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 Level Examination
June 2014

Physics (Specification A & B) PHY6T/Q14/test

Unit 6T A2 Investigative Skills Assignment (ISA) Q

For submission by 15 May 2014

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. • Show all your working.	• 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.....

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Section A

Answer **all** questions in the spaces provided.
You should refer to your documentation from Stage 1 as necessary.

1 (a) Calculate the percentage uncertainties in the pd and in the mean current for your measurements at room temperature.

[2 marks]

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1 (b) (i) Calculate the uncertainty in your value of the thermistor resistance at room temperature.

[2 marks]

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1 (b) (ii) Suggest **one** possible source of error that would not be accounted for in this uncertainty value.

[1 mark]

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1 (c) State **two** precautions you took to minimise the uncertainty in the temperature measurements.

[2 marks]

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1 (d) Explain why the current through the thermistor needs to be small.

[2 marks]

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1 (e) For this limited range of temperatures, a simple theory suggests that the resistance, R, of a thermistor varies with the Celsius temperature, θ, according to the equation

$$R = R_0 e^{-a\theta}$$

where R_0 and a are constants.

Describe and explain how you could use **the graph you drew in Stage 1** to check if this theory is valid.

[2 marks]

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Section B

Answer **all** questions in the spaces provided.

2 An experiment was performed to investigate how the resistance of a thermistor varied over a range of temperatures. The resistance was measured with an ohm-meter to a precision of $1\,\Omega$. The results are shown in **Table 1**.

Table 1

θ/°C	T/K	$1/T$ /$10^{-3}\,K^{-1}$	R/Ω	$\ln(R/\Omega)$
–15	258	3.876	146	4.98
0	273	3.663	97	4.57
15	288	3.472	64	4.16
30	303	3.300	46	3.83
45			31	
60			24	

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

[1 mark]

2 (b) Complete **Figure 1** on page 5 by plotting the remaining points and drawing a best fit straight line.

[2 marks]

2 (c) Determine the gradient of your straight line (**Figure 1**).

[2 marks]

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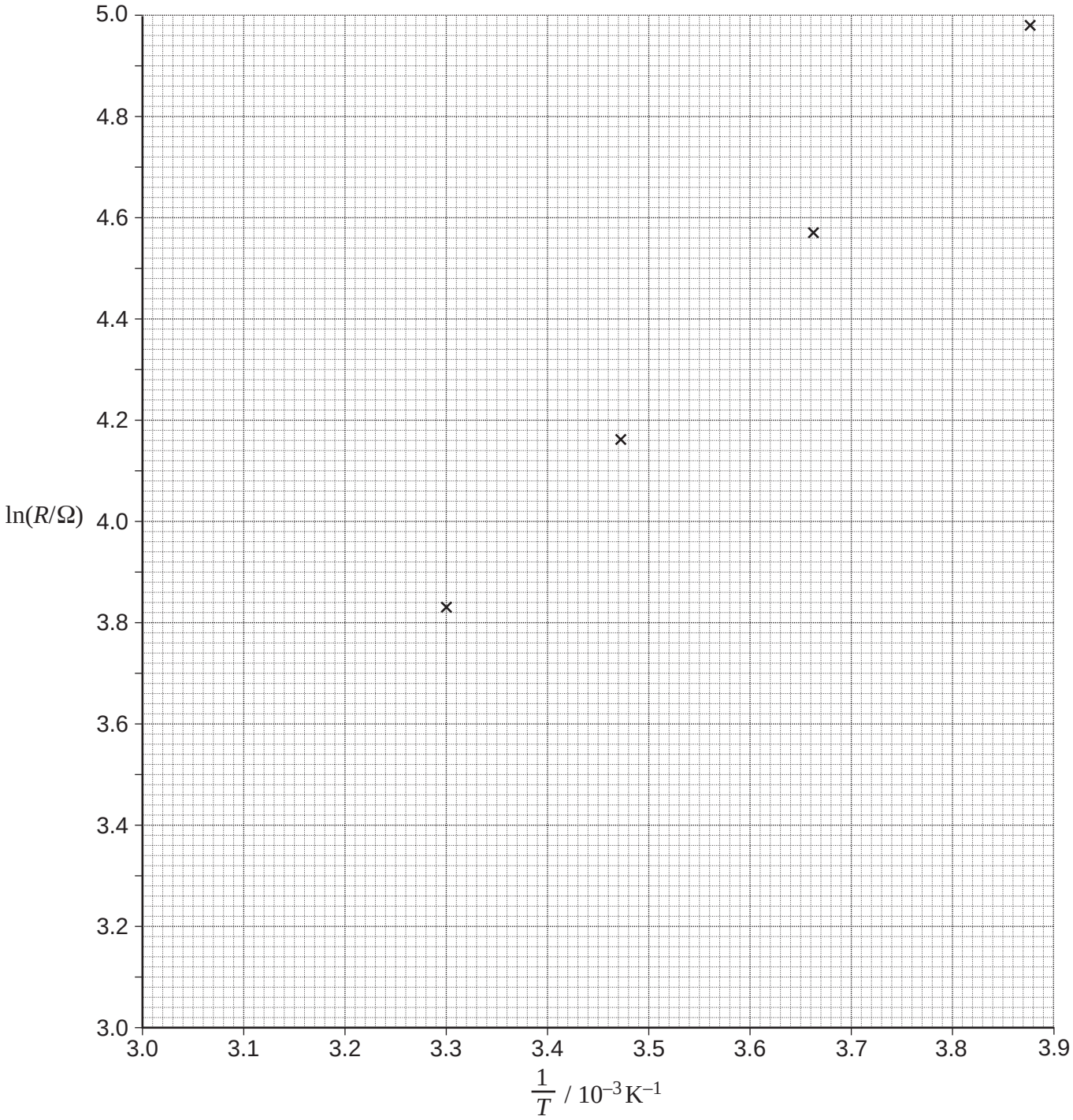
Figure 1



Do not write outside the box

2 (d) For all temperatures the relationship between R and T is of the form

$$\ln R = \frac{B}{T} + \ln A$$

where A and B are constants.

2 (d) (i) Determine the value of B and its unit.

[2 marks]

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2 (d) (ii) Determine the value of A and its unit.

[3 marks]

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2 (d) (iii) This relationship can also be written in the form

$$R = p\mathrm{e}^{\frac{q}{T}}$$

where p and q are constants.

Write the equation in this form substituting relevant values for p and q.

[1 mark]

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3 (a) Use values taken from the graph in **Figure 1** on page 5 to determine the resistance change per degree when the temperature changes between $-2\,°C$ and $+2\,°C$

[4 marks]

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3 (b) For every degree Celsius change in the range $26\,°C$ to $30\,°C$ the resistance changes by $1.2\,\Omega$.
It is suggested that the thermistor and ohm-meter used for the measurements in question 2 could, with a suitable display calibrated in °C, be used as a thermometer for outside air temperature measurements in the UK.

With reference to your answer to question 3(a), suggest how the suitability of the thermistor thermometer would vary from summer to winter.

[3 marks]

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4 To investigate the variation with temperature of the pressure of the air within a car tyre, a thermistor is placed inside an inflated tyre, with electrical connections to the outside. The tyre is submerged in a constant-temperature water bath with the means to measure its internal pressure.

The thermistor has been previously calibrated to give a graph of celsius temperature against resistance.

4 (a) Describe how you would determine the variation of pressure of the air inside the tyre with temperature as the tyre heats up from its initial temperature of about $15\,°C$ to the temperature of the bath at $80\,°C$.

[3 marks]

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4 (b) Suggest how you would use your results to estimate a value for the absolute zero of temperature in °C.

[2 marks]

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END OF QUESTIONS

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