29.5.3 Physics Paper 3 (232/3)

1 You are provided with the following:

- two retort stands, two clamps, two bosses
- a stop-watch
- a half-metre rule
- a metre rule
- some thread
- some sellotape
- two 50g masses

Proceed as follows:

(a) Using the two retort stands, set up two simple pendulums each of length 80cm and 46cm apart such that their points of support are in the same horizontal plane.

Ensure that the retort stands are firmly held on the bench.
Using the sellotape provided, attach a half-metre rule horizontally on to the strings of the pendulums, such that its upper edge is at a distance D = 20cm below the points of suspension. Ensure that the pendulums hang freely without touching the bench.

Figure 1 shows the set up.

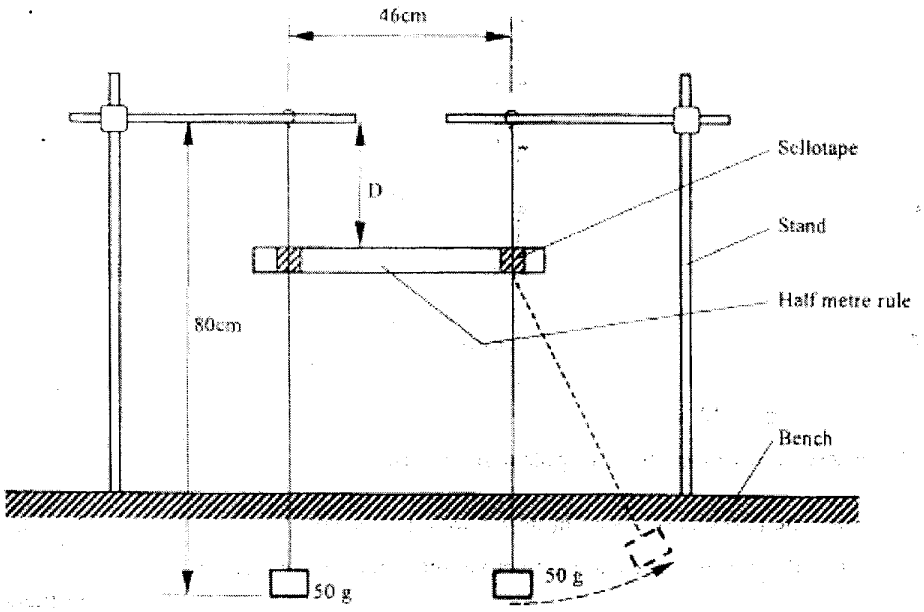

Figure 1

(b) While holding one of the 50g mass of one pendulum, displace the other 50g mass to one side, (see the dotted position in figure 1) and then release both pendulums simultaneously.

(c) Observe the motion of the two masses for about 30 seconds and hence:

(i) describe the pattern of the oscillation of the two masses; **(1 mark)**

(ii) state a reason for this pattern in terms of mechanical energy. **(1 mark)**

(d) Now focus on any **one** of the two pendulums.
Measure and record in table 1 the time T **taken** for the motion to change from one zero-amplitude state to the next zero-amplitude state.
(Zero-amplitude is when the pendulum is momentarily at rest.)

(e) Repeat the procedure in (d) for other values of D shown in table 1.
(Hint: D can be varied by sliding the half-metre rule downwards along the strings of the pendulums without removing the sellotape.) Complete the table.

Do not dismantle the apparatus yet.

Table 1

D (cm)	20	25	30	35	40	45	50
T(s)							
$f = \frac{1}{T}(s^{-1})$							

(7 marks)

(f) Plot a graph of f (y axis) against D. (5 marks)

(g) Use the graph to determine the frequency f_b , the value of f when D = 38 cm.
f_b = ... (1 mark)

(h) Now set the distance D at 38cm, and repeat the procedure in (b) above.

Measure the time interval t between two successive zero-amplitudes for **one** pendulum and count the number n of the oscillations in the interval.

n = ... (1 mark)

t = ... (1 mark)

(i) Determine f_o given that, $f_o = \frac{n}{t}$ (1 mark)

(j) Determine f_s given that $f_s = f_1 - f_o$ (2 marks)

2 You are provided with the following:

- a voltmeter
- an ammeter
- a galvanometer
- two dry cells and a cell holder
- a switch
- eight connecting wires each with a crocodile clip at one end
- a resistance wire labelled **X**
- a resistance wire labelled **AB** mounted on a millimeter scale
- six 10 ohm carbon resistors
- a jockey or crocodile clip

Proceed as follows:

(a) Set up the circuit, with the cells in **parallel** as shown in figure 2.

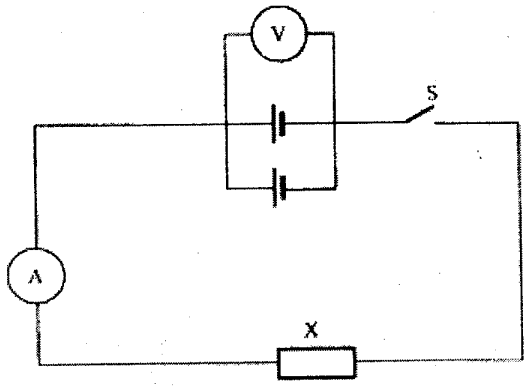

Figure 2

(b) With the switch open, record the reading E of the voltmeter.

E = ... volts. **(1 mark)**

(c) Close the switch. Record the current I flowing in the circuit and the potential difference V across the cells.

I = ... A **(1 mark)**

V = ... volts **(1 mark)**

(d) Given that $E = V + Ir$ and $V = IX$
determine the internal resistance r of the combined cells and the resistance of the wire labelled **X**.

r = ... ohms **(1 mark)**

X = ... ohms **(1 mark)**

(e) Now set up the circuit as shown in figure 3. Z is one of the 10 ohms carbon resistors.

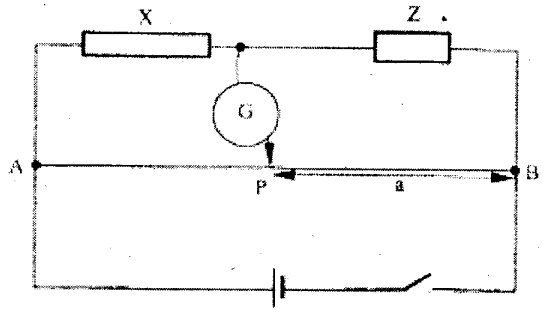

Figure 3

(f) Close the switch. Tap the jockey at various points on the wire AB and locate a point P at which the galvanometer shows zero deflection. Measure and record in table 2 the length a, where $a = PB$.

(g) Repeat the procedure in (f) using **two resistors** in parallel, **three** resistors in parallel, **four** resistors in parallel, **five resistors in parallel** and **six** resistors in parallel. Record your readings in table 2. Complete the table. R is the effective resistance for the parallel combination.

Table 2

Number of 10Ω carbon resistors	**One**	**Two**	**Three**	**Four**	**Five**	**six**
a (cm)						
$\frac{1}{R}(\Omega^{-1})$						
$\frac{1}{a}(cm^{-1})$						

(6 marks)

(h) Plot a graph of $\frac{1}{a}$ (y-axis) against $\frac{1}{R}$ **(5 marks)**

(i) Determine the slope, m, of the graph. **(2 marks)**

(j) Given that $\frac{1}{a} = \frac{X}{kR} + \frac{1}{k}$, where $k = 100\text{cm}$.

Use the graph to determine X. **(2 marks)**