Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Electricity

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Name of the Student:_____
Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

(a) Amount of **chemical energy** transferred / converted to **electrical energy** for 1 C of charge (through the battery).

OR

Work done in moving 1 C of charge **whole way** round circuit✔

Allow:

(The emf is) the terminal pd (of the battery) when there is no current in the battery.

1

(b) Use of $Q = It$

OR

Substitutes for I and t.

(Q =) 0.044 × 37 × 60 ***OR***

(Q =) 0.044 × 2220 ***OR***

(Q=) 97.68 (C)

Use of $Q = Ne$ ✔

(N=) $\frac{\text{their } Q}{1.6 \times 10-19}$ *or (N =) 6.25 x* 10^{18} *x their Q*

their Q must have supporting work which identifies it as Q

(*N* =) 6.1 × 10^{20} ✔

Accept answer correctly rounded to at least 2 sf.

Calculator display = 6.105 x 10^{20}

2

(c) Read off V = 3.4 V when I = 44 (mA) ✔

Accept any of the following pairs of values:

I (mA)	*V (V)*	*P (W)*
4 to 6	*2.8*	*0.011 to 0.017*
8 to 12	*2.9*	*0.023 to 0.035*
12 to 15	*3*	*0.036 to 0.045*
20	*3.1*	*0.062*
22 to 26	*3.2*	*0.070 to*

		0.083
40 to 47	*3.4*	*0.136 to 0.160*
64 to 72	*3.6*	*0.23 to 0.26*
96 to 100	*3.8*	*0.36 to 0.38*

Use of $P = VI$ ✔

Substitutes a voltage between 2.8 V and 3.8 V and a corresponding current value from table. Expect to see a consistent power in range quoted for that voltage.

Condone POT error in sub for current and its subsequent power. In MP1 and MP2

***OR** Uses I = 0.044 (A) and 3 V < V < 4V and obtaining a consistent answer.*

(P =) 0.15 (W) ✔

Accept answer correctly rounded to at least 2 sf.

MP3 must be 0.15 (W) or 0.150 (W) or 0.1496 (W).

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(d) **MP1✔**

Use of $V = IR$: (to find lost volts = Ir =) 0.044 × 1.5 OR 0.066 V

OR

$\left(\frac{\varepsilon}{I} =\right) \frac{12}{0.044}$ (To find total resistance = $\frac{3000}{11}$ or 272.7 (Ω))

MP2✔

(Total resistance - r = R =) $\frac{5967}{22}$ or **271.2 (Ω)**

OR

(Pd across R =) 271.2 × 0.044 or 11.9328 V or their R × 0.044

OR

(Total pd across LEDs =) 3 × 3.4 or 10.2 V **ECF**

OR

(Resistance of an LED =) $\frac{3.4}{0.044}$ or 77.3 (Ω) **ECF**

OR

(Resistance of an LED = $\frac{P}{I^2} =) \frac{0.15}{0.044^2}$ or 77.3 or 77.48 (Ω) **ECF**

MP3✔

(Total resistance of 3 LEDs =) 3 × 77.3 **or** 231.9 **or** 232.438 (Ω) **or** 3 x their resistance of one LED

OR

(Pd across **R** =) 12 - their total pd across LED - their lost volts or 1.734 (V)

OR

R = *R* - 3 × their resistance of one LED

OR

(*R* of **R** =) $\frac{\textit{their pd across unknown resistor}}{0{,}044}$ *or* $\frac{1{,}734}{0{,}044}$

MP4✔

(*R of* **R** =) 39(.4) (Ω) or 38.8 (Ω)

Alternative
MP1 *Use of ε = I(R + r) by substituting*
for ε, I and r (where R is external resistance)
MP2
Rearrange ε = I(R + r) to find R = ***271.2 (Ω)***

Condone POT in any of the working for ***MP1****,* ***MP2*** *and* ***MP3****.*

Condone answers in range 38.5 Ω to 39.7 Ω
Treat use of their V from (c) as an ECF e.g.
An answer of 53 (Ω) gains ***4 marks*** *(uses V= 3.2 V)*
Other consistent uses of their V identifiable in (c) can achieve ***4 marks****.*

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(e) **MP1**

lost volts = 3.5 × 1.5 or 5.25 V

OR

Current in LEDs = 8 mA (when *V* = 2.9 V)
Allow between 8 mA and 10 mA for this read-off.

OR

LEDs require 8.7 V to light✔

MP2

terminal pd = 6.75 V✔

MP3

LEDs won't light:

-because terminal pd is less than 8.7 V

-because pd across LED is less than 2.5 V, therefore, no current in LEDs

-because pd across **R** is zero as the resistance of LED is much greater the **R**, therefore, no current in LEDs

-Resistor **R** would require a pd of 0.315 V. Therefore, total pd required = 9.01 V is greater than terminal pd.

-their pd across each LED is below switch-on voltage (of 2.9 V)✔

***MP3** gives a valid reason why 6.75 V is insufficient.*
Needs to state LEDS won't light for to gain MP3.

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Q2.

(a) (1 C of) the charge gains ε J on passing through cell

OR

energy transferred (by 1 C) in R_1 is V_1 (J)

OR

energy transferred (by 1 C) in R_2 is V_2 (J)

OR

energy transferred (by 1 C) in *r* is *Ir* (J) ✔

If no other mark awarded, allow one mark for definition of emf in terms of energy transfer.
accept: 'dissipated'
accept 'lost volts' for Ir but reject 'voltage across r'
accept 'work done' for 'energy transferred'

(for conservation of energy)

$\varepsilon = IR_1 + IR_2 + Ir$ ✔

Alternative for MP2
$\varepsilon = V_1 + V_2 + Ir$
provided that MP1 is awarded.

2

(b) Equates emf to *Ir* + 2.89 in some form✔$_1$

If no other mark awarded, award one mark for use of emf value in MP2.
Allow in MP1 (their current/A) ×125Ω for 2.89 V

Calculates *I* from 2.89÷125 (=0.02312 A) ✔$_2$

Allow alternative routes for ✔$_1$ and ✔$_2$. E.g.
'Lost volts'= 0.11 V ✔$_1$
Applies potential-divider equation e.g.
0.11÷2.89 = r÷125 ✔$_2$
OR
3÷(125 + r) = 2.89÷125✔$_1$✔$_2$

Giving *r* = 4.76 (Ω) ✔$_3$

Must see at least 3 sf answer
Answer must round to 4.76(Ω)

(c) (Resistance splits 25 Ω and 104.8 Ω)

Applies potential divider formula eg $\frac{V}{3.00} = \frac{25}{129.8}$ ✔

V = 0.58 (V) ✔

Accept other routes for MP1 e.g.

using V = IR, with 25 Ω and their current, for example from

- *I = 0.023 A (from Q03.2)*
- *I =* $\frac{\text{emf}}{\text{total resistance}} = \frac{3}{125 + r}$
- *I =* $\frac{\text{terminal pd}}{125}$

OR

using V = $\frac{2.89}{5}$ *with an identification of 2.89 V as the terminal pd.*

If no other mark awarded, allow one mark for using 29.8 Ω instead of 129.8 Ω for total resistance giving 2.5(2) V.

2

(d) Any **four** from:

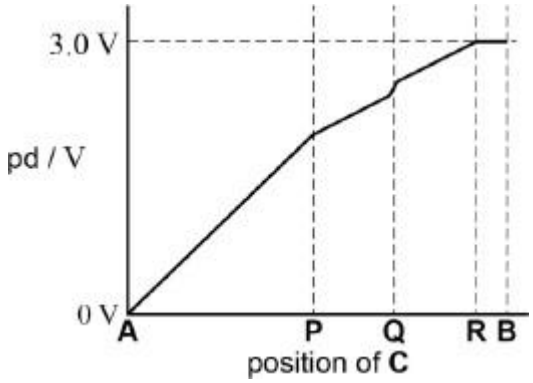
Straight line 0 V **A** to **P** $_1$✔

Less steep non-zero gradient from **P** to **Q** $_2$✔

Short steep increase at **Q** $_3$✔

Q to **R** about same non-zero gradient as **P** to **Q** $_4$✔

Horizontal line from **R** to **B** at 3.0 V $_5$✔



For $_3$✔ *allow range no greater than width of "**Q**" label on horizontal axis.*

*If graph sketched from 3 V (at **A**) to 0V (at **B**) award **max 2** (based on* $_2$ ✔ *and* $_4$✔*).*

If a single diagonal straight line from 0 V (at A) to B, award $_1$✔*only.*

If a single diagonal straight line from 0 V (at A) to R and then horizontal to B, award only ^{1}✔ ***and*** $_5$✔ *if scored (**ie max 2**).*

Max 4

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