

## Mark schemes

1.

(a) any **one** from:

- too few turns / coils on the secondary  
*allow number of turns / coils on the primary was increased*
- p.d. across the primary was reduced  
*ignore human error*

1

(b) the p.d. (across the secondary) goes above 2V

*allow p.d. across secondary is higher than p.d. across primary after 20 turns*

1

(c) it increases (until the nails reach a constant temperature)

1

(d)  $\frac{640}{4} = \frac{V_p}{1.75}$

1

$$V_p = \frac{640 \times 1.75}{4}$$

1

$$V_p = 280 \text{ (V)}$$

1

$$280 \times I_p = 336$$

*allow their calculated*

$$V_p \times I_p = 336$$

1

$$I_p = 1.2 \text{ (A)}$$

*allow an answer that is consistent with their calculated value of  $V_p$*

1

**or**

$$336 = I_s \times 1.75 \text{ (1)}$$

$$I_s = \frac{336}{1.75} \text{ (1)}$$

$$I_s = 192 \text{ (A) (1)}$$

$$I_p = 192 \times \frac{4}{640} \text{ (1)}$$

*allow*

$$I_p = \text{their calculated } I_s \times \frac{4}{640}$$

$$I_p = 1.2 \text{ (A) (1)}$$

*allow an answer that is consistent with their calculated value of  $I_s$*

*an answer of 1.2 (A) scores 5 marks*

**[8]**

**2.**

(a) It is easily magnetised.

1

(b) p.d. across the secondary coil is smaller (than p.d. across the primary coil)

1

(c) ratio  $\frac{V_p}{V_s} = \frac{6}{12}$

$$\frac{6}{12} = \frac{50}{N_p}$$

*accept any other correct ratio taken from the graph*

1

$$\frac{6}{12} = \frac{50}{N_p}$$

$$N_p = 100$$

*use of the correct turns ratio and substitution or correct transformation and substitution*

1

$$N_p = 100$$

*allow 100 with no working shown for 3 marks*

1

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3.

(a) a magnetic field

*accept electromagnetic field  
heat is insufficient*

1

that is alternating / changing

1

(b) 20

*allow 1 mark for correct  
substitution, ie*

$$\frac{230}{11.5}$$

*provided no subsequent step*

2

(c) (most) transformers are not 100% efficient

*allow energy / power is lost to the surroundings  
allow energy / power is lost as heat / sound  
power is lost is insufficient*

1

(d) (i) 0.01 (V)

1

because there is a change in p.d. each time (the number of turns changes)

*allow because all the results (to 2 decimal places) are different  
accept if results were to 1 decimal place, there might not be a  
difference*

1

(ii) student 2 moved the coil more slowly (than student 1)  
*accept student 2 moved the coil at a different speed to student 1*  
*do not accept student 2 moved the coil faster (than student 1)*

1

(iii) both sets of results show the same pattern  
*accept trend for pattern*  
*results are similar is insufficient*  
*results follow a pattern is insufficient*

1

(iv) (electromagnetic) induction  
*accept it is induced*  
*do not accept electric / magnetic induction*

1

(e) any **one** from:

- more economical / cheaper for the consumer  
*allow more convenient*
- easier/cheaper to replace if broken/lost  
*allow in case one gets lost*
- since fewer transformers need to be made less resources are used  
*allow fewer plug sockets are needed*  
*allow fewer transformers are needed*  
*environmentally friendly is insufficient*

1

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4.

(a) an alternating current through the primary coil (in the charging base)  
*it must be clear which coil is being referred to*

1

causes a changing / alternating magnetic field in / around the (iron) bar

1

which induces an (alternating) p.d. across the secondary coil (in the toothbrush)  
*accept induces an (alternating) current in the secondary coil*

1

(b) 18

*allow 1 mark for correct substitution, ie*

$$\frac{230}{7.2} = \frac{575}{n_s}$$

2

[5]

5.

(a) (i) Iron

1

(ii) 50

*ignore references to current  
reason only scores if 50 chosen*

1

there are more turns on the secondary coil (than the primary coil)  
*accept it is a step-up transformer  
not more coils*

1

(b) (i) 200

1

(ii) any **one** from:

- Lighter
- smaller
- use very little power / current (when switched on with no load / phone attached).

*accept more efficient*

*do not accept uses no power / current*

*a disadvantage of a traditional transformer is insufficient on its own*

1

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6.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

**0 marks**

No relevant / correct content.

**Level 1 (1–2 marks)**

**Either** there is an attempt at a description of the construction of a transformer

**or**

a correct statement of the effect of one type of transformer on the input p.d.

**Level 2 (3–4 marks)**

There is a description of the construction of a transformer

**and**

a correct statement of the effect of one type of transformer on the input p.d.

**Level 3 (5–6 marks)**

There is a clear description of the construction of a transformer

**and**

there is a correct description of how transformers affect the input p.d.

**details of construction:**

*extra information*

a (laminated) core

core is made from a magnetic material / iron

2 coils

the coils are made from an electrical conductor / copper

the coils are covered in plastic / insulation

the coils are (usually) on opposite sides

step-up transformer has more turns on secondary coil than (its) primary (or vice versa)

step-down transformer has fewer turns on secondary coil than (its) primary (or vice versa)

**effect on input p.d. :**

step-up transformer, the output p.d. is greater (than the input p.d.)

*accept voltage for p.d.*

step-down transformer, the output p.d. is lower (than the input p.d.)

6

[6]

7.

(a) step-down

1

- (b) (i) 1.6  
*correct order only* 1
- 12.8 1
- (ii) values of p.d. are smaller than 230 V 1
- (c) (i) a.c. is constantly changing direction  
*accept a.c. flows in two / both directions*  
*accept a.c. changes direction(s)*  
*a.c. travels in different directions is insufficient* 1
- d.c. flows in one direction only 1
- (ii) an alternating current / p.d. in the primary creates a changing / alternating magnetic field 1
- (magnetic field) in the (iron) core  
*current in the core negates this mark*  
*accept voltage for p.d.* 1
- (and so) an alternating p.d. 1
- (p.d.) is induced across secondary coil 1

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8.

- (a) 400 000  
*allow 1 mark for correct substitution ie*

$$\frac{25000}{?} = \frac{800}{12800}$$

**or**

$$\frac{25}{?} = \frac{800}{12800}$$

2

- (b) (i) any **one** from:
- do **not** accept any response in terms of heat insulation, safety or electric shock*
  - (so that there is) no short circuit
  - (so that the) current goes around the coil  
*do **not** accept electricity for current*
  - (so that the) current does not enter the core

1

- (ii) (easily) magnetised (and demagnetised)
- accept '(it's) magnetic'*
  - do **not** accept 'because it's a conductor'*

1

- (iii) alternating current in the primary (coil)

1

produces a changing magnetic field (in the core)

1

this induces an (alternating) potential difference across the secondary (coil)

1

- (c) any **two** from:
- if the (local) power station breaks down / fails / demand / load exceeds supply
  - electricity / power can be switched from elsewhere in the system / from other power station(s)
  - electricity can be generated in places remote from customers
  - (in total) fewer power stations are needed
  - power available in rural / remote areas
  - National Grid allows for (better) control of supply and demand

2

[9]