

Name of the Student: _____

Max. Marks : 24 Marks

Time : 24 Minutes

Mark Schemes

Q1.

- (a) power increases to a maximum / (up) to 3.0 (2.8 -3.4) Ω / / (up)to 3.0 W ✓
then decreases ✓

2

- (b) (i) (use of $P = I^2 R$)
when $R = 0.8 \Omega$ power = 1.95 W ✓
 $1.9 = I^2 \times 0.8$ ✓
 $I = \sqrt{2.375} = 1.5(4)$ (A) ✓
Range
1.9 - 2.0 W for power (first mark)
Current 1.5 – 1.6 A

3

- (ii) (use of $V = IR$)
 $V = 1.54 \times 0.8$ ✓
 $V = 1.2$ V ✓
CE from part (i)

2

- (iii) (use of $\varepsilon = V + Ir$)
 $6.0 = 1.2 + 1.54 \times r$ ✓
 $r = (6.0 - 1.2) / 1.54 = 3.1$ (2.9 – 3.2) (Ω) ✓
use of maximum power theorem (quoted) as alternative method can get both marks i.e. read peak maximum from graph
CE from part (ii)

2

- (c) power would decrease (as R increased) ✓
pd / voltage across R is now constant / equal to emf ✓
and so power proportional to $1 / R$ / inversely proportional to R OR
can quote $P = V^2 / R$ but only if scored second mark ✓

3

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Q2.

- (a) (i) (use of $V=Ir$)
 $V = 4.2 \times 1.5$ ✓ = 6.3 (V)

1

- (ii) pd = $12 - 6.3 = 5.7$ V ✓

NO CE from (i)

1

- (iii) (use of $I = V / R$)
 $I = 5.7 / 2.0 = 2.8(5) \text{ A}$ ✓
 CE from (ii)
 (a(ii)/2.0)
 accept 2.8 or 2.9

1

- (iv) $I = 4.2 - 2.85 = 1.3(5) \text{ A}$ ✓
 CE from (iii)
 (4.2 - (a)(iii))
 accept 1.3 or 1.4

1

- (v) $R = 5.7 / 1.35 = 4.2 \Omega$ ✓
 CE from (iv)
 (a(ii) / (a)(iv))
 Accept range 4.4 to 4.1

1

- (vi) $\frac{1}{R_{\text{Parallel}}} = \frac{1}{4.2} + \frac{1}{2.0} = 0.737$ ✓
 CE from (a)(v)

$R_{\text{parallel}} = 1.35 \Omega$
 second mark for adding internal resistance

$R_{\text{total}} = 1.35 + 1.5 \text{ ✓} = 2.85 \Omega$
 OR
 $R = 12/4.2 \text{ ✓}$
 $R = 2.85 \Omega \text{ ✓}$

2

(b) (i)

resistor	Rate of energy dissipation (W)
1.5 Ω internal resistance	$4.2^2 \times 1.5 = 26.5 \text{ ✓}$
2.0 Ω	$2.85^2 \times 2.0 = 16.2 \text{ (15.68 - 16.82) ✓}$
R	$1.35^2 \times 4.2 = 7.7 \text{ (7.1 - 8.2) ✓}$

CE from answers in (a) but not for first value
 2.0: $a(\text{iii})^2 \times 2$
 R: $a(\text{iv})^2 \times a(\text{v})$

3

- (ii) energy provided by cell per second = $12 \times 4.2 = 50.4 \text{ (W) ✓}$
 energy dissipated in resistors per second = $26.5 + 16.2 + 7.7 = 50.4 \text{ ✓}$
 (hence energy input per second equals energy output)
 if not equal can score second mark if an appropriate comment

2

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