2 A student investigates a circuit containing capacitors. The circuit is connected with a capacitor of capacitance A, as shown in Fig. 2.1.

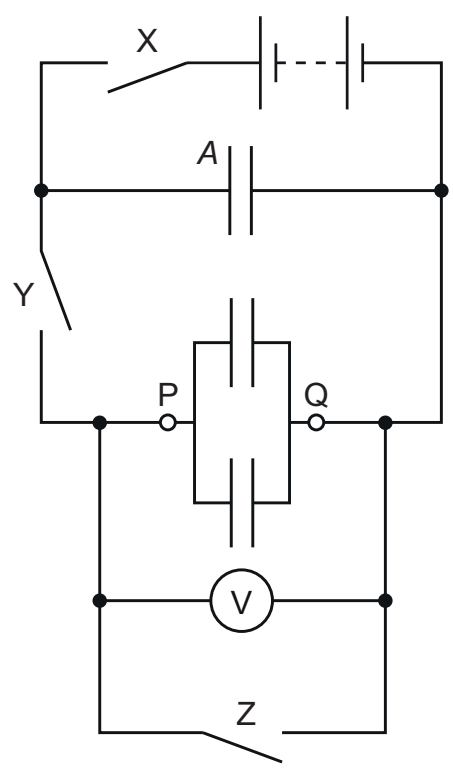


Fig. 2.1

Two capacitors, each of capacitance C, are connected in parallel between P and Q.

Initially, switch X and switch Z are closed and switch Y is open.

Switches X and Z are opened. Switch Y is then closed. The maximum potential difference between P and Q is measured using the voltmeter. This procedure is repeated and the mean maximum potential difference V between P and Q is determined.

The experiment is then repeated by changing the number n of capacitors, each of capacitance C, connected in parallel between P and Q.

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

$$EA = V(nC + A)$$

where E is the electromotive force (e.m.f.) of the battery.

(a) A graph is plotted of $\frac{1}{V}$ on the y-axis against n on the x-axis.

Determine expressions for the gradient and y-intercept.

gradient = ...

y-intercept = ...
[1]

(b) Values of n and the two measured values of the maximum potential difference V_1 and V_2 are given in Table 2.1.

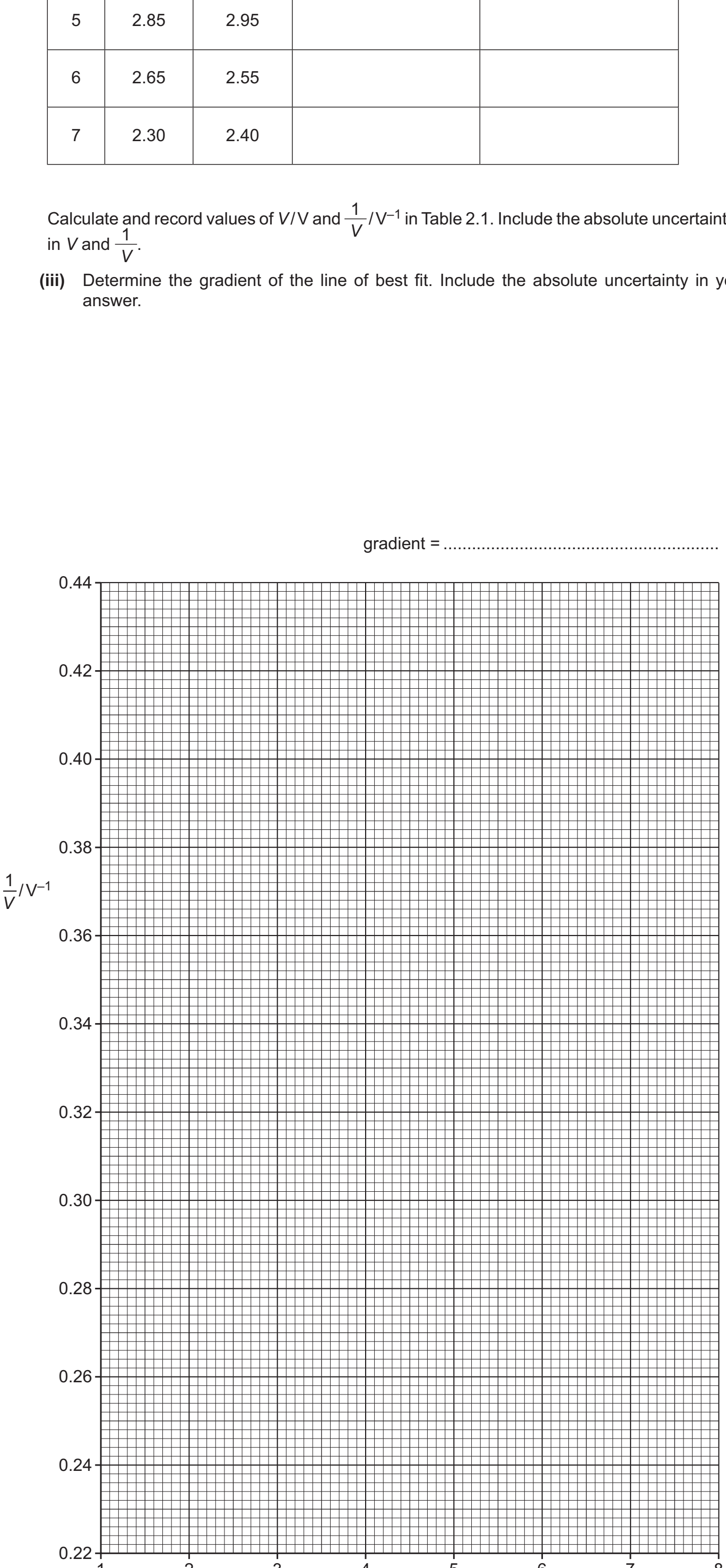
Table 2.1

n	V_1/V	V_2/V	V/V	$\frac{1}{V}$/V^{-1}
2	4.30	4.20		
3	3.65	3.75		
4	3.30	3.20		
5	2.85	2.95		
6	2.65	2.55		
7	2.30	2.40		

Calculate and record values of V/V and $\frac{1}{V}$/V^{-1} in Table 2.1. Include the absolute uncertainties in V and $\frac{1}{V}$. [2]

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

gradient = ... [2]



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

y-intercept = ... [2]

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

Data: $A = (2.2 \pm 0.2)$ mF

E = ...

C = ...
[2]

(ii) Determine the percentage uncertainty in your value of C.

percentage uncertainty = ...% [1]

(e) The experiment is repeated with 10 capacitors, each of capacitance C, connected in parallel between P and Q. Determine the maximum potential difference V between P and Q.

V = ...V [1]

[Total: 15]