Cambridge International AS & A Level

**Cambridge Assessment International Education**
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER | | | | | |

CANDIDATE NUMBER | | | | |

*2163865080*

**PHYSICS** **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2019**

**1 hour 15 minutes**

Candidates answer on the Question Paper.

No Additional Materials are required.

**READ THESE INSTRUCTIONS FIRST**

Write your centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **8** printed pages.


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**[Turn over**

**1** A student is investigating the behaviour of a capacitor-resistor circuit as shown in Fig. 1.1.

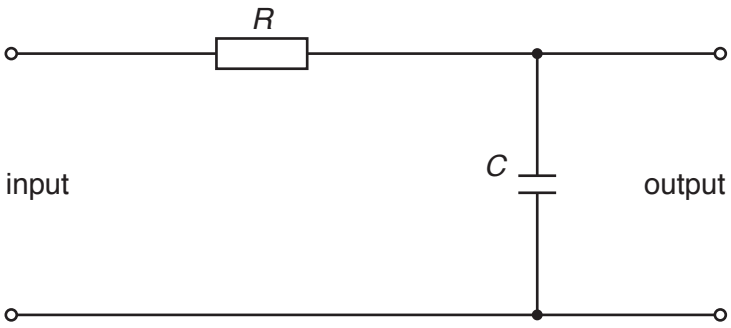



**Fig. 1.1**

A neon lamp flashes on and off when it is connected across the capacitor with a potential difference $V_F$ across the lamp of approximately 90 V.

The student has a number of unmarked resistors.

It is suggested that the period $T$ of the flashes of the lamp is related to the resistance $R$ of the resistor by the expression

$$T = RCK$$

where $C$ is the capacitance of the capacitor and $K$ is a constant.

The constant K is given by

$$K = \ln\left(\frac{V_i - V_L}{V_i - V_F}\right)$$

where $V_i$ is the potential difference across the input, $V_F$ is the potential difference required to make the lamp flash and $V_L$ is a constant.

Design a laboratory experiment to test the relationship between $T$ and $R$.
Explain how your results could be used to determine a value for $K$ and $V_L$.

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.

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**Diagram**

[15]

**2** A student is investigating the motion of a small steel ball in cooking oil. A measure of the oil's resistance to the ball's motion is called viscosity. Viscosity has the units pascal second (Pa s).

The student drops a ball into a cylinder of oil as shown in Fig. 2.1.

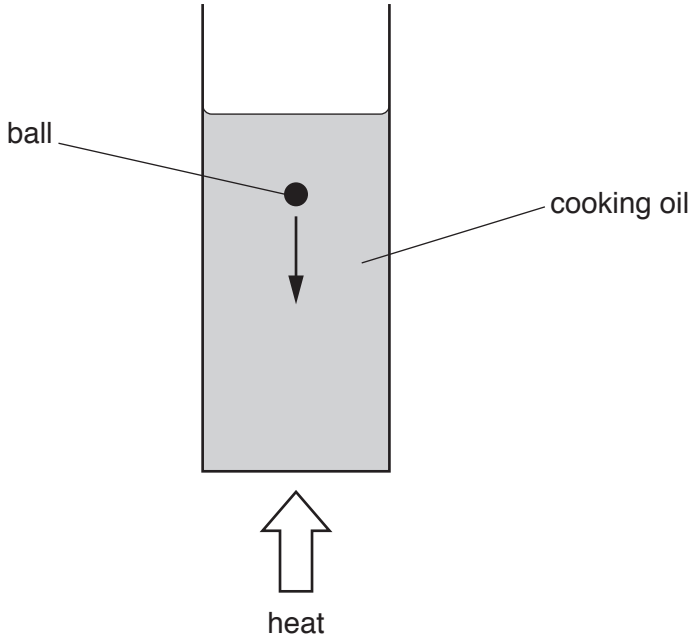



**Fig. 2.1**

The velocity of the ball is measured when it becomes constant and then the viscosity of the oil is determined.

The experiment is repeated for different temperatures of oil.

It is suggested that the viscosity $\eta$ and the Celsius temperature $\theta$ are related by the equation

$$\eta = p\theta^q$$

where $p$ and $q$ are constants.

**(a)** A graph is plotted of lg $\eta$ on the $y$-axis against lg $\theta$ on the $x$-axis.

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

gradient = .....

$y$-intercept = .....

[1]

**(b)** Values of $\theta$ and $\eta$ are given in Fig. 2.2.

| $\theta$/°C | $\eta/10^{-3}$ Pa s | lg ($\theta$/°C) | lg ($\eta/10^{-3}$ Pa s) |
|---|---|---|---|
| 38 | 41 ± 1 | | |
| 46 | 32 ± 1 | | |
| 55 | 25 ± 1 | | |
| 64 | 20 ± 1 | | |
| 72 | 17 ± 1 | | |
| 79 | 14 ± 1 | | |

**Fig. 2.2**

Calculate and record values of lg ($\theta$/°C) and lg ($\eta/10^{-3}$ Pa s) in Fig. 2.2.
Include the absolute uncertainties in lg ($\eta/10^{-3}$ Pa s). [2]

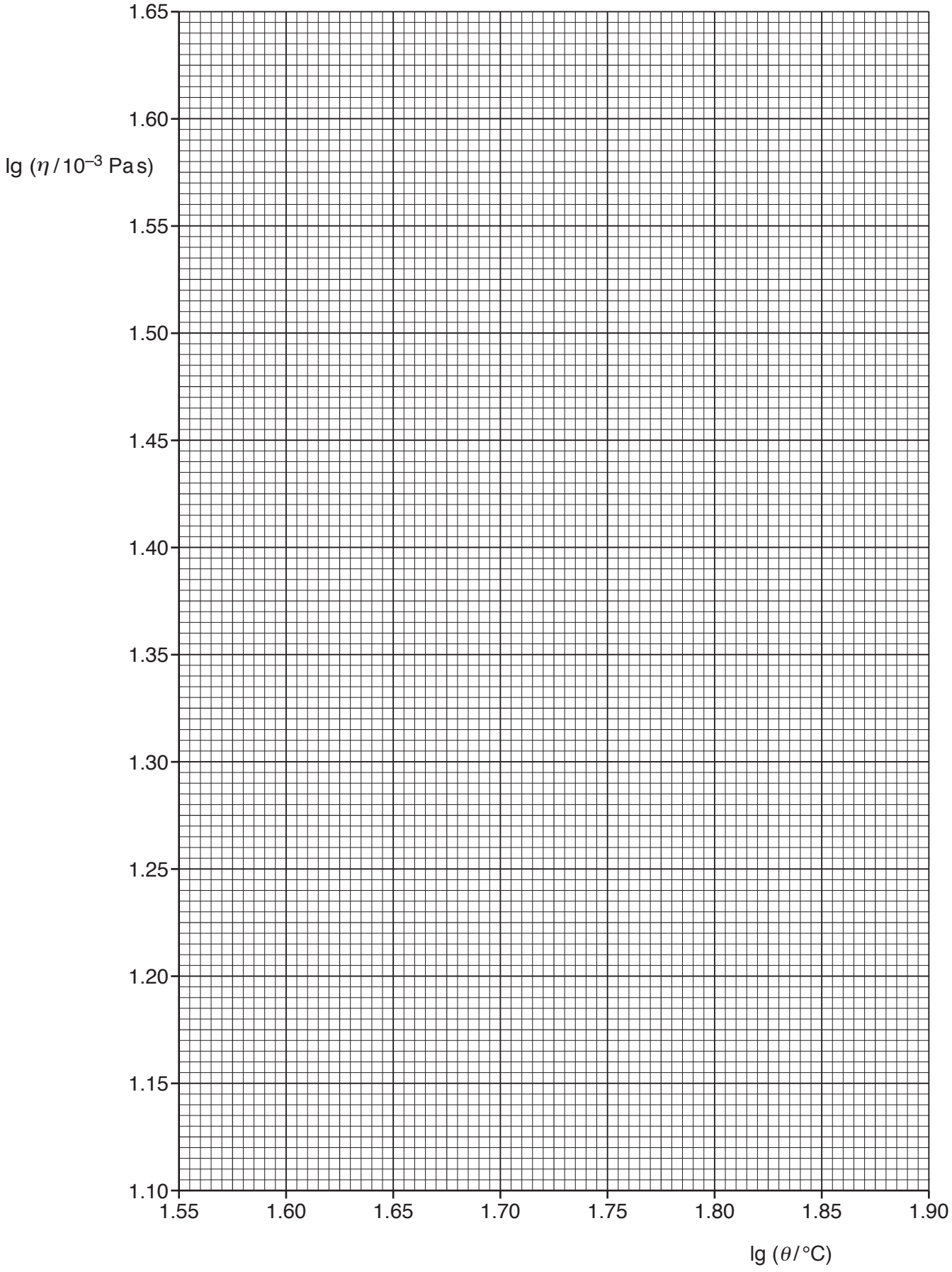
**(c) (i)** Plot a graph of lg ($\eta/10^{-3}$ Pa s) against lg ($\theta$/°C).
Include error bars for lg ($\eta/10^{-3}$ Pa s). [2]

**(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]

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[Turn over

**(iv)** Determine the *y*-intercept of the line of best fit. Include the absolute uncertainty in your answer.

*y*-intercept = ..... [2]

**(d)** Using your answers to **(a)**, **(c)(iii)** and **(c)(iv)**, determine the values of $p$ and $q$. Include the absolute uncertainties in your answer.

$p$ = .....

$q$ = .....
[3]

**(e)** Using your answers to **(d)**, determine the temperature $\theta$ at which the viscosity of the cooking oil is 0.10 Pa s.

$\theta$ = ..... °C [1]

[Total: 15]

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