1. (i) *a* b c d e f g h *i* j k *l* m n o p q r s t u *v* *w* *x* *y* z @¼ = (6½ marks)

  (ii) A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

@¼ = 6½ marks

(b) (i) m (ii) kg (iii) s (iv) kg m^{-3} (v) Nm^{-2} (vi) A (vii) V (viii) Ω
  (ix) J kg^{-1}K^{-1} (x) $^{\circ}$C (or K) @½ = 5 marks

2.

x (cm)	y (cm)	$\dfrac{x}{y}$	$\dfrac{y}{x}$	*x*y (cm^2)	1/*x* (cm^{-1})	1/y (cm^{-1})
10.4	8.1	1.3	0.78	84	0.0962	0.123
13.1	8.7	1.5	0.66	114	0.0763	0.115
16.8	9.2	1.8	0.55	155	0.0595	0.109
18.9	9.5	2.0	0.50	180	0.0529	0.105
23.0	10.2	2.3	0.44	235	0.0435	0.098
27.5	11.5	2.4	0.42	316	0.0364	0.087

Each scores ¼ mark giving a total of **14 marks**
OR

x/cm	y/cm	*x*/y	y/*x*	*x*y(m^2)	1/*x*(m^{-1})	1/y(m^{-1})
10.4	8.1	1.3	0.78	0.0084	9.62	12.3
13.1	8.7	1.5	0.66	0.0114	7.63	11.5
16.8	9.2	1.8	0.55	0.0155	5.95	10.9
18.9	9.5	2.0	0.50	0.0180	5.29	10.5
23.0	10.2	2.3	0.44	0.0235	4.35	9.8
27.5	11.5	2.4	0.42	0.0316	3.64	8.7

3.

Time for 20 oscill (s)	f (Hz)	T (s)	T^2 (s^2)
21.67	0.9229	1.084	1.175
23.07	0.8669	1.154	1.332
26.90	0.7435	1.345	1.809
30.60	0.6536	1.530	2.341
34.04	0.5875	1.702	2.897

OR:

Time for 20 oscill (s)	f (Hz)	T (s)	T^2 (s^2)
21.67	0.9229	1.084	1.174
23.07	0.8669	1.154	1.331
26.90	0.7435	1.345	1.809
30.60	0.6536	1.530	2.341
34.04	0.5875	1.702	2.897

Each scores ¼ mark giving a total of **7 marks**

4. (a) $t = \dfrac{2.52 + 2.52 + 2.51 + 2.50}{4} \Rightarrow \boldsymbol{½}$ = ½ mark

   = **2.51 mm**   (**½ + ½**) $\Rightarrow$ = 1½ marks

   (b)   Density $= \dfrac{m}{tlw}$ $\Rightarrow \boldsymbol{½}$ = ½ mark

   (c)   Density $= \dfrac{66.4 \times 10^{-3}}{2.52 \times 10^{-3} \times 7.8 \times 10^{-2} \times 4.7 \times 10^{-2}}$ = ½ mark

   = **7.2 x 10³ kg**   (1 + ½) $\Rightarrow$ = 1½ marks

5.

l (m)	u (ms⁻¹)	l^3 (m³)	u^2 (m²s⁻²)	$\log_{10}l^3$	$\log_{10}u^2$
0.760	0.945	0.439	0.893	-0.358	-0.049
0.660	0.840	0.287	0.706	-0.542	-0.151
0.575	0.750	0.190	0.563	-0.721	-0.249
0.520	0.670	0.141	0.449	-0.851	-0.348
0.410	0.560	0.069	0.314	-1.161	-0.503
0.330	0.470	0.036	0.221	-1.444	-0.656

Each scores ¼ mark giving a total of **8 marks.** The highlighted values in the first two columns **DO NOT** score since they are already given.

(b) Graph

   T_1 – Title of graph: A graph of $\log_{10}l^3$ against $\log_{10}u^2$ = ½ mark

   T_2 – Axes: Each axis drawn with an arrow in the increasing +ve direction of the plotted quantity. Each labeled with the quantity together with its unit.   @½ = 1 mark

   T_3 – Scales: Uniform, convenient, plotted pts spanning at least ½ page of each axis. The demarcations should be marked. The $\log_{10}u^2$ axis should start from zero.
   @½ = 1 mark

   T_4 – Plotting: Each point plotted as exactly as possible with a sharp pencil using a dot or cross (no shading), a star is not acceptable.   @½ = 3 marks

   T_5 – Best straight line for the plotted points, if at least 4 points were correctly plotted = ½ mark

   T_6 - Δ for slope spanning all the plotted points in each respect.   = ½ mark

   T_7 – Slope s correctly calculated and s = 1.76 – 1.82, to 2 decimal places (provided the coordinates were correctly read from the triangle)   1 + ½ = 1½ marks

   T_8 – Intercept, c, correctly read and c = - 0.25 to -0.29 2 or 3 decimal places (provided the $\log_{10}u^2$ axis indicates the zero value)   ½ + ½ = 1 mark

   T_9 - Correct substitution into **c = $\log_{10}L^3$**   = ½ mark

   T_{10}- L correctly calculated and L = 0.800 to 0.825 m, 3 decimal places (provided T_9 is correct)   1 + ½ = 1½ marks

6. Graph

G_1 – Title of graph: A graph of $\dfrac{1}{a}$ against b^2 = ½ mark

G_2 – Axes: Each axis drawn with an arrow in the increasing +ve direction of the plotted quantity. Each labeled with the quantity together with its unit.   @½ = 1 mark

G_3 – Scales: Uniform, convenient, plotted points spanning at least ½ page of each axis. The demarcations should be marked.   @½ = 1 mark

G_4 – Plotting: Each point plotted as exactly as possible with a sharp pencil using a dot or cross (no shading), a star is not acceptable.   @½ = 4 marks

G_5 – A smooth curve as the best fit.   = 1 mark

G_6 – The minimum value of $\dfrac{1}{a}$ correctly read, procedure indicated on the graph, and its value is

     $0.242 \leq \text{minimum} \leq 0.248 \text{ m}^{-1}$ - calculated to 3 decimal places $1 + ½$ = 1½ marks

G_7 – $a_m = \dfrac{1}{\text{minimum value in } G_6} = 4.03 \leq a_m \leq 4.13 \text{ m}$ $½ + ½$ = 1 mark

G_8 – Correct reading of b_o^2 and $13.2 \leq b_o^2 \leq 14.2 \text{ kg}^{-2}\text{s}^{-2}$ $1 + ½$ = 1½ marks

G_9 – $b_o = \sqrt{b_o^2}$ and $3.63 \leq b_o \leq 3.77 \text{ kg}^{-1}\text{s}^{-1}$ $½ + ½$ = 1 mark

Total mark = 67 marks