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 2012

Physics (Specification A & B) PHY6T/P12/test

Unit 6T A2 Investigative Skills Assignment (ISA) P

For submission by 15 May 2012

For this paper you must have:
- your documentation from Stage 1
- a ruler with millimetre measurement
- a calculator.

Time allowed
- 1 hour

Instructions:
- 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.

Information
- 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 ....

Section A

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

1 (a) Use your graph from Stage 1 to calculate the average rate of decrease in temperature of the water in cup A between t = 100 s and t = 500 s.

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(2 marks)

1 (b) R is the rate of decrease in temperature at a particular time, t.

1 (b) (i) Explain how you would use your graph to find R at t = 300 s.

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1 (b) (ii) Tick the box next to the statement below which best describes how R is related to t.

R does not change with t. ☐

R decreases with t. ☐

R increases with t. ☐

It is not possible to determine how R is related to t from my graph. ☐

(2 marks)

1 (c) The volume of a cylinder is given by the formula $V = \pi r^2 h$. Use your data from Stage 1 and this formula to calculate the volume, V_{10}, of the pile of ten coins in cm^3.

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(1 mark)

1 (d) If the uncertainty in your value for d is ± 0.2 mm and the uncertainty in your value for h is ± 1 mm, estimate the percentage uncertainty in your answer to part (c).

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(3 marks)

1 (e) The hot water in cup B cools quickly at first as heat is lost by the water and gained by the coins. This heat exchange is given, to a good approximation, by the equation

$$2.1 \times 10^5(\theta_A - \theta_B) = 6.4V_{10}\,c\,(\theta_B - \theta_S)$$

where c is the specific heat capacity, in SI units, of the metal of the coins.

Use this equation and your data from Stage 1 to calculate c. Your value for V_{10}, calculated in part (c), should **not** be converted to m^3.

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(2 marks)

Question 1 continues on the next page

1 (f) Consider the uncertainty in your temperature measurements due to the precision of the thermometer (as recorded by you in Stage 1) and your answer to part (d). State and explain whether using the ruler or the thermometer contributed most to the uncertainty in your value for c calculated in part (e).

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(4 marks)

14

Section B

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

2 Under certain conditions the rate of change of temperature of a warm body as it cools can be described by an empirical law attributed to Newton. This law states that the rate of decrease in temperature, R, is directly proportional to the temperature difference, ϕ, between the body and its surroundings.

Hence $R = k\phi$, where k is the cooling constant.

Assuming that this law applies, it can be shown that ϕ at time, t, is given by $\phi = \phi_o e^{-kt}$, where ϕ_o is the temperature difference at $t = 0$.

The table shows some of the measurements and calculated results from a cooling experiment to investigate Newton's Law. The temperature, θ, of the warm body was measured every five seconds. The temperature of the surroundings, θ_S, remained constant at 19.6 °C and $\phi = (\theta - \theta_S)$.

t/s	θ / °C	ϕ / °C	ln(ϕ / °C)
25.0	46.2	26.6	3.281
30.0	45.0	25.4	3.235
35.0	44.1	24.5	3.199
40.0	43.2	23.6	3.161
45.0	42.1		
50.0	41.3		
55.0	40.2		

2 (a) Explain why using a data logger with a temperature sensor justifies the three significant figure precision shown in the table, whereas the use of a stopclock or stopwatch and a thermometer would not.

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(1 mark)

Turn over ▶

Do not write outside the box

2 (b) Complete the table by calculating ϕ and $\ln\phi$ for $t = 45.0$, 50.0 and 55.0 s.

(1 mark)

2 (c) Complete the graph of the cooling data on the next page by plotting the remaining points and drawing a best fit straight line.

(2 marks)

2 (d) Explain how the graph supports the formula $\phi = \phi_0 e^{-kt}$.

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(2 marks)

2 (e) Determine the gradient of your straight line.

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(3 marks)

2 (f) Find the value of k and state its unit.

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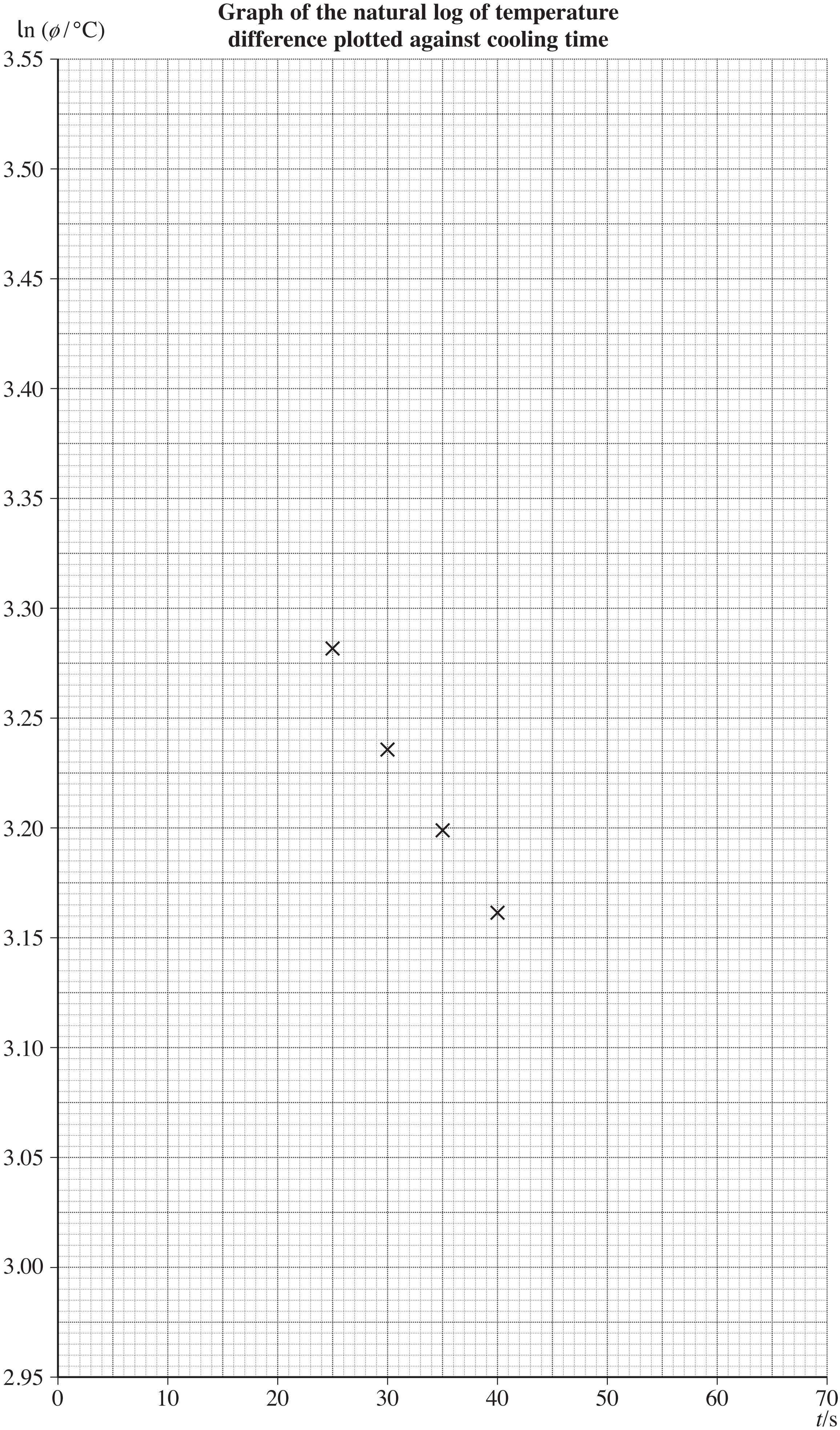
(2 marks)

Graph of the natural log of temperature difference plotted against cooling time



Turn over ▶

2 (g) Use the graph to find

2 (g) (i) the initial temperature difference, ϕ_o,

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2 (g) (ii) the initial rate of decrease in temperature, R_o,

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2 (g) (iii) the rate of decrease in temperature, R, at $t = 60\,s$.

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(3 marks)

2 (h) The results from this experiment do seem to support Newton's law. Suggest ways in which the same apparatus could have been used to test the wider validity of Newton's Law of cooling.

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(2 marks)

16

3 One major physical factor contributing to the heat loss from a heated swimming pool is evaporation from the water surface. This can be virtually eliminated while the pool is not in use by positioning a floating cover over the whole surface of the pool. Describe an experiment, based on the apparatus you used in Stage 1, to investigate how heat loss by evaporation varies with the initial temperature of the water.

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(4 marks)

4

END OF QUESTIONS