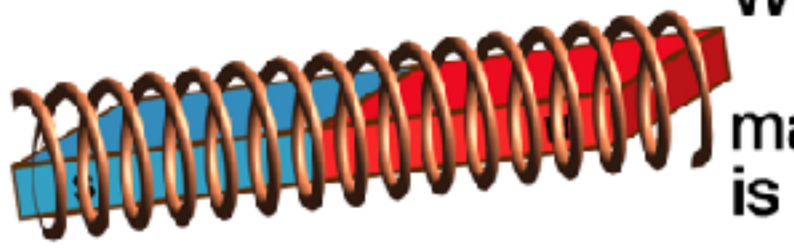
Is current flowing?



Piece of wire moving up and down between two magnets.

Is there a potential difference across the wire?

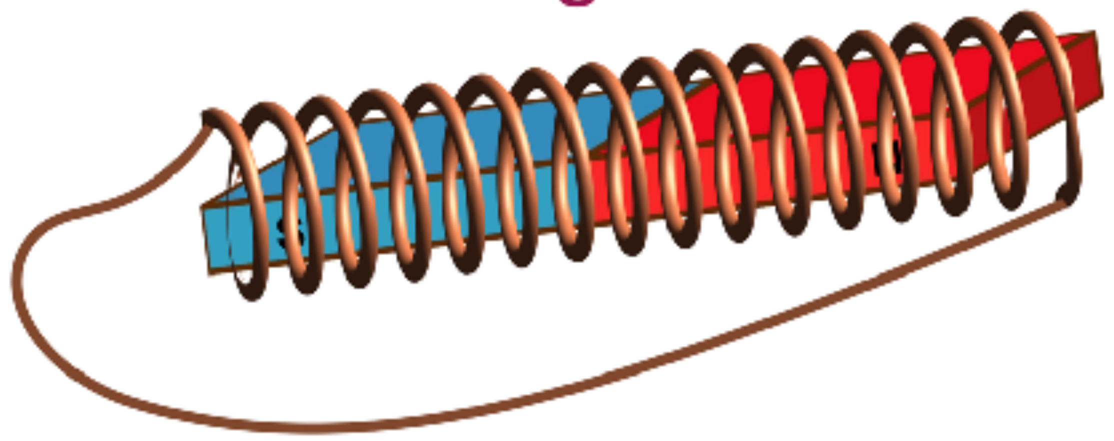
Is current flowing?



Wire wrapped round a magnet which is staying still.

Is there a potential difference across the wire?

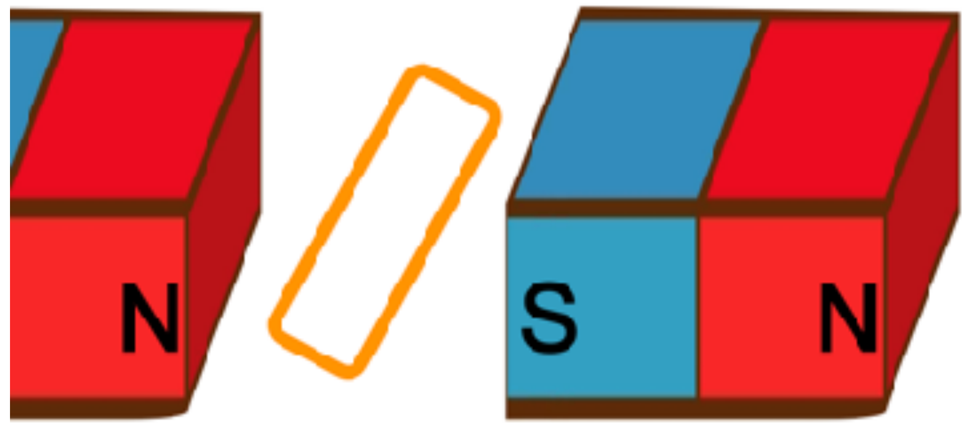
Is current flowing?



Wire wrapped round a magnet which is moving to and fro.

Is there a potential difference across the wire?

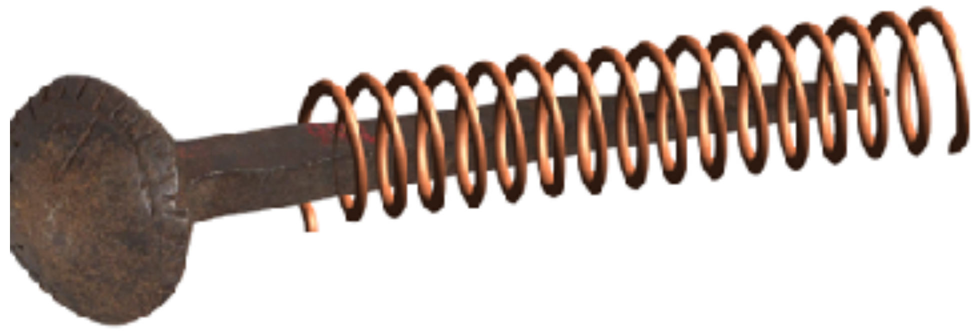
Is current flowing?



Loop of wire moving up and down between two magnets.

Is there a potential difference across the wire?

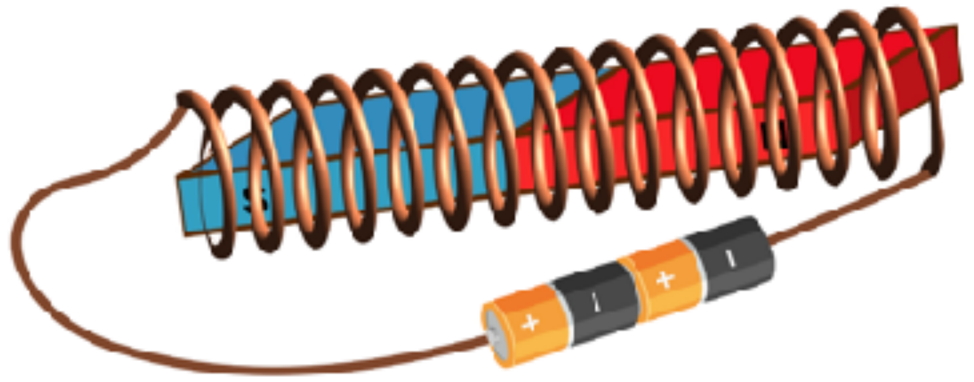
Is current flowing?



Wire wrapped round an iron nail which is moving two and fro.

Is there a potential difference across the wire?

Is current flowing?

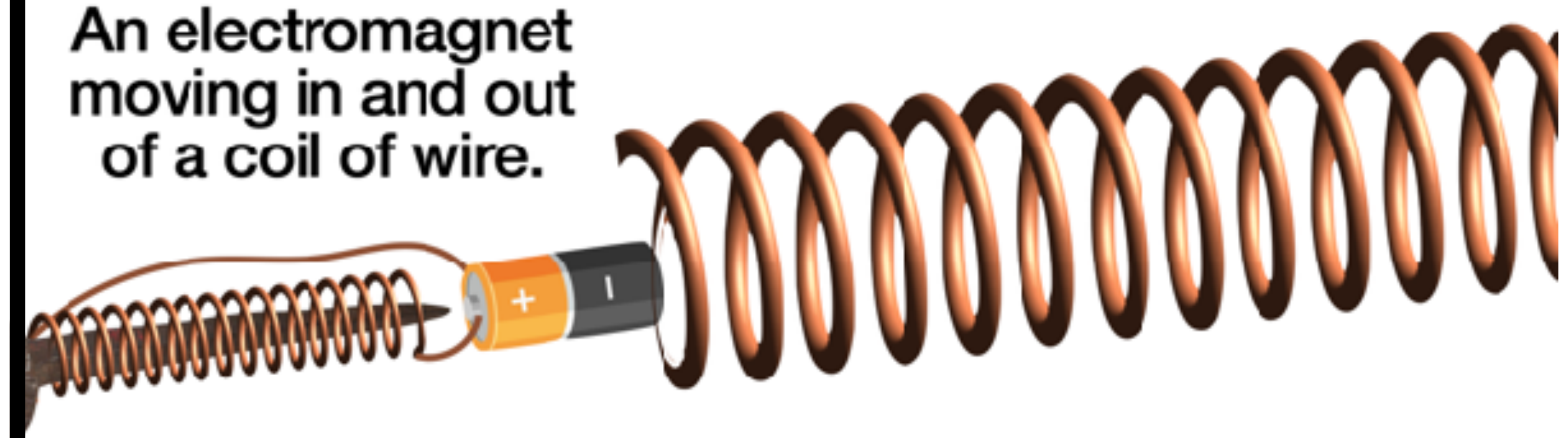


Wire connected to a battery, wrapped round a magnet which is staying still.

Is there a potential difference across the wire?

Is current flowing?

An electromagnet moving in and out of a coil of wire.



Theatre of Science IGCSE Physics: Magnetism 5: Transformers

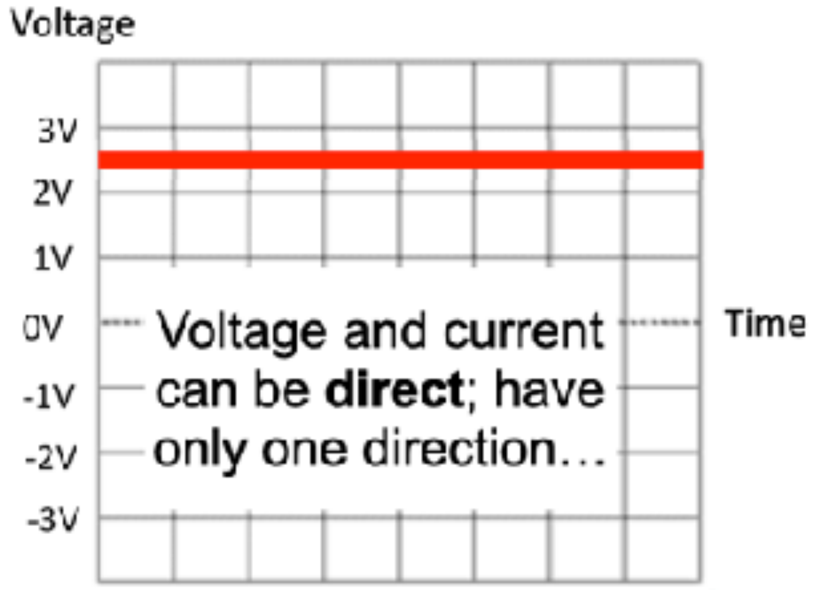
Bring: A phone / laptop charger.

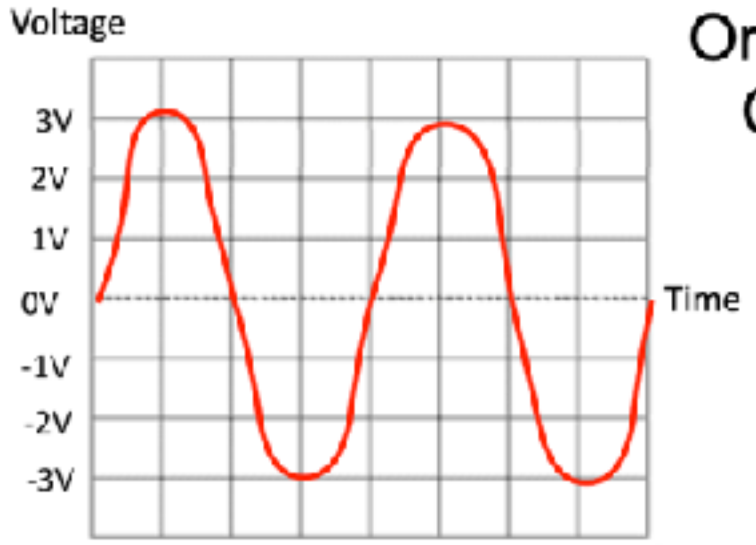
Today's lesson will cover the following spec points:

Cambridge: Describe the construction of a simple transformer with a soft iron core, as used for voltage transformations. Use the terms primary, secondary, step-up and step-down. Describe the use of transformers in high-voltage transmission of electricity. State the advantages of high-voltage transmission. Explain the principle of operation of a simple iron-cored transformer

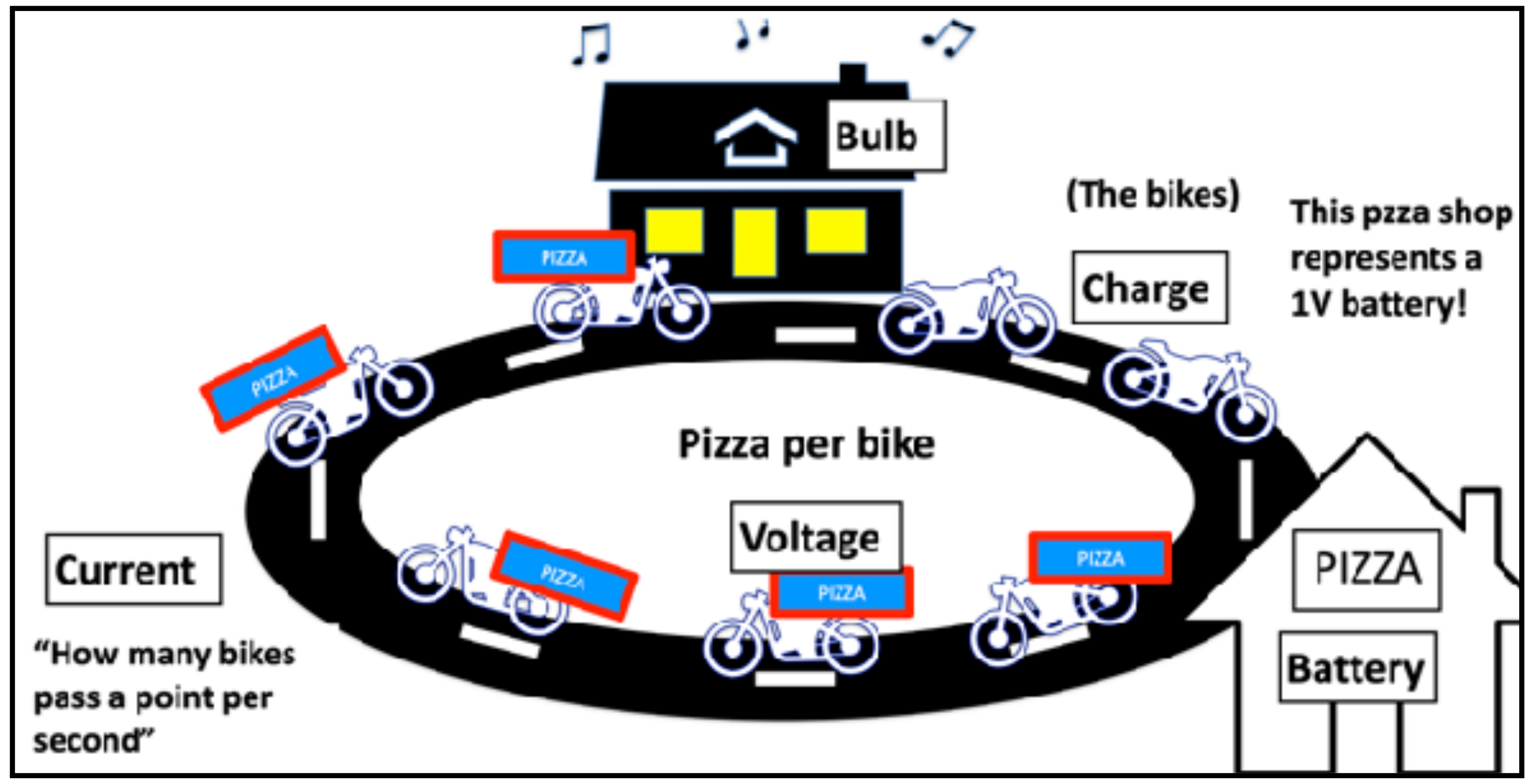
Pearson: describe the structure of a transformer and understand that a transformer changes the size of an alternating voltage by having different numbers of turns on the input and output sides Explain the use of step-up and step-down transformers in the large-scale generation and transmission of electrical energy.

Electricity Reminder:
Current is the rate of flow of charge.
Voltage is energy per charge.
Power = Current x Voltage





Or alternating! Constantly change direction.



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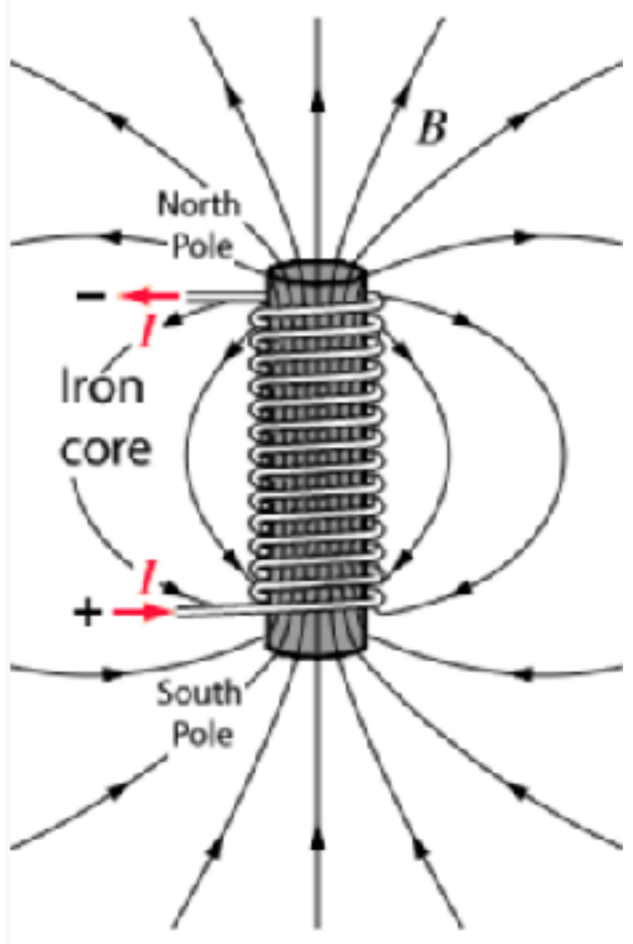
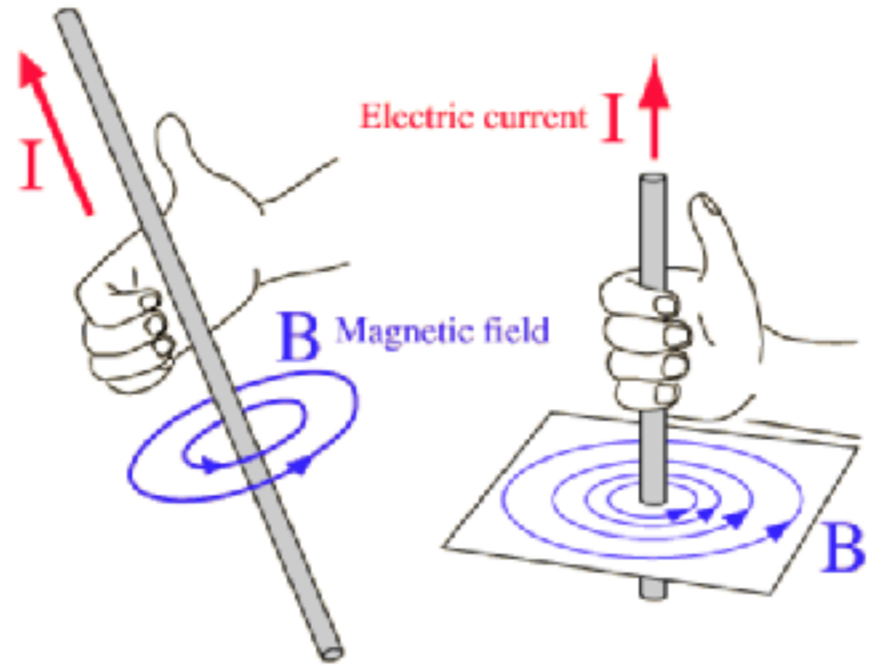
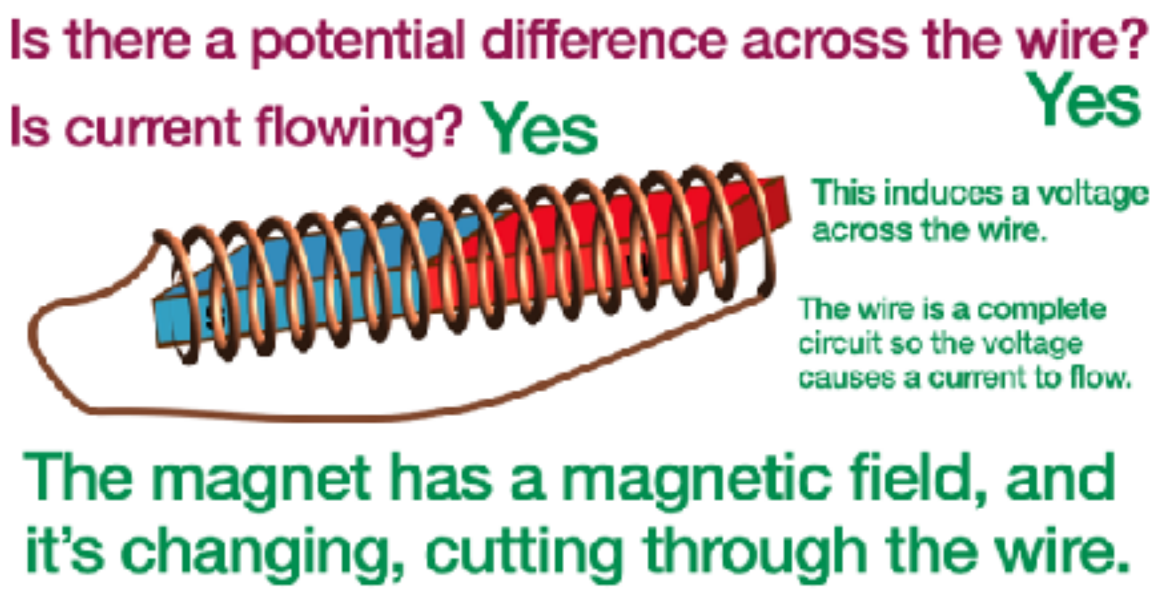
Here's a magnet moving scrap metal around.

Why wouldn't you want it to be a permanent magnet?

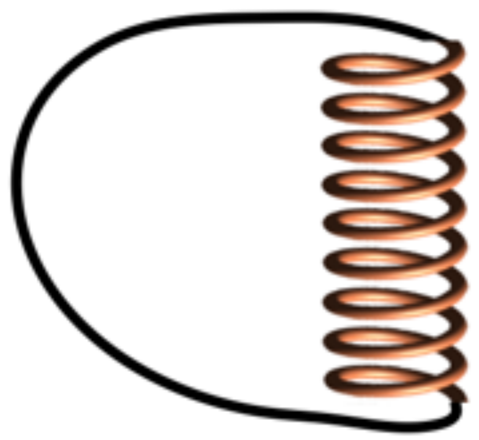
Would you run alternating current or direct current thought the wires? Why?

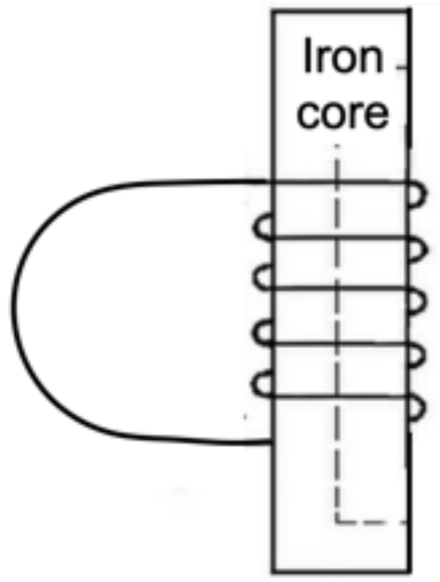


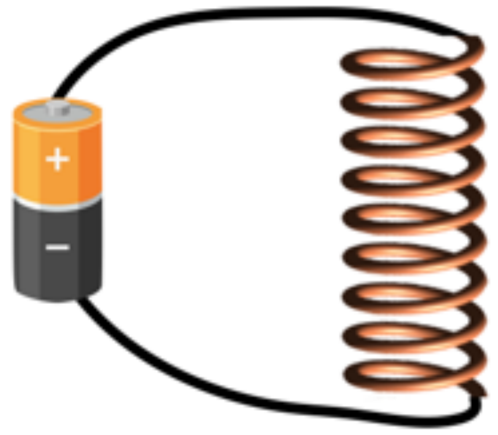


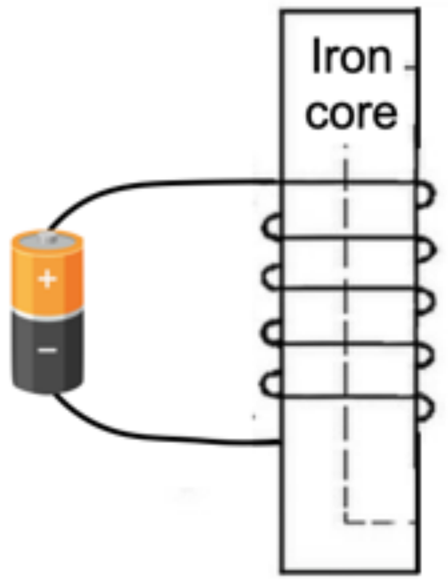


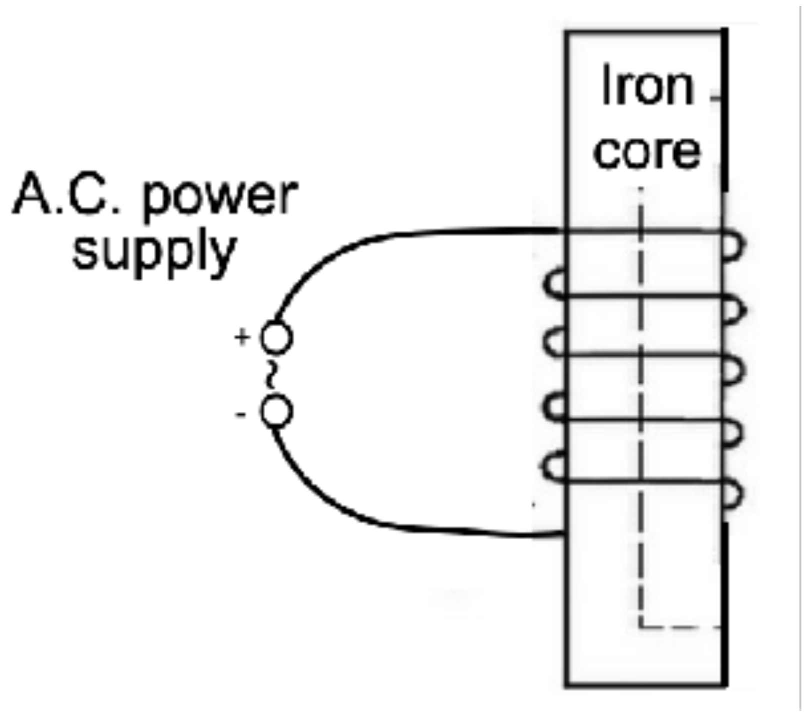
What would happen with these set ups?
Draw any magnetic fields / the direction of any current that should be on the diagram!

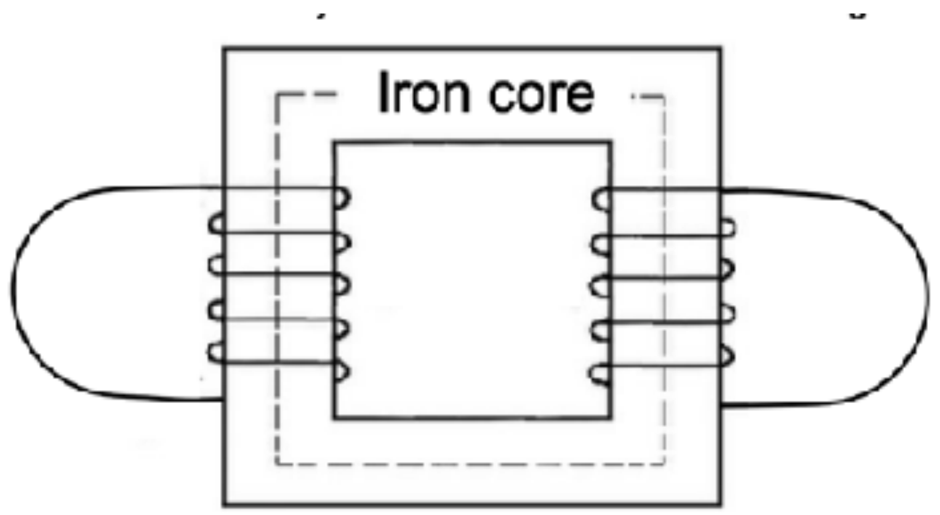


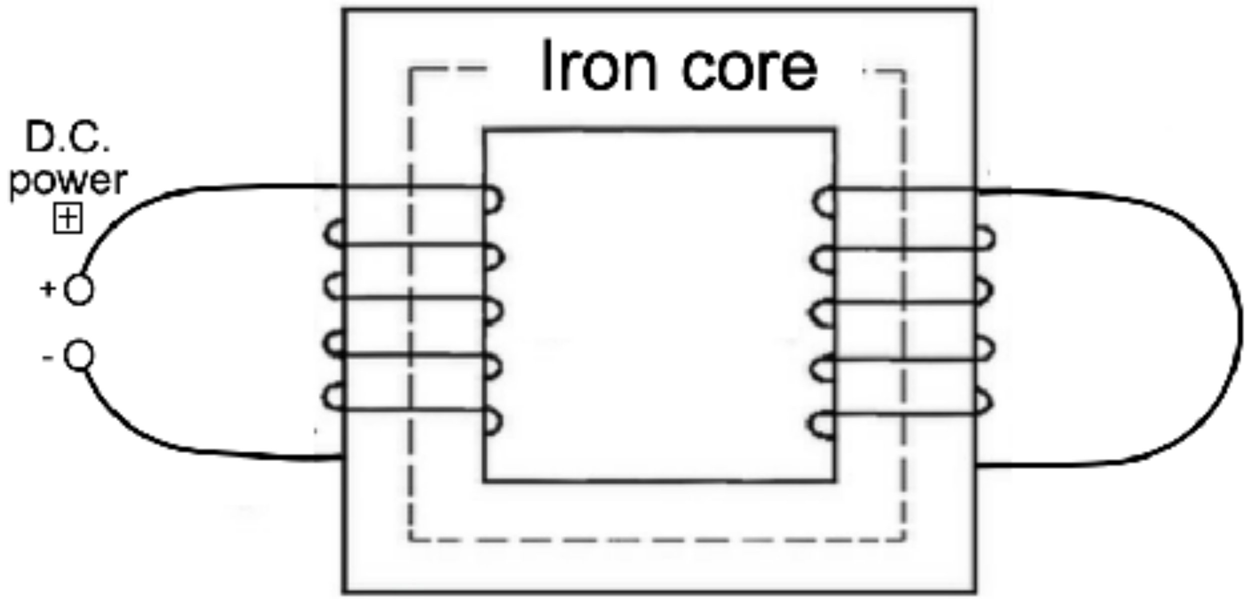


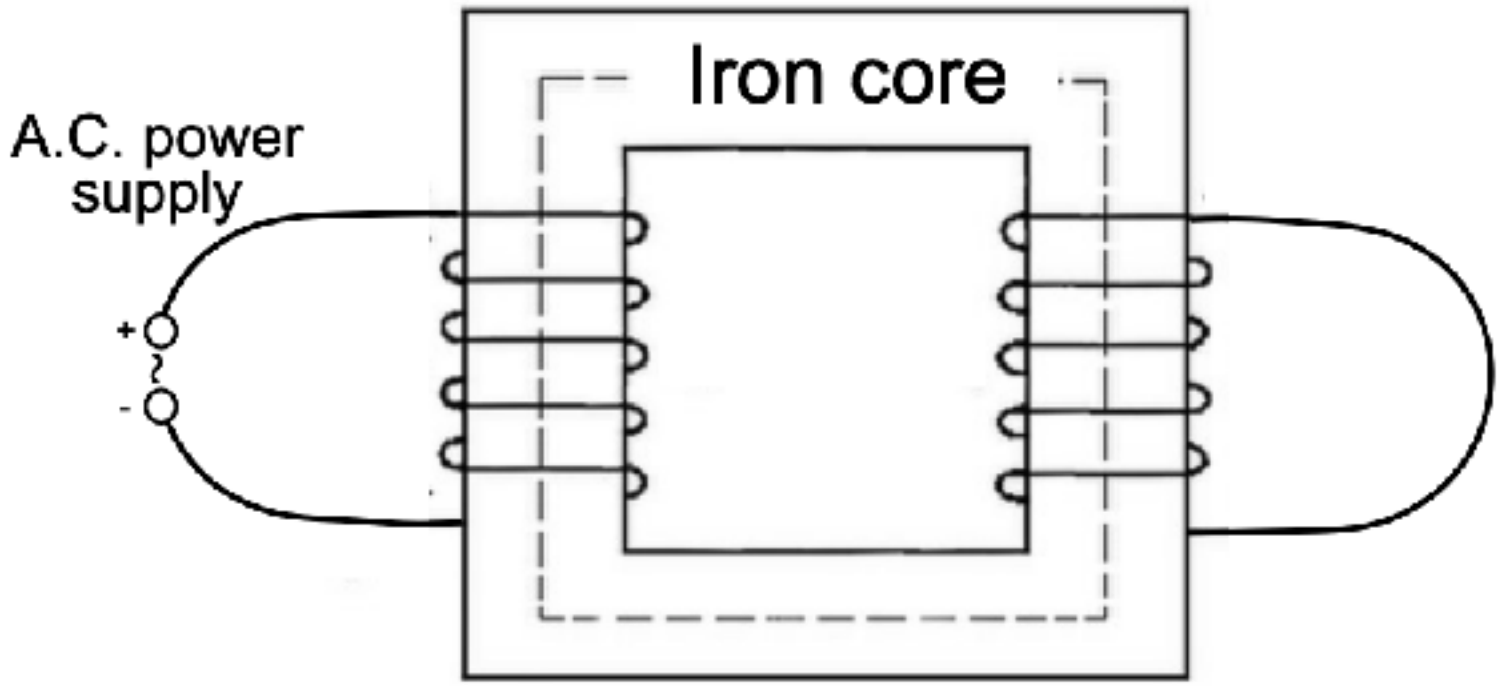


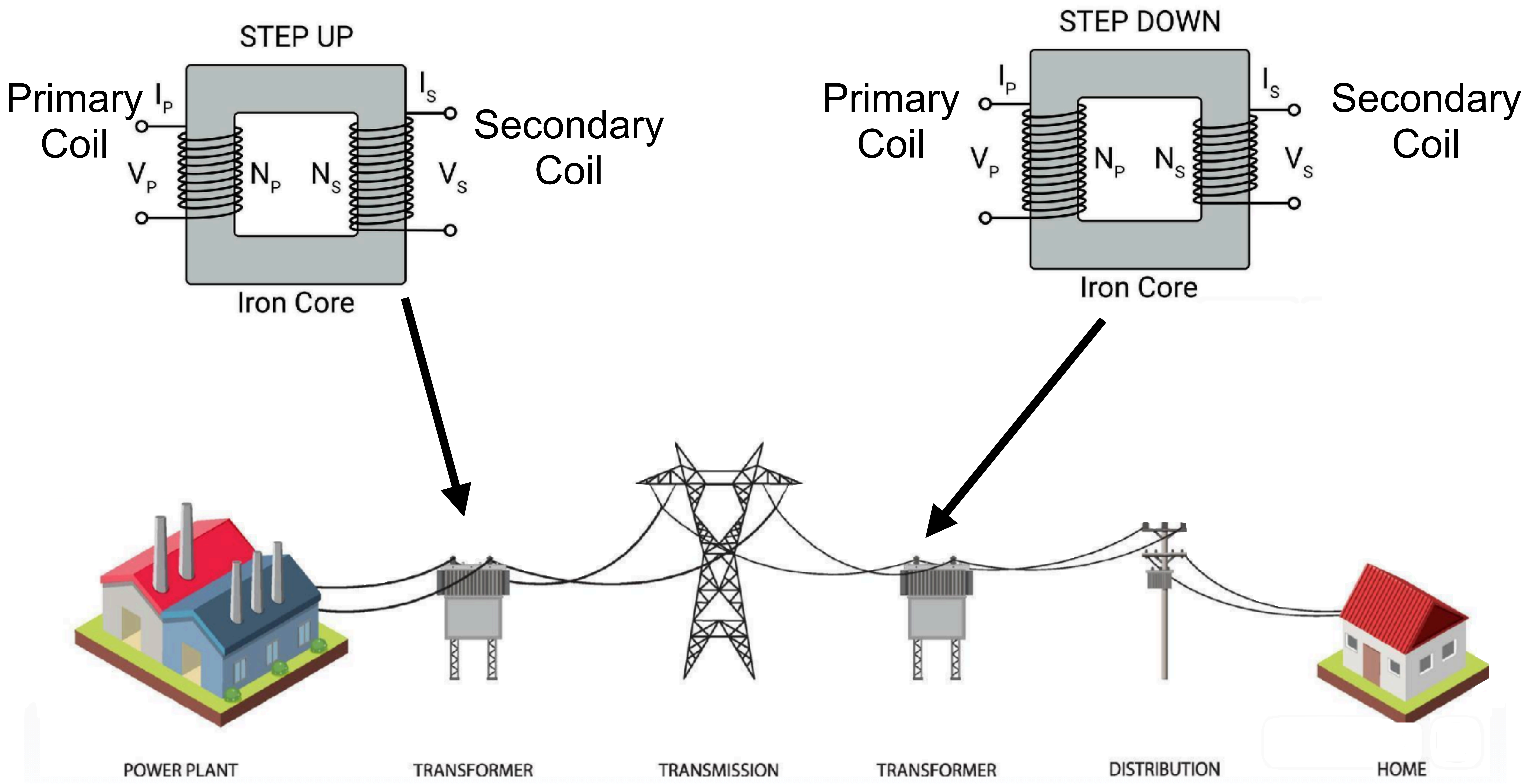











STEP UP
Primary Coil
I_P
V_P
N_P
N_S
I_S
V_S
Secondary Coil
Iron Core
STEP DOWN
Primary Coil
I_P
V_P
N_P
N_S
I_S
V_S
Secondary Coil
Iron Core
POWER PLANT
TRANSFORMER
TRANSMISSION
TRANSFORMER
DISTRIBUTION
HOME

Theatre of Science IGCSE Physics: Magnetism 6: Transformers II

Bring: A calculator, a magnet and paperclips / hair clips / drawing pins.

$$\frac{\text{Input (primary) voltage}}{\text{Output (secondary) voltage}} = \frac{\text{Number of primary turns}}{\text{Number of secondary turns}} \qquad \frac{V_p}{V_s} = \frac{N_p}{N_s}$$

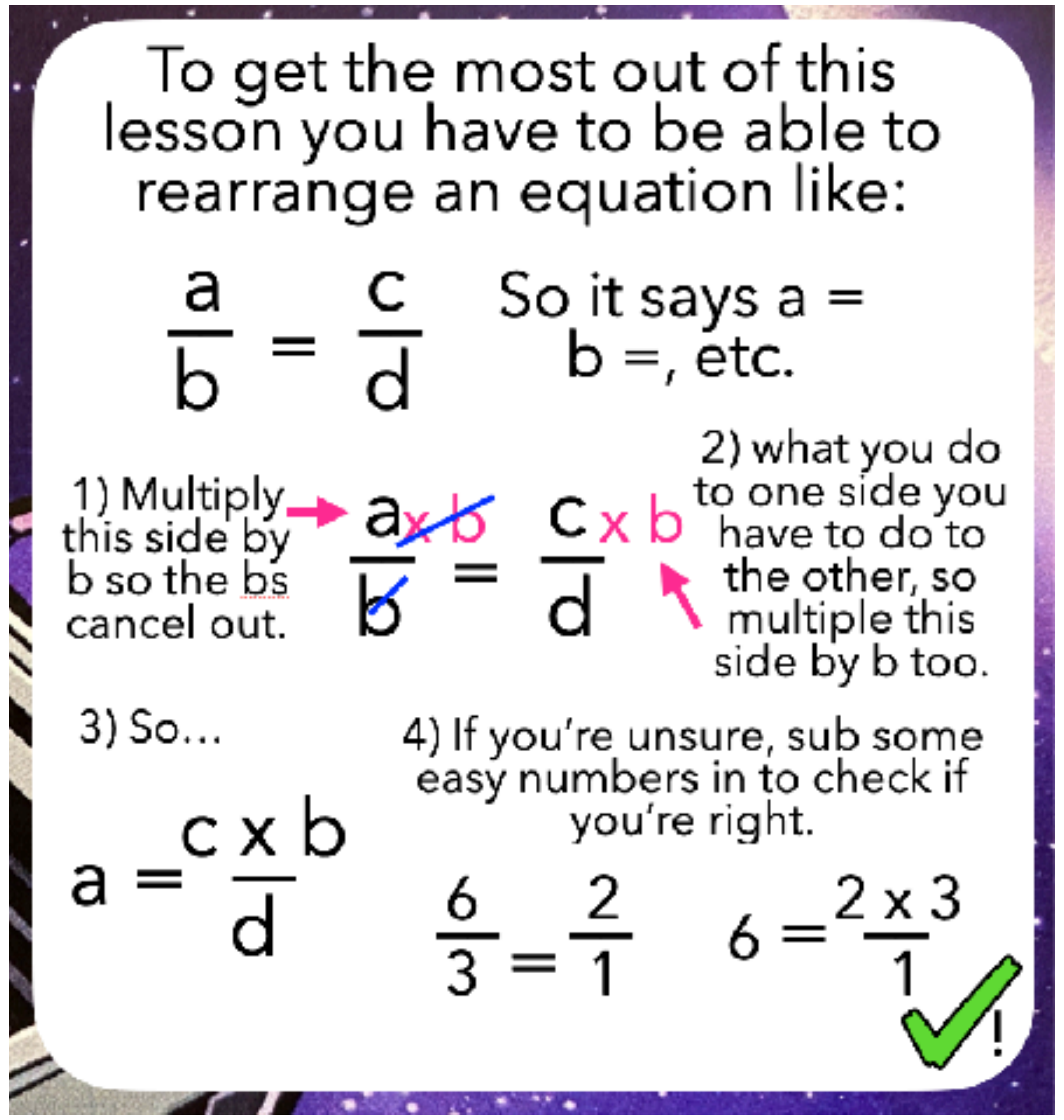
Today's lesson will cover the following spec points:

Cambridge: Describe the use of transformers in high-voltage transmission of electricity
State the advantages of high-voltage transmission Explain the principle of operation of a simple iron-cored transformer.
Recall and use the equation

$$\frac{\text{Input (primary) voltage}}{\text{Output (secondary) voltage}} = \frac{\text{Number of primary turns}}{\text{Number of secondary turns}}$$

Recall and use the equation for 100% efficiency in a transformer I p V p = Is Vs where p and s refer to primary and secondary
Recall and use the equation P = I^2 R to explain why power losses in cables are smaller when the voltage is greater
Pearson say the same as above but are vaguer!

1) A transformer has 30 turns on the primary coil and 150 turns on the secondary coil. Is it a step up or a step down transformer?



2) If the input voltage is 25V, what is the output voltage?

3) My phone charge has an input of 230V (from the UK mains) and an output of 11.5V. If there are 100 turns on the primary coil, how many are there on the secondary coil?

4) A food processor has an input voltage of 240V and an output voltage of 12V. If there are 250 turns on the secondary coil, how many are on the primary?

“Current in primary coil x voltage across it = current through secondary coil x voltage across it”!

Power = Current x voltage

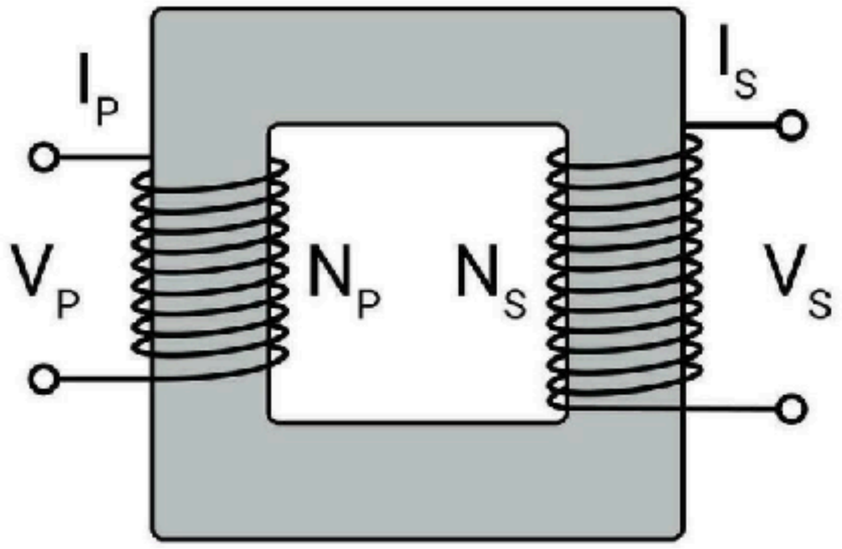
$$I_p V_p = I_s V_s$$

Input Power = Output Power

Question 1

6A

__A



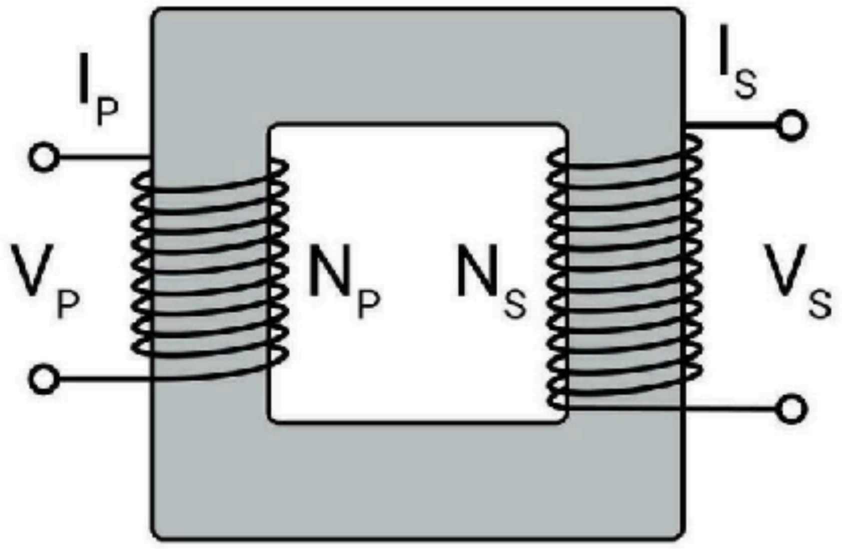
4V

12V

Question 2

__A

50W



10V

3. A transformer converts 15 000 V to 230 V. The power output runs a 1200 W dishwasher. What is the current in the primary coil?

4. A transformer converts 800 V into 240 V. What is the current through the primary coil, if the power output is 2 kW?