**M1.** (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) $18000 = I \times 300$

**1**

$I = 18000 / 300 = 60$

**1**

$13\ 800 = (60^2) \times R$

**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]**

**M2.** (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]**

**M3.** (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]**

**M4.** (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*

*$18 \times 2 = 12 \times I_s$ scores **1** mark*

**2**

**[12]**

**M5.** (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]**