Current, Potential Difference & Power

Mark Scheme 1

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	Current of Electricity
Sub Topic	Current, Potential Difference & Power
Paper Type	Theory
Booklet	Mark Scheme 1

Time Allowed: **80 minutes**

Score: **/66**

Percentage: **/100**

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 **(a** e.m.f.: energy converted from chemical / other forms to electrical per unit charge B1
p.d.: energy converted from electrical to other forms per unit char B1 [2]

(b) (i) the p.d. across the lamp is <u>less than</u> 12 V
or there are lost volts / power / energy in the battery / internal resistance B1 [1]

(ii) $R = V^2 / P$ (or $V = RI$ <u>and</u> $P = VI$) C
$= 144 / 48$
$= 3.0\ \Omega$ A1 [2]

(iii) $I = E / (R_T + r)$ C
$= 12 / 2.0$
$= 6.0$ A A1 [2]

(iv) power of each lamp $= I^2R$
$= (3.0)^2 \times 3.0$ C1
$= 27$ W A [2]

(c) less resistance (in circuit) / more current M1
more lost volts / less p.d. across battery A1 [2]

2 **(a** p.d. = work (done) / charge OR energy transferred from (electrical to other forms) / (unit) charge B1 [1]

(b) (i) $R = \rho l / A$ C1
$\rho = 18 \times 10^{-9}$ C1
$R = (18 \times 10^{-9} \times 75) / 2.5 \times 10^{-6} = 0.54\ \Omega$ A1 [3]

(ii) $V = IR$ C1
$R = 38 + (2 \times 0.54)$ C1
$I = 240 / 39.08 = 6.1\ (6.14)$ A A1 [3]

(iii) $P = I^2R$ or $P = VI$ **and** $V = IR$ or $P = V^2/R$ **and** $V = IR$ C1
$= (6.14)^2 \times 2 \times 0.54$ C1
$= 41\ (40.7)$ W A1 [3]

(c) area of wire is less (1/5) hence resistance greater (×5))
OR R is $\propto 1/A$ therefore R is greater
p.p.d. across wires greater so power loss in cables increas A1 [2]

3 **(a (i)** chemical to electrical B1 [1]

(ii) electrical to thermal / heat or heat and light B1 [1]

(b) (i) (P_B =) EI or $I^2(R_1 + R_2)$ A [1]

(ii) (P_R =) I^2R_1 A1 [1]

(c) $R = \rho l / A$ or clear from the following equation B1

ratio = $I^2R_1 / I^2R_2 = \dfrac{\rho l / \pi d^2}{\rho(2l) / \pi(2d)^2}$ or R_1 has 8 × resistance of R_2 C1

= 8 or 8:1 A1 [3]

(d) $P = V^2 / R$ or E^2 / R C1

(V or E the same) hence ratio is 1/8 or 1:8 = 0.125 (*allow ecf from* ***(c)***) A1 [2]

4 **(a** charge = current × time B1 [1]

(b) (i) $P = V^2 / R$ C1

$= (240)^2 / 18 = 3200$ W A [2]

(ii) $I = V / R = 240 / 18 = 13.3$ A A [1]

(iii) charge = $It = 13.3 \times 2.6 \times 10^6$ C1

$= 3.47 \times 10^7$ C A1 [2]

(iv) number of electrons = $3.47 \times 10^7 / 1.6 \times 10^{-19}$ ($= 2.17 \times 10^{26}$) C1

number of electrons per second = $2.17 \times 10^{26} / 2.6 \times 10^6 = 8.35 \times 10^{19}$ A1 [2]

5 **(a)** p.d. = <u>work done / energy transformed</u> (from electrical to other forms)
charge — B1 [1]

(b) (i) maximum 20 V — A1 [1]

(ii) minimum = (600 / 1000) × 20 — C1
= 12 V — A1 [2]

(c) (i) use of 1.2 kΩ — M1
1/1200 + 1/600 = 1/*R*, *R* = 400 Ω — A1 [2]

(ii) total parallel resistance (R_2 + LDR) is less than R_2 — M1
(minimum) p.d. is reduced — A1 [2]

6 **(a) (i)** $R = V^2 / P$ *or* $P = IV$ and $V = IR$ — C1
$= (220)^2 / 2500$
= 19.4 Ω (*allow 2 s.f.*) — A1 [2]

(ii) $R = \rho l / A$ — C1
$l = [19.4 \times 2.0 \times 10^{-7}] / 1.1 \times 10^{-6}$ — C1
= 3.53 m (*allow 2 s.f.*) — A1 [3]

(b) (i) *P* = 625, 620 or 630 W — A1 [1]

(ii) *R* needs to be reduced — C1
Either length ¼ of original length
or area 4× greater
or diameter 2× greater — A1 [2]

7 **(a)** total resistance = 20 (kΩ) C1
current = 12 / 20 (mA) or potential divider formula C1
p.d. = [12 / 20] × 12 = 7.2 V A1 [3]

(b) parallel resistance = 3 (kΩ) C1
total resistance 8 + 3 = 11 (kΩ) C1
current = 12 / 11 × 10^3 = 1.09 × 10^{-3} or 1.1 × 10^{-3} A A1 [3]

(c) **(i)** LDR resistance decreases M1
total resistance (of circuit) is less hence current increases A1 [2]

(ii) resistance across XY is less M1
less proportion of 12 V across XY hence p.d. is less A1 [2]