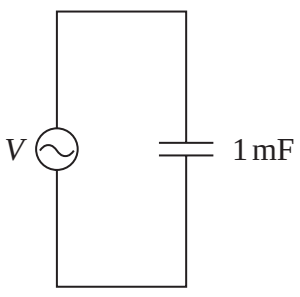
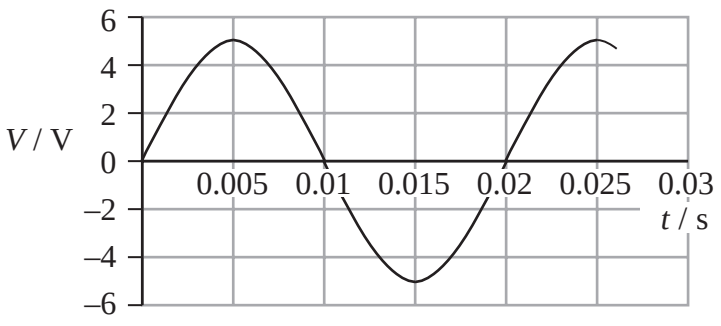
18 The circuit shows a 1 mF capacitor connected to an a.c. supply. The graph shows how the potential difference V varies with time t.





(a) (i) Calculate the root-mean-square potential difference.

(1)

Root-mean-square potential difference = ...

(ii) The formula used to generate this graph is $V = 5\sin(100\pi t)$

Explain why this formula leads to the graph above.

(3)

(b) A spreadsheet is used to model how the current I in the 1 mF capacitor varies with t. Six rows of the spreadsheet are shown below.

	A	B	C	D	E	F	G
	t / s	**Δt / s**	**V / V**	**$Q_{initial}$ / C**	**Q_{final} / C**	**ΔQ / C**	**I / A**
7	0.0050	0.0010	5.00	0.00476	0.00500	0.00024	0.24
8	0.0060	0.0010	4.76	0.00500	0.00476	–0.00024	–0.24
9	0.0070	0.0010	4.05	0.00476	0.00405	–0.00071	–0.71
10	0.0080	0.0010	2.94	0.00405	0.00294	–0.00111	–1.11
11	0.0090	0.0010	1.55	0.00294	0.00155	–0.00139	–1.39
12	0.0100	0.0010	0	0.00155	0.00000	–0.00155	–1.55

(i) Explain how cell E10 has been calculated.

(2)

(ii) State the formula used to calculate cell G11.

(1)

(iii) Calculate the maximum energy stored on the capacitor.

(2)

Maximum energy stored on the capacitor = ...

(c) The spreadsheet data are used to plot a graph to show how I varies with t. This is shown as a dashed line below.

The corresponding graph of V against t is also shown as a continuous line.

Deduce whether the capacitor dissipates power over one cycle of the a.c. supply.

(4)

(Total for Question 18 = 13 marks)