NAME _____ Class _____

Year 11 Physics

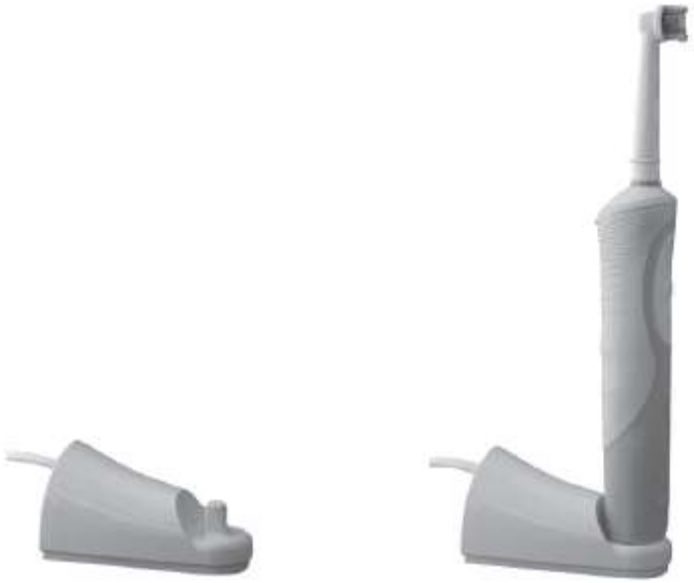
Total marks 45

Permitted materials:

Calculator

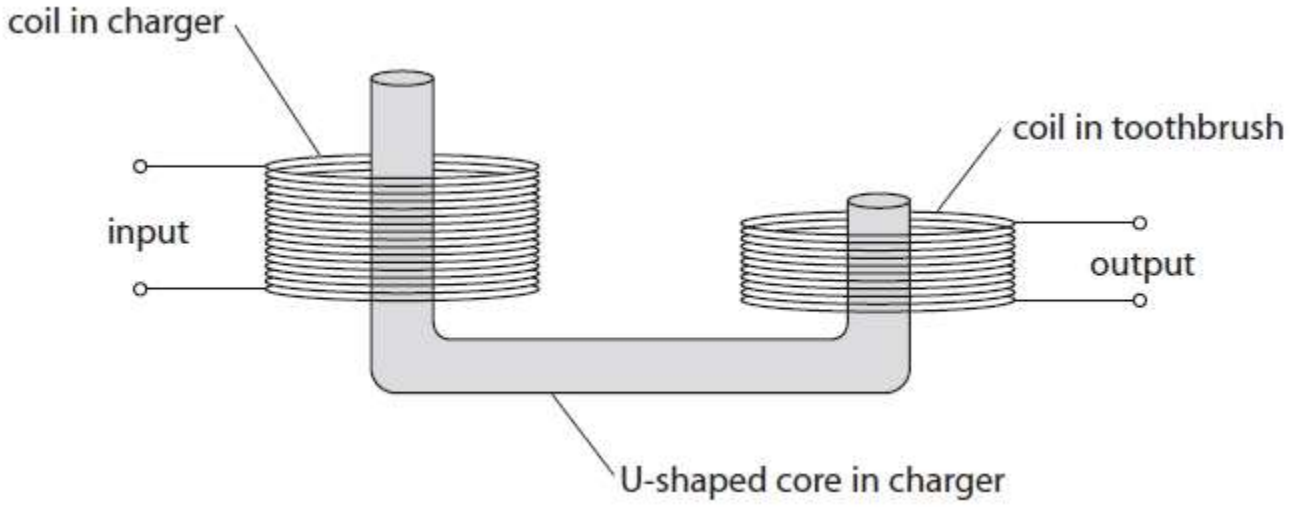
Q 1.

The photographs show how an electric toothbrush fits on its charger.



The charger and the toothbrush each have a coil of wire inside them.

The diagram shows how the two coils are linked by a U-shaped core.



This arrangement of core and coils acts as a transformer that reduces voltage.

(a) (i) Name the type of transformer that reduces voltage.

(1)

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(ii) Explain why the core is made of a soft magnetic material, such as iron.

(2)

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(b) (i) State the equation linking the input (primary) and output (secondary) voltages and the turns ratio of a transformer.

(1)

(ii) The transformer has 520 primary turns and 30 secondary turns.
The input voltage to the transformer is 44 V.
Calculate the output voltage.

(2)

output voltage = ... V

(c) (i) The alternating current in the transformer has a frequency of 27 000 Hz.

The toothbrush vibrates at the same frequency when it is being charged.
Explain why these vibrations cannot be heard.

(2)

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(ii) A circuit in the toothbrush delivers regular pulses of direct current.

There is a pulse every 1.5 ms.
Calculate the frequency of the pulses.

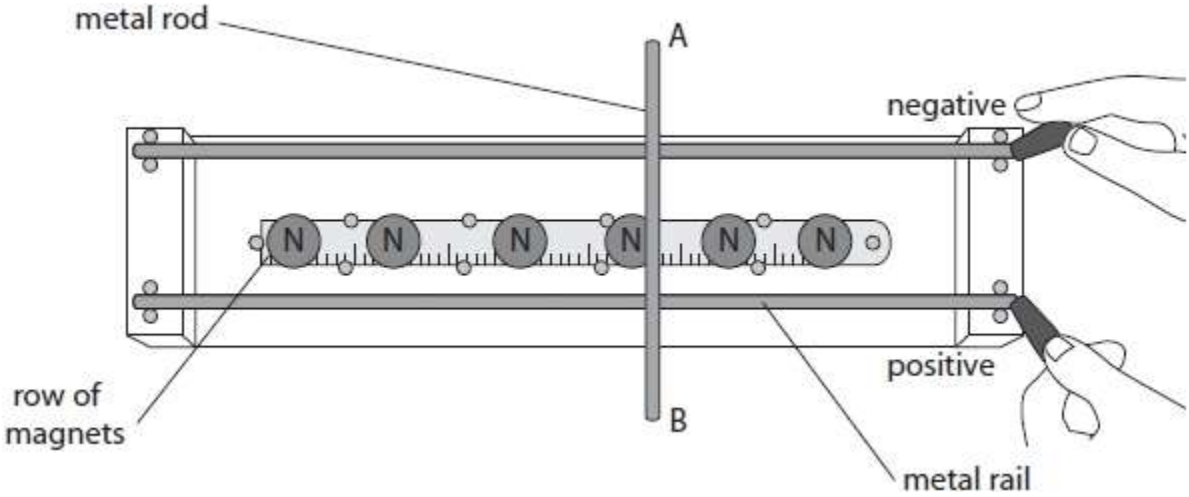
(2)

frequency = ... Hz

(Total for question = 10 marks)

Q 2.

(a) A student uses this apparatus to investigate what happens to a current-carrying conductor in a magnetic field.



The student connects the two parallel horizontal metal rails to the positive and negative terminals of a power supply.
The metal rod AB rests across the rails and is free to move.
Explain what happens to the metal rod AB.

(4)

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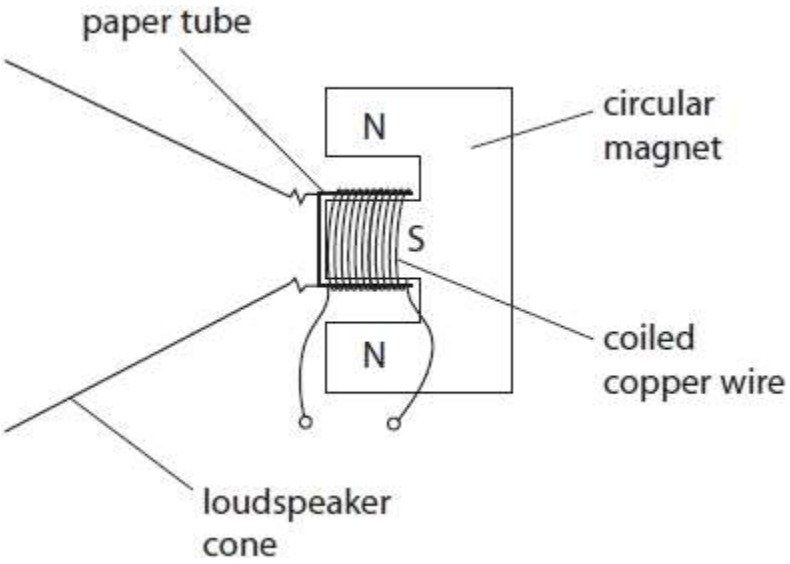
(b) This diagram shows the construction of a simple loudspeaker.



A coil of wire is wrapped around a paper tube attached to the loudspeaker cone.

When there is an alternating current in the coil, the cone moves.

Describe how the alternating current generates a sound wave.

You may draw a diagram if it helps your answer.

(4)

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(Total for question = 8 marks)

Q3.

The photograph shows a small electric motor.

(a) Explain why the coil starts to spin when the switch is closed.

(4)

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(b) (i) Suggest how to make the coil spin in the opposite direction.

(1)

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(ii) Suggest how to make the coil spin more slowly.

(1)

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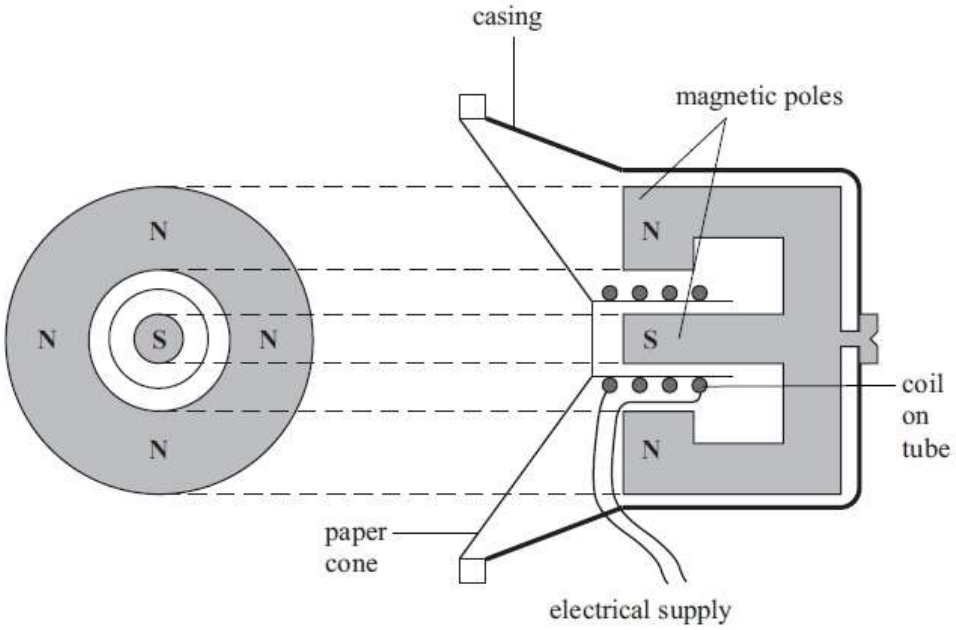
(Total for question = 6 marks)

Q4.

(c) In the radio, sound is produced by a loudspeaker.

The diagram shows the construction of a loudspeaker.



Describe how a loudspeaker uses an electrical supply to produce sound waves.

(5)

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Q5.

The photograph shows a plotting compass and a small bar magnet.

(a) Describe how you should use this apparatus to investigate the magnetic field pattern of the bar magnet.

(3)

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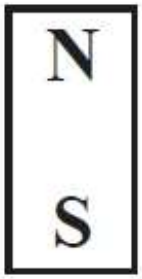
(b) Add the magnetic field pattern of the bar magnet to the diagram below.

(3)



(Total for question = 6 marks)

Q 6.

Diagram 1 shows some of the apparatus used to investigate the force on a current-carrying wire, XY, in a magnetic field.

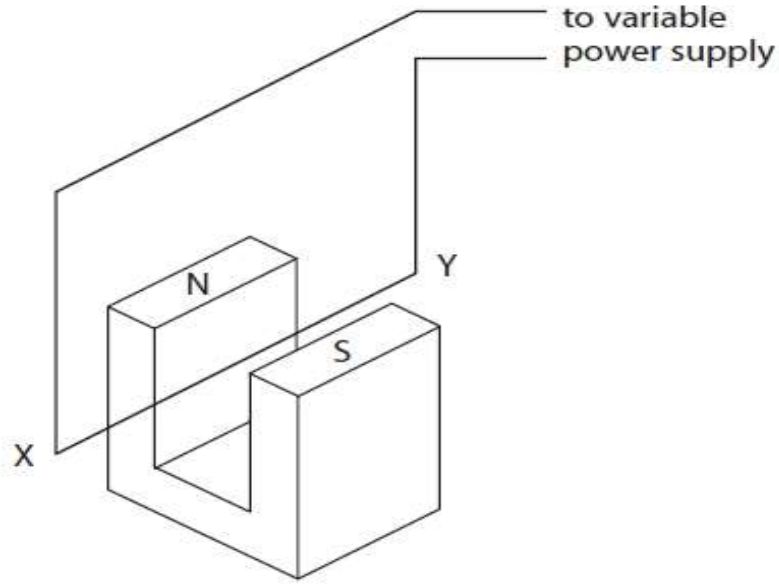


Diagram 1

(a) Diagram 2 shows the poles of the magnet viewed from above.

Draw the uniform magnetic field between the poles.

(2)

Diagram 2

(b) The current-carrying wire XY is at right angles to the magnetic field.

The current in the wire is 10 A.

(i) Suggest why the wire used in this investigation must be thick.

(1)

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(ii) Explain why the wire XY experiences a force when there is a current in the circuit.

(3)

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(iii) State two ways in which this force can be reduced.

(2)

1 .....

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2 .....

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(Total for question = 8 marks)

Q7. A step-down transformer reduces voltage from 230 V to 12 V.

The secondary current is 4.2 A.

(i) State the equation linking input power and output power for a transformer.
[assume that the transformer is 100% efficient]

(1)

(ii) Calculate the primary current.

(1)

primary current = ... A

(Total for question = 2 marks)

END OF TEST

Mark Scheme

Q1.

Question number	Answer	Notes	Marks
(a) (i)	step-down (transformer);		1
(ii)	MP1. soft material **loses** magnetism **quickly** / **easily**;	ignore unqualified references to losing magnetism	2
	MP2. idea that magnetic field (in core) alternates / changes;		

(b) (i)	$\frac{\text{input / primary voltage}}{\text{output / secondary voltage}} = \frac{\text{primary turns}}{\text{secondary turns}}$	allow • equation in words with turns ratio shown as a fraction • standard abbreviations :- s, p, in, out, 1, 2 • N or n for number of turns (condone T for number of turns) • "number of coils" for number of turns rearrangements also to include turns ratio as a fraction $(V_S/V_P) = (N_S/N_P)$ [equation inverted] $V_S = (V_P)(N_S/N_P)$ [V_S as subject] $V_P = (V_S)(N_P/N_S)$ [V_P as subject]	1
(ii)	substitution into a correct equation; evaluation (including rearrangement); e.g. 44 / V = 520 /30 (V =) 2.5 (V)	allow 3, 2.53, 2.54, 2.538	2

(c) (i)	idea of a (frequency) limit / range to (human) hearing OR (frequency) is {too high / ultrasound}; mention of upper limit as 20 000 Hz;	ignore references to lower limit allow 20 kHz ignore references to lower limit	2
(ii)	conversion of unit; substitution and evaluation; e.g. t = 1.5 ms = 0.0015 s (f =) 1/0.0015 = 670 (Hz)	allow 1000 or 0.001 in working, if no other mark can be given allow correct rounding only e.g. 700, 667, 666.7, 666.6 (recurring) 1 mark max for POT error e.g. 0.67, 6.7, 67 etc.	2

Q2.

Question number	Answer	Notes	Marks
(a)	any four from: MP1. there is a current in the rod; MP2. (therefore) magnetic field around rod; MP3. magnetic fields interact / overlap; MP4. producing a force (on the rod); MP5. catapult effect / motor effect / LH rule; MP6. rod moves to the right / towards the power supply;	allow 'AB' for rod throughout allow current in the rail ignore references to cutting field lines accept the rod moves sideways / left	4
(b)	any four from: MP1. alternating current changes direction (continuously); MP2. current in coil produces alternating magnetic field/eq; MP3. (producing) force on the coil/cone; MP4. reversing direction of current reverses direction of the force; MP5. hence coil/cone vibrates; MP6. cone vibrates air particles; total marks = 8	allow any marking point if clear from diagram allow changing magnetic field allow coil / cone moves in and out / backwards and forwards	4

Q3.

Question number	Answer	Notes	Marks
a	Any FOUR from: MP1. Current in <u>coil</u> ; MP2. (Creates) magnetic field (around the wires of the coil); MP3. Interaction of (this) field with that of (permanent) magnets; MP4. There is a force on the wire(of coil); MP5. Reference to left hand rule; MP6. force up on one side and down on other side;	 current in circuit is not enough coil becomes an electromagnet allow field cutting as the interaction idea of catapult field reference to moment/turning effect on the coil	4
b i	one of • Reverse supply polarity (however described); • reverse current direction (however described); • swap magnets over(however described);		1
ii	any one from: • Reduce current (however described); • Reduce voltage (however described); • increase resistance of circuit (however described); • weaker magnetic field (however described);	 Allow : less turns on coil Condone: fewer coils	1

Q4.

(c)	ANY FIVE RELEVANT POINTS, e.g. current in coil; changing current/alternating current; produces magnetic field; (constantly) changing (field); which interacts with field of permanent magnet / reference to Fleming's LHR; force on coil /coil moves; vibration in (coil / cone / air); making longitudinal wave;	DO NOT ALLOW 'coil spins'	5

Q5.

Question number	Answer	Notes	Marks
(a)	Place compass in field and observe the needle ; Make marks to record (field) ; ALLOW use of >1 compass / pencil Repeat process / join marks to make >1 line ;	e.g. "Place the compass next to the magnet and look where the needle points." e.g. "Place the compass next to the magnet and look where the needle points. The line is marked using a pencil and paper method (i.e. dots or arrows)" e.g. "Place the compass next to the magnet and look where the needle points. The line is marked using a pencil and paper method (dots or arrows). This is repeated for another line / in a different place" ALLOW use of iron filings for 1 mark	3
(b)	A correct field line ; Correct direction of field shown i.e. an arrow from N to S ; At least two correct complete lines, but not touching / crossing;	ALLOW incomplete line IGNORE field lines inside the magnet REJECT inconsistent / incorrect arrows	3

Total 6 marks

Q6.

Question number	Answer	Notes	Marks
(a) (i)	MP1. minimum of 3 straight lines evenly spaced (by eye); MP2. at least one arrow showing direction from N to S;	ignore field outside the rectangle defined by the magnets	2
(b) (i)	any sensible suggestion; e.g. otherwise large heat loss/overheating thin wire would melt to reduce the resistance so it does not sag/bend/eq		1
(ii)	any 3 of: MP1. magnetic field of wire/current; MP2. interacts with; MP3. magnetic field of (2) magnets; MP4. Fleming's left hand rule;	For MP1 and MP3 must refer to what is causing the magnetic field	3
(iii)	MP1. reduce current; MP2. use less powerful magnets/greater separation of magnets;	ACCEPT Use thinner wire, switch off, reduce voltage not 'smaller' magnets allow rotate the wire so that the angle with the magnetic field is smaller	2

Q7.

(i)	input power = output power;	allow $V_pI_p = V_sI_s$ rearrangements Use of 1,2 in place of P,S
(ii)	substitution into a correct equation; rearrangement; evaluation; e.g. $230 \times I_p = 12 \times 4.2$ $(I_p =) \ 12 \times 4.2/230$ $(I_p =) \ 0.22$ (A)	 0.21 (A) gets 2 marks only allow 0.2, 0.21913...