**Mark schemes**

Q1.

(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 Vp = 6

Vs 12

accept any other correct ratio taken from the graph

1

6 = 50

12 Np

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

1

Np = 100

allow 100 with no working shown for 3 marks

1

[5]

Q2.

(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

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

[11]

Q3.

(a) (i)

1

1

1

1

(ii) 16 000

allow 1 mark for correct substitution

ie 400 ÷ 25 = n ÷ 1000

2

(iii) p.d. increased (by transformer at power station)

do not accept energy increased

1

so current decreases

1

this reduces energy / power loss (in cables)

allow heat for energy

allow increases the efficiency

do not accept no energy losses

1

(b) smaller / lighter

1

uses little power / energy

1

when left switched on with no load applied

dependent on second marking point

1

[12]

Q4.

(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

[5]

Q5.

(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

2

[5]

Q6.

(a) (i) generator

1

(ii) alternating current

1

(iii) voltmeter / CRO / oscilloscope / cathode ray oscilloscope

1

(b) (i) time

1

(ii) peaks and troughs in opposite directions

1

amplitude remains constant

dependent on first marking point

1

(c) any two from:

• increase speed of coil

• strengthen magnetic field

• increase area of coil

do not accept larger

2

[8]

Q7.

(a) attempt to draw four cells in series

1

correct circuit symbols

circuit symbol should show a long line and a short line, correctly joined together

example of correct circuit symbol:

1

(b) (i) 6 (V)

allow 1 mark for correct substitution, ie

V = 3 × 2 scores 1 mark

provided no subsequent step

2

(ii) 12 (V)

ecf from part (b)(i)

18 – 6

or

18 – their part (b)(i) scores 1 mark

2

(iii) 9 (Ω)

ecf from part (b)(ii) correctly calculated

3 + their part (b)(ii) / 2

or

18 / 2 scores 1 mark

provided no subsequent step

2

(c) (i) need a.c.

1

battery is d.c.

1

(ii) 3 (A)

allow 1 mark for correct substitution, ie

18 × 2 = 12 × Is scores 1 mark

2

[12]

Q8.

(a) there is a magnetic field (around the magnet)

1

(this magnetic field) changes / moves

1

and cuts through coil

accept links with coil

1

so a p.d. induced across coil

1

the coil forms a complete circuit

1

so a current (is induced)

1

(b) ammeter reading does not change

must be in this order

accept ammeter has a small reading / shows a current

1

zero

1

greater than before

accept a large(r) reading

1

same as originally but in the opposite direction

accept a small reading in the opposite direction

1

(c) 0.30

allow 1 mark for correct substitution, ie 0.05 = Q / 6

2

C / coulomb

allow A s

1

[13]

Q9.

(a) (i) live

1

(ii) react faster

1

(iii) live and neutral

1

(b) (i) ammeter

1

to measure current

accept to measure amps

1

plus any one from:

• variable resistor (1)

to vary current (1)

accept variable power supply

accept change or control

• switch (1)

to stop apparatus getting hot / protect battery

or

to reset equipment (1)

• fuse (1)

to break circuit if current is too big (1)

2

(ii) any two from:

• use smaller mass(es)

• move mass closer to pivot

• reduce gap between coil and rocker

• more turns (on coil)coil / loop

• iron core in coil

accept use smaller weight(s)

2

[9]

Q10.

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]

Q11.

(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

[10]

Q12.

(a) iron

correct positions only

1

primary

1

secondary

1

(b) (it) decreases the p.d.

accept it would increase current

accept voltage for p.d.

the voltage goes from 230(V) to 20(V) is insufficient

do not accept decreases current / energy / power

do not accept decreases p.d. / voltage and current

1

(c) an environmental

1

[5]

Q13.

(a) (the alternating current creates) a changing / alternating magnetic field

1

(magnetic field) in the (iron) core

accept that links with the secondary coil

current in the core negates this mark

1

(causing a) potential difference (to be) induced in / across secondary coil

accept voltage for p.d.

1

(b) (i) 20

allow 1 mark for correct substitution, ie

or

2

(ii) 0.3

or

correct calculation using 230 × Ip = their (b)(i) × 3.45

allow 1 mark for correct substitution, ie

230 × Ip = 20 × 3.45

allow ecf from (b)(i) for 20

OR

substitution into this equation

2

(c) any one from:

• fewer (waste) batteries have to be sent to / buried in land-fill

• the soil is polluted less by batteries in land-fill

• fewer (waste) batteries have to be recycled

• fewer batteries have to be made

• less raw materials are used in making batteries

• customers have to replace their batteries less often

longer lifetime is insufficient

• customers have to buy fewer (replacement) batteries

it costs less is insufficient

1

[8]

Q14.

(a) 400 000

allow 1 mark for correct substitution ie

or

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]

Q15.

(a) which causes the magnet to turn / spin / rotate

1

(magnetic) field / lines of force / flux rotate(s) / move(s) / through / in / cut(s) the coil

do not credit the idea that movement ‘creates’ the magnetic field

1

potential difference / p.d. / voltage induced across the coil

do not credit just ‘current induced’

1

(b) any one from:

• more powerful / stronger / lighter magnet

do not credit ‘a bigger magnet’

• larger / more / bigger / lighter cups / with a bigger surface area

• longer arms

• lubricate the spindle

• add more turns to the coil

1

[4]

Q16.

(a) aluminium cannot be magnetised

accept aluminium is not magnetic

“it” refers to aluminium

do not accept aluminium is not easily magnetised

reference to conduction and aluminium negates mark

iron can be magnetised is insufficient

1

(b) (i) 10 to 50

either order

1

(ii) (data is) anomalous

accept does not fit the pattern

it is an error is insufficient

1

(iii) 21

accept 22

do not accept any fraction of a turn ie 20.1

1

secondary p.d. (just) larger than primary p.d.

accept output (just) larger than input/2V

or

there must be more turns on the secondary coil than primary coil

do not accept coil for turns

1

(c) to reduce/step-down the (input) p.d./voltage

mains p.d. is too high is insufficient

step-down transformer is insufficient

answers in terms of changing/ stepping-up current or fuse blowing or not working with 230 volts are insufficient

any mention of step-up negates mark

stepping down both voltage/p.d. and current negates mark

1

[6]

Q17.

(a) (i) step-up

both parts required

more turns on the secondary / output (coil)

do not accept coils for turns

’secondary output is greater than primary input’ is insufficient

1

(ii) (easily) magnetised (and demagnetised)

accept (it’s) magnetic

it’s a conductor negates answer

1

(b) 60

allow 1 mark for correct substitution, ie

2

[4]

Q18.

(a) iron

accept any unambiguous correct indication

1

(b) (i) step-down (transformer)

do not accept down step or a description

1

(ii) less than

accept any unambiguous correct indication

1

(c) (i) 2000

1

(ii) There is no pattern.

1

[5]

Q19.

(a) 10

allow 1 mark for correct substitution ie

2

(b) any one from:

• to prevent short circuiting

• to ensure that the current flows / goes round the coil

• to prevent the current entering the core

do not accept electrocution

do not accept electricity for current

answers including heat / energy loss negate mark

1

(c) (i) (soft) iron

do not accept ‘steel’

1

(ii) can be magnetised

because it is magnetic

answers including it’s a conductor negate mark

1

[5]

Q20.

(a) 400 000

allow 1 mark for correct substitution ie

or

2

volt(s) / V

an answer 400 gains 2 marks

an answer 400 kilovolts / kV gains 3 marks

although the unit mark is independent to gain 3 marks it must be consistent with the numerical value

1

(b) 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 round the coil

do not accept electricity for current

• (so that the) current does not enter the core

1

(c) (the alternating p.d. in the primary causes) an (alternating)

current in the primary

reference to the current in the core negates this mark

1

(causes an) alternating / changing (magnetic) field in the (iron) core

1

induces (alternating) p.d. across the secondary (coil)

accept in / through or similar for across

accept current for p.d.

accept output (coil) for secondary (coil)

to gain 3 marks the sequence must be correct

1

[7]

Q21.

(a) (i) (laminated soft) iron

do not accept steel

1

(ii) produces a magnetic field

accept magnetic flux

which is alternating / changing / varying

and which induces / produces an alternating / changing potential

difference across the secondary coil

accept current / voltage

3

(b) 3067 (V)

allow all 3 marks for 3060 to 3070 (V)

 gains 2 marks

 gains 1 mark

3

[7]

Q22.

(a) (i) iron

1

(ii) step-down (transformer)

1

(b) any one from:

• after the power station

• after the generator

• before the power lines

• before the pylons

1

(c) each correct (1)

in its correct place

current

coil

field

core

ends

5

[8]

Q23.

(a) (it is) magnetic

or will carry (an alternating) magnetic field

or magnetises and demagnetises (easily)

reference to conduction negates the mark

1

(b) so the current / electricity does not flow through the iron / core

accept ‘so the current / electricity / wires do not short (circuit)’

responses in terms of heat insulation negate the mark

ignore references to safety

1

(c) 5.75 or 5.8 or 6(.0)

allow for 1 mark either

or

p.d. = 230 ÷ 40

2

V / volt(s)

1

[5]

Q24.

(a) (i) (quickly) becomes magnetized

or (quickly) loses its magnetism

or ‘it’s (a) magnetic (material)’

any reference to conduction of electricity/heat nullifies the mark

1

(ii) any four from:

• insulation prevents electricity/current flowing through the iron/core

or ‘insulation so electricity/current only flows in the wires/turns/coils’

• alternating current/a.c. in the primary (coil)

• produces a changing magnetic field (in the iron/core)

• (and hence magnetic) field in the secondary (coil)

• induces/generates/produces an alternating potential difference/p.d./voltage across the secondary (coil)

• (and hence) alternating current/a.c. in the secondary (coil)

4

(b) 80 (turns)

or credit (1) for any equation which if correctly evaluated would give 80 example

example

2

[7]

Q25.

(a) (i) secondary(coil) / output (coil)

do not accept just coil

1

(ii) core

do not accept for either mark it is made out of iron ore

1

 (laminated soft) iron

allow 1 mark for ‘it is made out of iron core’

1

(iii) magnetic field

accept magnetism / magnetic force

1

 (which is) changing / alternating

direction (of field) changes / strength (of field) varies

scoring second mark is dependent on first mark

1

(b) ...step-up .... step-down ...

both in the correct order

1

(c) Do not build new houses ....

1

 Build new power lines away ....

deduct 1 mark for any other(s) to a minimum total of (0)

1

[8]

Q26.

(a) (i) step-down (transformer) because fewer turns on the output/secondary (coil)

no credit for just ‘step-down transformer’

accept ‘…less turns…’

do not credit ‘…fewer coils…’

or ‘the p.d. across the input / primary will be greater than the p.d. across the output / secondary’

1

(ii) to prevent a short (circuit)(through the turns of wire or through the core

do not credit references to safety or heat (insulation)

1

(iii) (easily) magnetised (and demagnetised)

accept ‘(it’s) magnetic’

do not accept ‘because it’s a conductor’

1

(b) 2250

correct substitution

eg gains 1 mark

or appropriate transformation

eg (p.d. across secondary =)

× p.d. across primary gains 1 mark

2

(c) any two from:

• to reduce the voltage / p.d. (of the domestic supply)

or to reduce to 230 V

allow ‘to reduce to 240 V’

do not credit ‘reduce current to 230V’

• higher voltage difficult to insulate

• higher voltage (would) result in (fatal) electric shock

not just ‘less dangerous’

• domestic appliances are not designed for (very) high

voltage (input) / (are designed) for 230V

do not credit ‘to increase efficiency’ / ‘to save energy’ do not credit just ‘it’s safer’

2

(d) any two (1) each

• if the (local) power station breaks down / fails / demand /

load exceeds supply

1

 or words to that effect

• electricity / power can be switched from elsewhere in the

system / from other power station(s)

or words to that effect

• electricity can be generated in places remote from customers

or words to that effect

• (in total) fewer power stations are needed

• power available in rural / remote areas

• National Grid allows for (better) control of supply and demand

do not credit just cheaper / more efficient / safer

1

[9]

Q27.

(a) step-down (transformer)

1

(b) alternating current

accept minor misspellings but

do not credit ‘alternative current’

1

(c) (i)(ii) magnet

 attracts

 upwards

correct order essential

accept ‘up’

3

[5]

Q28.

(a) 10 500

allow 1 mark for 75 × 32 200 ÷ 230

2

(b) any three from:

• alternating current (a.c.) in the primary (coil)

• produces a changing magnetic field / flux (in the core)

• which is made of (laminated soft) iron

• this induces

must be idea of inducing something in the secondary coil

• an alternating potential difference across the secondary coil

accept voltage for potential difference

3

[5]

Q29.

60

allow 1 mark for correct transformation

2

[2]

Q30.

(a) (i) one of the following:

• increase number of turns on the secondary coil

• decrease number of turns on the primary coil

1

(ii) constructed in (thin) layers

1

(b) (i) transformers only work with a c

1

(ii) used to increase or decrease or change voltage or current

reducing the energy or heat or power loss (along the cables)

1

or reduce to safe domestic level

must be consistent with first answer

1

(iii) (several metres of) air gives good electrical

insulation (between cables and earth)

or reduce chance of earthing or sparks or arcing

or to avoid people touching it

1

(c) (i)

accept

or

1

(ii) Np = 4000

 for 1 mark

2

(d) (i) resistance of cable decreases

1

(ii) convection (to the air)

or

conduction (to the air)

not radiation

1

[11]

Q31.

(i) iron

for 1 mark

1

(ii) 20

gains 2 marks

 else working

gains 1 mark

2

(iii) reverse input/output

for 1 mark

 or increase secondary turns

1

[4]

Q32.

(a) (i) Iron

for 1 mark

1

(ii) V/240 = 2000/10 000

V = 48

V

for 1 mark each

3

(b) changing current in primary causes changing (magnetic) field in core links to secondary inducing voltage (emf) in secondary (NOT current) secondary voltage/current is alternating

for 1 mark each

4

(c) magnetic field not changing/no electromagnetic induction because direct current

for 1 mark each

2

[10]

Q33.

(a) output voltage less than (the) input voltage

or p.d. across output less that p.d.

across input or output is (only) 4.2 V

(whereas) the input is 230V

or WTTE (words to that effect)

1

(b) any two from

(made of soft) iron

laminated

or designed to reduce eddy currents

or made of thin slices with slices of insulating material between them

core(s) joined to make a ring

2

[3]