**Name of the Student**:_____

**Max. Marks : 23 Marks**                                          **Time : 23 Minutes**

Mark Schemes

## Q1.

(a)   Idea that atoms gains energy (from beta particle) eg atoms excited or atoms/electrons moved to higher energy levels ✔

Idea that atom loses energy by emission of light/photons eg atoms de-excite or electrons move to lower energy levels ✔

   *Allow ionisation as named process*

**2**

(b)   Use of $E = \dfrac{hc}{\lambda}$ **OR** use of $c = f\lambda$ and $E = hf$ ✔
   *Condone POT error for λ*

$3.2 \times 10^{-19}$ (J) ✔
   *Allow $3.1 \times 10^{-19}$ (J) if $6.6 \times 10^{-34}$ used*

**2**

(c)   Use of $W = QV$ **OR** determines pd = 750 V ✔

$1.2 \times 10^{-16}$ (J) ✔

**2**

(d)   Max 3 from: ✔ ✔ ✔

Attempt to count squares **OR** calculate unit area **OR** Statement that area under curve = charge flow
   *1 small square = $2 \times 10^{-12}$ (C) ; 1 large square = $5 \times 10^{-11}$ (C)*

Counts number of squares/Determines area

Converts number of squares to charge
   *Accept 140 to 180 small or 5.5–7 large squares*

   *Accept $\dfrac{1}{2}$ base × height for triangle of base 12–16 ns and height 50 mA*

Divides their total charge by $1.60 \times 10^{-19}$

$2 \times 10^{9}$ ✔
   *Allow 1 sf answer*

**4**
**[10]**

# Q2.

(a) Use of power equation

Or combination of power equation and $V = IR$

To get $R$ = 96 (Ω). ✔

*Must see some working*
*Do not allow reverse arguments*

**1**

(b) Either calculation of current through one lamp

*Condone use of any other method eg use of power = 4.5 W and power equation.*

And multiply by 3

OR

calculate total resistance ✔ (and use $V = IR$)

To give 0.38 A. ✔ (at least 2sf)

*Allow ecf for their R from (a) used or their I*
*Use of 100 Ω gives 0.36 A (0.4A)*

**2**

(c) Evidence of equation to calculate area . ✔

$2.8 \times 10^{-8}$ m$^2$ ✔

Use of resistivity equation to get 49 Ω. ✔

*Allow POT error in MP1*
*Evidence for MP2 may be in final answer*
*Accept 48 Ω*

**3**

(d) Total resistance = 46 + 46 + 100/3 = 125 Ω. ✔

*Allow ecf for incorrect resistance*

Calculation of circuit current = 12/125 = 0.096 A. ✔

operating current of lamp (=1.5/12 = 0.13)/current for all 3 lamps to be fully on = 0.38 A. ✔

Yes demo works as lamps will be dimmer/ off (with constantan). ✔

*If no other marks awarded, one mark each can be given for (max 2)*
- *for resistance increases with length.*
- *Too much p.d. dropped across constantan*
- *Resistivity of constantan is greater than resistivity of copper*

*For MP3 allow quoted comparison to previously calculated current in (b)*
*For MP4 allow ecf if answer is yes and is consistent with their calculation*

**4**

(e) **Advantage**

Zero resistance/resistivity. ✔

Reduce heat/energy transfer / power loss in cables ✔

**Difficulty**

Difficult to maintain low temperature (over long distances) ✔

Must be kept at/below the critical temperature. ✔
       *Ignore references to critical field.*
       *Allow very low resistance*

                                                                       **Max 3**
                                                                        **[13]**

Zero resistance/resistivity. ✔

Reduce heat/energy transfer / power loss in cables ✔

**Difficulty**

Difficult to maintain low temperature (over long distances) ✔