Centre Number						Candidate Number				
Surname						Other Names				

Notice to Candidate. The work you submit for assessment must be your own. If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified.

Candidate Declaration. I have read and understood the Notice to Candidate and can confirm that I have produced the attached work without assistance other than that which is acceptable under the scheme of assessment.

Candidate Signature		Date	

For Teacher's Use	
Section	Mark
PSA	
Stage 1	
Section A	
Section B	
TOTAL (max 50)	

General Certificate of Education
Advanced Subsidiary Examination
June 2015

Physics (Specification A & B) PHY3T/Q15/test

Unit 3T AS Investigative Skills Assignment (ISA) Q

For submission by 15 May 2015

For this paper you must have:	**Time allowed**
• your documentation from Stage 1 • a ruler with millimetre measurement • a calculator.	• 1 hour
Instructions:	**Information**
• Use black ink or black ball-point pen. • Fill in the boxes at the top of this page. • Answer **all** questions. • You must answer the questions in the space provided. Do not write outside the box around each page or on blank pages. • Do all rough work in this book. Cross through any work you do not want to be marked.	• The marks for questions are shown in brackets. • The maximum mark for this paper and Stage 1 is 41.

Details of additional assistance (if any). Did the candidate receive any help or information in the production of this work? If you answer yes give the details below or on a separate page.

Yes ☐ No ☐

Teacher Declaration:
I confirm that the candidate's work was conducted under the conditions laid out by the specification. I have authenticated the candidate's work and am satisfied that to the best of my knowledge the work produced is solely that of the candidate.

Signature of teacher ..... Date .....

USEFUL FORMULAE

Resistance $R = \frac{V}{I}$

Electromotive force, emf $\varepsilon = I(R + r)$

Power $P = VI = I^2R = \frac{V^2}{R}$

Do not write outside the box

Section A

Answer **all** questions in the spaces provided.
You should refer to your documentation from Stage 1 as necessary.
The formulae on page 2 may be useful when answering questions in this section.

1 (a) State the dependent variable in your experiment.

[1 mark]

.....

1 (b) (i) Show that the y intercept of your graph is $\frac{r}{\varepsilon}$, where r is the internal resistance and ε is the emf of the cell.

[2 marks]

.....

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.....

1 (b) (ii) Using your graph, determine the internal resistance of the cell. You may assume the emf of the cell used in your experiment was $1.5\ \text{V}$.

[2 marks]

internal resistance = ...

1 (c) (i) Using the data from your table of results from Stage 1, state which of your values of $\frac{1}{I}$ will have the largest percentage uncertainty.

[1 mark]

.....

Do not write outside the box

1 (c) (ii) Calculate the percentage uncertainty in this value of $\frac{1}{I}$.

[1 mark]

percentage uncertainty = ... %

1 (d) Explain why you were told to switch off the circuit between readings.

[1 mark]

.....

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.....

Do not write outside the box

1 (e) A teacher sets up an experiment similar to the one you have performed.
He uses a cell of emf $1.5\ \text{V}$ and internal resistance $2.0\ \Omega$.
A $1.5\ \Omega$ resistor is to be connected across the cell.

1 (e) (i) Calculate the power that will be dissipated in the $1.5\ \Omega$ resistor.

[2 marks]

power = ... W

1 (e) (ii) Resistors of resistance $1.5\ \Omega$ are available with the following power ratings:

$0.25\ \text{W}$ $0.5\ \text{W}$ $1.0\ \text{W}$

Circle the power rating of any resistor(s) which could safely be used in this experiment.

[1 mark]

11

Turn over for the next question

Do not write outside the box

Section B

Answer **all** the questions in the spaces provided.
The formulae on page 2 may be useful when answering questions in this section.

2 The power P dissipated in a resistor of resistance R is measured for a range of values of the potential difference V across it. The results are shown in **Table 1**.

Table 1

V / V	V^2 / V^2	P / W
1.00	1.0	0.21
1.71	2.9	0.58
2.25		1.01
2.67		1.43
3.00	9.0	1.80
3.27	10.7	2.18
3.50	12.3	2.43

2 (a) Complete **Table 1**.

[1 mark]

2 (b) Complete the graph in **Figure 1** on page 7 by plotting the two remaining points and draw a best fit straight line.

[2 marks]

2 (c) Determine the gradient of the graph in **Figure 1**.

[3 marks]

gradient = ...

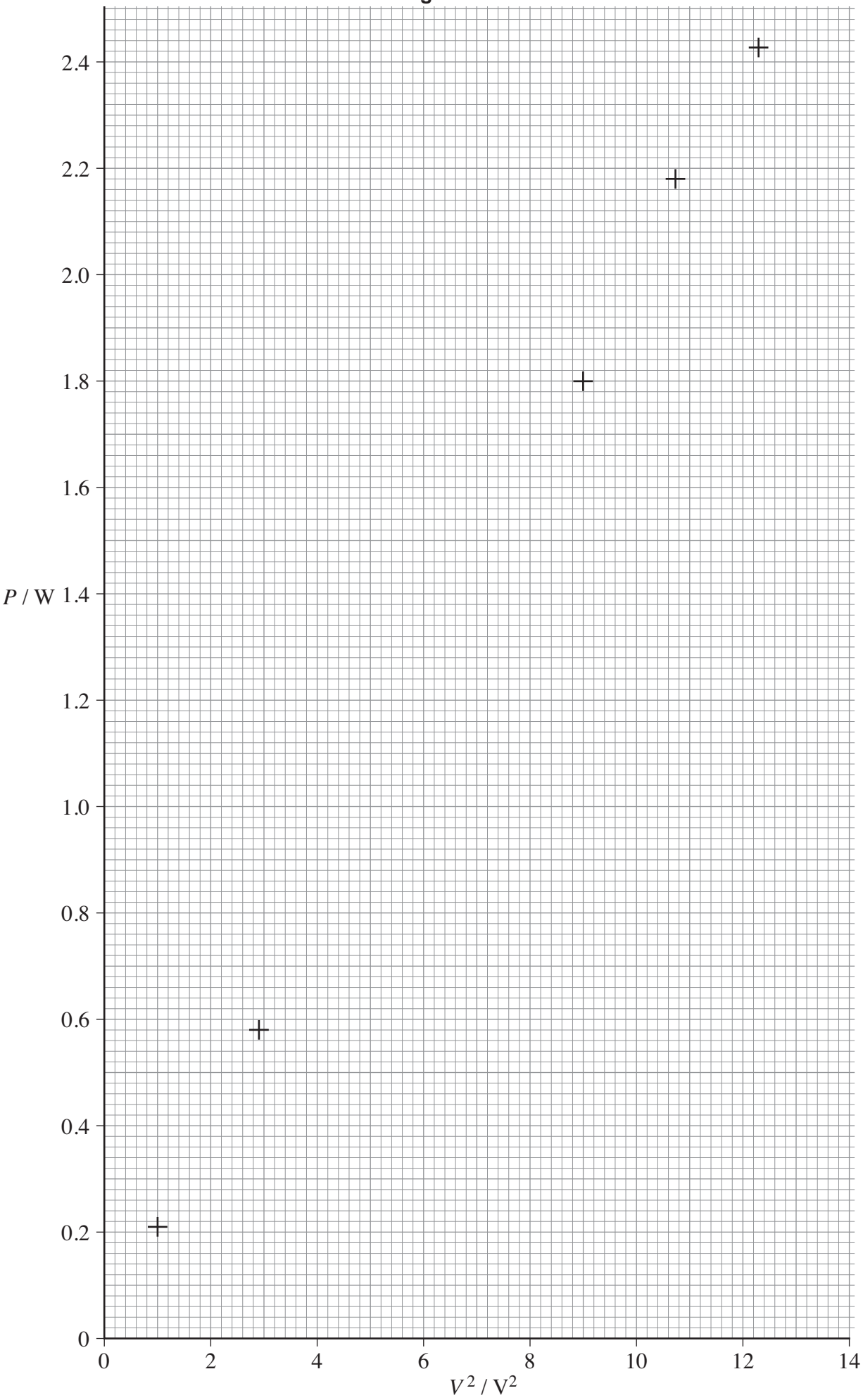
2 (d) Use the gradient of the graph in **Figure 1** to obtain a value for R.

[1 mark]

R = ...

7

Figure 1



Do not write outside the box

3 The following questions are based on the data in **Table 1**.

3 (a) (i) Determine the value of R when $V = 3.50\ \text{V}$.

[1 mark]

$R =$ ..... Ω

3 (a) (ii) The uncertainty in V is $\pm\ 0.01\ \text{V}$. The uncertainty in P is $\pm\ 0.05\ \text{W}$.

Calculate the percentage uncertainty in the value of R calculated in part 3(a)(i).

[3 marks]

percentage uncertainty = ... %

3 (a) (iii) Hence calculate the uncertainty in the value of R.

[1 mark]

uncertainty = ...

Do not write outside the box

3 (a) (iv) State and explain whether the value of R you calculated in part 3(a)(i) is consistent with the value of R you determined from the gradient in part 2(d).

[2 marks]

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7

Turn over for the next question

Do not write outside the box

4 (a) (i) Describe how you would make a direct measurement of the emf ε of a cell, stating the type of meter you would use.

[1 mark]

.....

.....

4 (a) (ii) Explain why this meter must have a very high resistance.

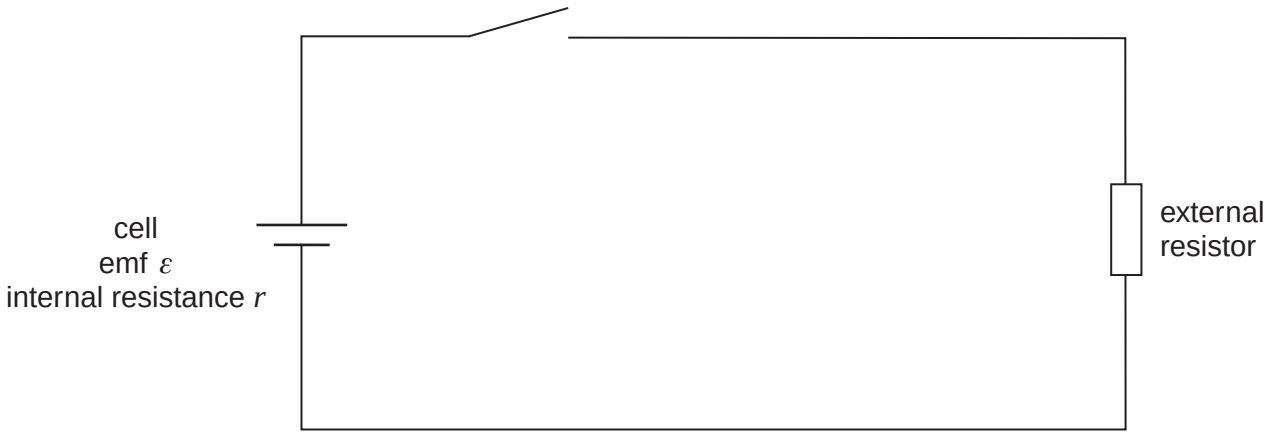
[1 mark]

.....

.....

4 (b) A student is provided with the circuit shown in **Figure 2**.

Figure 2



The student wishes to determine the efficiency of this circuit.

In this circuit, useful power is dissipated in the external resistor. The total power input is the power produced by the battery.

$$\text{Efficiency} = \frac{\text{useful power output}}{\text{total power input}}$$

The efficiency can be determined using two readings from a voltmeter.

Do not write outside the box

4 (b) (i) Show that the efficiency = $\frac{V}{\varepsilon}$ where ε is the emf of the cell and V is the potential difference across the external resistor.

[1 mark]

4 (b) (ii) Add a voltmeter to **Figure 2** and explain how you would use this new circuit to take readings of ε and V.

[2 marks]

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.....

Question 4 continues on the next page

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4 (c) Describe how you would obtain a set of readings to investigate the relationship between efficiency and the resistance of the external resistor. State any precautions you would take to ensure your readings were reliable.

[2 marks]

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4 (d) State and explain how you would expect the efficiency to vary as the value of R is increased.

[2 marks]

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9

END OF QUESTIONS