1 The Poiseuille equation relating the volume flow rate $\frac{V}{t}$ of a fluid under laminar conditions through a horizontal tube of length *L* and internal radius *r* is

$$\frac{V}{t} = \frac{\pi p r^4}{8\eta L}$$

where *p* is the pressure difference between the two ends of the tube and η is the viscosity of the fluid.

(a) Show that the SI base units for η is kg m^{-1} s^{-1}.

[2]

(b) In an experiment to determine η for water, a student recorded the following measurements in SI units, as shown in Table 1.1.

Table 1.1

quantity	magnitude in SI units	percentage uncertainty / %
$\frac{V}{t}$	1.0×10^{-6}	3
p	500	2
L	0.20	0.5

The internal diameter of the tube was measured and recorded as (0.200 ± 0.002) cm.

(i) Calculate the percentage uncertainty in the internal radius *r* of the tube.

percentage uncertainty = ... % [1]

(ii) Using the results in Table 1.1 and **(b)(i)**, determine η with its associated uncertainty. Give your answer to an appropriate number of significant figures.

η = ... ± ..... kg m^{-1} s^{-1} [4]

(iii) State and explain which measured quantity has the greatest contribution to the uncertainty of η.

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.....[1]

[Total: 8]