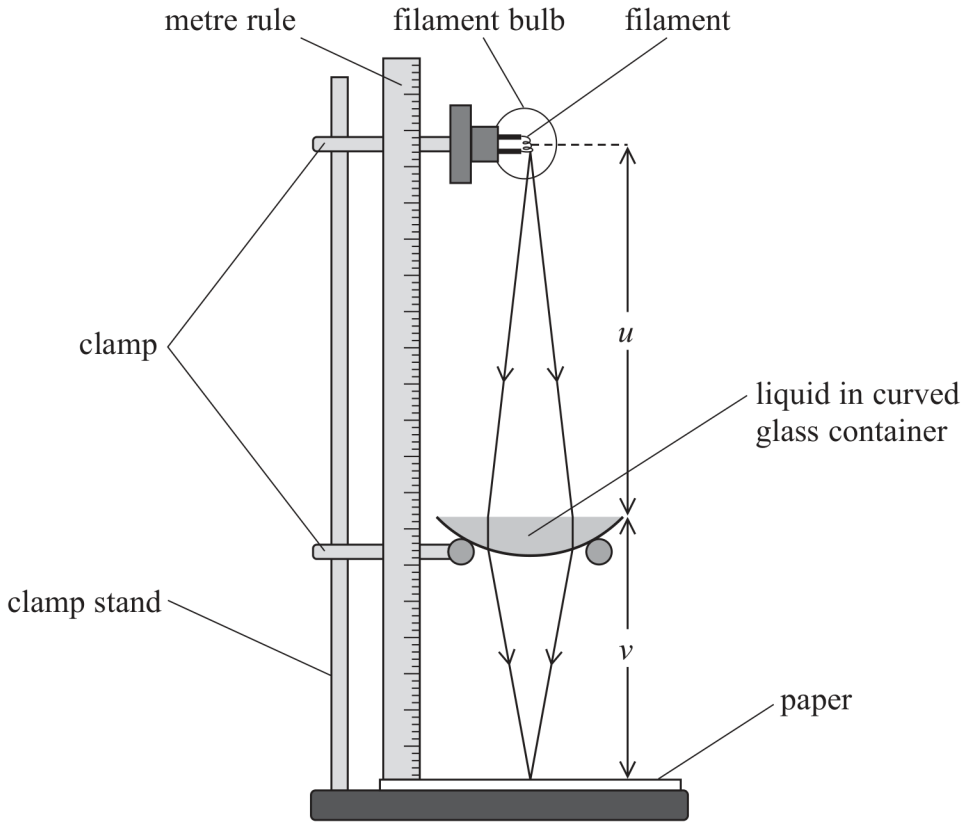
3 A student investigated the refractive index of a liquid.

He placed the liquid into a curved glass container so that the liquid acted as a converging lens.

Light from a filament bulb was transmitted through the lens, as shown.



The student adjusted the position of the filament bulb until a clear image of the filament was formed on the paper.

The student calculated the power P of the lens using the distance u between the container and the filament, and the distance v between the container and the paper.

(a) (i) Describe a method to measure u and v.

(3)

(ii) Identify a possible source of uncertainty in the measurement of u, and how it can be dealt with.

(2)

(b) The student repeated the experiment for different values of v and recorded his results in a table.

u/m	v/m	P/D
0.832	0.325	4.28
0.724	0.342	4.31
0.615	0.374	

(i) For a lens, P can be calculated using

$$P = \frac{1}{u} + \frac{1}{v}$$

Calculate the value missing from the table.

(2)

$P =$ ..... D

(ii) When surrounded by air, the power of a lens this shape can be calculated using the equation

$$P = \frac{n_{\text{lens}} - n_{\text{air}}}{n_{\text{air}}}\left(\frac{1}{r}\right)$$

where r is the radius of the curve that forms the lens
n_{air} is the refractive index of air
n_{lens} is the refractive index of the liquid.

Determine the value of n_{lens} when $r = 0.070\,\text{m}$.

(3)

$n_{\text{lens}} =$ .....

(Total for Question 3 = 10 marks)