



Rewarding Learning

ADVANCED
General Certificate of Education
2017

Centre Number

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Candidate Number

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Physics

Assessment Unit A2 3
 Practical Techniques
 Session 1

[AY231]

TUESDAY 9 MAY, MORNING



AY231

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Turn to page 2 for further Instructions and Information.

| For Examiner's use only | | |
|-------------------------|-------|--------|
| Question Number | Marks | Remark |
| 1 | | |
| 2 | | |
| 3 | | |
| Total Marks | | |

INSTRUCTIONS TO CANDIDATES

Answer **all** questions in this paper. Rough work and calculations must also be done in this paper. Except where instructed, do not describe the apparatus or experimental procedures. The supervisor will tell you the order in which you are to answer the questions. Not more than 30 minutes are to be spent in answering each question. You may be told to start with the experimental tests in Section A, or with the single question in Section B.

Section A consists of two experimental tests. A 28-minute period is allocated for you to use the apparatus. Two minutes is allocated to the supervisor to prepare the station for the next candidate. At the end of the 30-minute period you will be instructed to move to the area set aside for your next question. Section B consists of one question in which you will be tested on aspects of planning and design.

INFORMATION FOR CANDIDATES

The total mark for this paper is 60.

All questions carry 20 marks each.

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each part question.

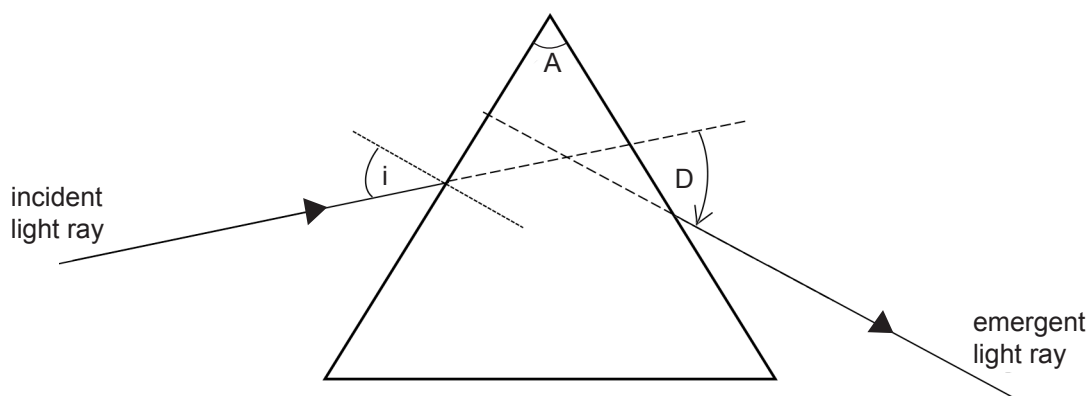
You may use an electronic calculator.

Section A

- 1 The angle through which a light ray deviates after refraction through a triangular prism depends on the refractive index of the prism and the incident angle. The angle of deviation, D , is the angle between the incident ray and the emergent ray, see **Fig. 1.1**.

Aims:

- To measure values of the angle of deviation for different angles of incidence,
- To draw a graph of angle of deviation against angle of incidence,
- To find a value for the refractive index between the media.

**Fig. 1.1**

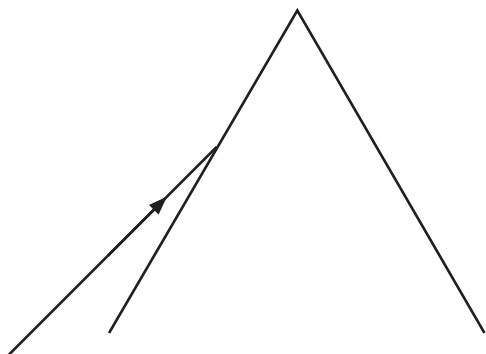
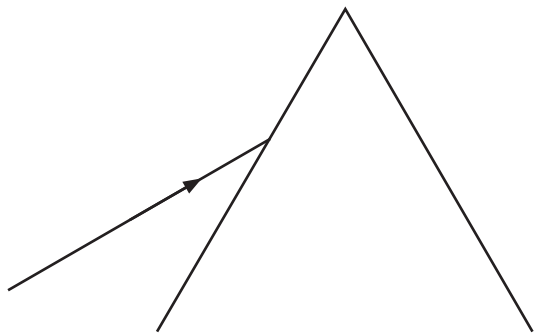


Fig. 1.2

(b) Complete each diagram by using a ruler to

(i) draw the path taken by the emergent ray and

(ii) extend the incident and emergent rays until they meet

as shown in **Fig. 1.1**.

[1]

(c) Complete **Table 1.1** by inserting the value of the angle of incidence, i , and the corresponding angle of deviation, D , for each diagram.

Table 1.1

| | | | | | |
|--------------|--|--|--|--|--|
| $i / ^\circ$ | | | | | |
| $D / ^\circ$ | | | | | |

[5]

- (d) (i) On the grid of **Fig. 1.3** draw the graph, angle of deviation against angle of incidence. Plot the points and draw a best fit curve.

[4]

| Examiner Only | |
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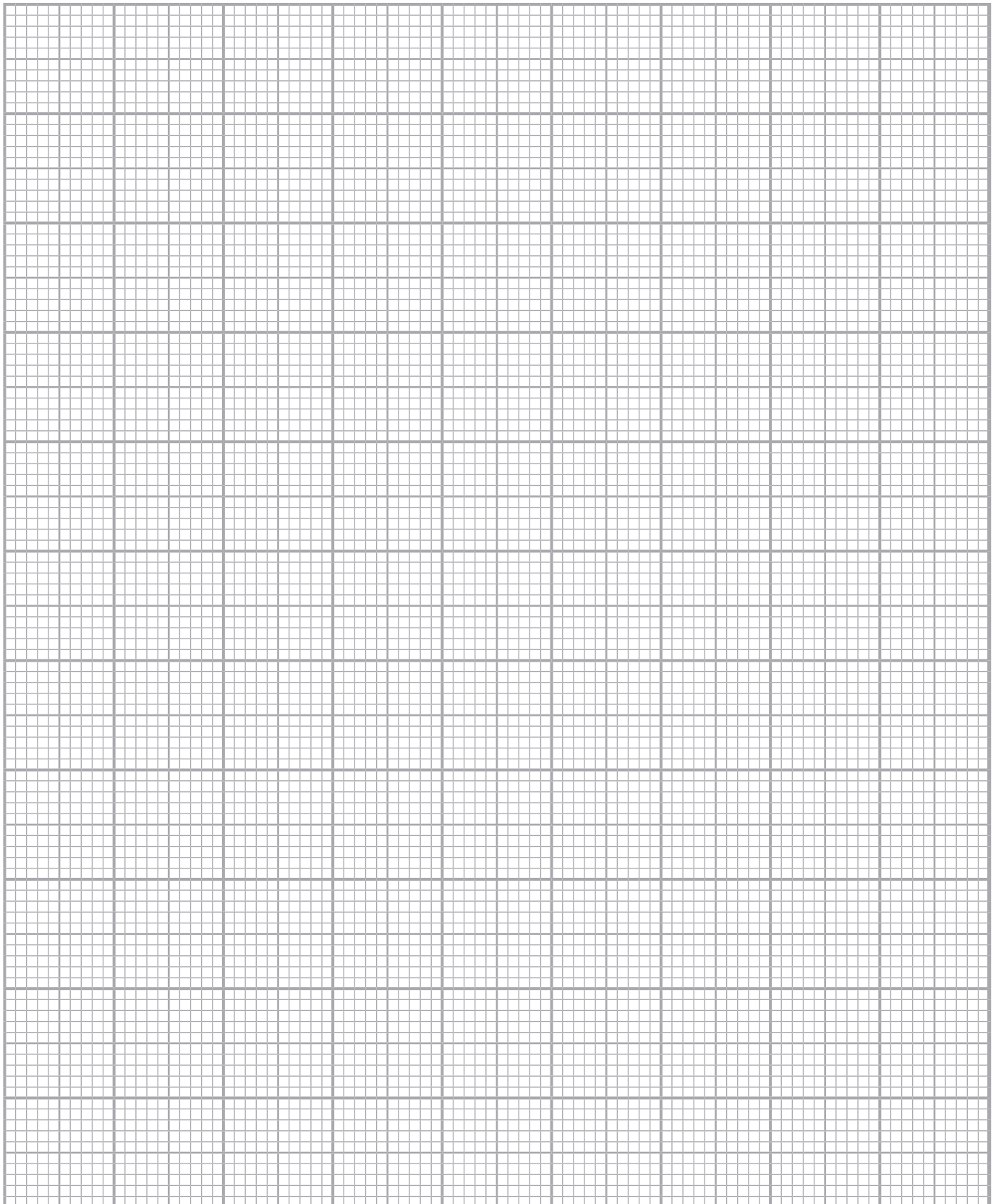


Fig. 1.3

- 2 The opposition to alternating current caused by a capacitor is called the reactance. The reactance, X , is defined as the ratio of the alternating potential difference, V , across the capacitor to the alternating current, I , through it: that is, $X = V/I$. In this experiment you will measure the reactance of a capacitor, at various frequencies. Reactance is measured in ohm, Ω .

The aims of the experiment are:

- to obtain values of the alternating current through and alternating voltage across a capacitor,
- to calculate the reactance of the capacitor at various frequencies,
- to analyse the results and compare them with a theoretical relationship between reactance and frequency.

Obtaining values of alternating current and alternating voltage

You are provided with the circuit shown in **Fig. 2.1**.

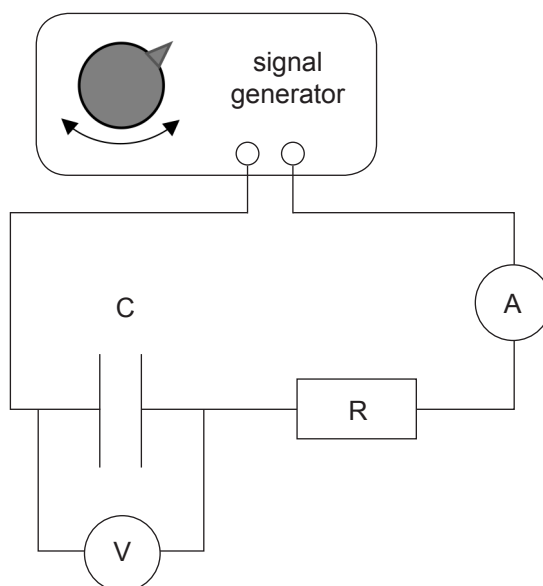


Fig. 2.1

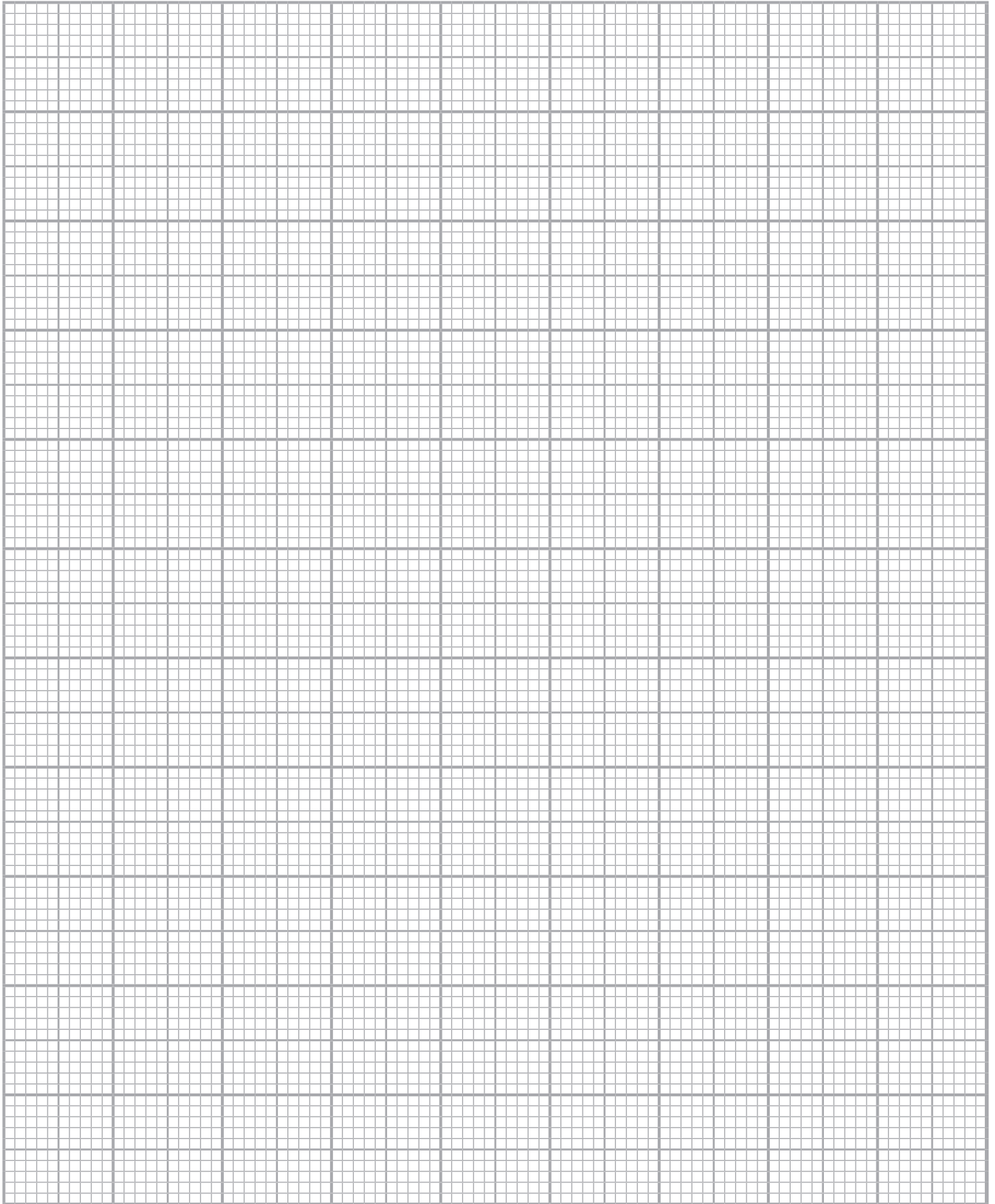
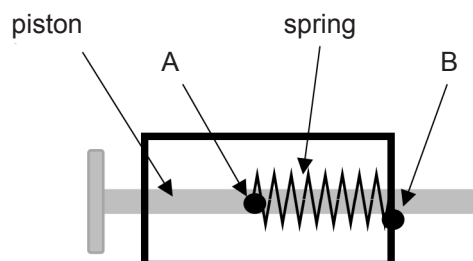


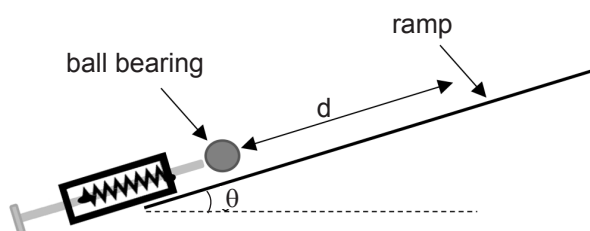
Fig. 2.2

| Examiner Only | |
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| Marks | Remark |
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- The spring has been mounted so that it can easily be stretched as shown in **Fig. 3.1**. The spring has been attached to the piston at position A and to a rigid box at position B. The spring is stretched by pulling the piston to the left.



It has been suggested that the energy stored in the spring can be determined using a ramp. A ball bearing is projected by the piston up a ramp at an angle θ to the horizontal, as shown in **Fig. 3.2**.



When the piston is released the ball bearing travels up the ramp, a distance d , before coming momentarily to rest.

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| Marks | Remark |
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(a) Determining the energy stored in the stretched spring.

Using the conservation of energy principle, derive an equation that links the energy, E , stored in the stretched spring to the distance, d . Identify any other symbols you use.

$$E = \underline{\hspace{4cm}} \quad [3]$$

(b) Determining the relationship between d and spring extension, x .

In **(a)** E was linked to d , but E depends on the extension, x , of the spring and as a consequence x and d are related. The relationship between x and d is shown in **Equation 3.1**.

$$x^2 = Ad + Z \quad \text{Equation 3.1}$$

where A and Z are positive constants.

- (i)** A linear graph can be drawn to show if **Equation 3.1** is correct. On **Fig. 3.3** label the axes for this graph. Sketch the graph you would expect to obtain.



Fig. 3.3

[2]

| Examiner Only | |
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- (ii) Explain how the percentage uncertainty in A is determined and describe how it is used to obtain a value for the percentage uncertainty in k.

[3]

| Examiner Only | |
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| Marks | Remark |
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THIS IS THE END OF THE QUESTION PAPER

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