PHYSICS

Welcome to the SmarterEd 2026 HSC Physics Revision Series.

Key features of this year's Revision Series include:

- ~17 hours of carefully selected HSC revision questions
- Targeted practice across the most important HSC question types
- Designed for students aiming for a Band 5-6 result
- Higher weighting towards historically difficult question types
- Topic and question weightings reflect historical HSC exam allocations
- Develop your own revision resource by ***carefully reviewing and annotating*** these worksheets throughout Term 3.

**Philosophy: Every question has earned its place. Historical HSC trends, common question types and past areas of student difficulty have all influenced the selection process.*

IMPORTANT

If you've already completed some of these questions during the year, **that's a good thing.**

Many of the highest-performing students credit repeated practice with challenging past HSC questions as a key ingredient in their HSC success. This revision series focuses on the highest-value question types, helping you build confidence and critically, *speed* through the exam.

HSC Final Study: M6 Electromagnetism

Worksheet 3 of 4 | Estimated exam weighting of strand: 27.6%

Key Areas addressed by this worksheet:

Electromagnetic Induction (11.4%)

- *Electromagnetic Induction* is the blue whale of not just module 6, but the whole Physics course! It's eye-opening average contribution of 11.4% is the highest of any topic area. Students should expect 1-2 longer answer questions as well as two multiple-choice.
- *Lenz and Faraday* **(★)** are hammered by examiners. They represent the most commonly examined concepts, tested extensively in the 2020-24 period although notably absent in 2025.
- Questions on this topic typically require students to analyse complex situations where induced currents arise and apply relevant physics laws. *2024 HSC 33, 2023 HSC 30, 2021 HSC 31* and *2020 HSC 33* **(★)** all caused problems and are important revision examples. Students should make it a priority in their revision to provide clear, logical cause and effect explanations in their answers, making the markers job easy.
- *Transformer Calculations/Efficiency* **(★)** has been tested in 6 of the last 7 exams, including longer answer questions on three occasions. Revision examples look at voltage calculations (typically well-answered) and more importantly, follow up questions looking at efficiency and circuit resistance (not well answered).
- *Electromagnetic Induction* **(★)** commonly appears in difficult questions towards the end of the multiple-choice section. *2024 HSC 18 MC, 2019 HSC 18 MC* and *2021 HSC 10 MC* represent the upper difficulty level students will encounter and should be closely reviewed.

KEY: ★ Priority Revision – content or specific questions flagged by SM analysis as key revision.

"When the mind grows weary from electromagnetism, step outside and look up and let clarity come not by force, but by space."

~ Marcus Aurelius

PHYSICS 2026

HSC Revision Series

Module 6 Electromagnetism

Electromagnetic Induction

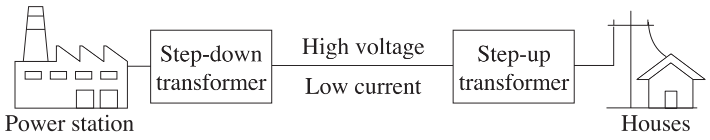
Exam Equivalent Time: 105 minutes *(based on allocation of 1.5 minutes per mark)*

Questions

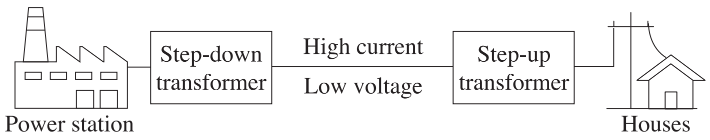
1. PHYSICS, M6 2023 HSC 2 MC

Which diagram best represents the transmission of energy from a power station to people's houses?

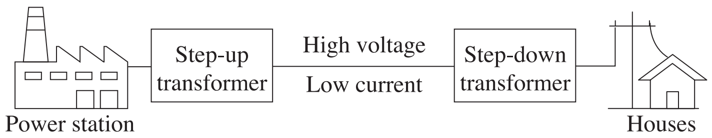
A.



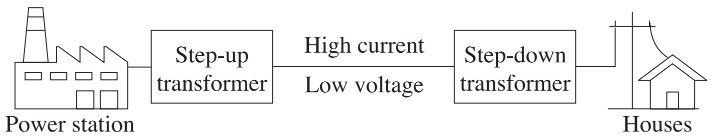
B.



C.

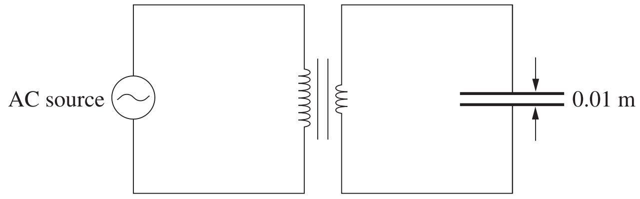


D.

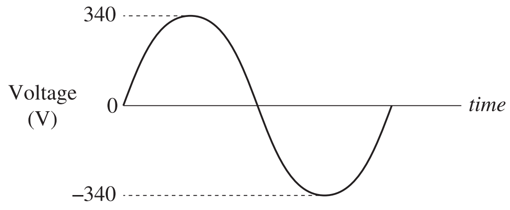


2. PHYSICS, M6 2017 HSC 11 MC

An AC source is connected to a transformer having a primary winding of 900 turns. Connected to the secondary winding of 450 turns is a pair of parallel plates 0.01 m apart.



The AC input is shown in the graph.



What is the maximum field strength (in V m^{-1}) produced between the plates?

A. 1.7

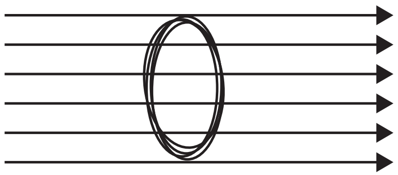
B. 6.8

C. 1.7×10^4

D. 6.8×10^4

3. PHYSICS, M6 2020 VCE 5 MC

A coil consisting of 20 loops with an area of 10 cm^2 is placed in a uniform magnetic field B of strength 0.03 T so that the plane of the coil is perpendicular to the field direction, as shown in the diagram below.



The magnetic flux through the coil is closest to

A. 0 Wb

B. 3.0×10^{-5} Wb

C. 6.0×10^{-4} Wb

D. 3.0×10^{-1} Wb

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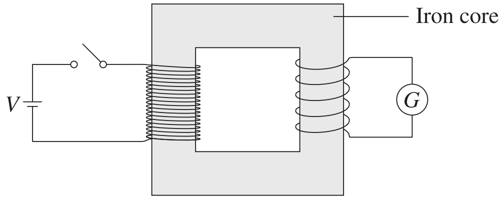
4. PHYSICS, M6 2015 HSC 18 MC

The diagram shows an ideal transformer.



When the switch is closed, the pointer on the galvanometer deflects.

How could the size of the deflection be increased?

A. Decrease the number of primary coils

B. Decrease the number of secondary coils

C. Replace the iron core with a copper core

D. Place a resistor in series with the galvanometer

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5. PHYSICS, M6 2021 HSC 7 MC

In a certain ideal transformer, the current in the secondary coil is four times as large as the current in the primary coil.

Which row of the table correctly identifies the type of transformer and the ratio of turns?

	Type of transformer	*Ratio of turns in primary coil to turns in secondary coil*
A.	Step up	4 : 1
B.	Step up	1 : 4
C.	Step down	4 : 1
D.	Step down	1 : 4

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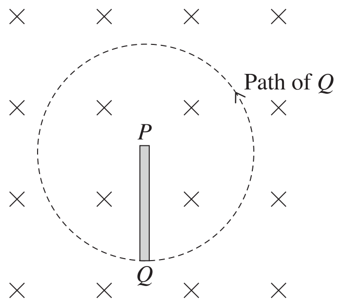
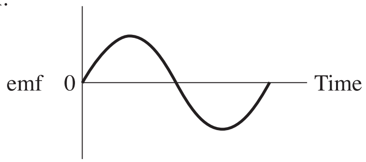
6. PHYSICS, M6 2024 HSC 15 MC

A uniform magnetic field is directed into the page. A conductor PQ rotates about the end P at a constant rate.

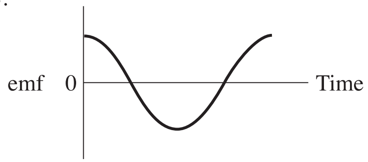


Which graph shows the emf induced between the ends of the conductor, P and Q, as it rotates one revolution from the position shown?

A.

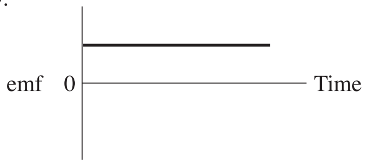


B.



C.

D.



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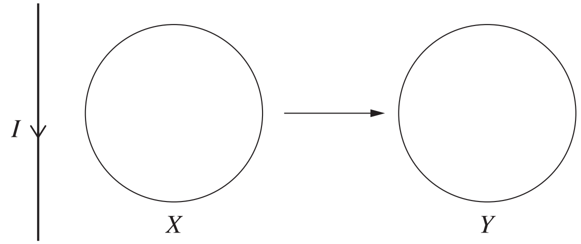
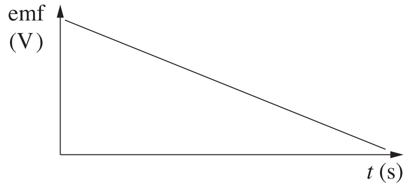
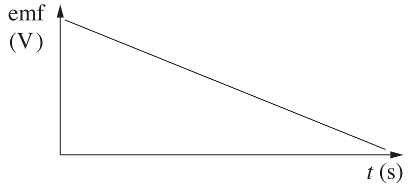
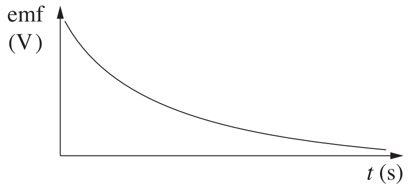
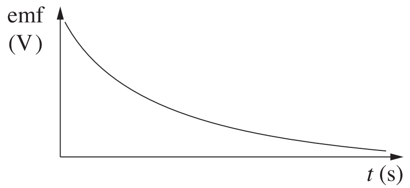
7. PHYSICS, M6 2025 HSC 17 MC

A circular loop of wire is placed at position X, next to a straight current-carrying wire with the current direction shown.

The loop is moved to position Y at a constant speed.

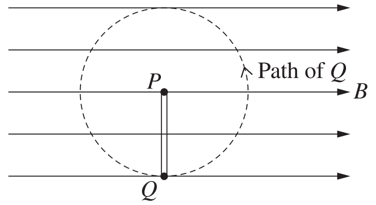


Which row in the table best describes the induced electromotive force (emf) in the loop as it moves from X to Y ?

	Induced emf in loop	*Direction of induced emf in loop*
A.		Anticlockwise
B.		Clockwise
C.		Anticlockwise
D.		Clockwise

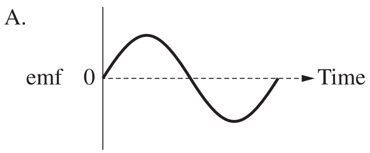
8. PHYSICS, M6 2020 HSC 19 MC

A conductor PQ is in a uniform magnetic field. The conductor rotates around the end P at a constant angular velocity.

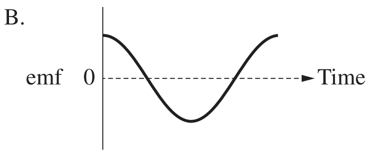


Which graph shows the induced emf between P and Q as the conductor completes one revolution from the position shown?

A.

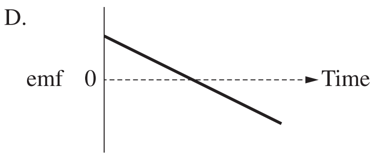


B.



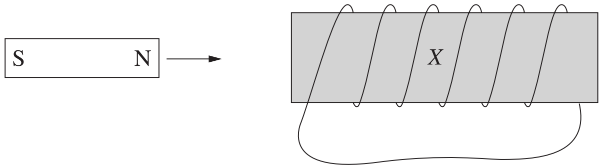
C.

D.



9. PHYSICS, M6 2024 HSC 18 MC

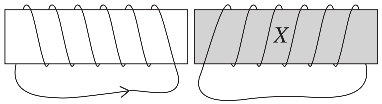
The diagram shows a magnet moving towards a coil X.



This action causes a current to be induced in the coil.

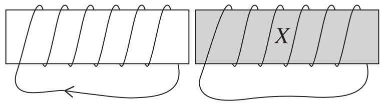
Which situation will induce a current in coil X that is in the same direction as the current induced by the movement of the magnet?

A.



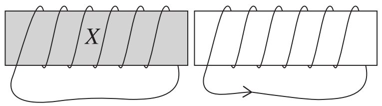
Increasing current

B.



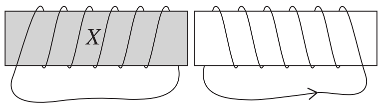
Increasing current

C.



Decreasing current

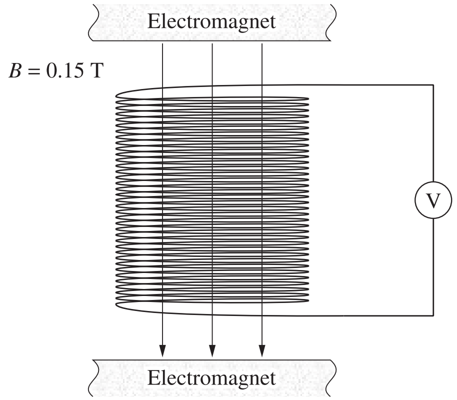
D.



Decreasing current

10. PHYSICS, M6 2021 HSC 24

A stationary coil of 35 turns and cross-sectional area of 0.02 m^2 is placed between two electromagnets, and connected to a voltmeter as shown. The electromagnets produce a uniform magnetic field of 0.15 T through the coil.

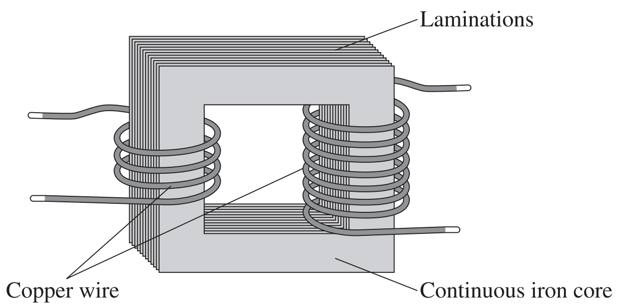


The magnitude of the magnetic field is then reduced to zero at a constant rate over a period of 0.4 s.

Calculate the magnitude of the emf induced in the coil. ***(3 marks)***

11. PHYSICS M6 2022 HSC 22

The diagram shows features of a transformer.



For TWO features of the transformer, describe how each contributes to the transformer's efficiency. *(4 marks)*

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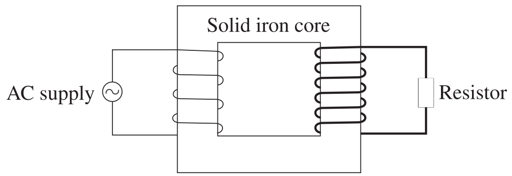
12. PHYSICS, M6 2019 HSC 24

A step-up transformer is constructed using a solid iron core. The coils are made using copper wires of different thicknesses as shown.



The table shows electrical data for this transformer.

V_s	I_s	$V_p I_p$
50 V	9 A	500 J s^{-1}

a. Explain how the operation of this transformer remains consistent with the law of conservation of energy. Include a relevant calculation in your answer. *(3 marks)*

b. Explain how TWO modifications to this transformer would improve its efficiency. *(4 marks)*

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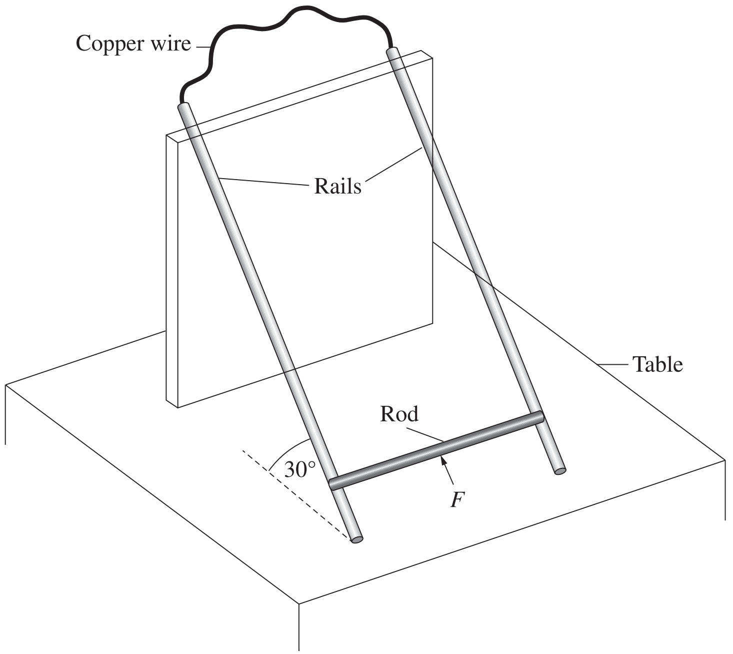
13. PHYSICS, M6 2020 HSC 28

A metal rod sits on a pair of parallel metal rails, 20 cm apart, that are connected by a copper wire. The rails are at 30° to the horizontal.

The apparatus is in a uniform magnetic field of 1 T which is upward, perpendicular to the table.



A force, F, is applied parallel to the rails to move the rod at a constant speed along the rails. The rod is moved a distance of 30 cm in 2.5 s.

a. Show that the change in magnetic flux through the circuit while the rod is moving is approximately 5.2×10^{-2} Wb. *(2 marks)*

b. Calculate the emf induced between the ends of the rod while it is moving, and state the direction of flow of the current in the circuit. *(2 marks)*

c. The experiment is repeated without the magnetic field.

Explain why the force required to move the rod is different without the magnetic field. *(3 marks)*

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14. PHYSICS, M6 2015 HSC 25b

The diagram shows a label on a transformer used in an appliance.

Input:	240 V AC	5.0 A
Output:	2 kV AC	1.0 A

Explain why the information provided on the label is not correct. Support your answer with calculations. *(3 marks)*

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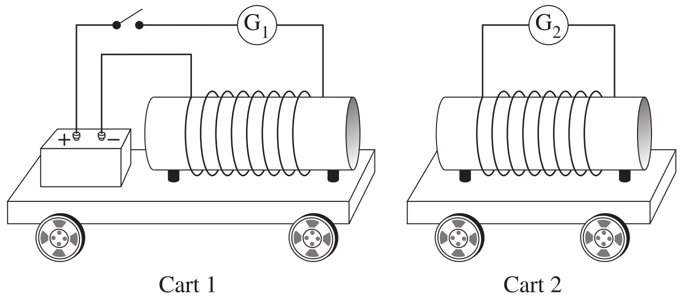
15. PHYSICS, M6 2021 HSC 31

Two identical solenoids are mounted on carts as shown. Each solenoid is connected to a galvanometer, and the solenoid on cart 1 is also connected to an open switch and a battery. The total mass of cart 1 is twice that of cart 2.



Explain what would be observed when the switch on cart 1 is closed. In your answer, refer to the current in each galvanometer and the initial movement of the carts. *(7 marks)*

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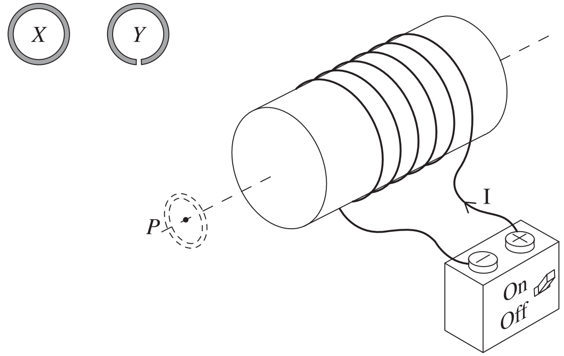
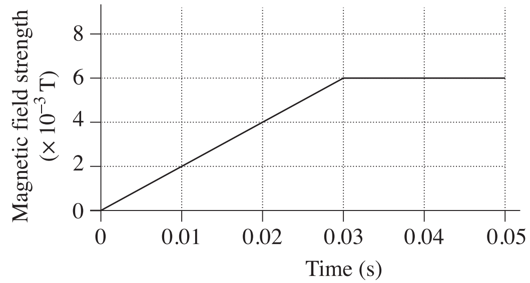
16. PHYSICS, M6 2023 HSC 30

The diagram shows apparatus that is used to investigate the interaction between the magnetic field produced by a coil and two copper rings X and Y, when each is placed at position P, as shown.



Ring X is a complete circular ring, and a small gap has been cut in ring Y. Each of the rings has a cross-sectional area of 4×10^{-4} m².

The power supply connected to the coil produces an increasing current through the coil in the direction shown, when the switch is turned on. This produces a magnetic field at P that varies as shown in the graph.



a. In the first part of the investigation, ring X is held near the end of the electromagnet at position P.

Account for the force acting on the ring from 0 to 0.05 seconds after the power supply is turned on. *(4 marks)*

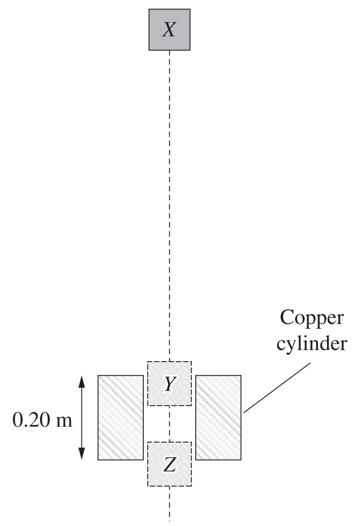
b. **i.** In the second part of the investigation, ring Y is placed at P, and the power supply is turned on.

Explain the behaviour of the ring. *(2 marks)*

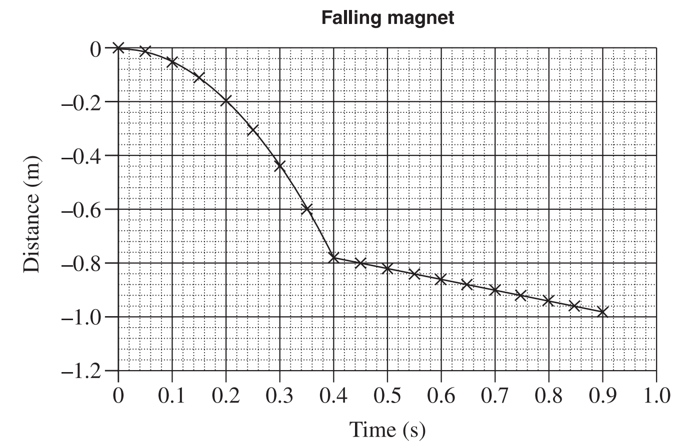
ii. Calculate the maximum induced emf in ring Y. *(2 marks)*

17. PHYSICS, M6 2020 HSC 33

A strong magnet of mass 0.04 kg falls 0.78 m under the action of gravity from position X above a hollow copper cylinder. It then travels a distance of 0.20 m through the cylinder from Y to Z before falling freely again.



The magnet takes 0.5 seconds to pass through the cylinder. The displacement-time graph of the magnet is shown.

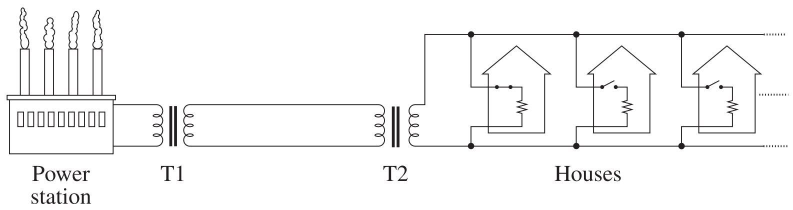


Analyse the motion of the magnet by applying the law of conservation of energy.

Your analysis should refer to gravity and the copper cylinder, and include both qualitative and quantitative information. *(9 marks)*

18. PHYSICS, M6 2018 HSC 30

The diagram shows a model of a system used to distribute energy from a power station through transmission lines and transformers to houses.

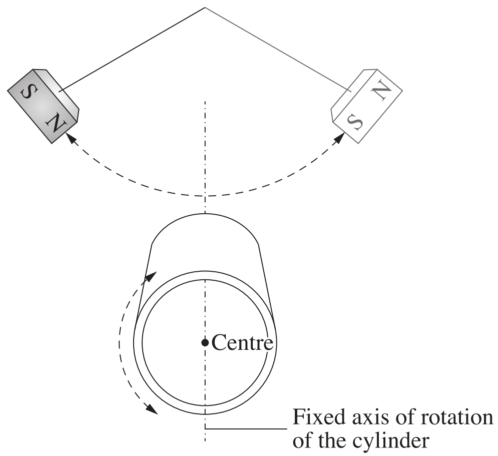


During the evening peak period there is an increase in the number of electrical appliances being turned on in houses.

Explain the effects of this increased demand on the components of the system, with reference to voltage, current and energy. *(6 marks)*

19. PHYSICS, M6 2024 HSC 33

A magnet is swinging as a pendulum. Close below it is an aluminium (non-ferromagnetic) can. The can is free to spin around a fixed axis as shown.



Analyse the motion and energy transformations of both the can and the magnet. *(7 marks)*

Worked Solutions

1. PHYSICS, M6 2023 HSC 2 MC

- Energy from power stations passes through a step-up transformer to increase the voltage and decrease the current.
- This energy then passes through a step-down transformer to be used in homes.

$\Rightarrow C$

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2. PHYSICS, M6 2017 HSC 11 MC

Maximum voltage in primary coil = 340 V (see graph)

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

$$\frac{340}{V_s} = \frac{900}{450}$$

$$V_s = \frac{450 \times 340}{900} = 170 \text{ V}$$

$\therefore$ The maximum voltage in the secondary circuit is 170 V.

$$E = \frac{V}{d} = \frac{170}{0.01} = 1.7 \times 10^4 \text{ V m}^{-1}$$

$\Rightarrow C$

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3. PHYSICS, M6 2020 VCE 5 MC

- Convert cm^2 to m^2: 1 cm^2 = 0.01 m × 0.01 m = 0.0001 m^2
- 10 cm^2 = 0.0010 m^2
- $\Phi = BA = 0.03 \times 0.0010 = 3.0 \times 10^{-5}$ Wb

$\Rightarrow B$

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4. PHYSICS, M6 2015 HSC 18 MC

♦ Mean mark 45%.

- In order to increase the deflection of the galvanometer, the current through the secondary coil must increase.

$$\frac{V_s}{V_p} = \frac{n_s}{n_p} \quad \Rightarrow \quad V_s = \frac{V_p n_s}{n_p}$$

$$V_s \propto n_s$$

- Decreasing the number of secondary coils will decrease V_s.

$$V_s I_s = V_p I_p \quad \Rightarrow \quad V_s \propto \frac{1}{I_s}$$

- Decreasing the number of secondary coils will increase I_s.

$\Rightarrow B$

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5. PHYSICS, M6 2021 HSC 7 MC

♦ Mean mark 42%.

- Larger current in secondary coil → Lower voltage in secondary coil
- Step down transformer → Primary coil has more turns

$\Rightarrow C$

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6. PHYSICS, M6 2024 HSC 15 MC

- As the conductor rotates in the magnetic field, all of the charges in the conductor will have a velocity.
- This will produce a force on each positive and negative charge in the rod according to the equation $F = qvB$.
- Using the right hand rule, the direction of the force applied to each positive charge in the rod during the rotation will be towards P. Similarly, the direction of force on each negative charge will be towards Q.
- This separation of positive and negative charges to opposite ends of the conductor generates the emf.
- As the velocity of the charges during the circular motion will remain constant, the force on the charges will be constant. Therefore, a constant emf will be produced in the conductor.

♦♦ Mean mark 35%.

$\Rightarrow D$

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7. PHYSICS, M6 2025 HSC 17 MC

- The downward current in the straight wire creates a magnetic field out of the page on the loop's side (right-hand grip rule).
- As the loop moves from X to Y, this outward flux decreases. Lenz's Law means that the loop induces an anticlockwise current to oppose the change (eliminate B and D).
- Using $\epsilon = -\dfrac{\Delta\Phi}{\Delta t}$, the induced emf is equal to the negative slope of the flux-time graph.
- Because the magnetic field gets weaker with distance $(B \propto \frac{1}{r})$ and the loop moves at constant speed, the flux drops in a curved (non-linear) way rather than straight.
- This means the induced emf also decreases in a curved way, not as a straight-line fall.

♦♦ Mean mark 37%.

$\Rightarrow C$

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8. PHYSICS, M6 2020 HSC 19 MC

- At the starting position shown, electrons in the rod are moving to the right, parallel to the magnetic field lines. So, there is no force acting on the conductor (EMF of zero).
- After a quarter of a rotation, electrons in the rod are moving up the page. Using the right hand palm rule, they experience a force out of the page. This will not induce an EMF between P and Q.
- The correct graph will show an EMF of zero at both $t = 0$ and after a quarter of a rotation.

♦♦ Mean mark 10%.

$\Rightarrow C$

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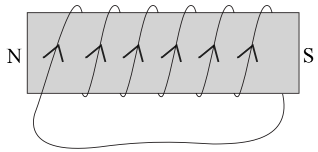
9. PHYSICS, M6 2024 HSC 18 MC

♦♦♦ Mean mark 28%.

- As the north pole of the magnet moves towards coil X, the magnetic flux through X is increased. By Lenz's law, a current will be generated in the coil that produces a magnetic field to oppose the increase the flux. Using Lenz's law, the current in X will generate a north pole to the left to repel the approaching magnet. The induced current will run up the coils as viewed from the front.



- The current will be induced in the same direction in D. Using the right hand grip rule, the current though the white coil will produce magnetic field lines gong to the left. As the current is decreasing, the change of flux through X is decreasing. Therefore by Lenz's law, the current induced in X will strengthen the magnetic field to oppose the decreasing magnetic flux.
- Therefore, the magnetic field lines produced by the current in X will also be to the left, and using the right hand grip rule, the current through X will run up the coils (front view).
- In all the other options, the current will run down the coils (front view).

$\Rightarrow D$

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10. PHYSICS, M6 2021 HSC 24

$$\Phi = BA = 0.15 \times 0.02 = 0.003\ \text{Wb}$$

$$\varepsilon = -N\frac{\Delta\Phi}{\Delta t} = -35\frac{(0-0.003)}{0.4} = 0.3\ \text{V}$$

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11. PHYSICS M6 2022 HSC 22

***Keyword - "Describe"**: Provide characteristics and features.*

Continuous Iron Core:

- The continuous iron core of the transformer increases the flux linkage between the primary and secondary coils. This maximises the proportion of magnetic flux produced by the primary coil that passes through the secondary coil.

Laminations:

- The laminations in the iron core prevent the production of large eddy currents in the iron core. This reduces energy losses in the form of heat.

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12. PHYSICS, M6 2019 HSC 24

***Keyword (Part a. and b.) - "Explain"**: Relate cause and effect, make the relationships between things evident, provide why and/or how.*

a. The energy input into this transformer is $500\ \text{J s}^{-1}$

- The energy output is given by:

  $P = V_s I_s = 50 \times 9 = 450\ \text{J s}^{-1}$
- This is consistent with the law of conservation of energy as $500\ \text{J s}^{-1}$ of energy is converted into other energy forms such as heat.

b. Modification 1:

♦ Mean mark part 48%.

- Laminating the iron core prevents large eddy currents from being induced in it.
- This reduces energy loss in the form of heat, increasing efficiency.

Modification 2:

- Increasing the thickness of the wire in the primary coil.
- This reduces its resistance, increasing the transformer's efficiency.

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13. PHYSICS, M6 2020 HSC 28

***Keyword (Part c.) - "Explain"**: Relate cause and effect, make the relationships between things evident, provide why and/or how.*

a. $\phi = BA\cos\theta$

$= 1 \times (0.3 \times 0.2) \times \cos 30^\circ$

$= 0.05196\ldots$

$\approx 5.2 \times 10^{-2}$ Wb

b. $\varepsilon = -N\dfrac{\Delta\phi}{t}$

♦ Mean mark (b) 51%.

$= -1 \times \dfrac{5.2 \times 10^{-2}}{2.5}$

$= 0.208\ldots$

$= 2.1 \times 10^{-2}\ \text{V}\ \ (\text{V}>0)$

- The direction of the induced current is anticlockwise as viewed from above (Lenz's Law).

c. Repeating experiment is without the magnetic field:

♦ Mean mark (c) 50%.

- When the magnetic field is present, the induced current results in a force acting on the rod which opposes its motion (Lenz's Law).
- Additionally, the force required to move the rod must also overcome the downwards gravitational force.
- Without the magnetic field, there is no opposing force due to the induced current so the force applied only needs to overcome gravity.
- Hence, the force required to move the rod is less without the magnetic field.

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14. PHYSICS, M6 2015 HSC 25b

Calculating the input power:

♦ Mean mark 45%.

$P = VI = 240 \times 5 = 1200\ \text{W}$

Calculating the output power:

$P = VI = 2000 \times 1 = 2000\ \text{W}$

- The output power is greater than the input power.
- The label is incorrect as this is inconsistent with the law of conservation of energy.

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15. PHYSICS, M6 2021 HSC 31

***Keyword - "Explain"**: Relate cause and effect, make the relationships between things evident, provide why and/or how.*

♦ Mean mark 45%.

- When the switch on cart one is closed, a direct current will flow through the cart 1 solenoid causing a deflection on G_1.
- Using the right hand grip rule, this will create a magnetic field with a south pole on the right hand side of this solenoid. As this magnetic field is generated, the solenoid on cart two experiences a change in magnetic flux.
- According to Faraday's law, an induced emf and current will be generated in the cart 2 solenoid.
- By Lenz's law, this current will flow in a direction that opposes the original change in flux, causing a magnetic south pole on the left hand side of this solenoid, and a momentary deflection of G_2 in the opposite direction to G_1.
- As the two solenoids produce south poles facing each other, they will repel causing the carts to move away from each other. The law of conservation of momentum dictates that since cart 1 is double the mass of cart 2, it will have half the velocity of cart 2.

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16. PHYSICS, M6 2023 HSC 30

***Keyword (Part b.) - "Explain"**: Relate cause and effect, make the relationships between things evident, provide why and/or how.*

♦ Mean mark (a) 44%.

a. Between 0 – 0.03 seconds:

- The magnetic field strength at point P is increasing at a constant rate.
- Thus, ring X experiences a change in flux, which causes an EMF to be induced across the ring (Faraday's Law)
- This induced EMF causes a current to flow through ring X that will interact in the external magnetic field to reduce the change in flux that created it (Lenz's Law).
- Thus, a clockwise current will run through the ring, creating a north pole towards the solenoid, causing the ring to have a repulsive force away from the solenoid acting on it.

Between 0.03 – 0.05 seconds:

- There is no change in flux through the ring due to there being a constant magnetic field.
- Therefore, there is no induced EMF or induced current.
- Therefore, there is no force acting on the ring.

♦♦ Mean mark (b)(i) 38%.
♦ Mean mark (b)(ii) 49%.

b.i. Ring Y behaviour when placed at P:

- Ring Y will experience the same change in flux and hence the same induced EMF as ring X within 0 – 0.03 seconds.
- However, due to the gap in ring Y (i.e. there is no closed circuit), no induced current will be able to flow through the ring.
- Hence, there is no force exerted on ring Y.

b.ii.

$$\begin{aligned}\varepsilon &= N\frac{\Delta\phi}{\Delta t}\\ &= N\frac{A\Delta B}{\Delta t}\\ &= 1\times\frac{4\times10^{-4}\times(6\times10^{-3}-0)}{0.03-0}\\ &= 8\times10^{-5}\ \text{V}\end{aligned}$$

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17. PHYSICS, M6 2020 HSC 33

***Keyword - "Analyse"**: Identify components and the relationship between them, draw out and relate implications.*

♦ Mean mark 51%.

During the first 0.4 seconds:

- The magnet is accelerating downwards at 9.8 m s^{-2} due to gravity.
- The magnet's gravitational potential energy is being converted into kinetic energy consistent with the law of conservation of energy.
- Quantitatively:

$$\Delta E_k = \Delta U = mg\Delta h = 0.04\times9.8\times0.78 = 0.30576\ \text{J}$$

- Hence 0.30576 joules of the magnet's gravitational potential energy is converted into kinetic energy as it falls under gravity.

As magnet reaches the copper cylinder:

- Its downwards motion causes the formation of induced currents in the cylinder which produce a magnetic field that opposes the magnet's motion (Lenz's law).
- This causes the magnet to decelerate to 0.4 m s^{-1} and lose kinetic energy.
- Finding the magnets speed before entering the copper cylinder:

$$\begin{aligned}E_k &= \frac{1}{2}mv^2\\ 0.30576 &= \frac{1}{2}\times0.04\times v^2\\ v &= 3.91\ \text{m s}^{-1}\end{aligned}$$

- Quantifying the kinetic energy loss:

$$\begin{aligned}\Delta E_k &= \frac{1}{2}mv^2-\frac{1}{2}mu^2\\ &= \frac{1}{2}\times0.04\times3.91^2-\frac{1}{2}\times0.04\times0.4^2\\ &= 0.30256\ \text{J}\end{aligned}$$

- Applying the law of conservation of energy shows that 0.30256 J of the magnet's kinetic energy is being converted to heat energy within the cylinder as the magnet decelerates.

- Finally, as the magnet passes through the copper cylinder, its gravitational potential energy decreases while its velocity remains constant.
- Quantifying the decrease in gravitational potential energy:

$$\Delta U = mg\Delta h = 0.04 \times 9.8 \times 0.2 = 0.0784$$

- Hence, 0.0784 J of the magnet's gravitational potential energy is converted into heat energy in the cylinder, consistent with the law of conservation of energy.

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18. PHYSICS, M6 2018 HSC 30

***Keyword - "Explain"**: Relate cause and effect, make the relationships between things evident, provide why and/or how.*

Current and voltage:

♦♦ Mean mark 42%.

- An increase in the number of electrical appliances causes an increase in energy demand, and a greater power requirement.
- As $P = VI$, and V is constant at approximately 240V at the secondary coil of the step down transformer (T2), a greater current is drawn.
- Similarly, this increases the current in the transmission lines as well as the power station.
- As the voltage of T2 is approximately fixed at 240V and the ratio of coils in each transformer stays constant, the output voltage from the power station, the transmission line voltage and the supply voltage to houses will also remain approximately constant.

Energy losses:

- As the current increases, the heat produced by resistance in the wires increases leading to losses in energy according to $P_{loss} = I^2R$.
- Energy loss is also caused by the formation of eddy currents in the transformer cores, and this increases as current increases.
- This power loss will cause slight voltage drops along the transmission lines leading to slight decreases in voltage inputs and outputs at each of the transformers.

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19. PHYSICS, M6 2024 HSC 33

♦♦ Mean mark 47%.

- When the magnet swings down from its high position toward the can, its gravitational potential energy transforms into kinetic energy.
- As the magnet moves, it creates changing magnetic flux through the aluminium can. This flux change is strongest when there's the fastest relative motion between the magnet and can.
- The induced emf is described in the equation $\varepsilon = -N\dfrac{\Delta\phi}{\Delta t}$.
- This emf creates eddy currents in the can, which produce both heat and a magnetic field. Following Lenz's law, this magnetic field opposes the magnet's motion.
- The magnetic fields from both the magnet and the eddy currents interact, causing the can to initially rotate clockwise.
- Eventually, this interaction dampens the magnet's swing. The magnetic interaction between the eddy currents and the magnet causes the can to rotate back and forth with decreasing amplitude, as the system's energy gradually converts to heat.
