OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced Subsidiary GCE

PHYSICS (B) (ADVANCING PHYSICS) 2860

Physics in Action

Friday **31 MAY 2002** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Data, Formulae and Relationships Booklet
Electronic calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your name, Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces on the question paper.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Show clearly the working in all calculations, and round answers to only a justifiable number of significant figures.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The values of standard physical constants are given in the Data, Formulae and Relationships Booklet. Any additional data required are given in the appropriate question.
- You are advised to spend about 20 minutes on Section A, 40 minutes on Section B and 30 minutes on Section C.
- You will be awarded marks for the quality of written communication in Section C.

FOR EXAMINER'S USE		
Section	Max.	Mark
A	20	
B	40	
C	30	
TOTAL	90	

This question paper consists of 18 printed pages and 2 blank pages.

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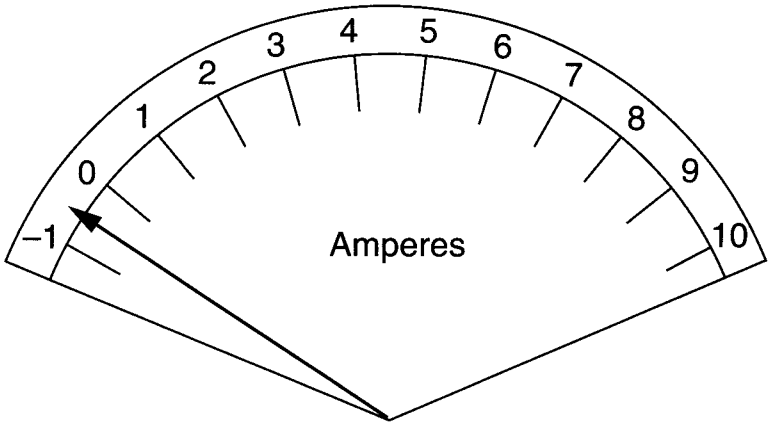
For Examiner's Use

Section A

1 The moving coil ammeter scale illustrated below is to be used to measure a current. The full scale deflection is 10 A.



The meter has a systematic zero-error as shown, when the current is zero.

(a) Use this example to explain the meaning of **systematic error** in instrumentation.

[1]

(b) When the meter indicates a reading of 6.5 A, what is the actual current?

current = ... A [1]

2 The material chosen for a hip joint replacement needs to be strong.

(a) State **one** other **mechanical** property that is important for this use of the material, and explain its meaning.

mechanical property: .....

meaning of property: .....[2]

(b) Explain the importance of the property to this use of the material.

[1]

3 The graph in Fig. 3.1 shows how the stress in a rubber cord varies with strain, up to the breaking stress of 30 MPa.

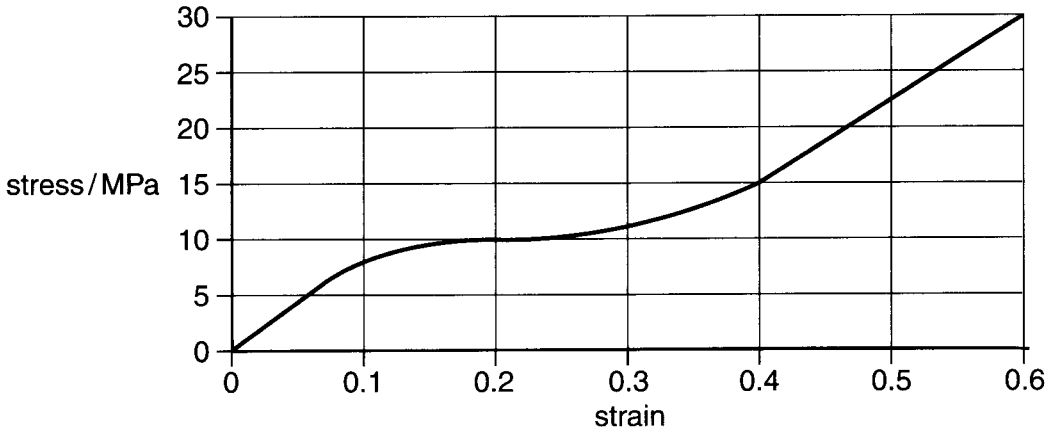


Fig. 3.1

The rubber cord is cooled to well below room temperature. It is found that it becomes much stiffer, finally breaking at the same stress, but at half the original breaking strain.

Sketch this variation for the cooled rubber cord on the graph of Fig. 3.1. [3]

4 Here is a list of five units for physical quantities:

$N\,m^{-2}$ D J $\Omega\,m$ $S\,m^{-1}$

From the list:

(a) Write down the unit for the power of a lens. .....[1]

(b) Write down the unit for electrical conductivity. .....[1]

For Examiner's Use

5 An overhead projector uses a converging lens to produce a magnified image of a transparency, as shown below.

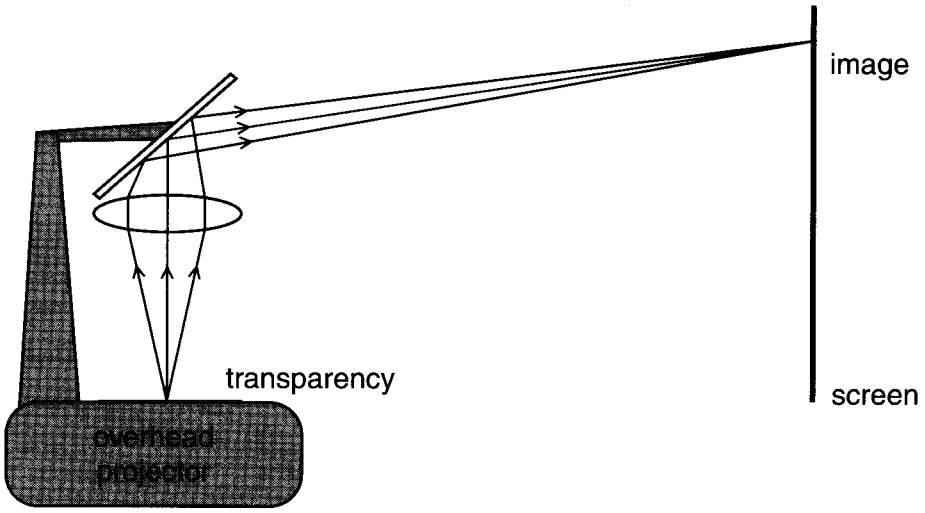


Fig. 5.1

The transparency is 0.20 m wide, and the image is 1.20 m wide.

(a) Calculate the linear magnification of the system.

linear magnification = ... [1]

(b) The image distance $v = 2.40$ m from the projector lens.

Use your answer to **(a)** to calculate the object distance u of the transparency from the lens.

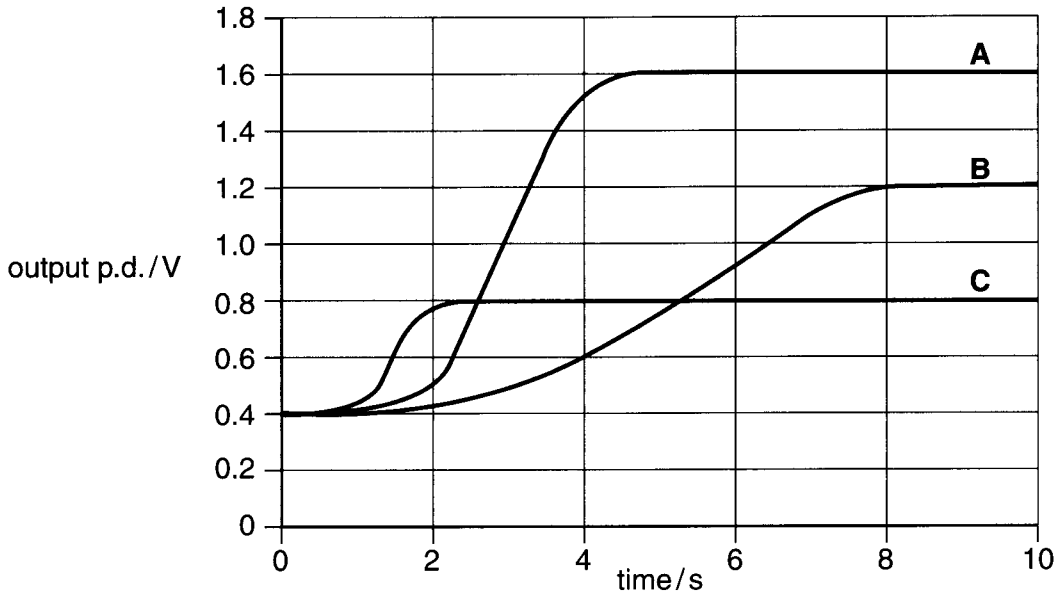
[2]

6 A Radio One FM station transmits at 99.8 MHz.

Calculate the wavelength of the transmission.

wavelength = ... m [2]

7 Three temperature sensors **A**, **B** and **C** were plunged into boiling water at the same moment. The graph below shows their responses.



(a) Which sensor has the shortest response time? ..... [1]

(b) Which sensor has the greatest sensitivity? ..... [1]

8 A ray of light is refracted at an air-water boundary as shown below.

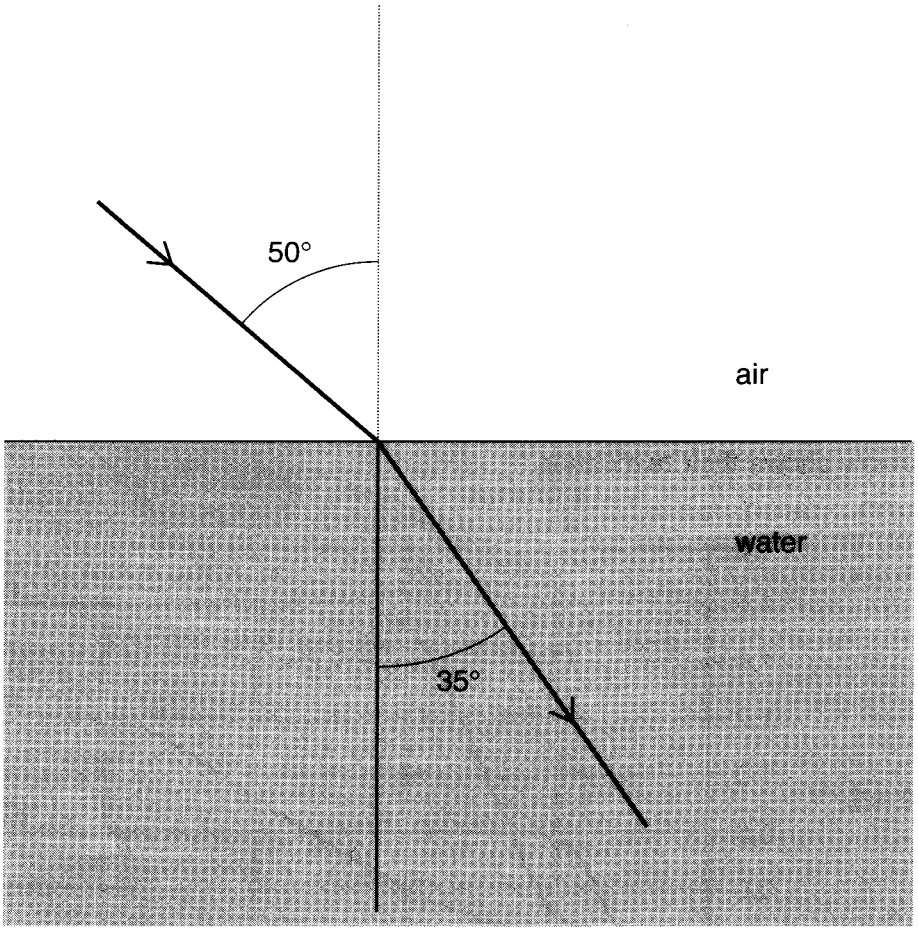


Fig. 8.1

Use the data from the diagram to calculate the refractive index for water.

[3]

For Examiner's Use

Section B

9 This question is about some aspects of mobile phone technology.
A SIM card provides the memory for a mobile phone, and contains a small memory chip. This can be programmed to remember the user's personal telephone directory, with up to 100 names and numbers.

An example of a stored entry might be: **LAURENT 01396 813976**
Memory is reserved for names of up to ten letters and numbers of 12 digits.

(a) There are ten alternative decimal digits (0 to 9).

By working out the number of alternatives that can be coded by a 4-bit binary number, show that 4 bits is sufficient to code for each decimal digit in the number.

[2]

(b) Calculate the number of bits of information needed to store one hundred 12-digit numbers in memory.
Convert this to bytes.

bits required = ... bytes required = ... [2]

(c) Explain why more memory is needed to code for a letter from the English alphabet, than for a decimal digit.

[2]

(d) (i) A mobile phone samples sound 10 000 times per second.

Write down the highest sound frequency the mobile phone can transmit.

highest frequency = ... kHz [1]

(ii) The mobile phone reproduces speech satisfactorily, but the quality of music reproduction is poor.

Suggest **two** reasons for this.

1.

2. [2]

[Turn over

10 A solar cell generates electrical power in constant bright sunlight.
A circuit is required to measure the p.d. and current delivered into a variable load resistor.

(a) Complete the circuit in Fig. 10.1 showing the connection of a variable load resistor and a voltmeter to measure the output p.d. across the load.

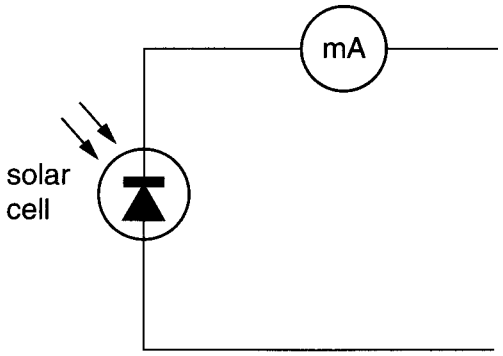


Fig. 10.1

[3]

The solar cell is placed in constant bright sunlight.
The graph in Fig. 10.2 shows this variation of p.d.

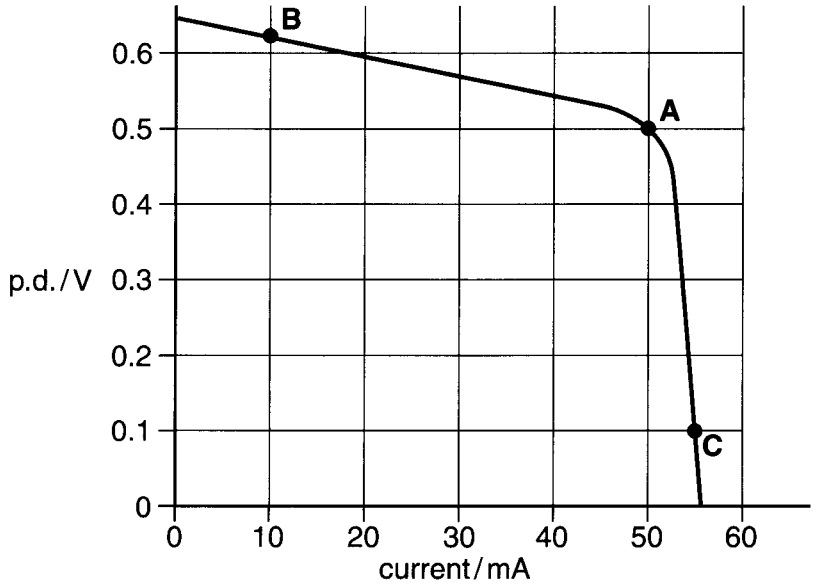


Fig. 10.2

(b) **(i)** Using the graph Fig. 10.2 describe how the p.d. of the solar cell varies, as more current is drawn from it.

[2]

(ii) Suggest a reason for the variation you have described in **(b)(i)**.

[1]

(c) **(i)** The maximum power from the cell is gained at the point **A** indicated in Fig. 10.2. Calculate this maximum power delivered.

maximum power delivered = ... W [3]

(ii) At both points **B** and **C** in Fig. 10.2, how do the values on the graph suggest that the power delivered is lower than at **A**?

[2]

[Turn over