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) 20

1

(b) 50

1

(c) (i) 115

1

(ii) 230

1

(iii) if one goes out the other still works

or

brighter

accept power (output) is greater

can be switched on/off independently is insufficient

1

(d) the outside/casing is plastic

there is plastic around the wires is insufficient

it is plastic is insufficient

1

and plastic is an insulator

an answer the light fitting is double insulated gains both marks

1

(e) (residual current) circuit breaker

accept RCCB

accept RCBO

accept RCCD

accept RCB

accept miniature circuit breaker / MCB

trip switch is insufficient

breaker is insufficient

do not accept earth wire

1

[8]

6 (a) pin
made from brass because it is (hard and) a (good electrical) conductor

accept copper for brass
metal is insufficient
heat conductor on its own negates

1

outer case
plastic/rubber because it is a (good electrical) insulator

heat insulator on its own negates

1

(b) (i) live

1

(ii) makes it hot/warm

melts is insufficient

1

(iii) 8.7

accept an answer that rounds to 8.7
*allow **1** mark for correct substitution ie 2000 = 230 × I*
*an answer of 0.0087 **or** 0.009 **or** 3.0(4) **or** 5.65 **or** 5.7 gains **1** mark*

2

(c) a (large) current goes from the live wire to the earth wire

accept metal case for live wire
accept a current goes from live to earth
do not accept electricity for current

1

(which causes) the fuse to (overheat and) melt

accept blow for melt
break is insufficient
do not accept snap / blow up for melt

1

(d) reduce chance of an electric shock

accept to reduce the risk of an accident
accept prevent electric shock
accept prevent electrocution
accept prevent or reduce the risk of an (electrical) fire
accept an electric shock can kill you
accept it can kill you
accept so you can use it safely

1

[9]

7 (a) charge

1

(b) (i) blue

1

(ii) earth wire

1

fuse

1

(c) (i) case is non-metal / non-conducting / plastic / insulator

must refer to case / outside of appliance

do not accept plastic coating / covering

1

(ii) earth (wire)

1

(d) (i) 60 (W)

*P = 3 × 20 gains **1** mark*

provided no subsequent step shown

2

(ii) 15

300 = 20 × Q

or

*20 = 300 / Q gains **1** mark*

2

C / coulombs

must clearly be upper case C accept J / V or As

1

[11]

8 (a) (i) (3-pin) <u>plug</u>

*do **not** accept plug socket*

1

(ii) live and neutral

1

(iii) double

1

(b) direct current (d.c.) only

1

(c) (i) live

1

(ii) too great a current flows

accept a surge of current
accept too great a power
accept an electrical fault
*do **not** accept voltage / energy / electricity too high*

1

(iii) can be reset

accept does not need replacing

1

(disconnects circuit) faster

cheaper is insufficient
does not melt is insufficient
quicker to fix / replace is insufficient

1

[8]

9 (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]

10 (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]

11 (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]

12 (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]

13 (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]

14 (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]

15 (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 <u>ice</u>

allow volume / weight / amount / quantity of <u>ice</u>

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* $E = 500 \times 2.0 \times 60$

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

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

$E = 500 \times 2.0$ ***or*** $0.50 \times 2.0 \times 60$

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]

16 (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]

17 (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]

18 (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]

19 (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]

20 (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 directly 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]

21 (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]

22 (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]

23 (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]

24 (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]

25 (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 <u>direct current/d.c</u> 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]

26 (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]