

A Level Physics A

H556/03 Unified physics

Question Set 3

- 1 A student is investigating how the discharge of a capacitor through a resistor depends on the resistance of the resistor.
The equipment is set up as shown in Fig. 3.1.

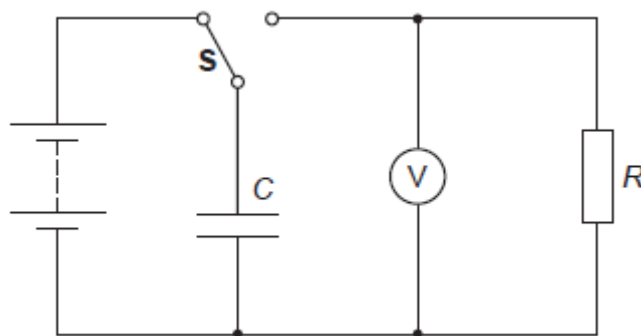


Fig. 3.1

The student charges the capacitor of capacitance C and then discharges it through a resistor of resistance R using switch S . After a time $t = 15.0$ s the student records the potential difference V across the capacitor. The student repeats this procedure for different values of R .

It is suggested that V and R are related by the equation

$$V = V_0 e^{-\frac{t}{CR}}$$

where V_0 is the initial potential difference across the capacitor and t is the time over which the capacitor has discharged.

(a)

The student decides to plot a graph of $\ln(V/V_0)$ on the y -axis against $\frac{1}{R}$ on the x -axis to obtain a straight line graph. Show that the magnitude of the gradient is equal to $\frac{15}{C}$.

[2]

(b) Values of R and V at $t = 15.0$ s are given in the table below.

$R/\text{k}\Omega$	V/V	$\left(\frac{1}{R}\right)/10^{-6}\Omega^{-1}$	$\ln(V/V_0)$
56	3.0 ± 0.2	18	
68	3.7 ± 0.2	15	1.31 ± 0.06
100	5.0 ± 0.2	10	1.61 ± 0.04
150	6.4 ± 0.2	6.7	1.86 ± 0.03
220	7.3 ± 0.2	4.5	1.99 ± 0.03
330	8.1 ± 0.2	3.0	2.09 ± 0.03

(i) Complete the missing value of $\ln(V/V_0)$ and its absolute uncertainty in the table above.

[1]

- (ii) Use the data to complete the graph of Fig. 3.2. Four of the six points have been plotted for you. [2]

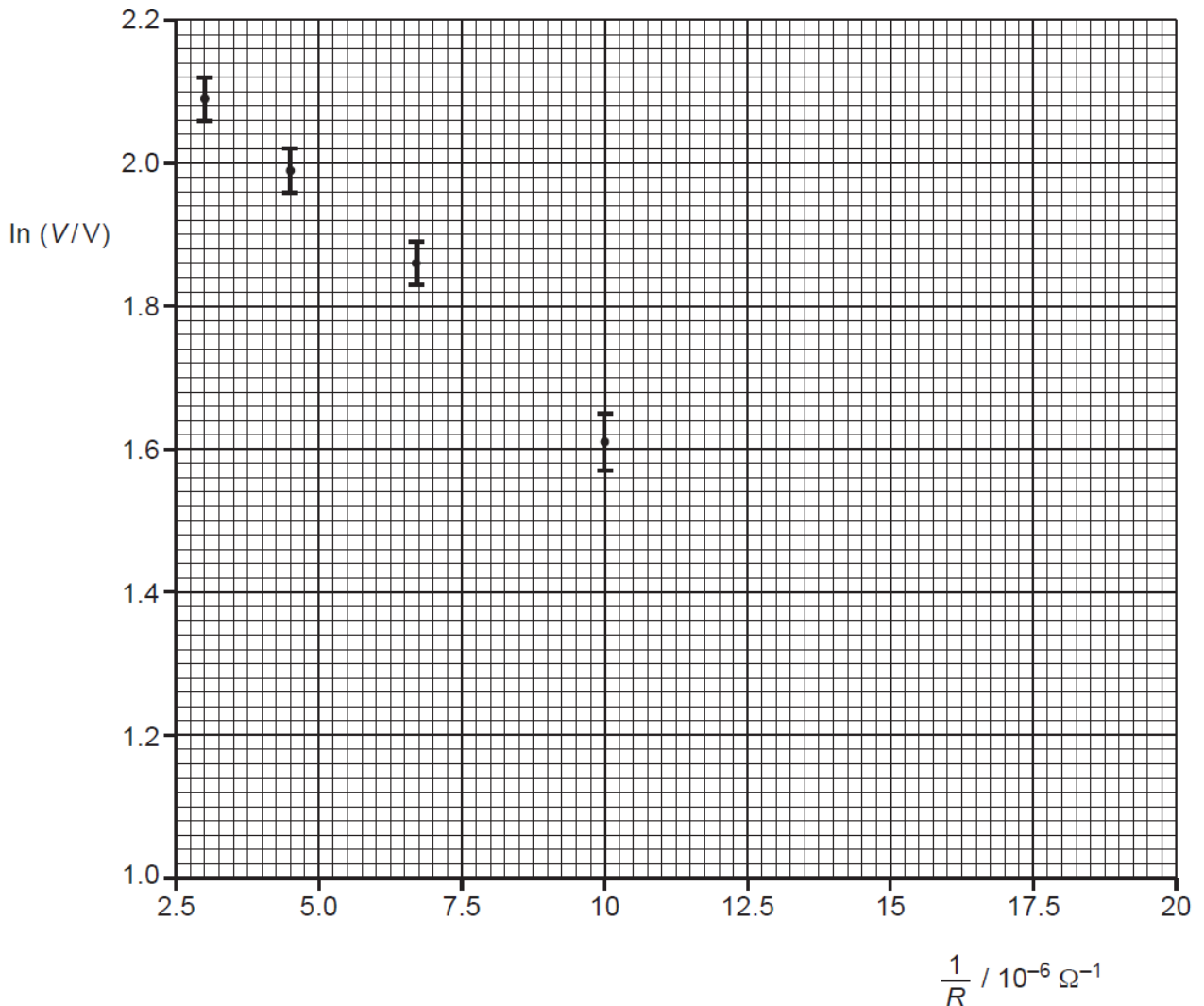


Fig. 3.2

- (iii) Use the graph to determine a value for C . Include the absolute uncertainty and an appropriate unit in your answer.

$$C = \dots \pm \dots \text{ unit} \dots [4]$$

- (c) Determine the value of R , in $k\Omega$, for which the capacitor discharges to 10% of its original potential difference in 15.0s. Show your working.

$$R = \dots k\Omega [2]$$

Total Marks for Question Set 3: 11

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