Mark schemes

1 (a) any **two** from:

- nuclear
- oil
- (natural) gas

2

(b) 4 (hours)

1

(c) a system of cables and transformers

1

(d) The power output of wind turbines is unpredictable

1

(e) 1500 / 0.6

1

2500 (wind turbines)

1

*allow 2500 with no working shown for **2** marks*

(f) Most energy resources have negative environmental effects.

1

[8]

2 (a) current that is always in the same direction

1

(b) total resistance = 30 (Ω)

1

V = 0.4 × 30

1

12 (V)

1

*allow 12 (V) with no working shown for **3** marks*
*an answer of 8 (V) or 4 (V) gains **2** marks only*

(c) P = 0.4 × 12 = 4.8

1

5 (W)

1

*allow 5 (W) with no working shown for **2** marks*
*allow 4.8 (W) with no working shown for **1** mark*

[6]

3 (a) he may receive an electric shock

or

he may be electrocuted

1

if he touches the live wire

1

(b) 10 690 = I × 230

1

I = 10 690 / 230

1

46.478(260) (A)

1

46

1

*allow 46 (A) with no working shown for **4** marks*

(c) cost is higher

1

more energy is used (per second)

1

[8]

4 (a) (because the) potential of the live wire is 230 V

1

(and the) potential of the electrician is 0 V

1

(so there is a) large potential difference between live wire and electrician

1

charge / current passes through his body

allow voltage for potential difference

1

(b) diameter between 3.50 and 3.55 (mm)

*allow correct use of value of cross-sectional area of 9.5 to 9.9 (mm^2) with no final answer given for **1** mark*

2

(c) 18000 = I × 300

1

I = 18000 / 300 = 60

1

13 800 = (60^2) × R

1

$R = 13\ 800 / 60^2$

1

3.83 (Ω)

1

*allow 3.83(Ω) with no working shown for **5** marks*
answer may also be correctly calculated using P = IV and V = IR if 230 V is used.

[11]

5 (a) (i) 150

1

(ii) transferred to the surroundings by heating
reference to sound negates mark

1

(iii) 0.75
*450 / 600 gains **1** mark*
*accept 75% for **2** marks*
*maximum of **1** mark awarded if a unit is given*

2

(iv) 20 (s)
*correct answer with or without working gains **2** marks*
*correct substitution of 600 / 30 gains **1** mark*

2

(b) (i) to avoid bias

1

(ii) use less power and last longer

1

1 LED costs £16, 40 filament bulbs cost £80

or

filament costs (5 times) more in energy consumption

1

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

1

[10]

6 (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]

7 (a) (i) any **six** from:

- switch on
- read both ammeter and voltmeter

allow read the meters

- adjust variable resistor to change the current
- take further readings
- draw graph
- (of) V against I

allow take mean

- R = V / I

allow take the gradient of the graph

6

(ii) resistor would get hot if current left on

1

so its resistance would increase

1

(iii) 12 (V)

*0.75 × 16 gains **1** mark*

2

(iv) 15 (Ω)

1

16 is nearer to that value than any other

1

(b) if current is above 5 A / value of fuse

1

fuse melts

allow blows / breaks

*do **not** accept exploded*

1

breaks circuit

1

[15]

8 (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 × I_s scores **1** mark*

2

[12]

9 (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]

10 (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]

11 (a) (black) is a good absorber of (infrared) radiation

1

(b) (i) amount of energy required to change (the state of a substance) from solid to liquid (with no change in temperature)

melt is insufficient

1

unit mass / 1kg

1

(ii) 5.1×10^6 (J)

accept 5×10^6

*allow **1** mark for correct substitution ie $E = 15 \times 3.4 \times 10^5$*

2

(c) (i) mass of *ice*

allow volume / weight / amount / quantity of ice

1

(ii) to distribute the salt throughout the ice

1

to keep all the ice at the same temperature

1

(iii) melting point decreases as the mass of salt is increased

allow concentration for mass

accept negative correlation

*do **not** accept inversely proportional*

1

(d) 60 000 (J)

accept 60 KJ

*allow **2** marks for correct substitution ie E = 500 × 2.0 × 60*

*allow **2** marks for an answer of 1000 **or** 60*

*allow **1** mark for correct substitution ie*

*E = 500 × 2.0 **or** 0.50 × 2.0 × 60*

*allow **1** mark for an answer of 1*

3

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

0 marks
No relevant content

Level 1 (1–2 marks)
There is *an attempt at a description of some advantages or disadvantages.*

Level 2 (3–4 marks)
There is a basic description of *some advantages* ***and*** */* ***or*** *disadvantages for some of the methods*

Level 3 (5–6 marks)
There is a clear description of the advantages and disadvantages of all the methods.

examples of the points made in the response

extra information

energy storage

advantages:

- no fuel costs
- no environmental effects

disadvantages:

- expensive to set up and maintain
- need to dig deep under road
- dependent on (summer) weather
- digging up earth and disrupting habitats

salt spreading

advantages:

- easily available
- cheap

disadvantages:

- can damage trees / plants / drinking water / cars
- needs to be cleaned away

undersoil heating

advantages:

- not dependent on weather
- can be switched on and off

disadvantages:

- costly
- bad for environment

6 **[18]**

12 (a) (i)

Wire	Plug terminal
Live	C
Neutral	A
Earth	B

*all 3 correct for **2** marks*
*allow **1** mark for 1 correct*

2

(ii) plastic
or
rubber

accept:
ABS
UF / urea formaldehyde
nylon
PVC

1

(b) (i) 600

*allow **1** mark for correct substitution,*

ie $P = \frac{30\,000}{50}$
provided no subsequent step

2

(ii) power is greater than 820 (W)
power is 1200 W is insufficient

1

the lead /cable / wire will overheat / get (too) hot
accept lead / cable will melt
may overheat / get hot is insufficient

1

so there is a risk of fire
accept causing a fire

1

(c) X

any **one** from:

- most / more efficient
- smallest energy input (per second)
- cheapest to operate

mark only scores if X is chosen
mark is for the reason
accept smallest input (power) for same output (power)
accept wastes least energy
smallest (power) input is insufficient
uses least electricity is insufficient

1

[9]

13 (a) water heated by radiation (from the Sun)

accept IR / energy for radiation

1

water used to heat buildings / provide hot water

*allow for **1** mark heat from the Sun heats water if no other marks given*
*references to photovoltaic cells / electricity scores **0** marks*

1

(b) 2 (minutes)

$1.4 \times 10^3 = \frac{168 \times 10^3}{t}$

*gains **1** mark*
*calculation of time of 120 (seconds) scores **2** marks*

3

(c) (i) 150 (kWh)

1

(ii) £60(.00) or 6000 (p)

*an answer of £6000 gains **1** mark*
*allow **1** mark for 150 × 0.4(0) 150 × 40*
*allow ecf from **(c)(i)***

2

(iii) 25 (years)

an answer of 6000 / 240
or
*6000 / their **(c)(ii)** × 4*
*gains **2** marks*
an answer of 6000 / 60
or
*6000 / their **(c)(ii)** gains **1** mark, ignore any other multiplier of **(c)(ii)***

3

(iv) any **one** from:

- will get £240 per year

  *accept value consistent with calculated value in **(c)(iii)***
- amount of light is constant throughout the year
- price per unit stays the same
- condition of cells does not deteriorate

1

(d) any **one** from:

- angle of tilt of cells
- cloud cover
- season / shade by trees
- amount of dirt

1

[13]

14 (a) (i) to obtain a range of p.d. values

accept increase / decrease current / p.d. / voltage / resistance

accept to change / control the current / p.d. / voltage / resistance

to provide resistance is insufficient

a variable resistor is insufficient

*do **not** accept electricity for current*

1

(ii) temperature of the bulb increases

accept bulb gets hot(ter)

accept answers correctly

expressed in terms of collisions between (free) electrons and ions / atoms

bulb gets brighter is insufficient

1

(iii) 36

*allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown*

2

watt(s) / W

accept joules per second / J/s

*do **not** accept w*

1

(b) 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 refer to the information in the Marking guidance, and apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a basic comparison of either a cost aspect or an energy efficiency aspect.

Level 2 (3-4 marks)
There is a clear comparison of either the cost aspect or energy efficiency aspect
OR
a basic comparison of both cost and energy efficiency aspects.

Level 3 (5-6 marks)
There is a detailed comparison of both the cost aspect and the energy efficiency aspect.

For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost

- halogen are cheaper to buy
  simply giving cost figures is insufficient
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency

- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

6

[11]

15 (a) 35

*an answer with more than 2 sig figs that rounds to 35 gains **2** marks*
*allow **2** marks for correct method, ie* $\frac{230}{6.5}$
*allow **1** mark for I = 6.5 (A) **or** R =* $\frac{230}{26}$
*an answer 8.8 gains **2** marks*
*an answer with more than 2 sig figs that rounds to 8.8 gains **1** mark*

3

(b) (maximum) current exceeds maximum safe current for a 2.5 mm^2 wire
accept power exceeds maximum safe power for a 2.5 mm^2 wire

or
(maximum) current exceeds 20 (A)
(maximum) current = 26 (A) is insufficient

1

a 2.5 mm^2 wire would overheat / melt

accept socket for wire

*do **not** accept plug for wire*

1

(c) a.c. is constantly changing direction

accept a.c. flows in two directions

accept a.c. changes direction

a.c. travels in different directions is insufficient

1

d.c. flows in one direction only

1

[7]

16 (a) (i) 50 (Hz)

1

(ii) 2760 (W)

1

(b) 12

*allow **1** mark for correct substitution, ie 2400/200*

or

*allow **1** mark for 2760/230 provided no subsequent step shown*

2

amps

1

(c) the charge is <u>directly</u> proportional to the time switched on for

*accept for **1** mark the longer time (to boil), the greater amount of charge*

***or** positive correlation*

***or** they are proportional*

2

[7]

17 (a) (i) 50(Hz)

ignore any unit given

1

(ii) any **two** from:

- (some) current flows to Earth
  accept ground for Earth
- current flows through copper braid
  accept current flows through the earth wire
  accept electricity for current in either the first or second marking point but not both
- RCCB detects difference between current in live and neutral wire

2

(iii) can be reset
accept does not need replacing

or

faster acting
accept switches circuit off faster

1

(b) (i) 79 200
*allow **1** mark for correct substitution, ie* $11 = \frac{Q}{2 \times 3600}$
*an answer 22 gains **1** mark*

2

coulombs / C
*do **not** accept c*

1

(ii) 18 216 000
*accept for **2** marks 18 216 kJ **or** 18.216 MJ*

or

230 × their (b)(i) correctly calculated
*allow **1** mark for correct substitution, ie 230 × their (b)(i) **or***
*allow **1** mark for power calculated as 2530(W)*

2

(c) increases temperature of thermistor

1

changes resistance (of thermistor)
*do **not** accept increases resistance (of thermistor)*
*an answer decreases resistance (of thermistor) gains **2** marks*

1

[11]

18 (a) iron

1

hairdryer

1

kettle

1

answers can be in any order

(b) (i) **Y**

1

(ii) bar drawn with any height greater than **Y**

ignore width of bar

1

(c) (bigger volume) takes more time (to boil)

accept explanation using data from graph

1

(so) more energy transferred

*do **not** accept electricity for energy*

1

(and) this costs more money

ignore reference to cost of water

wasting more money because heating more water than needed is insufficient

1

[8]

19 (a) (i) connect the earth wire (to pin)

answers must be in terms of correcting the faults

1

screw cable grip (across cable)

accept tighten the cable grip

1

(ii) any **two** from:

- fuse gets (very) hot
- fuse melts

accept blows for melts

*do **not** accept break / snap fuse / blow up*

- circuit breaks / switches off

accept stops current flowing

2

(b) any **two** from:

- hairdryer is plugged into mains (electricity socket)

  it refers to hairdryer
  hairdryer works from the mains

  or
  hairdryer is using 230 V

  accept 240 for 230

- water conducts electricity

  *do **not** accept water and electricity don't mix*

- radio is low power / current / pd / voltage

  accept radio not connected to the mains
  *do **not** accept radio is waterproof*

- (the current in / pd across) hairdryer more likely to give a (fatal) electric shock

  accept the idea of electrocution if hairdryer is wet
  accept the idea of radio not causing electrocution if wet

2

[6]

20 (a) d.c. flows in (only) one direction

1

a.c. changes direction (twice every cycle)

accept a.c. constantly changing direction
ignore references to frequency

1

(b) a current flows through from the live wire / metal case to the earth wire

accept a current flows from live to earth
*do **not** accept on its own if the current is too high*

1

this current causes the fuse to melt

accept blow for melt
*do **not** accept break / snap / blow up for melt*

1

[4]

21 (a) **A**

*only scores if **A** chosen*

1

it is alternating / a.c.

accept because B and C are d.c.

or

it changes direction/p.d.

accept voltage for p.d.

it goes up and down is insufficient

it is constantly changing is insufficient

an answer B and/or C with the reason because it is direct current/d.c scores 1 mark

1

(b) too much current (through socket)

accept electricity for current

accept too much power

accept socket/circuit overloaded

do not accept voltage/p.d for current

1

wiring / socket gets hot

accept melts for gets hot

accept risk of fire

risk of fire in appliances is insufficient

ignore reference to sparking

overloaded plugs and plugs getting hot or fuses melting is insufficient

1

[4]

22 (a) (i) earth wire

1

(ii) double

1

(b) if too much current flows through the wire

accept power for current

*do **not** accept electricity for current*

accept if more than 20 amps flows through the wire

1

the fuse (overheats and) melts

accept 'blows' for melts

do not accept explodes / breaks / snaps etc

1

breaking the circuit

accept stopping the current flow

1

[5]

23 (a) (i) 50 000

*allow **1** mark for correct substitution, ie*

6 = 0.00012 × R

***or** 6 = 0.12 × R*

***or** answers of 25 000 or 50 gain **1** mark*

***or** allow 1 mark for an incorrect answer caused by one error only ie using 3V or an incorrect conversion of current*

2

ohm / Ω

*an answer 50kΩ gains **3** marks*

1

(ii) (body) resistance changes

or

body fat/resistance affected by (many) factors

accept named factor, eg age, gender, height, fitness, bone structure, muscle, drinking water related to body fat / resistance

1

(iii) gives misleading / wrong/inaccurate value

do not credit if specifically linked to a change in mass / weight

1

(because) high water content changes body resistance

accept a specific change to resistance

water changes body mass is insufficient

1

(b) (i) RCCB – detects difference between current in live and neutral (wires)

accept RCCB can be reset

1

fuse – (overheats and) melts

accept blows for melts

1

(ii) switches the circuit / hedge trimmers off within 60 milliseconds

*allow for **1** mark the RCCB / it is (very) fast.*

do not accept the bigger the current the faster the RCCB switches off

2

[10]

24 (a) (i) 0.6
or
60%

*allow **1** mark for correct substitution ie* $\frac{720}{1200}$ *provided no subsequent step shown*

*an answer of 0.6 / 60 with a unit gains **1** mark only*

*an answer of 60 gains **1** mark only*

2

(ii) heat

allow thermal

1

(b) 12 000 p
or
£120

to score both marks the unit must be consistent with the numerical answer

*answers 12 000 and 120 gain **1** mark only*

*allow **1** mark for correct substitution ie 800 × 15 **or** 800 × 0.15*

provided no subsequent step shown

2

[5]

25 (a) (i) 720

*allow **1** mark for correct substitution,*

ie 72 × 10 provided no subsequent step shown

2

(ii) 720
or
their (a)(i)

1

(b) (i) gravitational potential

allow gravitational

allow potential

1

(ii) 432

*allow **1** mark for correct substitution, ie* $\frac{21600}{50}$ *provided no subsequent step shown*

2

watt / W

1

[7]

26 (a) (i) circuit not complete

accept circuit is broken

accept switch / s are open / off

1

(ii) 9

*allow **1** mark for correct substitution, ie 0.5 × 18 provided no subsequent step shown*

2

(iii) 36

1

(b) can be switched on / off from top or bottom of stairs

1

(c) (i) (electric) shock

accept fitting becomes live

accept answers giving a possible consequence of electric shock, eg death

1

(ii) connect the earth wire

1

[7]

27 (a) (i) **D**

1

(ii) plastic or rubber

accept a specific type of plastic

accept electrical insulator

1

(b) 460

*allow **1** mark for correct substitution ie 2 × 230*

2

(c) any **two** from:

- not all appliances need a 13 A fuse
  idea that 13 A is (much) bigger than required by many appliances
  *do **not** accept some appliances require more than 13 A*
  *do **not** accept 13 A fuse will blow*
- can choose the most suitable fuse (for the appliance)
  accept install correct fuse for the appliance
- (in the event of a fault) 13 A fuse may allow too much current to flow through an appliance
  or
  fuse may not melt (before appliance is damaged)
- may already have the fuse
  idea of reusing a fuse
  *do **not** accept cheaper unless explained correctly*

2

[6]

28 (a) (i) 0.25 (A)

1

(ii) 75

*allow **1** mark for converting 5 minutes to 300 seconds*
***or** allow **1** mark for correct substitution*
ie 0.25 × 300
*allow **1** mark for an answer 1.25*
*allow **1** mark only for their (a)(i) × 300 correctly calculated*

2

coulombs or C

*do **not** accept c*

1

(b) any **two** from:

- fault not repaired
  accept if a fault was to occur
- larger current will (still) flow
- aluminium foil will not melt (if a fault)
  accept aluminium foil needs a higher current / charge to melt
- wiring will overheat / (may) cause a fire
  accept idea of fire hazard
  *do **not** accept explode etc*

2

[6]

29 (a) brown

1

(b) outside / case is plastic / an insulator
accept is double insulated
accept non-conductor for plastic
*do **not** accept it / hairdryer is plastic*

1

(c) (i) (1) S_1
and no other

1

(2) S_1 and S_3
both required, either order

1

(ii) S_1 must be ON (for either heater to work)
*do **not** accept reference to 'fan' switch*

1

S_1 switches the fan on

1

(d) 1495
*allow **1** mark for correct substitution*
ie, 6.5 × 230

2

watt(s) or W

*an answer of 1.495 kW gains **3** marks*

although the unit is an independent mark for full credit

the unit and numerical value must be consistent

accept joules per second or J/s

1

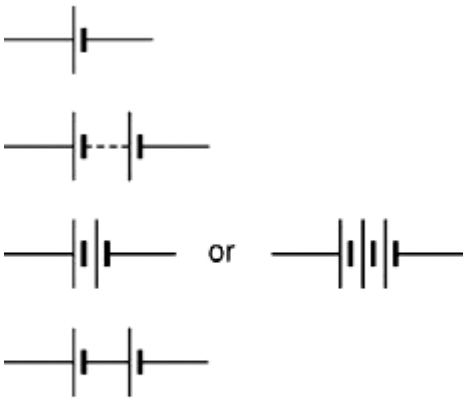
[9]

30 (a) (i) ammeter and battery **in series** with the **gauge**

symbols must be correct

ignore a voltmeter drawn in series

accept



not

or cells reversed to cancel out

1

voltmeter in parallel with the gauge

symbol must be correct

accept a freestanding circuit

diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge

1

(ii) d.c. flows only in one direction

a.c. changes direction is insufficient

1

(b) (i) 75

this answer only

*allow **1** mark for correct substitution **and** transformation,*

ie resistance = $\frac{3.0}{0.040}$

2

(ii) increases

1

(iii) elastic / strain potential

*do **not** accept potential*

1

[7]

31 (a) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or

becomes dissipated / spread out

accept warms the surroundings

accept degraded / diluted

accept a correct description for

surroundings eg to the washing machine

*do **not** accept transformed into heat on its own*

1

(b) a smaller proportion / percentage of the energy supplied is wasted

owtte

*accept a statement such as 'less energy is wasted' for **1** mark*

*do **not** accept costs less to run*

ignore references to uses less energy

2

(c) (i) 2.4 (p)

accept 2 p if it is clear from the working out this is rounded from 2.4 p

*allow **1** mark for correct substitution of correct values*

ie 0.2 × 12

*allow **1** mark for calculating cost at 40 °C (13.2 p)*

or

cost at 30 °C (10.8 p)

2

(ii) any **one** from:

- less electricity needed
  ignore answers in terms of the washing machine releasing less energy
  an answer in terms of the washing machine releasing CO_2 negates the mark
  *do **not** accept less energy is produced*
- fewer power stations needed
- less fuel is burned
  accept a correctly named fuel
  *do **not** accept less fuel is needed*

1

[6]

32 (a) (i) connect the earth wire (to pin)
answers must be in terms of correcting the faults

1

screw cable grip (across cable)
accept tighten the cable grip

1

(ii) earth (wire)
accept the green and yellow (wire)

1

(iii) any **two** from:

- fuse gets (very) hot
- fuse melts
  accept blows for melts
  *do **not** accept break / snap fuse / blow up*
- circuit breaks/ switches off
  accept stops current flowing

2

(b) any **two** from:

it refers to hairdryer

- hairdryer is plugged into mains (electricity socket)

  hairdryer works from the mains

  or

  hairdryer is using 230 V

  accept 240 for 230

- water conducts electricity

  *do **not** accept water and electricity don't mix*

- radio is low power / current / pd / voltage

  accept radio not connected to the mains

  *do **not** accept radio is waterproof*

- (the current in / p.d.across) hairdryer more likely to give a (fatal) electric shock

  accept the idea of electrocution if hairdryer is wet

  accept the idea of radio not causing electrocution if wet

2

[7]

33 (a) 125

*allow **1** mark for obtaining time period = 0.008 (s)*

or

frequency = 1 / time period (or their calculated time period)

2

hertz

or

Hz

*do **not** accept hz*

1

(b) 50 (hertz)

1

[4]

34 (a) (rate of) <u>flow</u> of charge / electrons / ions

accept movement for flow

*do **not** accept flow of electricity*

1

(b) 7(.0)

accept 6.96 / 6.95 or an answer that would approximate to 6.96 if rounded

*allow **1** mark for obtaining correct power and changing to watts ie 1600*

or

*allow **2** marks for correct substitution and transformation ie 1600 ÷ 230*

*an answer 0.00696 / 0.007 gains **2** marks*

*allow **1** mark for 1.6 / 230 or 1.7 / 230*

*an answer 7.39 or 7.4 gains **2** marks*

3

amp (ere)

accept A

1

[5]

35 (a) 230

1

50

1

(b) (i) has a plastic case

accept outside is plastic

accept cover / handle/ hair dryer is plastic / non-conductor

or does not have a metal case **or** plastic is an insulator

accept is double insulated

1

(ii) copper

1

[4]

36 (a) d.c. flows in (only) one direction

1

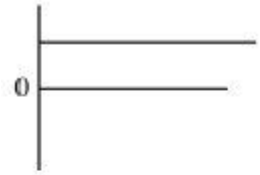
a.c. <u>changes</u> direction (twice every cycle)

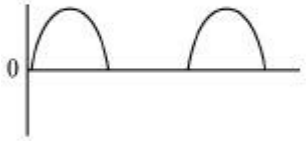
accept a.c. constantly changing direction

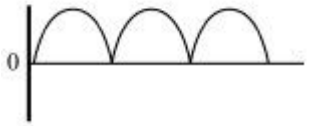
ignore references to frequency

accept answers presented as a clear diagram

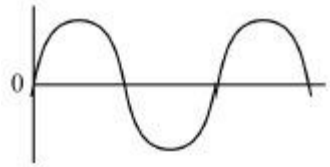
e.g.







ac:



1

(b) (i) 10

*allow **1** mark for correct transformation and substitution i.e.*

$\frac{2.3}{230}$ *or* $\frac{2300}{230}$ *an answer 0.01 gains **1** mark*

2

(ii) 13 A

e.c.f.

accept the fuse size that is the next listed value greater than answer (b)(i)

1

[5]

37 (a) (i) 0.0046

accept 4.6 mA

*allow **1** mark for correct substitution and transformation*

i.e. current $= \frac{230}{50000}$

*an answer of 4.6 gains **1** mark*

2

(ii) • increases overall resistance

1

• (in event of a shock) gives a smaller current

accept gives smaller shock
*do **not** accept no shock/current*

1

(b) (i) 50 (hertz)

ignore units

1

(ii) NO has the lowest current at which people cannot let go

answer and reason needed
accept a sensible reason in terms of their answer to (b) (i)

or YES changing the frequency changes the current by only a small amount

1

(c) a current flows through from the live wire/metal case to the earth wire

accept a current flows from live to earth
*do **not** accept on its own if the current is too high*

this current causes the fuse to melt

accept blow for melt

2

[8]

38 (a) electric drill **C**

1

MP3 player **E**

1

toaster **B**

1

(b) (i) 2100

no unit required / ignore units

accept 2.1 kW must have units for this

1

(ii) **Y**

1

(iii) bar drawn with any height greater than **Y**

ignore width of bar

1

(c) (i) any **one** from:

answers must be a comparison

- holds more water

  *do **not** accept 1 litre of water on its own*

- works in other countries

  accept a named country

  accept works at 2 voltages

- boils faster

- has a more powerful element

  *do **not** accept 1 kW element on its own*

- can filter water

1

ignore can wash filter

(ii) any **one** from:

- it weighs less

- smaller to pack

- cheaper to use

answers must be a comparison

***or** state why the chosen feature is an advantage*

accept boils enough for one drink

1

[8]

39 (a) (i) hairdryer 13

all correct

saw 3

*allow **1** mark for 2 correct*

1

mixer 13

1

(ii) fuse melts

accept blows/ breaks/ snaps for melts
*do **not** accept blows up*
*do **not** accept fuse gets hot on its own*
*do **not** accept does not work on its own*

1

(b) (i) 920

*allow **1** mark for correct substitution*

2

(ii) no earth (wire)

1

outside / case may become live

cause a fire insufficient

or danger of electric shock

1

(c) (i) L and N

both required

1

(ii) 9 (volts)

correct answer only

1

[9]

40 (a) (i) blue

1

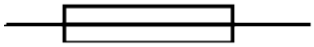
(ii) earth

1

(iii) rubber / plastic

*accept any suitable **named** non conductor eg polypropylene*
*do **not** accept bakelite*
*do **not** accept an insulator*

1

(iv) 

1

(b) any **two** from:

- draws too high a current

  accept power for current
  *do **not** accept electricity/ electric for current*
  accept too much current goes through the socket
  *do **not** accept too many currents go through the socket*

- socket overloaded

  *it = socket do **not** accept circuit for socket*

- wiring gets too hot / melts

  accept socket for wiring
  *do **not** accept fuse melts or blows*
  *do **not** accept plug/ appliances overheating*

- (may) cause a fire

- (may) cause sparking

- (possible) physical damage to the socket

  a physical reason, such as stick out from the wall is insufficient
  ignore reference to electric shocks

2

[6]

41 (a) alternates

accept switches
accept (constantly) changes
accept goes up and down

1

between positive and negative

1

(b) potential difference between the neutral and earth (terminal)

accept voltage for p.d

or potential of the neutral terminal with respect to earth

1

(c) (i) 0.025 (s)

1

(ii) 40 (Hz)

accept 1 ÷ their (a)(i)

1

[5]

42 (a) earth yellow and green

accept green and yellow

1

live brown

1

neutral blue

1

(b) (i) path shows electricity flowing from washing machine through to the person (and on to earth)

ignore direction of arrows

1

(ii) electricity flows through earth wire (to earth) **or** goes to ground

***not** escaping electricity*

***not** fuse wire blowing*

1

not through the person **or** miss the person **or** not electrocuting

***not** electric shock*

1

(c) hairdrier

*hairdrier needed for second mark **except** allow double insulated if iron or fridge **but not** plastic case*

1

double insulated **or** plastic case

accept 'It's made of plastic'
accept 'it does not conduct'

1

[8]

43 (a) 800 (W)

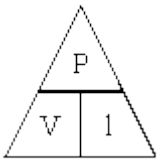
accept 0.8kW but this answer must have the unit

1

(b) (i) power = voltage × current

accept the equation rearranged

accept P = VI
do not accept C for current
do not accept P = VA
do not accept power = VA
do not accept



unless subsequent calculation shows understanding

1

(ii) 3.5 (A)

accept a larger number of d.p. but you must be able to round to 3.5

allow 1 mark for

$$\textit{current} = \frac{\textit{power}}{\textit{voltage}}$$

or $(I =) \frac{800}{230}$

2

(iii) 5 (A)

independent of (ii) unless e.c.f from part (b)(ii)

1

(c) 0.95 **or** 95 (%)

allow I mark if useful energy output is given as 760 ignore any incorrect unit

2

[7]

44 (a) (i) live and neutral wrong way around

accept blue and brown wrong way round or in the wrong place
for credit both wires must be given
*do **not** accept the wires are in the wrong holes*

1

(ii) to protect the appliance

*accept melt or blow **or** burns out if too much current **or** power or energy or electricity flows*

*accept to stop too much current **or** power **or** energy **or** electricity flowing*

*accept stop overheating **or** a fire*

*do **not** accept 'safety' unless qualified by above*

1

(b) (i) (metal) cover

accept (heating) element

*do **not** accept the mains cable*

1

[3]

45 (a) horse completes circuit between wire and earth **or** horse earths the wire

1

charge **or** electrons **or** current **or** electricity flows through the horse

1

(b) **two** from:

- RCB breaks circuit when it detects a difference between currents in live and neutral wires
- fuse breaks circuit only when fuse rating exceeded or when it melts
- RCB is resettable

2

(ii) 500 (ms)

*leakage current = 0.02A **1** mark only*

1

[6]

46 (a) (i) 7

1

(ii) (electrical) power = voltage x current

accept P = V × I (correct standard symbol)
accept watts = volts x amps
accept a correct rearrangement

accept 

if subsequent use of  *is correct*

1

(iii) 1610
or their (a)(i) × 230

*1.61 kW = **2** marks*

*do **not** accept 7 × 240*

2

watts

accept watt
accept W
accept .J/s

(iv) melts

accept burns out
accept blows
accept breaks
*do **not** accept stops working*
*do **not** accept burns*

2

current greater than 13(A)
or current exceeds fuse rating **or** current 15(A)

*do **not** accept too much current*
unless qualified

(b) (i) if live wire touches case

accept if case becomes live

accept metal for case

2

current flows to earth **or** ground
or fuse melts **or** stops iron becoming live

accept electricity flows to earth

*do **not** accept - you will get a shock*

*accept with <u>no earth</u> (wire) you would or could get a shock for **1**mark*

(ii) (outer) case is made of insulator

accept outside is plastic

*accept outside is not made of metal **or** conductor*

cable is (also) insulated

accept wires for cable

*do **not** accept it has two layers of insulation without explanation*

*do **not** credit answers in terms of heat*

2

[10]

47 (a) A – fuse
B – (cable) grip

for 1 mark each

2

(b) X – brown/red
Y – green + yellow/green
Z – blue/black

for 1 mark each

3

(c) any plastic/rubber

for 1 mark

1

(d) (i) earth

for 1 mark

1

(ii) metal appliance needs earthing/safety qualified

for 1 mark

1

(e) cut less insulation on earth; neutral wire needs connecting;
fit fuse properly; cable grip needs to be an outer cable **or** allow identifying faults

for 1 mark each

4

[12]

48 (a) in range $6 < I \geq 13$ A

for 1 mark
(no unit no mark)

1

(b) 4

gains 2 marks

(else working

gains 1 mark

(resistance of circuit correctly worked (2Ω))

2

(c) 72 (I^2 R) ecf

gains 2 marks

else working

gains 1 mark

an answer of 36W (ie for one lamp) – (1)

2

(d) 1000 or 16.7 min (ecf from (c))

gains 2 marks

else working

gains 1 mark
(formula with incorrect substitution – no mark (12V)

2

[7]

49

(a) Mains socket – once only
Shower cable can get wet
Trailing cable to fire (not heater unless fire clearly identified)
Use of fire
Free running cable from ceiling
Appliance on side of bath
Use of ordinary light switch
Free cable to sink light

any 3 each for1 mark

3

(b) (i) 7, 4, 1, 80.5

Four right – 2
Three right – 1
All right in W – 1

2

(ii) Toaster

1

(iii) 32p

gets 3 marks

Else 8 × 4

gets 2 marks

Else unit cost = 8p

gets 1 mark

3

[9]

50 (a) Current = 0.4A (1)
R = V/I or 240/0.4 (1)
R = 600 ohm (1)

3

(b) Doubles

gets 2 marks

OR gets bigger

gets 1 mark

2

(c) P = V.I or 240 × 0.4
P = 96W

for 1 mark each

2

(d) 1 = 0.2A
P = 48W

for 1 mark each

BUT may get equation mark here if not in (c)

2

(e) P = V.I.t (1)
P = 240 × 0.2 × 6 × 3600
OR P = 48 × 6 × 3600

gets 1 mark

P = 1036800 W

gets 1 mark

3

[12]

51 (a) Earth
return/neutral
live
for 1 mark each **3**

(b) (i) rubber/plastic
for 1 mark **1**

(ii) cable/wire/grip
cable/wires
fuse
for 1 mark each **3**

(iii) case
for 1 mark **1**

[8]

52 (a) (i) S_3
for 1 mark **1**

(ii) S_1, S_2 and S_3
for 1 mark **1**

(b) (i) increases/current passes through heaters/current unaffected in fan
for 1 mark **1**

(ii) (fan) blows/air moving prevents dryer overheating
for 1 mark each **2**

(c) (i) brown
blue
any order
for 1 mark each **2**

(ii) earth/green and yellow
for 1 mark **1**

(iii) (case is) plastic
plastic does not conduct (electricity)
for 1 mark each

2

(d) (i) 1300/power
for 1 mark

1

(ii) time/units of time
for 1 mark

1

[12]

53 (a) heat / thermal
kinetic / movement
each for 1 mark

2

(b) (i) its a good (electrical) conductor
for 1 mark

1

(ii) its a good (electrical) <u>insulator</u> / very <u>poor conductor</u>
for 1 mark

1

(c) (i) 2.75 × 6
gains 1 marks

but
16.5
gains 2 marks

2

(ii) (c)(i) × 7 or no. of kW h × cost/kW h
gains 1 marks

but
115.5 or e.c.f if correct
gains 2 marks

2

(d) it would heat and melts / blows / burns out / breaks circuit

any two for 1 mark each (fuse wire just breaks – gains 1)
(blows up – gets 0)
(fuse causing wire to melt gets 1)

2

[10]

54

(a) (i) 13A

for 1 mark

1

(ii) fuse heated melts owtte / blows / burns out **Not** explodes / burns circuit breaks

any 2 for 1 mark each

2

(b) (i) 2750 × 6 or 2.75 × 6

gains 1 mark

but
16.5

gains 2 marks

2

(ii) 2750 × 6 × 7 or 2.75 × 6 ×7 or (b)(i) × 7 or kW h × cost / kW h

gains 1 mark

but
115p or 116p or 115.5p or £1.16 or £1.15

gains 2 marks

2

[7]

55

(a) E – green and yellow
N – blue (*not* black **but** black / blue OK)
L – brown (*not* red **but** red / brown OK)

for 1 mark each

3

(b) fuse
screws to secure wires
cable grip (maybe described)
reference to an earth
(plastic case *wrong*)

any two for 1 mark each

2

[5]

56 (i) power = current × voltage
or any correctly transposed version

accept watts = amps × volts

accept P = IV

do not credit P = CV

accept p.d. for voltage triangle acceptable only if used correctly in (ii)

1

(ii) 2 000 000 (1)

2000 kilowatts/kW (2)

accept KW

watts/W (1)

2 megawatts/MW (2)

*do not credit mW (1) if correct method is clearly shown but answer is numerically incorrect **or** unit is absent **or** incorrect*

do not credit any working from an incorrect equation in (d)(i) but an appropriate unit should be credited

2

[3]

57 (a) series circuit

all four components must be included

if a battery included the neatness mark may still be awarded

1

circuit fully functional **or** properly connected

this is the neatness mark

do not credit a parallel circuit with one switch controlling both components

1

(b) case **or** outer parts are made of plastic **or** insulator **or** non-metallic

1

there is no electrical pathway between inner and outer insulation

accept no connection between inner and outer part

do not credit two layers of insulation

1

(c) (i) [A] power = voltage × current

*accept P = V I **or***

W = V × A

***or** any transformation*

1

[B] 1600 ÷ 230 =current

1

6.96 **or** 7

accept with no working for two marks

accept 6.95

in [A] award a mark for a triangle if calculation correctly performed

1

(ii) [A] voltage = current × resistance

*accept V = I R **or** any transformation*

1

[B] 230 ÷ 7 = overall R = 33

accept 230 ÷ 6.96 = overall R = 33

1

resistance of motor = 33 – 20 = 13

accept with no working for two marks

do not credit negative answer

accept consequential errors from c(i)

in [A] award a mark for a triangle if calculation correctly performed

1

[10]

58 (a) (i) P = V × 1

or equivalent

credit a triangle if part (ii) correctly uses the relationship

*credit power = volts × amps **or** watts V × A*

do not accept C for current

1

(ii) (P = 230 × 10 =) 2300

credit 2.3

1

W **or** J/s

kW

1

(b) (i) 15 A

*credit 13 A **or** amps*

1

(ii) any **three** from

earth

any short (to the metal tank) causes fuse to blow

fuse is in the live wire

to prevent damage to the heater

credit to stop the current

3

(c) (i) $V = I \times R$

or equivalent

credit a triangle if part (ii) correctly uses the relationship

1

(ii) (230 = 10 × R =) 23

ohms **or** Ω

2

[10]

59 (a) earth at top

1

neutral on left

1

live on right

1

(b) (i) (when a short occurs to the metal case) electricity flows to earth

a logical sequence of events is required which address each of the key aspects

1

electricity **or** current flows to earth

*accept flows to ground **or** down the earth wire*

1

(a surge of current) blows the fuse

this breaks the (live) circuit

do not accept a short circuit

1

stops electricity flowing (through person **or** appliance)

do not accept it stops an electric shock

1

(ii) 3 A

accept 5 A

1

[8]

60 (a) *Formula mark*

P = V × I

*accept P = VI **or** W = V 5 A **or** any transformation*

1

Substitution mark I = 900 ÷ 230

1

Calculation mark 3.9

*accept 3.9 **or** 3.91 **or** 4 for three marks with no working*

1

(b) 900 + 1300 = 2200 ÷ 230 = 9.6

*accept 9.57 to 9.6 **or** 10 for both marks with no working*

2

(c) 1.2 + 0.45 = 1.65

1

× 0.5 = 0.825

*accept 0.8 **or** 0.83 for both marks with no working*

1

(d) any **one** from

use less energy (to cook something)

*accept fewer energy losses **or** use less electricity*

cook faster

do not credit a cost argument about buying two different ovens

1

[8]