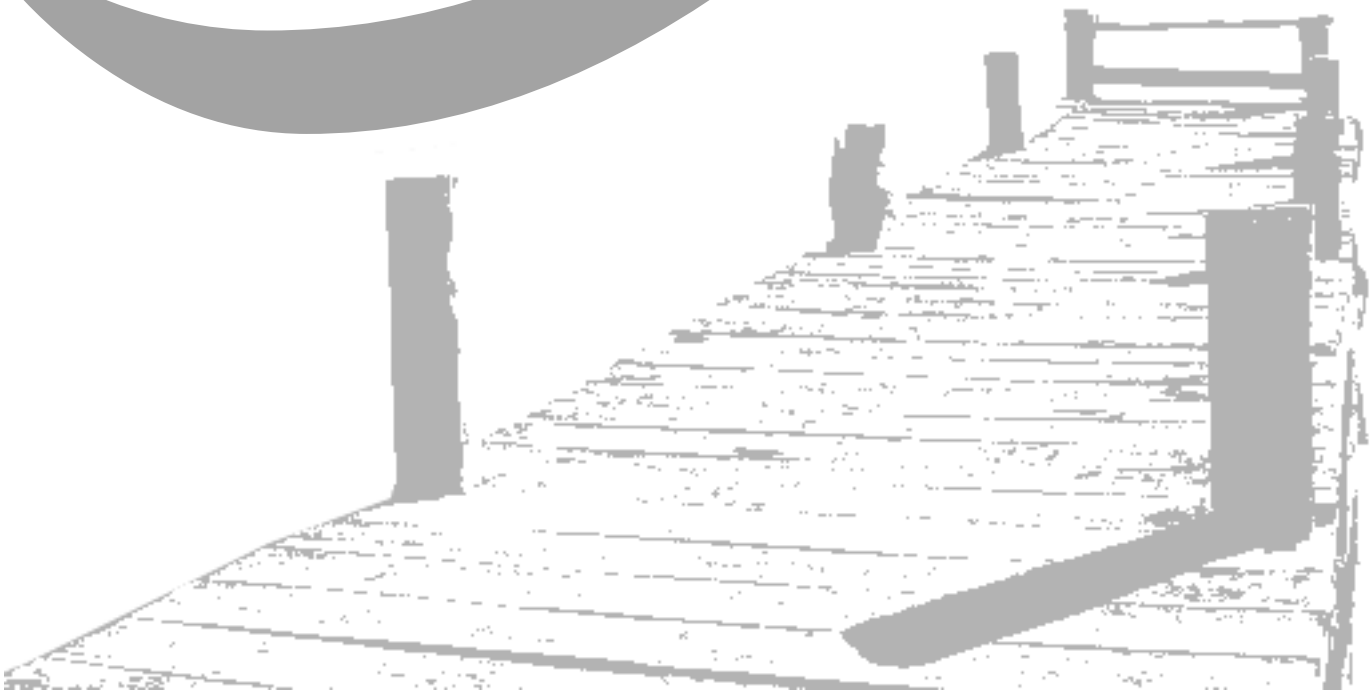
GCE
AS and A Level

Physics A

AS exams 2009 onwards
A2 exams 2010 onwards

Unit 6T: Approved specimen question paper

Version 1.0



Surname		Other Names	
Centre Number						Candidate Number				
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General Certificate of Education
2010
Advanced Level Examination

version 1.0

PHYSICS
Investigative and Practical Skills in A2 Physics

Unit 6 ISA PHA6T

SPECIMEN PAPER

For this paper you must have:
- a calculator
- a ruler
- a protractor
- your completed documentation from stage 1

Time allowed: 1 hour

Instructions
- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided. A separate sheet of graph paper is required. Attach your graph to this book before handing it to the invigilator at the end of the examination.
- Show all your working.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 41.
- The marks for the questions are shown in brackets.

For Examiner's Use			
Sec A	Mark	Sec B	Mark
1		1	
2		2	
3		3	
4		4	
5		5	
		6	
Total (Sec A)			
Total (Sec B)			
TOTAL			
Examiner's Initials			

SECTION A

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

1 Justify the range you chose for the independent variable when you plotted your graph of the results in Part 1.

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(2 marks)

2 (a) From your graph find the peak value of the potential difference across capacitor C_2 for both values of R_2.

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(b) Explain the difference between these two voltages.

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(2 marks)

3 From your graph find the time T_m at which the voltage peaked for both values of R_2.

.....

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(1 mark)

4 Use your graph to estimate the percentage uncertainty in your answer for T_m with $R_2 = 100\ k\Omega$ and explain how you arrived at this estimate.

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(3 marks)

5 What was the most significant source of error when you were obtaining your readings in Part 1?

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(1 mark)

6 Estimate T_m for $R_2 = 33$ kΩ. Explain your reasoning.

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(2 marks)

SECTION B

Answer all questions in the spaces provided.

1 Theory predicts that

$$T_m = \frac{T_1 T_2}{(T_1 - T_2)} \ln\left(\frac{T_1}{T_2}\right)$$

where $T_1 = C_1 \times R_1$ and $T_2 = C_2 \times R_2$.

(a) Use the formula to calculate T_m for the discharge in part 1 when $R_2 = 100\ \text{k}\Omega$. Compare this value with your answer in Part 2 (**3**) with reference to your answer from Part 2 (**4**).

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(b) What is the significance of the product of capacitance and resistance when a capacitor is discharged through a resistor?

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(5 marks)

2 Describe how you would attempt to verify the formula given in Part 3 (**1**).

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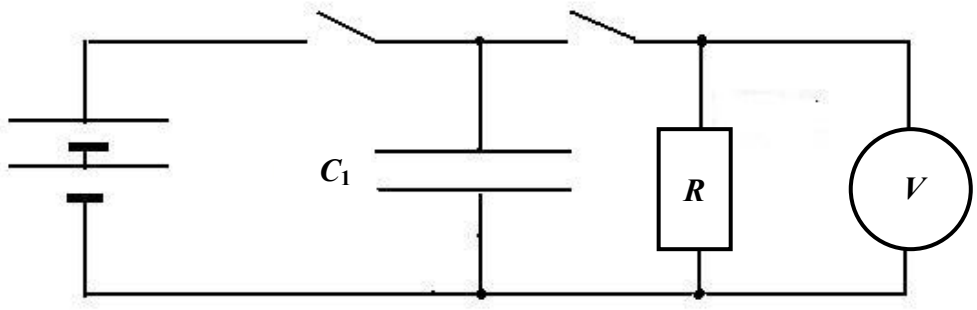
(3 marks)

In a separated experiment, data was collected for the variation of voltage V with time t as capacitor C_1 discharged through a resistor, R, using the circuit shown in **Figure 2**.

Figure 2



The table in **Figure 3** gives the results from this experiment.

Figure 3

***t*/s**	0.01	0.02	0.03	0.04	0.05
***V*/V**	4.88	3.97	3.23	2.63	2.14

3 (a) State what was probably used to obtain these results and explain why?

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(b) Draw a table with three columns for these data. The third column is for ln (V/V).

Complete the table and plot a graph of ln (V/V) against t.

(6 marks)

4 (a) Measure the gradient of your graph and hence find a value for the time constant τ for the circuit in **Figure 2**, given that

$$V = V_0 e^{-(t/\tau)}$$

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(b) Use the graph to find V_0.

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(7 marks)

5 Capacitor discharge is a good model for the nuclear decay of a sample of a radioisotope, since both processes have a constant half-life. Quite often one radioisotope decays into another with a shorter half-life. By considering your results from the experiment in Part 1, suggest the conditions necessary for the number of atoms of the second radioisotope to remain constant for a number of years.

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(2 marks)

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PHYSICS A PHA6T
Unit 6: Practical and Investigative Skills in A2 Physics

Specimen ISA

Centre Instructions for the Investigation

SPECIMEN ISA 'CAPACITOR CHARGE AND DISCHARGE'

PHA6T

Centre instructions for the Investigation

In this ISA, candidates will be investigating the discharge of a capacitor through an arrangement of two resistors and another capacitor.

The following components will be required for the circuit.

- three resistors; 47 kΩ, 100 kΩ, 470 kΩ
- capacitors; 220 μF, 100 μF
- three switches
- battery (either 3V or 6V)
- voltmeter
- leads
- stopclock or equivalent

Information for Centres

Candidates can be told approximately one week before undertaking Stage 1 of the ISA that they will be investigating the discharge of a capacitor through a circuit. Preparation could include the revision of the following topics:

Exponential decay
Capacitor discharge (including time constants)
Radioactive nuclear decay (including half-life)

Stage 2 of the ISA, (the written tests; Section A & B) should be given as soon as possible after the practical investigation.

SPECIMEN ISA 'CAPACITOR CHARGE AND DISCHARGE'

PHA6T

Task Sheet

Stage 1: Investigation

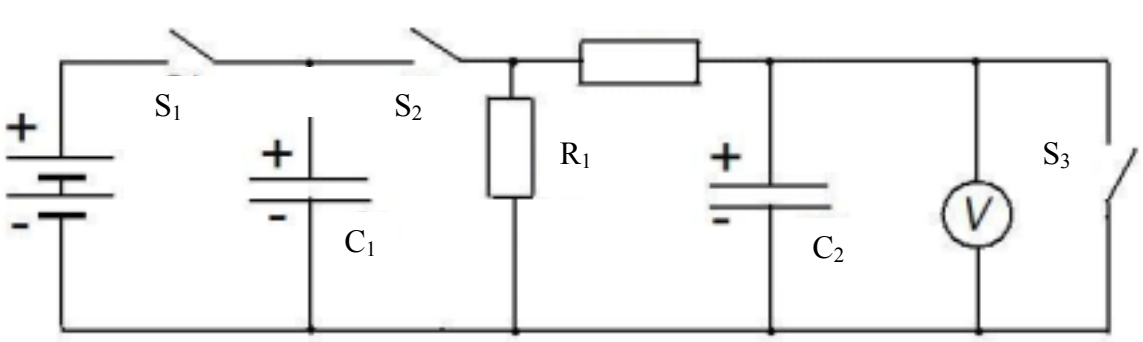
You are going to investigate the discharge of a capacitor through an arrangement of two resistors and another capacitor.

You are provided with various components.

- Set up the circuit shown in **Figure 1.**

Ensure that the negative terminals of the capacitors are connected to the negative terminal of the battery as shown on the circuit diagram.

Figure 1



Component values: R_1 = 470 kΩ, R_2 = 100 kΩ, C_1= 220 μF, C_2= 100 μF

You should follow the instructions as listed below;

Instruction 1
Open switches S_2 and S_3 and close S_1. The capacitor C_1 will now be fully charged.

Instruction 2
Close S_3: the voltmeter reading should fall to zero showing that C_2 is fully discharged.

Instruction 3
Open S_3, open S_1 and then close S_2. C_1 will now discharge through R_1, R_2 and C_2. Observe the reading on the voltmeter for the next couple of minutes. This should increase to a maximum value and then start to decrease again.

If the voltmeter reading does not change in this way ask for help from your teacher.

Repeat **Instructions 1** and **2.**
Using the stopclock provided, take sufficient readings to plot an accurate graph of V against t.
V is the potential difference across C_2 and t is the time after S_2 is closed.

- Present your results in a table.

Replace R_2 with the 47 kΩ resistor and repeat the experiment.

- Record your results in a second table.
- Draw your graphs V against t using the same axis.

At the end of the investigation, please hand the following in to your teacher.

- Your completed answer sheet(s) which should include two results tables.
- A sheet of graph paper with your V-t graph.

This documentation will be required for Stage 2 of the ISA. Please ensure you have entered your centre details, candidate number and name on all the sheets you have completed.