Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

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General Certificate of Education
June 2002
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

PHYSICS (SPECIFICATION A) PHA3/P
Unit 3 Practical

Thursday 16 May 2002 Morning Session

In addition to this paper you will require:
- a calculator;
- a pencil and a ruler.

Time allowed: 1 hour 45 minutes

Instructions
- Use a blue or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **both** questions in the spaces provided. All working must be shown.
- Do all rough work in this book. Cross through any work you do not want marked.

Information
- The maximum mark for this paper is 30.
- Mark allocations are shown in brackets.
- The paper carries 15% of the total marks for Physics Advanced Subsidiary and carries $7\frac{1}{2}$% of the total marks for Physics Advanced.
- A *Data Sheet* is provided on pages 3 and 4. You may wish to detach this perforated sheet at the start of the examination.
- You are expected to use a calculator where appropriate.
- You are advised to spend no more than 30 minutes on Question 1.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Data Sheet

- A perforated *Data Sheet* is provided as pages 3 and 4 of this question paper.
- This sheet may be useful for answering some of the questions in the examination.
- You may wish to detach this sheet before you begin work.

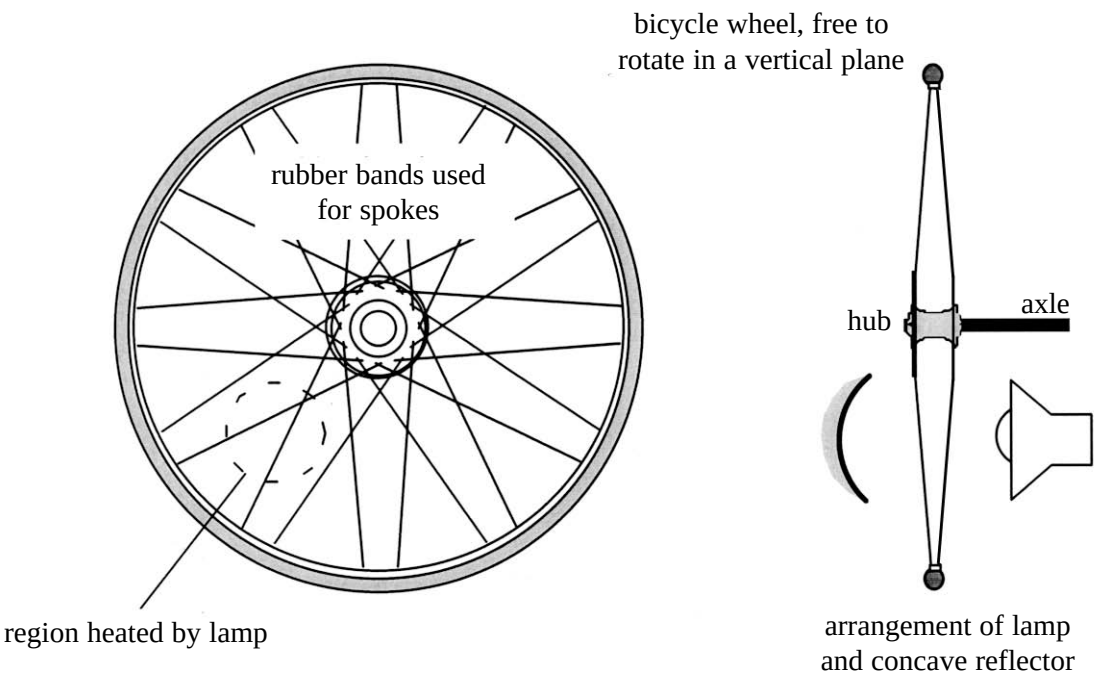
DATA SHEET

DATA SHEET

Answer **both** questions.

You are advised to spend no more than 30 minutes on Question 1

1 A *heat engine* is a device that can transform heat energy into kinetic energy.
A novel form of heat engine is illustrated in the diagram.



The spokes of a bicycle wheel have been replaced by rubber bands. Using a combination of a lamp and a concave reflector, heat is directed at part of the wheel. This makes the rubber contract and causes the position of the centre of mass of the wheel to move above the hub. As a result the wheel starts to turn and after a few seconds reaches a steady rate of rotation of about 1 rotation per second.

Design an experiment to investigate how the rate of rotation of the wheel changes as the power input is varied. You should assume that the normal apparatus found in school physics laboratories is available to you.

You are advised to draw a suitable diagram of the arrangement you intend to use as part of your answer. You should also include the following in your answer:

- The quantities you intend to measure and how you will measure them
- How you propose to use your measurements
- The factors you will need to control and how you will do this
- How you could overcome any difficulties in obtaining reliable results.

Write your answers to Question 1 on **pages 6 and 7** of this booklet.

(8 marks)

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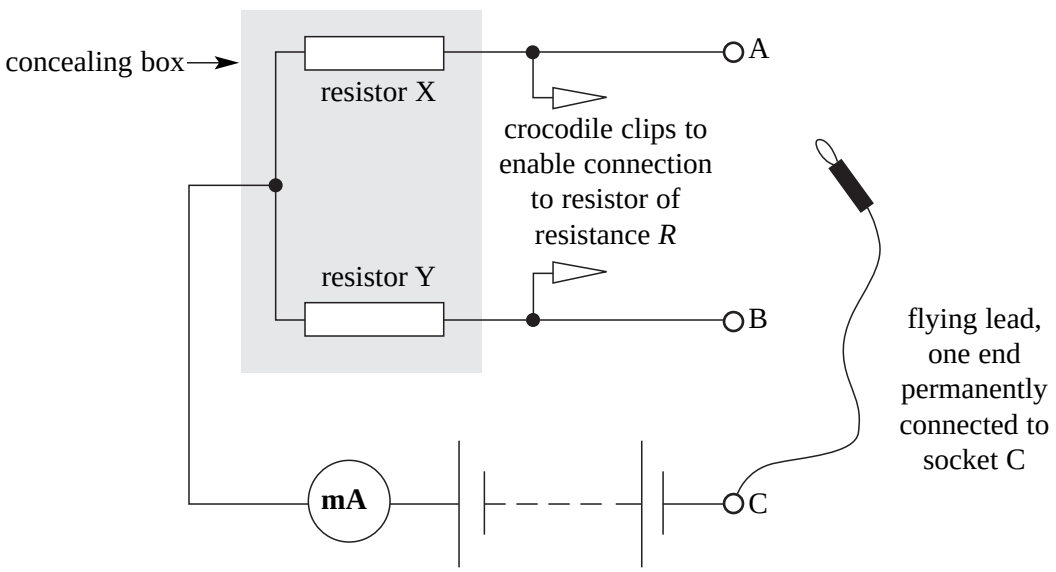
TURN OVER FOR THE NEXT QUESTION

This question is divided into parts (a) to (e) printed on pages 8 to 12.

2 In this experiment you are required to investigate currents in a circuit containing a resistor of known resistance R and two resistors, X and Y, of unknown resistance. Note that the circuit in the shaded part of the diagram has been concealed from you.

No description of the experiment is required.

You are provided with the circuit shown below and six resistors of resistances 10 Ω, 47 Ω, 100 Ω, 220 Ω, 470 Ω and 1000 Ω.



(a) Connect the 10 Ω resistor between the crocodile clips (i.e. so that R = 10 Ω).

(i) Connect terminal C to terminal A using the flying lead. Read and record the current, I_1.

I_1 = ...

(ii) Connect terminal C to terminal B using the flying lead.
Read and record the current, I_2.

I_2 = ...

(iii) Calculate k, where $k = \frac{I_1}{I_2}$.

k = ...

QUESTION 2 CONTINUES ON THE NEXT PAGE

(b) Using each of the other resistors in turn, repeat the procedure to determine k for the five further values of R.
Record all your measurements in the space below.

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(7 marks)

(c) Using the grid **on page 11** of this booklet, plot a graph with k on the vertical axis and $\frac{(1-k)}{R}$ on the horizontal axis.
Use the space below to tabulate the data you will plot on the graph.

(6 marks)

(d) Measure and record the gradient G, of your graph.

G = ...

(3 marks)

QUESTION 2 CONTINUES ON PAGE 12

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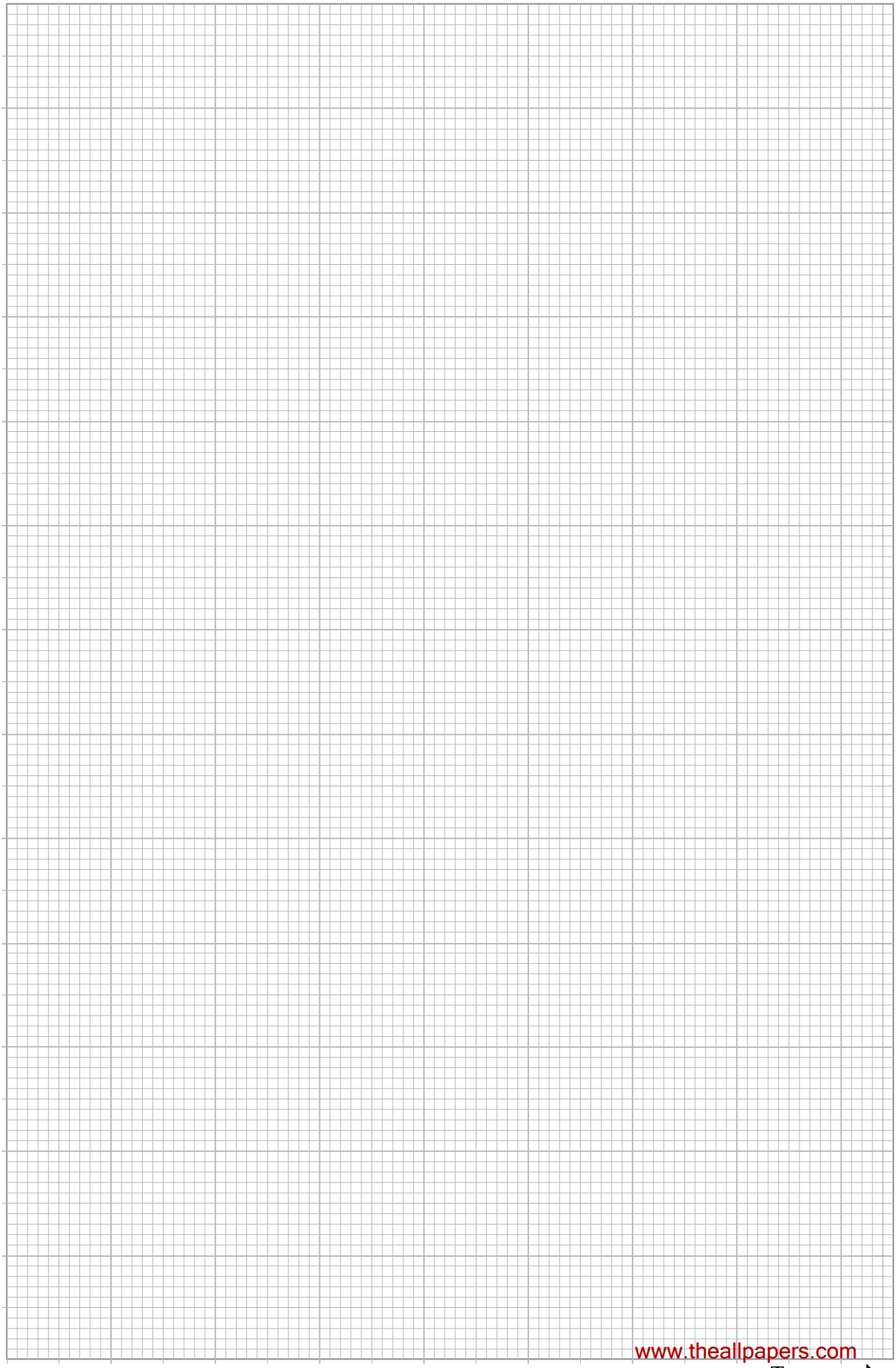

(e) (i) Explain whether the graph you have drawn shows that k is directly proportional to $\frac{(1-k)}{R}$.

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(ii) A student performs the experiment using combinations of three 100 Ω resistors. By considering the number and range of different resistances that the student could produce, explain if any advantage is gained by this approach compared with the experiment that you have performed.

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(6 marks)

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END OF QUESTIONS