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 Examiner's Use	
Examiner's Initials	
Section	Mark
Section A Part 1	
Section B Part 2	
Section B	
TOTAL	

General Certificate of Education
Advanced Level Examination
June 2011

Physics (Specifications A and B) PHA6/B6/X

Unit 6 Investigative and Practical Skills in A2 Physics
Route X Externally Marked Practical Assignment (EMPA)

Section B Written Test

For this paper you must have	**Instructions**
• your completed Section A Part 2 question paper / answer booklet. • a ruler • a pencil • a calculator.	• 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. • Show all your working. • Do all rough work in this book. Cross through any work you do not want to be marked.
Time allowed • 1 hour 15 minutes	**Information** • The marks for questions are shown in brackets. • The maximum mark for this paper is 24.

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 ☐

Practical Skills Verification Teacher Declaration: I confirm that the candidate has met the requirement of the practical skills verification (PSV) in accordance with the instructions and criteria in section 3.8 of the specification.	**Yes** ☐

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

Section B

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

The time allowed is 1 hour 15 minutes.

You will need to refer to the work you did in Section A Part 2 when answering these questions.

1 (a) (i) Determine the gradient, G, of your graph of $\ln(V/\text{mV})$ against Q.

.....

.....

.....

G = ...

1 (a) (ii) Read and record the vertical intercept from your graph.

vertical intercept = ...

(3 marks)

1 (b) A student claims that an analogy can be made between the experiment in which light is absorbed by the ink solution and an experiment in which ionising radiation is absorbed by different thicknesses of metal plates.
Using the analogy, she suggests that the output voltage of the solar cell, V, is given by

$$V = Pe^{-\lambda Q},$$

where P and λ are constants.

1 (b) (i) If the student's analogy is correct, describe the form that a graph of $\ln(V/\text{mV})$ against Q should take and explain how the values of P and λ may be deduced from the graph.

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1 (b) (ii) Explain whether the qualitative and quantitative evidence obtained from your graph confirms the student's analogy.

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(6 marks)

9

Turn over for the next question

2 (a) (i) Describe **one** difficulty you experienced when measuring the volume of the ink solution.

.....

.....

2 (a) (ii) Explain **one** precaution you took to reduce the uncertainty when measuring the volume of ink solution in the measuring cylinders.
You may wish to use a sketch to illustrate your answer.

.....

.....

(2 marks)

2 (b) Having transferred between 90ml and 100 ml of ink solution to the beaker, students A and B did not follow the instructions about which measuring cylinders they should then use.
Student A used only the **larger** measuring cylinder (capacity 100 ml, 1 ml graduations).
Student B used only the **smaller** measuring cylinder (capacity 25 ml, 0.5 ml graduations).

2 (b) (i) Give a disadvantage of the procedure followed by student A.

.....

.....

2 (b) (ii) Give a disadvantage of the procedure followed by student B.

.....

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(2 marks)

4

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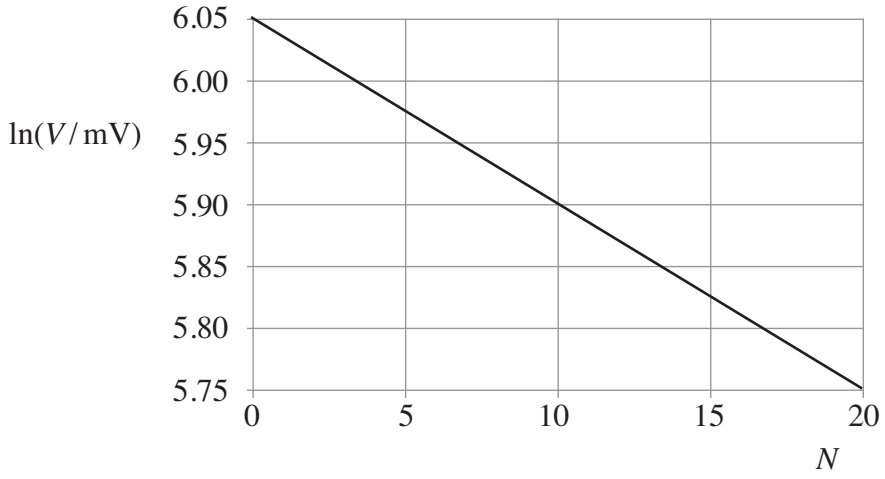
ANSWER IN THE SPACES PROVIDED

3 A student adapts the experiment to investigate how light is absorbed by glass.
The student uses a varying number of glass microscope slides (up to a maximum of 20 slides) placed in a single stack on top of the solar cell to produce different thicknesses of the glass.

The student plots a graph of his results, as shown in **Figure 5**.
Note that N = number of glass microscope slides placed on top of the solar cell.

Figure 5



Assuming that the output voltage of the solar cell is directly proportional to the light intensity incident upon it, the student intends to determine the half-value thickness of glass, ie the thickness of glass that would reduce the output voltage by half.

3 (a) Use the information provided in the student's graph to calculate $N_{0.5}$, the value of N equivalent to the half-value thickness of the glass.

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(3 marks)

3 (b) To determine the half-value thickness of the glass in mm, the student needs to make one additional measurement.

3 (b) (i) Identify the measurement the student needs to make and explain how this is used to determine the half-value thickness of the glass.

.....

.....

.....

.....

The student uses a micrometer screw gauge to make the additional measurement.

3 (b) (ii) Identify **one** procedure that can be used to reduce the effect of random errors when making the measurement.

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3 (b) (iii) Identify **one** procedure that can be used to detect, and hence correct, for possible systematic errors in the measurements made with the micrometer screw gauge.

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(3 marks)

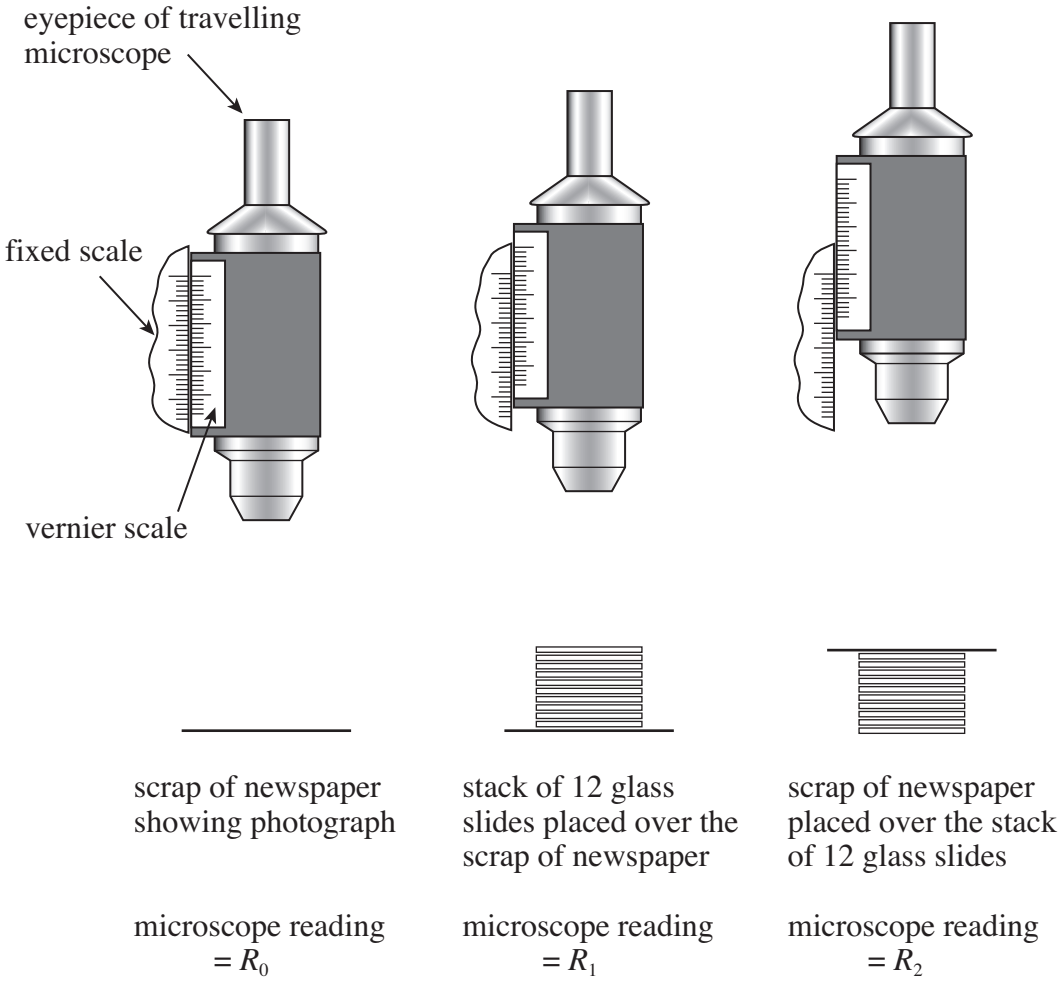
6

4 The student uses a travelling microscope to learn more about the properties of the glass slides.

The eyepiece of the microscope is arranged to move vertically up or down above a scrap of newspaper showing a photograph.
The photograph is composed of dots which are only clearly visible when viewed through the microscope. By adjusting the position of the microscope the student brings the dots into focus and then reads the position of the microscope, R_0, using the vernier scale.
The student then places a stack of 12 slides over the photograph and refocuses the microscope. She records the new reading, R_1.
Finally, she places the photograph on top of the slides, refocuses the microscope, and records the new reading R_2.

The sequence of operations is illustrated in **Figure 6**.

Figure 6



The readings made by the student are shown in the table below.

R_0 / mm	R_1 / mm	R_2 / mm
2.74	**7.31**	**17.02**

4 (a) Assuming that the slides have identical dimensions, use the readings to determine the thickness of one glass microscope slide.

.....

.....

(1 mark)

4 (b) Determine n, the refractive index of the glass, given by $n = \dfrac{R_2 - R_0}{R_2 - R_1}$.

.....

.....

(1 mark)

4 (c) The uncertainty in each of the readings R_0, R_1 and R_2, is 0.04 mm.

4 (c) (i) State the uncertainty in $R_2 - R_0$.

.....

4 (c) (ii) State the uncertainty in $R_2 - R_1$.

.....

4 (c) (iii) Hence calculate the percentage uncertainty in n.

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(3 marks)

5

END OF SECTION B

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