

PHYSICS



EXAM QUESTION PACK

P4.2 USES OF MAGNETISM

SCORE

/89

PERCENTAGE

%

STEMUP

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Gateway Physics A (9-1)

Uses of magnetism

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:

Additional resources may be supplied with this paper.

Other materials required:

- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate
forename

Candidate
surname

Centre number

Candidate number

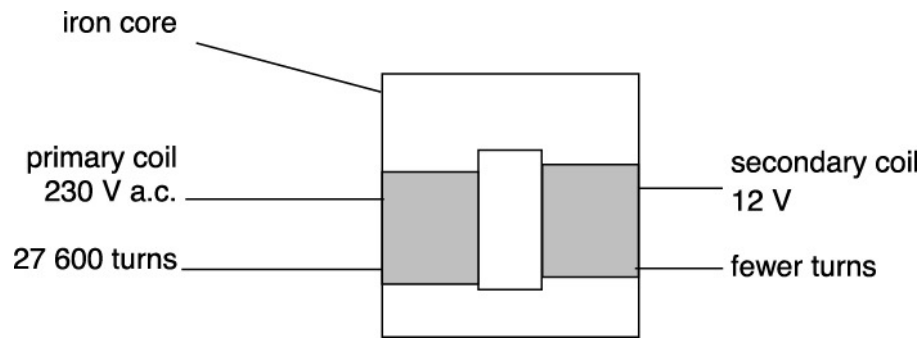
INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **89**.
- The total number of marks may take into account some 'either/or' question choices.

1(a) The diagram below shows the structure of a transformer.



Explain why there is more alternating current in the secondary coil than in the first.

----- [3]

(b) The secondary coil produces an output of 12 V.

Calculate the number of turns needed on the secondary coil.

Show your working.

----- [2]

(c) Voltage is increased before transmission through the National Grid.

It is increased from 25 000 V up to 400 000 V. This increases the voltage 16 times.

(i) How much would this increase in voltage affect the current?

----- [2]

(ii) Use the formula: **power = current² × resistance**

to explain why this voltage increase is important to power loss in transmission cables.

----- [2]

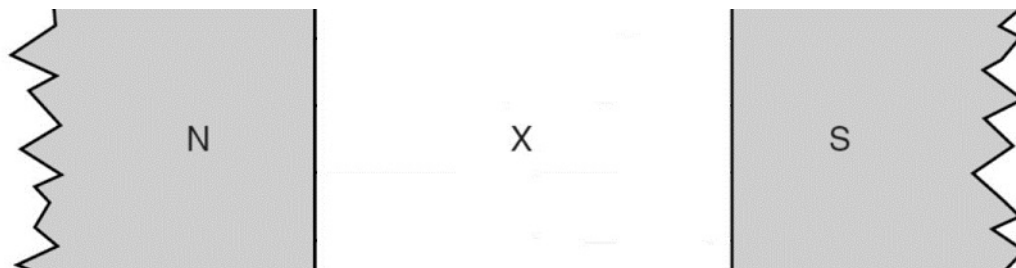
2 Which of the following is **not** needed to generate a.c. in an alternator?

- A changing magnetic field
- B coil of wire
- C commutator
- D rotating magnet

Your answer ☐

[1]

3 The diagram shows two poles of a magnet.



X is the position of a wire carrying a current perpendicularly into the paper.

Which direction does the wire move?

- A ↓
- B →
- C ←
- D ↑

Your answer

[1]

4(a)

- (i) Write down the name of the rule which can be used to predict the direction of the force perpendicular to a current-carrying conductor in a magnetic field.
-
-
- [1]

A student places four wires of different lengths perpendicular to different magnetic fields with different currents flowing.

Look at the table of their results.

Wire	Magnetic flux density (T)	Current (A)	Length (m)
A	0.10	2.5	0.50
B	0.15	2.0	0.75
C	0.20	4.5	0.25
D	0.25	5.0	1.00

- (ii) Use the data to show that wire D experiences the highest force.

Show your working.

[2]

(b)

- (i) The student decides to build a model transformer.

The transformer is a step-up transformer which doubles the input voltage.

Describe how they could build this step-up transformer in a science laboratory.

----- [4]

- (ii) Suggest **one** risk associated with this experiment and how it can be reduced.

----- [2]

- (c) Describe how a microphone works.

----- [2]

- 5 Mia has a simple electric motor.

She can increase the speed of the motor by increasing the current.

Write down one other way she can change her motor to increase its speed.

----- [1]

6 The National Grid transfers power from power stations to homes and factories.

Transformers are used as part of the National Grid to change voltages.

Jack has completed his homework on transformers.

He asks John to check his homework.

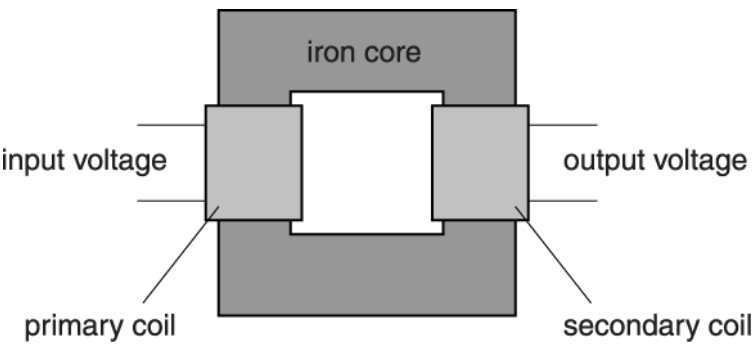
John finds two mistakes in the **voltage columns**.

Row	Primary coils	Secondary coils	Input voltage in V	Output voltage in V	Step up / down
A	25	250	10	100	Step-up
B	2000	10000	40	200	Step-up
C	400	20	50	1000	Step-down
D	30	600	10	1000	Step-up

Identify which two rows in the table, **A**, **B**, **C** or **D** are incorrect and explain why.

[2]

7 This question is about transformers.



Transformers are used to change the voltage of an AC supply.

Susan has completed her homework on identifying step-up and step-down transformers.

	Input voltage in V	Output voltage in V	Step-up or step-down
A	10	20	Step-up
B	40	100	Step-down
C	25	50	Step-down
D	50	10	Step-down

Susan spots **two** mistakes in her work.

Which two rows, A, B, C or D are incorrect?

_____ and _____

Explain your choices.

-----[2]

8 Elin's phone charger plugs into the 230 V mains.

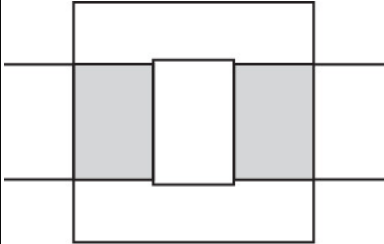
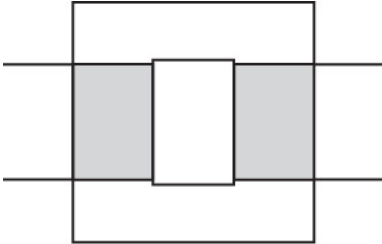
The charger reduces the voltage to 12 V.

Name the device in the charger that is used to reduce the voltage.

-----[1]

9 This question is about transformers.

Look at the information about two different transformers.

	 transformer A	 transformer B
Type of core	iron	iron
Number of primary turns	500	1000
Number of secondary turns	1000	500
Input voltage	20 volts AC	20 volts AC

Write about the similarities and differences between transformer A and transformer B.

Include information about their construction, output voltage and uses.

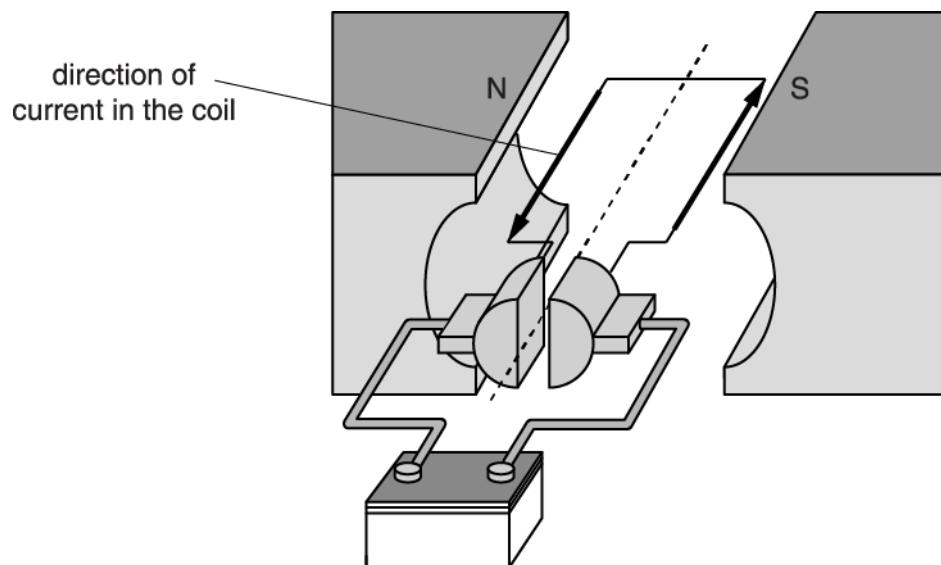


The quality of written communication will be assessed in your answer to this question.

[6]

10(a) DC electric motors are used in many different appliances.

Look at the diagram of a DC motor.



Use Fleming's Left Hand rule to predict if the coil will spin **clockwise** (↻) or **anti-clockwise** (↺) in the following arrangements.

The motor is set up as shown in the diagram. It will spin _____.

The current is reversed. It will now spin _____.

With the current still reversed, the north and south poles are also reversed.

It will now spin _____.

[1]

(b) Many motors have different speed settings.

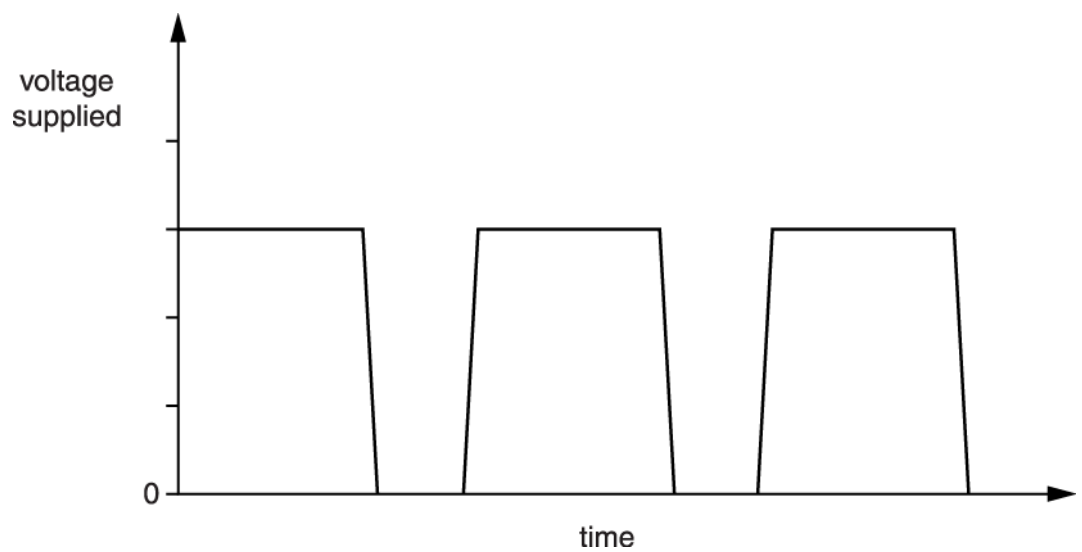
(i) Suggest how the **same** motor can be made to have different speed settings.

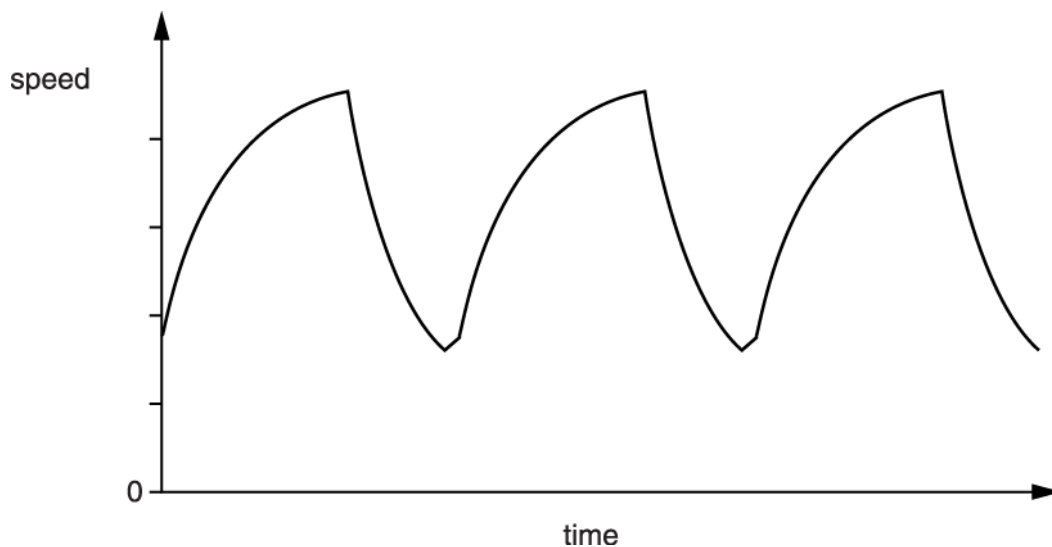
[1]

(ii) Look at the data on the graphs.

They show how the voltage supplied and the speed of the motor are related.

The supply voltage is switched on **and** off regularly.





Describe what happens to the speed of the motor as the voltage is regularly switched on and off.

----- [2]

(iii) Suggest how the speed of the motor will vary if the supply voltage is switched on and off more frequently.

----- [1]

11 This question is about electrical devices.

Look at the information about five different transformers.

Put a tick (?) in the correct column to identify each type of transformer.

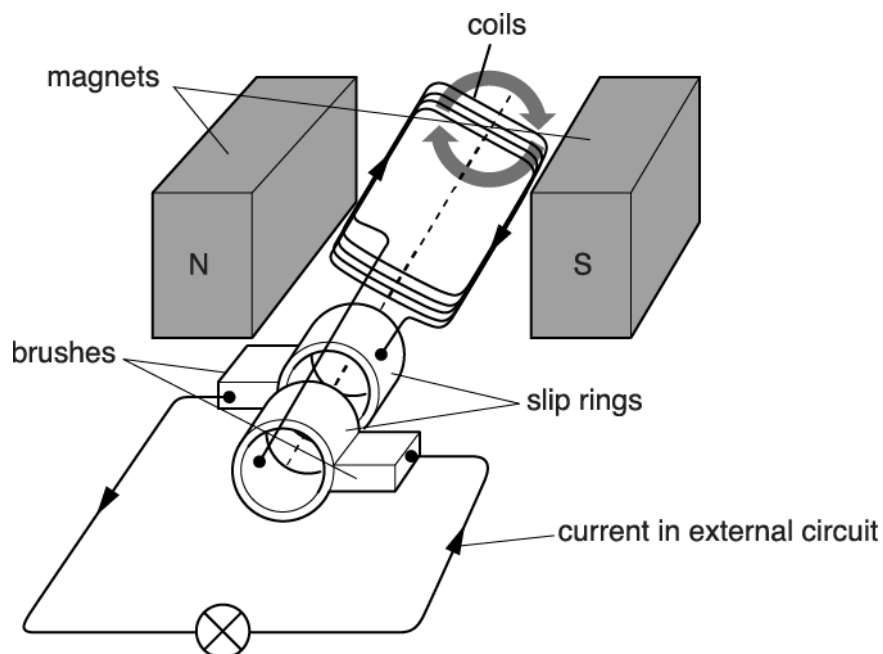
The first one has been done for you.

Input voltage	Output voltage	Step up	Step down	Isolating
12	240	?		
500	10			
230	230			
240	80			
1000	10000			

[2]

12(a) AC generators are used to generate electricity.

Here is a diagram of a small AC generator.

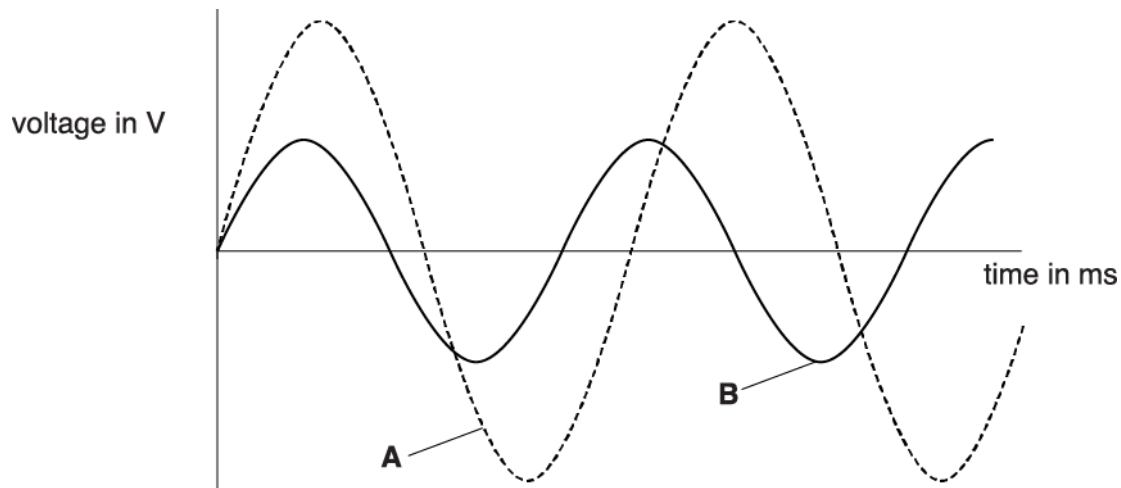


Explain how this AC generator works.

Use **all** the labels in the diagram in your explanation.

[2]

(b) Look at the diagram.



Graph **A** shows the output from this small AC generator.

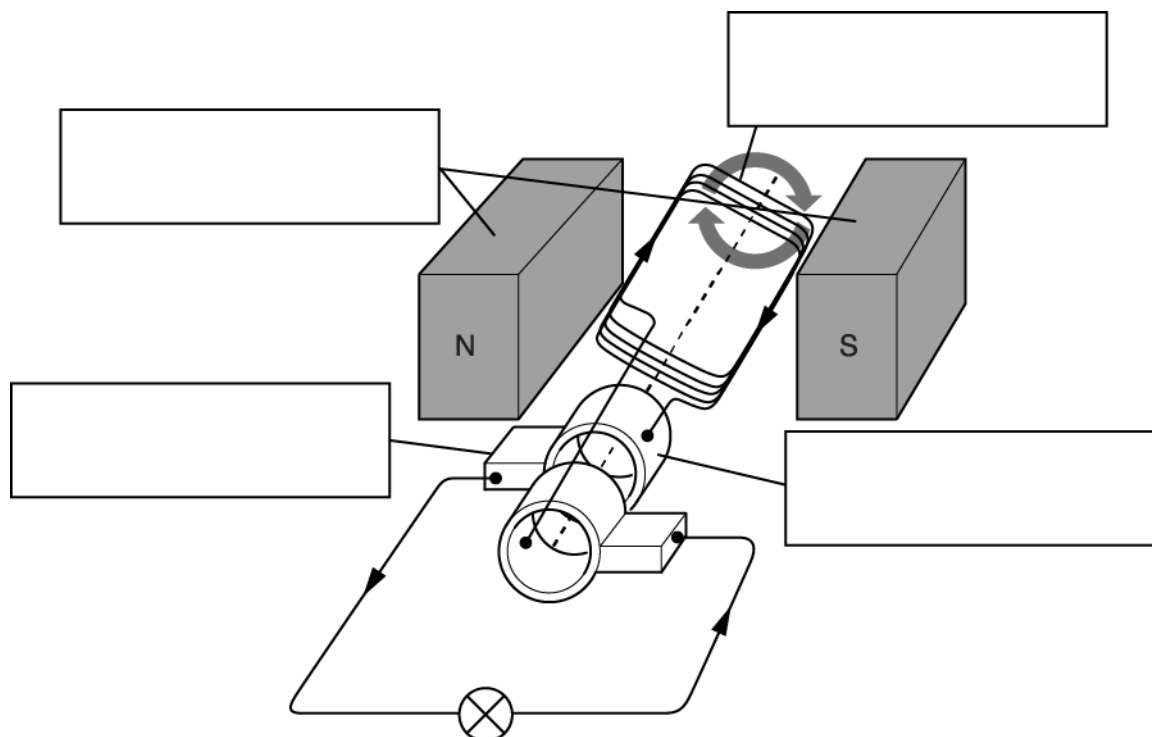
The generator can also produce the output shown by graph **B**.

Suggest what changes are needed to produce the output shown by graph **B**.

----- [2]

13(a) AC generators are used to generate electricity.

Here is a diagram of a small AC generator.



Label the four parts of the generator on the diagram.

Use the words

brush

coil

magnet

slip

ring

[1]

(b) This AC generator generates electricity by rotating the coils of wire.

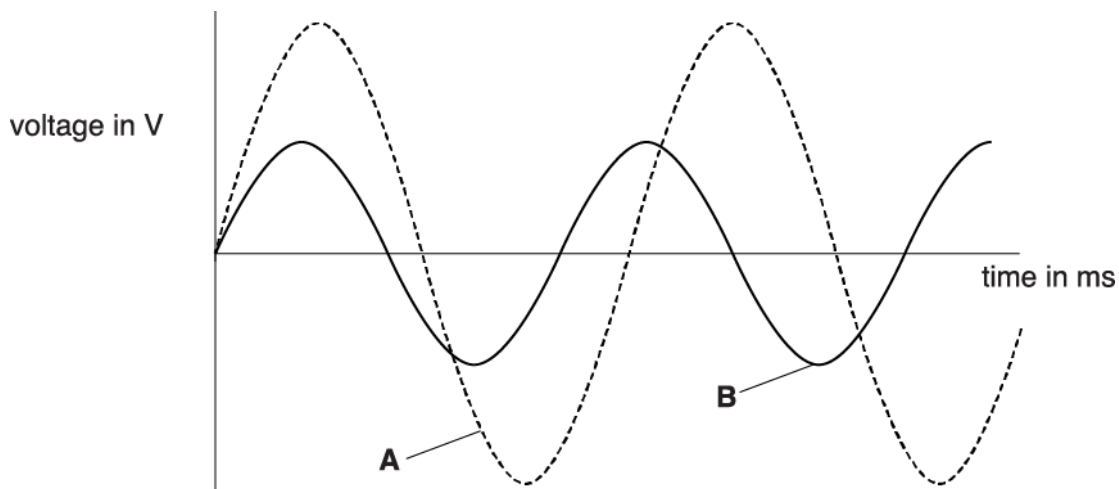
Describe another way electricity can be generated using an AC generator.

----- [1]

(c) The mains electricity in the UK is supplied at a frequency of 50 Hz.

Look at the diagram.

It shows two different AC voltages.



A has a frequency of 50 Hz and a supply voltage of 230 V.

Compare these values with the frequency **and** supply voltage of B.

How does the frequency **and** supply voltage of B compare with A?

[2]

14 Complete the sentences about transformers.

Use a **different** word for each sentence.

Choose words from

AC

DC

isolating

step-down

step-up

Transformers are devices that work with _____ .

Phone chargers use _____ transformers.

Bathroom shaver sockets producing 230 V output use _____

transformers.

[2]

15 Wendy's mobile phone charger contains a transformer.

Look at the information about the transformer.

Input voltage	230 V AC
Input current	50 mA
Output voltage	5 V

Describe, in detail, the construction of the transformer and explain how applying a 230 V input produces a 5 V output.

Include a diagram and a calculation in your answer.

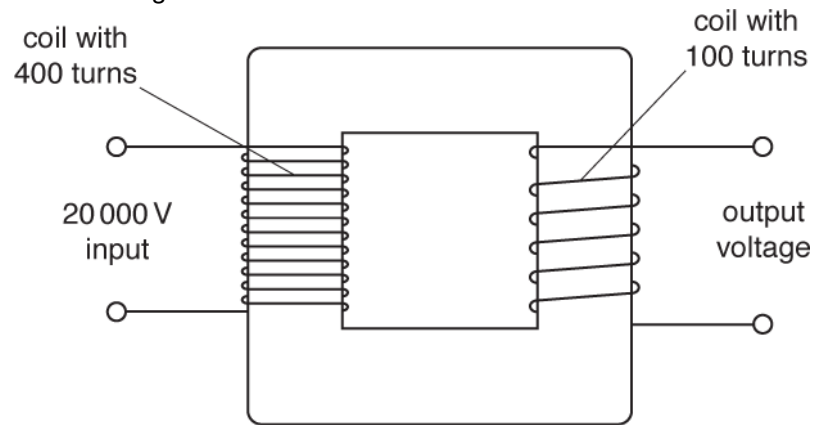


The quality of written communication will be assessed in your answer to this question.

[6]

16(a)

Transformers are constructed using wire and an iron core.



(i) Describe the construction of **this** transformer.

----- [2]

(ii) Calculate the output voltage.

answer ----- V [2]

(b) Isolating transformers have two main features:

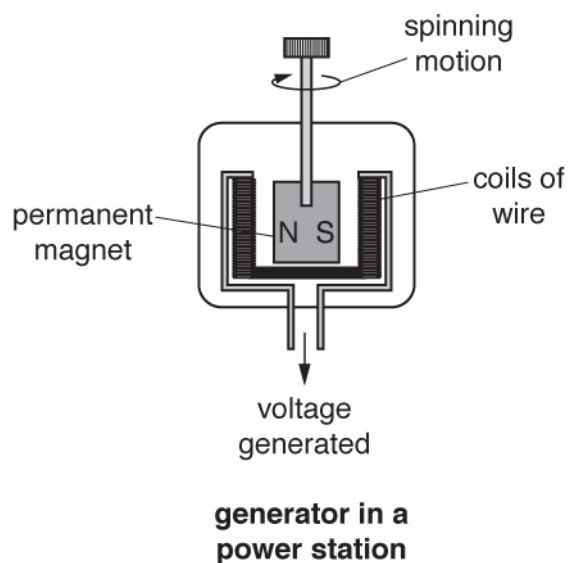
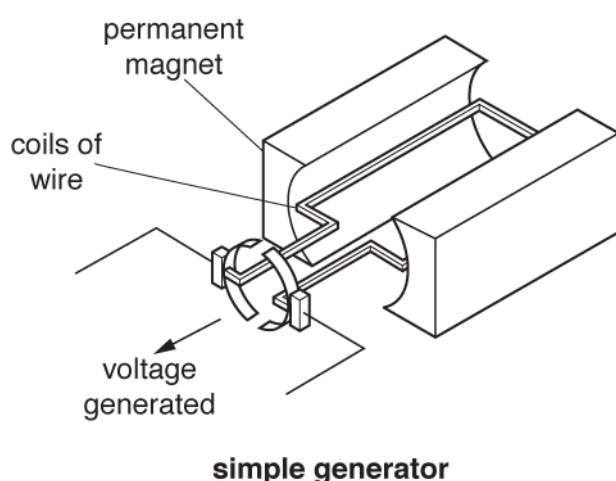
- the primary and secondary coils have equal numbers of turns
- they improve safety in some mains circuits.

Explain why these **two** features are important in a bathroom shaver socket.

----- [2]

17 Tanya compares two generators

- a simple generator
- a generator in a power station.



Write about the similarities and differences in the way the two generators work.

Describe how the **size** of the voltage generated can be changed in the two generators.



The quality of written communication will be assessed in your answer to this question.

[6]

18(a)

There are three types of transformers

- isolating transformer
- step-down transformer
- step-up transformer.

Which type is used in a bathroom shaver socket?

Explain your answer.

[2]

(b) Tick (✓) the **two** correct sentences about transformers.

Step-down transformers are used in mobile phone chargers.

☐

Step-up transformers are used in laptops.

☐

Transformers change AC to DC.

☐

Transformers only work with AC.

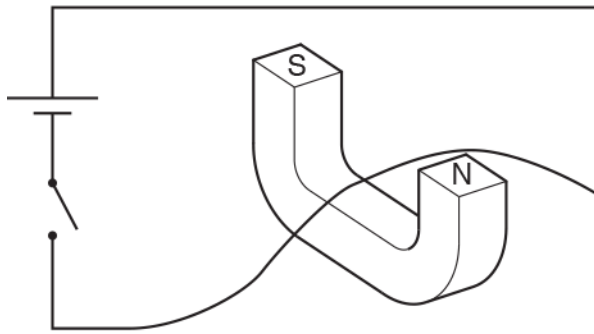
☐

Transformers only work with DC.

☐

[2]

19 A wire is placed inside a horseshoe magnet.



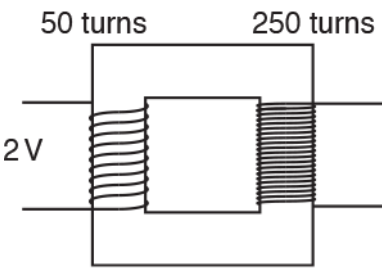
Which direction will the wire move when the switch is closed?

- A Downwards
- B Left
- C Right
- D Upwards

Your answer

[1]

20 What output voltage does the transformer produce?



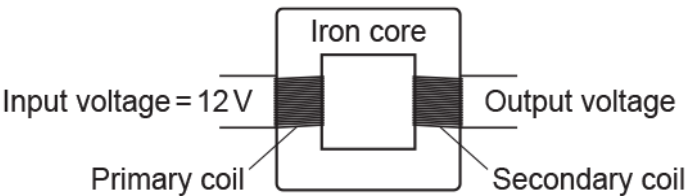
- A 0.2 V
- B 0.4 V
- C 5 V
- D 10 V

Your answer

[1]

21 A student investigates building model transformers in the laboratory.

Look at the diagram.



The student builds four different transformers, each with different primary and secondary coils.

Using an input voltage of 12 V the student measures the output voltage.

Look at the results.

Attempt	Number of turns in primary coil	Number of turns in secondary coil	Output voltage (V)
A	100	200	23
B	200	100	6

22 A 0.5 m length of wire is placed inside four different magnetic fields.

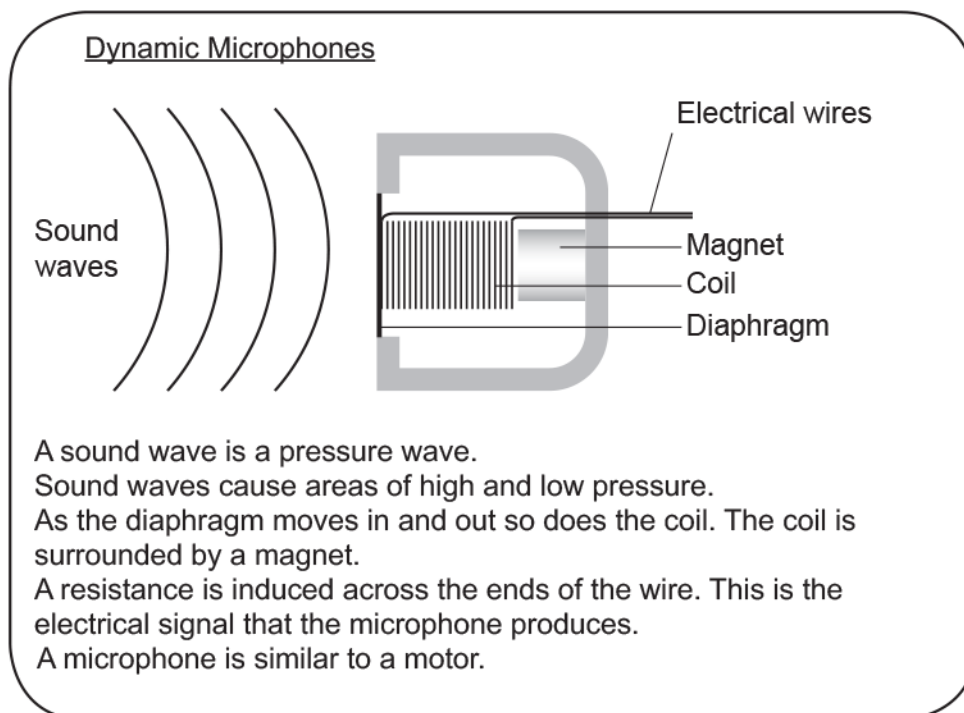
Magnetic Field	Force on wire (N)	Current in wire (A)
A	2.0	0.1
B	2.0	0.2
C	4.0	0.1
D	4.0	0.4

Which magnetic field has the **greatest** magnetic flux density?

Your answer

[1]

Look at her project. The student uses two incorrect words in her work.



(i) Identify **one** of the incorrect words **and** write a correct sentence to replace the mistake.

Incorrect word

Corrected sentence

.....

[2]

(ii) Name a device which uses this effect in reverse.

.....

[1]

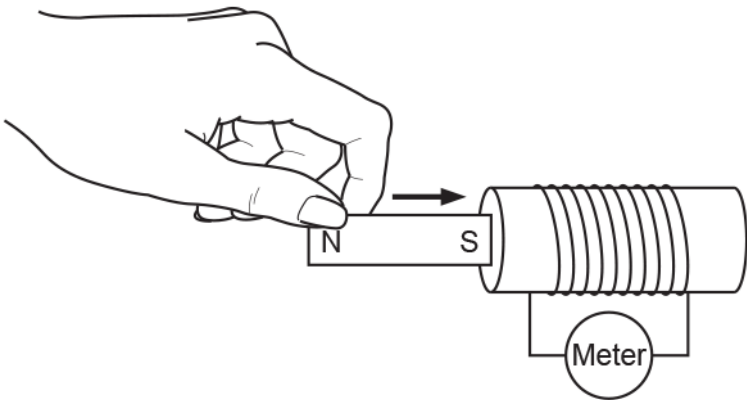
24 Which row in the table is correct for a **step-down** transformer?

	Current	Potential difference
A	Decreases	Decreases
B	Decreases	Increases
C	Increases	Decreases
D	Increases	Increases

Your answer

[1]

25 A student inserts a magnet into a coil of wire.



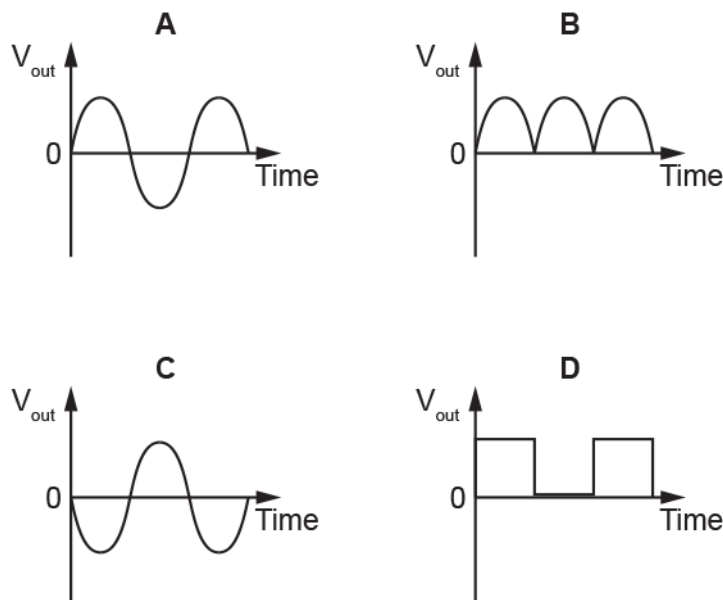
What is induced across the ends of the coil of wire?

- A Charge
- B Magnetism
- C Potential difference
- D Resistance

Your answer

[1]

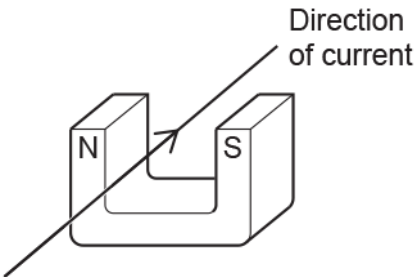
26 Which of the following graphs shows the typical output potential difference, V_{out} , for a dynamo?



Your answer

[1]

27 A wire is placed between the poles of a magnet, perpendicular to the magnetic field lines.



Which direction will the wire move when a current flows?

- A Down
- B Left
- C Right
- D Up

Your answer

[1]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1	a		Fewer coils in the secondary coil (1) Means it induces less potential difference in secondary coil (1) More current induced as power is constant (1)	3	
	b		$\frac{230}{27600} = \frac{12}{X_2}$ (1) OR $\frac{230 \times 12}{27600}$ / AW (1) 1 440 (turns) (1)	2	
	c	i	Simple use of $P = V \times I$ / idea of ratios using transformer equations (1) Current reduced by 16 times (1)	2	ALLOW current reduced (1)
		ii	Very large decrease in power loss (1) Power loss is related to the square of the current / AW (1)	2	
			Total	9	
2			C	1	
			Total	1	
3			A	1	
			Total	1	
4	a	i	Fleming's left hand rule (1)	1	ALLOW left hand rule / motor rule
		ii	Reference to B, I, L are the largest in the table (1) Some calculation to show the use of $F = BIL$ e.g. one mark point for four correct calculations: A: 0.125 N B: 0.225 N C: 0.225 N D: 1.250 N (1)	2	If no calculations are made pupils can only receive 1 mark

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	b	i	Wind two coils of wire around an iron core / AW (1) Secondary coil has twice / double the number of primary turns / ORA (2) Connect primary coil to an a.c. supply (1)	4	ALLOW secondary coil has more turns than the primary coil / ORA (1)
		ii	High voltages can be produced / AW (1) Any 1 from: Insulate the secondary coil (1) Use very low voltages on the primary coil (1) Keep primary coil voltages low / AW (1)	2	ALLOW below 6 V
	c		Microphones convert pressure variations in sound waves (1) into variations in current / voltage in electrical circuits / AW (1)	2	
			Total	11	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5			any one from more turns / AW [1] stronger magnetic field / (soft) iron core / AW [1]	1	Ignore change voltage / resistance / improve brushes for better connection allow idea of greater turns or coils concentration / turns closer together / greater density of turns or coils [1] ignore larger (sized) magnets allow use a radial field or curved magnets / bringing magnets closer together [1] Examiner's Comments As a suggestion of how to increase the speed of the motor most candidates gave a correct answer. Using 'more coils' or a 'stronger magnetic field' was mentioned in approximately equal numbers [1]. Using a soft iron core [1] was also seen from time to time.
			Total	1	
6			C has input and output voltages wrong way round / should be 1000(v) then 50(v) / could be 50(v) then 2.5(v) / ratios incorrect [1] D the ratio is wrong / output should be 200 / input should be 50 / correct ratio of 20:1 [1]	2	If no other marks scored then: EITHER C and D identified OR C is a step-down transformer so output voltage should be lower / AW [1] Examiner's Comments The candidates were asked to look at the data in the table and identify and explain the incorrect rows. Few clearly referred to the incorrect ratios for 2 marks. A mark however, was often gained for stating that the D output should be 200. A compensation mark was sometimes gained for 'C is a step-down' or the identification of C and D being incorrect [1]. B was often incorrectly identified as being incorrect.
			Total	2	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
7			B and C [1] (idea that) the output voltage is higher than the input voltage / ora [1]	1	both required in either order Examiner's Comments Most candidates could identify errors in a table of step up and step down transformers. Only the lowest ability candidates found this question challenging.
			Total	2	
8			(step down) transformer [1]	1	ignore type of transformer Examiner's Comments Only about 25% of candidates correctly identified the device that reduces mains voltage as a transformer.
			Total	1	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
9	[Level 3] Answer includes one difference in output Voltage AND one similarity AND one difference in construction AND describes a correct use for either A or B Quality of written communication does not impede communication of the science at this level (5 – 6 marks) [Level 2] Answer includes one similarity and one difference in construction AND a correct use for either A or B OR one correct comparison of output voltage Quality of written communication partly impedes communication of the science at this level (3 – 4 marks) [Level 1] Answer includes two correct statements in terms of construction or output voltage or uses Quality of written communication impedes communication of the science at this level (1 – 2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to C. Indicative scientific points may include: Construction -Similarities • both have an iron core / same material • both have the same input voltage / 20 volts/ AC • both have different numbers of turns on the primary compared to the secondary coils • both isolating transformers • input voltage is connected to the primary coil / output voltage is connected to the secondary coil Construction -Differences • transformer A has less turns on the primary / transformer B has more turns on the primary • transformer A has more turns on the secondary / transformer B has less turns on the secondary Output voltage • both change the output voltage • transformer A is a step-up transformer • transformer B is a step down transformer • the output of transformer A will be 40V or more than 20 V • the output of transformer B will be 10V or less than 20 V Uses • transformer A is used in the National Grid / used in (CRT) TVs • transformer B is used in e.g. mobile phone chargers / radios / laptops / National Grid (to decrease voltage) / any electronic device that is mains powered e.g. halogen lights

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					Use the L1, L2, L3 annotations in scoris. Do not use ticks Examiner's Comments This 6 mark level of response question on transformers was targeted up to grade C. For level 1, examiners were seeking to award marks for a description of the observed similarities in the construction of two transformers. For level 2, most candidates gained a partial match for a correct description in similarities and differences in construction. Some candidates went on to compare the output voltages arising from the different turns ratios of the transformers. However, very few candidates reached a secure level 3 which required a comparison of the applications of a step up or step down transformer.
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
10	a		Clockwise anticlockwise clockwise [1]	1	allow appropriately drawn curly arrows Examiner's Comments About a third of answers were correct.
	b	i	(idea of using) variable resistor [1] (idea of using) more or less or changing the: voltages / pd / current / power (input) [1]	1	ignore stronger current ignore changes to coils ignore changes to field / magnets Examiner's Comments Suggestions for changing the speed of this motor often referred inappropriately to field strength, magnets or the number of turns. Better answers referred to using a variable resistor (rarely seen) [1] or either changing voltage or current [1].
		ii	any two from: when switched on the motor's speed increases [1] when switched off the motor's speed decreases [1] the motor doesn't stop spinning [1]	2	Allow high voltage for 'switched on' Allow low voltage for 'switched off' Ignore reference to constant speed If no mark scored allow one mark for 'speed varies' Examiner's Comments Most stated that the speed fluctuated [1] and some linked switching on as high speed and off (or low) as lower speed [2].
		iii	any one from: (idea of) smoother speed / less jerky [1] (idea that) variation in motor speed will be less [1]	1	Examiner's Comments Some answers described the speed as having less variation [1].
			Total	5	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																					
11			<table><tr><th>step up</th><th>step down</th><th>isolating</th></tr><tr><td>(✓)</td><td></td><td></td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td></td><td></td><td>✓</td></tr><tr><td></td><td>✓</td><td></td></tr><tr><td>✓</td><td></td><td></td></tr><tr><td colspan="3">(2)</td></tr></table>	step up	step down	isolating	(✓)				✓				✓		✓		✓			(2)			2	all correct (2) 2 or 3 correct (1) Examiner's Comments Most candidates showed a good grasp of the structure of different types of transformer to gain both marks.
			step up	step down	isolating																					
			(✓)																							
				✓																						
					✓																					
				✓																						
			✓																							
			(2)																							
			Total	2																						

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12	a		coil is rotated / moves (in a magnetic field) to produce current in the coil [1] induction / (current or voltage) induced [1] slip rings / brushes keep circuit complete or make sure the current continues to flow (in the external circuit) [1] brushes make good / continuous contact (between the coil and the external circuit) [1]	2	If motor is described award a maximum of [1] available for last two marking points Eg. coils break magnetic field lines to produce current [1] Eg. magnets make coil spin and a current is induced [0] BUT magnets make coil spin and a current is induced and the slip rings pass current into the circuit [1] Eg. coil spins and induces current [2] Eg. Slip rings keep current flowing [1] Ignore Slip rings prevent wires tangling Eg. brushes / slip rings carry / pass on current to (external) circuit [1] <u>Examiner's Comments</u> In explaining the generator many candidates mistakenly described a motor, stating that the coil was forced or made to rotate. Marks were available for the coils turning in the magnetic field producing a current [1]. Also the brushes passing on current to the external circuit gained one mark. Motor explanations were limited to the second of these marking points at best (maximum one mark).

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	b		increase the speed / frequency of rotation of the coils (1) and any one from decrease the number / area of coils (1) reduce the magnetic field strength / AW (1)	2	Allow weaker / less powerful magnet [1] Allow move magnets apart [1] ignore size of magnet <u>Examiner's Comments</u> In this question about a different generator output, common answers were the reverse of those required. Some candidates did gain a mark for faster coil rotation but also said stronger field or more coils. Only the highest ability candidates gained two marks here.
			Total	4	

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Question			Answer/Indicative content	Marks	Guidance
13	a		magnet coil brush slip ring (1)	1	all four required <u>Examiner's Comments</u> ??The vast majority could match the labels to the parts of an ac generator.
	b		moving the magnet(s) (1)	1	allow move magnet and coil (1) <u>Examiner's Comments</u> ??Only higher ability candidates could describe the movement of the magnets as a way to generate electricity. In part this may have been due to them trying to look at how it could be done with the generator shown in the diagram rather than another generator as this has been a focus in previous years.
	c		(supply) voltage of B is lower / ORA (1) frequency of B is higher / ORA (1)	2	<u>Examiner's Comments</u> This part-question discriminated particularly well across the ability range. A significant number struggled to communicate the comparison of the two features for the two supplies and hence did not gain credit.
			Total	4	
14			(Transformers are devices that work with) AC. (Phone chargers use) step-down (transformers.) (Bathroom shaver sockets use) isolating (transformers.)	2	3 correct = 2 marks 1 or 2 correct = 1 mark <u>Examiner's Comments</u> ??Most achieved at least one mark for knowing that transformers work with AC or that phone charges had step down transformers. Most did not know about the use of isolating transformers in a shaver socket and so very few scored two marks.
			Total	2	

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Question	Answer/Indicative content	Marks	Guidance
15	[Level 3] Describes the construction of the transformer AND performs a calculation to determine the turns ratio or output current AND explains the process of electromagnetic induction. Quality of written communication does not impede communication of the science at this level. (5–6 marks) [Level 2] Describes the construction of this transformer AND EITHER performs a simple calculation OR gives a partial explanation of electromagnetic induction. Quality of written communication partly impedes communication of the science at this level. (3–4 marks) [Level 1] Describes two features of the basic construction of a transformer. Quality of written communication does impede communication of the science at this level. (1–2 marks) [Level 0] Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	This question is targeted at grades up to A. Level 3 relevant points: • two coils wrapped around core made of iron secondary less turns than primary • $46 \times$ more turns on primary or calculate current = 2300mA • varying magnetic field in primary and varying magnetic field in secondary inducing an emf. Level 2 diagram or description of transformer construction: • two coils wrapped around (iron) core with secondary less turns than primary • ratio 230:5 or 2% or sensibly attempted calculation using transformer equation. Level 1 diagram or description of transformer construction: • two coils of wire • wrapped on (iron) core • step down transformer Use the L1, L2, L3 annotations in Scoris. Do not use ticks. Examiner's Comments This was a challenging 6 mark question on transformers targeted up to A* grade. About a third of candidates failed to score any marks here. Some made no attempt at all whilst others wrote of potential dividers or relays. Two thirds of candidates, however made valiant attempts at the question and produced a wide spread of marks enabling differentiation and discrimination to happen. Most described the transformer correctly and this was often seen as a diagram. Better answers then described the relative turns and performed a simple calculation

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Question			Answer/Indicative content	Marks	Guidance
					[4]. Higher grade answers also did this but in addition explained the induction process in clear detail to gain [6].
			Total	6	
16	a	i	step-down transformer (1) more turns or coils in primary / LHS / first side / input coil / ORA (1)	2	Allow output voltage lower than input voltage (1) If no marks scored then different numbers of turns on each side (1)
		ii	5 000 (V) (2) but if answer is incorrect or incomplete then: $\frac{20\,000}{x} = \frac{400}{100} \quad (1)$	2	 allow any manipulation of this equation (1)
	b		no change in voltage (1) appliance or socket is not live / no direct connection between live (to primary coil) and output (from secondary coil) (1)	2	ignore references to current allow isolates from mains (supply) / high voltage (for safety) (1) Allow less chance of an electric shock. Allow can't get a shock (1)
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
17			Level 3: (5–6 marks) similarity OR difference AND detailed description of how the size of the voltage can be changed. Quality of written communication does not impede communication of science at this level. Level 2: (3–4 marks) similarity OR difference AND simple description of how the size of the voltage can be changed. Quality of written communication partly impedes communication of science at this level. Level 1: (1–2 marks) similarity OR difference OR simple description of how the size of the voltage can be changed. Quality of written communication impedes the communication of science at this level Level 0: (0 marks) Insufficient or irrelevant science. Not worthy of credit.	6	This question is targeted up to grade C Indicative scientific points may include (but are not limited to) the following: similarities • generate electricity • work in an opposite way to a motor • both have moving parts • movement of coil of wire relative to magnet / ORA differences • simple generator has coil inside the magnet / generator in power station has magnet inside coil • simple generator has coil of wire moving / spinning • generator in power station has magnet moving / spinning changes to size of voltage • change speed of rotation of coil (in the simple generator) • change speed of rotation of magnet (in the generator in the power station) • change number of coils (in both generators) • change the strength of the magnet
			Total	6	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
18	a		isolating (1) and any one from shaver not connected directly to mains / shaver isolated from mains (1) reduces risk of electrocution (1) current cannot reach user (1)	2	allow idea that voltage is unchanged / primary coils = secondary coils (1) allow no risk of electrocution / no risk of (electric) shock (1) allow blocks current from one circuit to another / decouples one circuit from the other (1)
	b		Step-down transformers are used in mobile phone chargers. ☒ Step-up transformers are used in laptops. ☐ Transformers change AC to DC. ☐ Transformers only work with AC. ☒ Transformers only work with DC. ☐ (2)	2	each correct tick = 1 mark three ticks, with one or two correct = 1 mark four ticks = 0 marks
			Total	4	
19			A ✓	1 (AO2.1)	<u>Examiner's Comments</u> About 40% of the candidature gave the right answer A. The common incorrect response was usually 'D'.
			Total	1	
20			D ✓	1 (AO2.2)	<u>Examiner's Comments</u> This calculation was answered successfully by about three quarters of the candidates stating D.
			Total	1	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
21	Please refer to the marking instructions on page 4 of this mark scheme for guidance on how to mark this question. Level 3 (5–6 marks) Detailed explanation about how a transformer works. AND A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i> Level 2 (3–4 marks) Simple explanation of how a transformer works. AND A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. OR Detailed explanation about how a transformer works. AND A qualitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i> Level 1 (1–2 marks) Simple explanation of how a transformer works. OR A quantitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. OR	6 (AO1.1x3) (AO3.1ax2) (AO3.2ax1)	AO1.1 Demonstrates knowledge and understanding of scientific ideas to give an explanation of how a transformer works For example: • Alternating current / ac / voltage / potential difference • (induces) (alternating) pd / current in secondary • Linking different numbers of coils to changing potential differences (or currents) • More secondary coils = bigger output potential difference • Alternating current in primary coil induces alternating magnetic field in the iron core • Alternating magnetic field in the iron core induces alternating potential difference in the secondary coil • An alternating current flows if the output is connected to a circuit • Ratio of potential differences depends on ratio of coils • Step up transformers increase potential difference and have more secondary coils ORA AO3.1a Analyse information and ideas to interpret – quantitative • Correct equation selected from data sheet • Data from table processed • For A and C expect secondary pd of 24 V • For B and D expect secondary pd of 6 V AO3.1a Analyse information and ideas to interpret - qualitative For example: • Double the number of secondary coils (compared to primary) and the output potential difference is doubled (compared to input) • Halve the number of secondary coils (compared to primary) and the output potential difference is halved

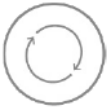
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			A qualitative link between coil and potential difference ratios to inform judgement that the data supports the expected output voltages. <i>There is an attempt at a logical structure with a line of reasoning. The information is in the most part relevant.</i> 0 marks <i>No response or no response worthy of credit.</i>		(compared to input) • In transformer A the number of coils increases by 100% and the voltage increases by almost 100%/AW • In transformer B the number of coils decreases by 50% and the voltage decreases by 50%/AW • In transformer C the number of coils increases by 100% and the voltage increases by almost 100%/AW • In transformer D the number of coils decreases by 50% and the voltage decreases by 50%/AW AO3.2a Analyses information and ideas to make judgements • Data supports the expected output voltages • Energy losses in A and C • B and D are efficient ALLOW voltage for potential difference and vice versa <u>Examiner's Comments</u> This question gave candidates the opportunity to apply their knowledge and understanding of the operational of a transformer and to demonstrate that they are able to use the equation linking number of turns and potential difference given on the data sheet. The question is open ended so that candidates have the opportunity of demonstrating their knowledge as well as having the opportunity to structure their answers logically. The question required candidates to explain the operation of the transformer. Most candidates were able to select an appropriate equation from the data sheet and discuss the meaning of step-up and step-down transformers in terms of the turns ratio and the p.d. ratio. Few candidates mentioned that transformers worked on a.c. or clearly

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Question	Answer/Indicative content	Marks	Guidance
			explained the alternating magnetic field in the iron core of the transformer inducing an alternating p.d. across the secondary coil. For the highest marks, it was expected that clear calculations for each of the four transformers would be shown with a comment as to whether they supported the theoretical predictions. Many candidates did not show any working. There was also the opportunity to discuss energy losses in transformers particularly about transformer A and transformer C. Exemplar 4 A transformer can either increase or decrease the voltage depending whether it is a step-up transformer or a step-down transformer. The input voltage in the primary coil allows a current to flow and a current through a wire creates a magnetic field which is trapped inside the iron core. The secondary coil is coiled cutting magnetic field lines so through the process of electromagnetic induction an induced potential difference is created along both sides of the coils. The induced potential difference depends on the number of turns in the secondary coil. The formula $\frac{V_s}{V_p} = \frac{N_s}{N_p}$ shows the voltage in primary coil / voltage in secondary coil = Number of turns in primary coil / Number of turns in secondary coil. Therefore the expected output voltage in attempt 63 and attempt 64 are not correct. However the output voltage in attempt 64 and 65 are correct and should be 220V according to the formula. doesn't support the how a transformer works as the output voltage is expected to be 240V, not 220V. [6] This candidate has written a plan of how they intend to answer the question. The initial part of the plan explains how the transformer works. The candidate includes the alternating current, the alternating magnetic field in the iron core and the alternating p.d. induced across the secondary coil. The candidate then discusses step-up and step-down transformers. Before using the data, an equation is given with each of the symbols defined. Working is then shown for the four transformers with a reason why the step-up transformers do not agree with the predicted data. This candidate's response demonstrates a detailed explanation of how the transformer works and there is a quantitative line between the coils and potential difference

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Question			Answer/Indicative content	Marks	Guidance
					ratios in relation to the expected output voltages. This is a Level 3 response. The response has a well-developed line of reasoning which is clear and logically structured and the information is relevant so this candidate is given six marks.  AFL Candidates should practice explaining physics concepts.
			Total	6	
22			C ✓	1 (AO2.1)	<u>Examiner's Comments</u> About two thirds of candidates gave the correct answer C.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
23		i	Incorrect word (A) resistance (is induced across the ends of the wire) ✓ Corrected sentence (A) potential difference/voltage (is induced across the ends of the wire) ✓ OR Incorrect word (A microphone is similar to a) motor ✓ Corrected sentence (A microphone is similar to a) generator ✓	2 (AO2.1 x2)	ALLOW current is induced ALLOW dynamo <u>Examiner's Comments</u> A large number of candidates correctly identified that “resistance” was incorrect. Many realised that a potential difference is induced across the ends of the wire. The Examiners on this occasion also allowed a current is induced across the end of the wire. Other candidates identified “motor” as incorrect and substituted “generator” in the sentence A significant number of candidates stated that pressure was incorrect and re-wrote the sentence with longitudinal. A few candidates replaced “similar” with “not similar” which did not gain credit.
		ii	Loudspeaker/speaker/headphones ✓	1 (AO1.1)	IGNORE phone <u>Examiner's Comments</u> Most candidates stated speaker(s). It is important that candidates stated a relevant device as opposed to an appliance such as a phone.
			Total	3	

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Question			Answer/Indicative content	Marks	Guidance
24			C ✓	1 (AO1.1)	
			Total	1	
25			C	1 (AO1.1)	
			Total	1	
26			B	1 (AO2.1)	
			Total	1	
27			A	1 (AO2.1)	
			Total	1	