2 In this experiment, you will investigate the behaviour of paper on water.

You have been provided with two sheets of tracing paper.

(a) • On one of the sheets of tracing paper, draw two identical rectangles as shown in Fig. 2.1 where c = 4.0 cm and d = 6.0 cm. The orientation of the rectangles must be as shown in Fig. 2.1.

• Add labels A and B to the rectangles, as shown in Fig. 2.1.

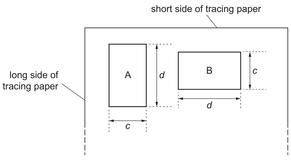

Fig. 2.1

• Use the scissors to cut out the rectangles.

• Take measurements to determine the average value of d.

d = ... cm [1]

(b) (i) • When A is placed flat on the surface of the water in one of the bowls, the shape will curl up as shown in Fig. 2.2. Two edges of the paper will curl and then meet.

Fig. 2.2

The time between placing A on the water and the two edges meeting is T_A.

• Place A flat on the water.

• Determine T_A.

T_A = ...

• Remove A from the water and place it in the empty bowl.

[2]

(ii) Estimate the percentage uncertainty in your value of T_A. Show your working.

percentage uncertainty = ... % [1]

(c) (i) • Repeat the procedure in **(b)(i)** for B. The time between placing B on the water and the two edges meeting is T_B.

T_B = ...

• Remove B from the water.

• Compare your values of T_A and T_B. Record the longer time.

longer time = ...

[1]

(ii) The quantity W is given by

$$W = \frac{\text{longer time}}{\text{shorter time}}.$$

Calculate W.

W = ... [1]

(iii) Justify the number of significant figures that you have given for your value of W.

.....

.....

..... [1]

(d) Repeat **(a)**, **(b)(i)**, **(c)(i)** and **(c)(ii)** using new rectangles with c = 4.0 cm and d = 9.0 cm.

d = ... cm

T_A = ...

T_B = ...

longer time = ...

W = ...

[3]

(e) It is suggested that the relationship between W and d is

$$W^2 = kd$$

where k is a constant.

Using your data, calculate **two** values of k.

first value of k = ...

second value of k = ...

[1]

(f) It is suggested that the percentage uncertainty in the values of k is 20%.

Using this uncertainty, explain whether your results support the relationship in **(e)**.

.....

.....

.....

..... [1]

(g) (i) Describe **four** sources of uncertainty or limitations of the procedure for this experiment.

For any uncertainties in measurement that you describe, you should state the quantity being measured and a reason for the uncertainty.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

(ii) Describe **four** improvements that could be made to this experiment. You may suggest the use of other apparatus or different procedures.

1 .....

.....

2 .....

.....

3 .....

.....

4 .....

.....

[4]

[Total: 20]