Answer **all** questions from this section.

1 **(a)** **(i)** Express the volt (V) in SI base units.

V = ... [2]

(ii) The unit for potential difference (p.d.) and electromotive force (e.m.f.) is the volt.

Explain the difference between p.d. and e.m.f. using energy considerations.

.....

.....

..... [2]

(b) A sound system for a concert is being designed. One part of the system consists of an amplifier and speaker.

The speaker dissipates energy as sound. Speakers are available with a range of resistances.

To study the electrical properties of the system, a cell with e.m.f 1.5 V and internal resistance 25 Ω (representing the amplifier) is connected to a variable resistor (representing the speaker).

The resistance of the variable resistor can be changed from 0 to 100 Ω.

(i) Calculate the potential difference across the variable resistor when its resistance is 100 Ω.

potential difference = ... V [2]

(ii) Calculate the current through the variable resistor when its resistance is 100 Ω.

current = ... A [2]

(c) The resistance R of the variable resistor is altered. For each value of R, the potential difference V across the variable resistor is measured, the current I through the variable resistor is measured three times and the average current I_{avg} determined. Table 1.1 shows the data recorded.

I_{avg} is the average of the three I measurements.

Table 1.1

R/Ω	V/V	I_1/mA	I_2/mA	I_3/mA	I_{avg}/mA
5	0.25	51	49	50	50
10	0.43	45	41	43	43
20	0.67	33	33	32	33
30	0.82	26	27	28	27
40	0.92	23	23	23	23
50	1.00	18	19	23	
60	1.06	17	18	19	18
70	1.11	16	16	15	16
80	1.14	15	15	13	14

(i) Complete Table 1.1. [1]

(ii) Show that the power P dissipated in the variable resistor when its resistance is 40 Ω is 21 mW.

[2]

(iii) The power dissipated in the variable resistor is P. Information from Table 1.1 is used to plot data points on a P against R grid.

Use your answer from **(c)(ii)** to complete Fig. 1.1 and add a line of best fit. [3]

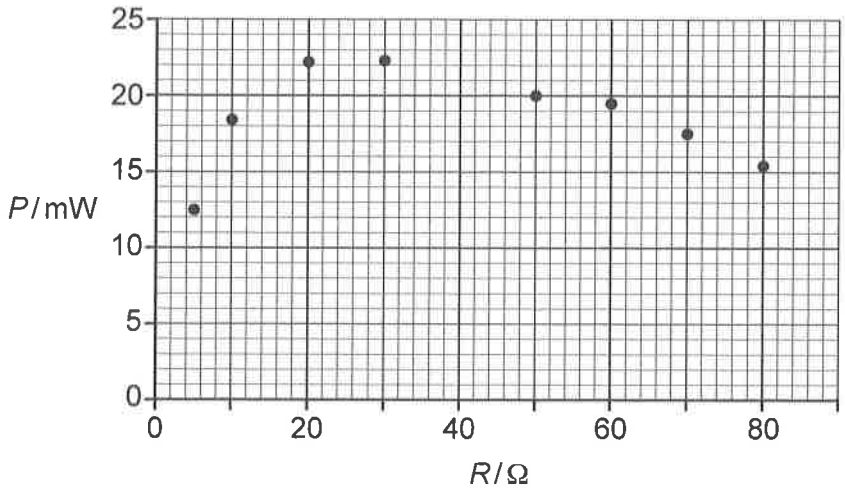

Fig. 1.1

(iv) Use Fig. 1.1 to estimate the value of R at which P is a maximum and compare it with the internal resistance of the cell.

.....

..... [2]

(d) The sound system designer requires the sound system to be as loud as possible.

Use the ideas from parts **(b)** and **(c)** to suggest how the sound system should be designed to make it as loud as possible.

.....

.....

..... [2]

[Total: 18]