Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

8119336502

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2020**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 30.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **8** pages. Blank pages are indicated.

DC (NF/FC) 183948/3

1 Fig. 1.1 shows a bar magnet attached to a spring.

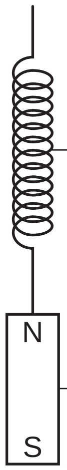

Fig. 1.1

The bar magnet is displaced a distance x from its equilibrium position and released. It then oscillates vertically.

A student investigates how the maximum induced electromotive force (e.m.f.) E in a coil placed below the magnet depends on x.

It is suggested that the relationship between E and x is

$$E = \alpha BNx\sqrt{\frac{k}{m}}$$

where B is the magnetic flux density at one of the poles of the bar magnet, N is the number of turns on the coil, k is the spring constant, m is the mass of the magnet and α is a constant.

Design a laboratory experiment to test the relationship between E and x.
Explain how your results could be used to determine a value for α.

You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to:

- the procedure to be followed
- the measurements to be taken
- the control of variables
- the analysis of the data
- any safety precautions to be taken.

Diagram

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[15]

2 A student investigates the discharge of a capacitor through a resistor as shown in Fig. 2.1.

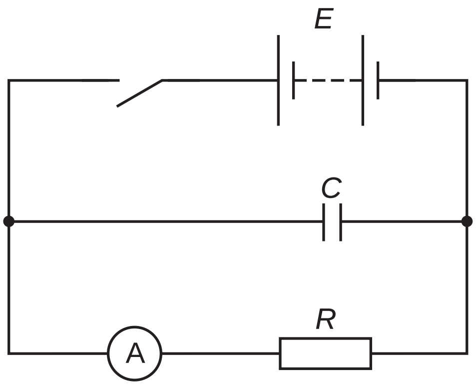


Fig. 2.1

The student initially closes the switch and charges the capacitor. The switch is then opened and a stop-watch is started. The capacitor discharges through the resistor. At different times *t* the current I is measured.

It is suggested that I and *t* are related by the equation

$$I = \frac{E}{R}e^{-\left(\frac{t}{RC}\right)}$$

where *E* is the e.m.f. of the power supply, *C* is the capacitance of the capacitor and *R* is the resistance of the resistor.

(a) A graph is plotted of $\ln I$ on the *y*-axis against *t* on the *x*-axis.

Determine expressions for the gradient and the *y*-intercept.

gradient = ...

y-intercept = ...
[1]

(b) Values of t and I are given in Table 2.1.

Table 2.1

t / s	I / μA	ln (I / μA)
0	46 ± 2	
12	40 ± 2	
24	34 ± 2	
36	28 ± 2	
48	24 ± 2	
60	20 ± 2	

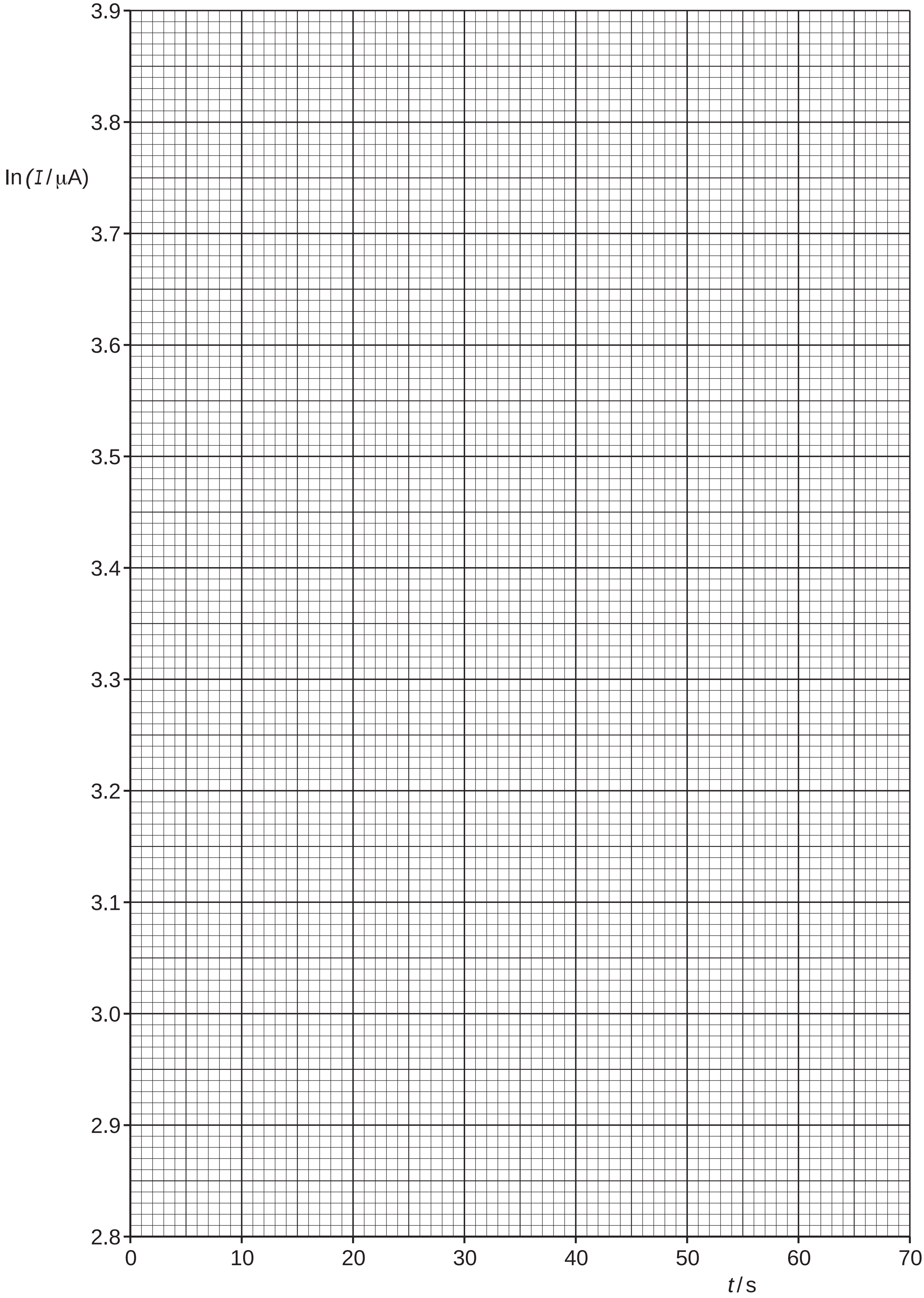
Calculate and record values of ln (I / μA) in Table 2.1.
Include the absolute uncertainties in ln (I / μA). [2]

(c) (i) Plot a graph of ln (I / μA) against t / s.
Include error bars for ln (I / μA). [2]

(ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ... [2]


ln (I / μA)
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3.0
2.9
2.8
0
10
20
30
40
50
60
70
t / s

(iv) Determine the y-intercept of the line of best fit. Do **not** include the absolute uncertainty in your answer.

y-intercept = ... [1]

(d) **(i)** Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of C and E. Include appropriate units.

Data: $R = 150\,\text{k}\Omega$

C = ...

E = ...
[3]

(ii) The percentage uncertainty in the resistance R of the resistor is 5%.

Determine the absolute uncertainty in C.

absolute uncertainty in C = ... [1]

(e) Using your results, determine the value of I after the capacitor has discharged through the resistor for 2.0 minutes.

I = ...A [1]

[Total: 15]