A Level AQA Physics
10 Circuits – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	Solar cell in series with ammeter and variable resistor Voltmeter in parallel with variable resistor (or solar cell)		1 1	3.5.1.6 AO1
01.2	Allow sensible suggestions: Control light intensity • Use of lamp with shielding round solar cell (black card) Control of temperature • Turn light on for short periods when taking reading and leave to cool • Place a clear container with water between the solar cell and light source	1 mark for how to control light intensity 1 mark for control of temperature	1 1	PS1.1 AO3
01.3	Change the resistance of the circuit using the variable resistance and record a series of potential difference and current readings Plot a graph of p.d. against current The y-intercept is the e.m.f. The gradient is the (negative) internal resistance		1 1 1 1	3.5.1.6 AO2
01.4	The e.m.f. depends on the light intensity/temperature so they can only quote a value for average conditions	Any sensible suggestion	1	3.5.1.6 AO3
01.5	Use of $\varepsilon = I(R + r)$ or recognising $\varepsilon = 8.2\,V$ $\varepsilon = IR + Ir = V + Ir$ $8.2 = 5.5 + (0.1 \times r)$ $2.7 = 0.1r$ $r = 27\,\Omega$		1 1 1	3.5.1.6 AO2
02.1	The current flowing into a junction must equal the current flowing out of the junction (owtte)		1	3.5.1.4 AO1
02.2	The sum of the p.d.s in a closed loop must equal the sum of e.m.f.s in that loop (owtte)		1	3.5.1.4 AO1

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OXFORD Revise

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02.3	Bulbs in series, so same current flows into each Use of or mention $P = I^2R$ (or $P = VI$ or $P = \frac{V^2}{R}$) Since I constant $P \propto R$ so **A** must have greater resistance		1 1 1	3.5.1.4 AO2
02.4	Bulbs in parallel so this time p.d. the same $P = \frac{V^2}{R}$ Since V constant $P \propto \frac{1}{R}$ Bulb **B** brightest	If they think B has the higher resistance, then allow e.c.f. if correct reasoning applied	1 1 1	3.5.1.4 AO2
03.1	1 litre = 1000 cm^3 191 litres per hour = 53 $cm^3\,s^{-1}$ mass per second = ρV = $1000 \times 53 \times 10^{-6} = 0.053\,kg\,s^{-1}$		1 1	3.4.2.1 AO2
03.2	$P = \frac{\Delta W}{\Delta t}$ or $E_p = mgh$ $P = 0.053 \times 9.81 \times 0.3 = 0.16\,W$		1 1	3.4.1.7 3.4.1.8 AO2
03.3	$P = VI$ $I = \frac{1.2}{5} = 0.24\,A$		1	3.5.1.4 AO1
03.4	Use of $\varepsilon = I(R + r)$ $\varepsilon = IR + Ir = V + Ir$ $6 = 5 + (0.24 \times r)$ $1 = 0.24r$ $r = 4.2\,\Omega$ OR Resistance of pump $R = \frac{V}{I} = \frac{5}{0.24} = 20.8\,\Omega$ $\varepsilon = I(R + r)$ $6 = 0.24(20.8 + r)$ $6 = 5 + 0.24r$		1 1 1	3.5.1.4 AO2

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04.1	$P = VI$ **A:** $I = \frac{0.7}{3.5} = 0.2\,\text{A}$ **B:** $I = \frac{1.95}{6.5} = 0.3\,\text{A}$ **C:** $I = \frac{0.3}{1.5} = 0.2\,\text{A}$		1 1 1	3.5.1.4 AO1
04.2	$I = 0.2\,\text{A} + 0.3\,\text{A} + 0.2\,\text{A} = 0.7\,\text{A}$		1	3.5.1.4 AO2
04.3	p.d. across $R_1 = 9.0 - 6.5 = 2.5\,\text{V}$ $R_1 = \frac{V}{I} = \frac{2.5}{0.7} = 3.6\,\Omega$	Allow e.c.f. from answer to 04.2	1 1	3.5.1.4 AO2
04.4	p.d. across $R_3 = 6.5 - 1.5 = 5.0\,\text{V}$ $R_3 = \frac{V}{I} = \frac{5.0}{0.2} = 25\,\Omega$		1 1	3.5.1.4 AO2
05.1	In series: $\varepsilon = 1.5\,\text{V} + 1.5\,\text{V} = 3.0\,\text{V}$ $r = 0.5\,\Omega + 0.5\,\Omega = 1.0\,\Omega$		1 1	3.5.1.4 AO1
05.2	In parallel: $\varepsilon = 1.5\,\text{V}$ $r = \left(\frac{1}{0.5} + \frac{1}{0.5}\right)^{-1} = 0.25\,\Omega$		1 1	3.5.1.4 AO1
05.3	Two cells in parallel with one cell in series		1	3.5.1.4 AO2
05.4	Use of $\varepsilon = I(R + r)$ or $r = \frac{3}{4} = 0.75\,\Omega$ $3.0 = I(2.0 + 0.75)$ $I = 1.1\,\text{A}$		1 1	3.5.1.6 AO2

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05.5	$P = I^2R = 1.1^2 \times 2$ $= 2.4\,\text{W}$		1 1	3.5.1.4 AO2
06.1	Diagram showing 3 resistors connected in series		1	3.5.1.4 AO1
06.2	Total resistance = 33 Ω + 110 Ω + 67 Ω = 210 Ω		1	3.5.1.4 AO1
06.3	Diagram showing three resistors connected in parallel		1	3.5.1.4 AO1
06.4	Total resistance = $\left(\frac{1}{110} + \frac{1}{67} + \frac{1}{33}\right)^{-1}$ $R = 18\,\Omega$		1 1	3.5.1.4 AO1
06.5	Diagram showing two 33 Ω resistors in series and also in parallel with two other 33 Ω resistors in series		1	3.5.1.4 AO2
06.6	Smaller current through each resistor/less power transferred by each resistor/still resistance if 1 resistor breaks	Accept any sensible suggestion	1	3.5.1.4 AO3
07.1	$P = \frac{V_2}{R}$ $R = \frac{V_2}{P} = \frac{12^2}{50} = 2.9\,\Omega$		1 1	3.5.1.4 AO1
07.2	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$ $\frac{1}{2.9} = \frac{8}{R}$ $R = 8 \times 22.9 = 23.2\,\Omega$ (23.0 if you use unrounded number)		1 1	3.5.1.4 AO1

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07.3	$R = \frac{\rho L}{A}$ $A = \frac{\rho L}{A}$ $A = d \times 0.003$ m $d = 1.1\times10^{-5} \times \frac{0.75}{23} \div 0.003 = 0.12$ mm		1 1	3.5.1.3 AO2
07.4	$5\,\mu\Omega\,\text{cm} = 5\times10^{-6}\,\text{cm} = 5\times10^{-8}\,\Omega\,\text{m}$		1	3.1.1. AO2
07.5	This 1 cm strip will have a much lower resistance, $R \propto \rho$ But the strip is 75 cm long so will not affect overall resistance	owtte	1 1	3.1.3 AO3
08.1	LDR and resistor drawn in series, correct symbols Some indication that V_{OUT} is across the fixed resistor		1 1	3.5.1.5 AO2
08.2	The resistance of the LDR decreases so current increases The p.d. across the fixed resistor increases since current increases, $V = IR$/has a greater share of the total resistance so p.d. increases	This first mark maybe given even if V_{OUT} wrongly labelled in 08.1	1 1	3.5.1.5 AO2
08.3	Examples of calculation: 1 MΩ: Dark $V_{out} = \frac{1\times10^6}{1\times10^6 + 1\times10^6} \times 6 = 3$ V Light $V_{out} = \frac{1\times10^6}{1\times10^6 + 5400} \times 6 = 6$ V 10 kΩ: Dark $V_{out} = \frac{1\times10^4}{1\times10^4 + 1\times10^6} \times 6 = 0.06$ V Light $V_{out} = \frac{1\times10^4}{1\times10^4 + 5400} \times 6 = 4$ V	3 marks max for examples of calculations	max 4	3.5.1.5 AO2 × 2 AO3 × 2

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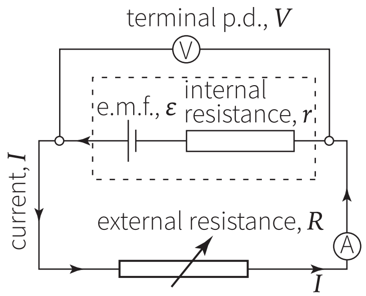
	1 kΩ: Dark $V_{out} = \frac{1 \times 10^3}{1 \times 10^3 + 1 \times 10^6} \times 6 = 0.006\,V$ Light $V_{out} = \frac{1 \times 10^3}{1 \times 10^3 + 5400} \times 6 = 0.9\,V$ 10 kΩ has the greatest range	1 mark for correct deduction with explanation		

Skills box answers

Question	Answer
1	
2	Circuit is connected as briefly as possible to prevent the cell heating up, which would alter the resistance.
3	e.m.f. = 3.15 V, resistance = 15 Ω (The gradient is in $\frac{V}{mA}$ so need to multiply by 10^3 to obtain Ω.)

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