Practical Circuits & Kirchoff's Law

Mark Scheme 3

Level	International A Level
Subject	Physics
Exam Board	CIE
Topic	D.C. Circuits
Sub Topic	Practical Circuits & Kirchoff's Law
Paper Type	Theory
Booklet	Mark Scheme 3

Time Allowed: **72 minutes**

Score: **/60**

Percentage: **/100**

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

1	**(a**	∞	A1	
		$2R$	A1	
		R	A1	[3]
	(b)	**(i)** $I_1 + I_3 = I_2 + I_4$	A1	[1]
		(ii) $E_2 - E_1 = I_3R$	A1	[1]
		(iii) $E_2 = I_3R + 2I_4R$	A1	[1]

2	**(a**	*either* $P = VI$ and $V = IR$ *or* $P = V^2 / R$	C1	
		resistance = 38.4 Ω	A1	[2]
	(b)	zero	B1	
		1.5 kW	B1	
		3.0 kW	B1	
		0.75 kW	B1	
		2.25 kW	B1	[5]

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3	**(a**	**(i)**	**1** total resistance = 0.16 Ω	A1	
			2 e.m.f. = *either* (14 – *E*) *or* (*E* – 14)	A1	[2]
		(ii)	*either* 14 – *E* = 42 × 0.16 *or* (*E* – 14) = -42 × 0.16	C1	
			E = 7.3 V	A1	[2]
	(b)	**(i)**	charge = *It*	C1	
			= 12.5 × 4 × 60 × 60		
			= 1.8×10^5 C	A1	[2]
		(ii)	*either* energy = *EQ* *or* energy = *Eit*	C1	
			either energy = 14 × 1.8 × 10^5 *or* energy = 14 × 12.5 × 4 × 3600		
			= 2.52×10^6 J	A1	[2]
		(iii)	energy = I^2Rt *or* *Vit* <u>and</u> *V* = *IR*	C1	
			= $12.5^2 \times 0.16 \times 4 \times 3600$		
			= 3.6×10^5 J	A1	[2]
	(c)		efficiency = $(2.52 \times 10^6 - 3.6 \times 10^5)/(2.52 \times 10^6)$	C	
			= 86%	A1	[2]

4	**(a)**		both measure (energy / work) / charge	B1	
			for e.m.f., transfer of chemical energy to electrical energy	B1	
			for p.d., transfer of electrical energy to thermal energy / other forms	B1	[3]
	(b)	**(i)**	$I_1 + I_2 = I_3$	B1	[1]
		(ii)	**1.** $E_2 = I_2R_2 + I_3R_3$	B1	[1]
			2. $E_1 - E_2 = I_1R_1 - I_2R_2$	B1	[1]

5	**(a)**	lamp C	M1	
		lamp is shorted	A1	**[2]**
	(b)	shorted <u>lamp A</u> would cause damage to the supply/lamps /blow fuse in supply	B1	**[1]**
	(c)	15 Ω	B1	**[1]**
	(d) **(i)**	$V = I R$	C1	
		$R = 30\ \Omega$	A1	**[2]**
	(ii)	$P = VI$ or I^2R or V^2 / R	C1	
		$P = 1.2$ W	A1	**[2]**
	(e)	filament is cold when measuring with ohm-meter in (b)	B1	
		resistance of filament rises as temperature rises	B1	**[2]**

6	**(a)**	*either* $V = E R_1 / (R_1 + R_2)$ *or* $I = E / (R_1 + R_2)$	C1	
		$= \frac{1800}{3000} \times 4.50$ $\quad V = \frac{1800}{3000} \times 4.50$	M1	
		$= 2.70$ V $\quad = 2.70$ V	A0	**[2]**
	(b)	for a wire, $V = I \times (\rho L/A)$	M1	
		I, ρ *and* A are constant	A1	
		so $V \propto L$	A0	**[2]**
	(ii)	2.70 V	A1	**[1]**
		2 $\frac{L}{100} = \frac{2.70}{4.50}$	C1	
		$L = 60.0$ cm	A1	**[2]**
	(iii)	thermistor resistance decreases as temperature rises	M1	
		so QM is shorter	A1	**[2]**

7	**(a)**	potential difference/current	B1	**[1]**
	(b)	**1)** 1.13 W **2)** 1.50 V	B1	**[1]**
	(ii)	power = V^2 / R <u>or</u> power = VI and $V = IR$ $R = 1.50^2/1.13$ $= 1.99\ \Omega$	C1 A1	**[2]**
	(iii)	<u>either</u> $E = IR + Ir$ or voltage divided between R and r $I = 1.5 / 2.0$ (=0.75 A) p.d. across R = p.d. Across r = 1.5 $3.0 = 1.5 + 0.75r$ $r = 2.0\ \Omega$ so $R = r = 1.99\ \Omega$	C1 C1 A1	**[3]**
	(c)	larger p.d. across R means smaller p.d. across r smaller power dissipation at larger value of V since power is VI and I is same for R and r	M1 A1 A1	**[3]**

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