
Lab. 1. A spring and balancing of a rod

Student name: ……

HUST ID:……TROY ID:……

Group:……..Time/date:……

I. Purpose of the experiment

In this experiment, you will investigate the equilibrium of a metal rod supported by a spring.

II. Experimental plan

2.1. Tools and Materials

- A metal rod
- A spring
- scissors, pen, …
- A wire
- A stand
- Calculator

2.2. Lab Procedure and Report

(a) (i) Before assembling the apparatus, measure and record the length C_o of the coiled section of the spring, as shown in Fig. 1.1.

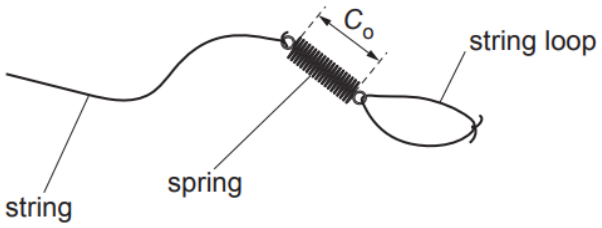


Fig. 1.1

C_o = ... cm [1]

(ii) • Assemble the apparatus as shown in Fig. 1.2 with each nail held securely in a boss.

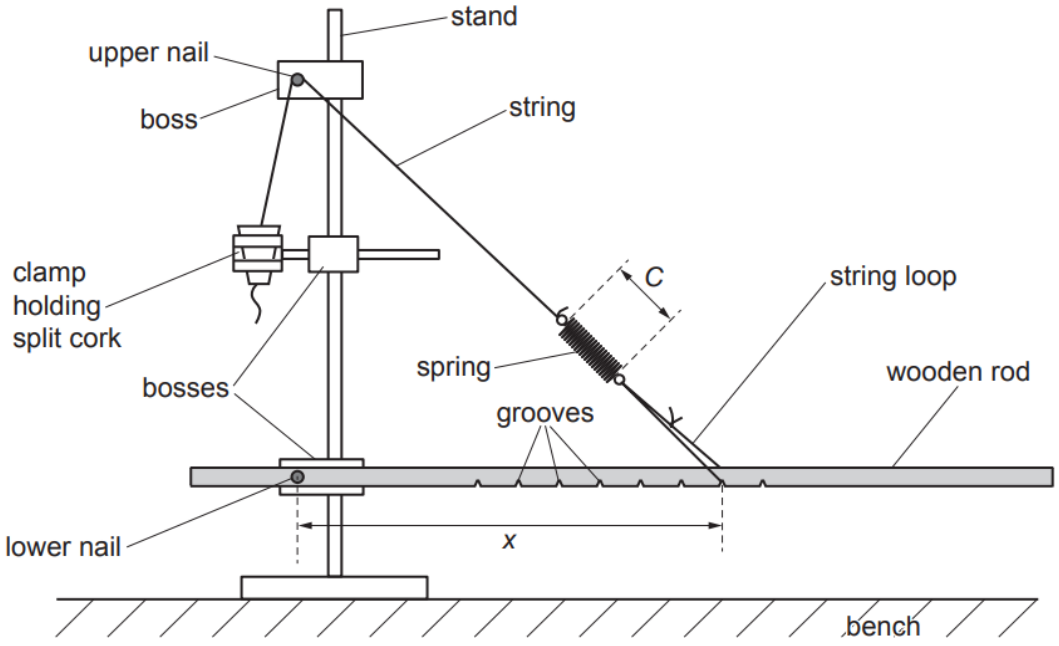


Fig. 1.2

• Adjust the bosses until the upper nail is approximately 35 cm above the bench and the lower nail is approximately 10 cm above the bench.

• Position the string loop in one of the grooves near the middle of the rod.

• Adjust the free end of the string so that the rod is parallel to the bench and then secure it in the split cork.

(b) Move the string loop into another groove and adjust the apparatus so that the rod is parallel to the bench. Measure C and x.

C = ……

x=……

Calculate : $E = C - C_0$

E=…….

Repeat until you have at least six sets of values of C and x. Record your results in a table. Include values of E and $\frac{1}{E^4}$ in your table.

(c) (i) Plot a graph of $\frac{1}{E^4}$ on the y-axis against x on the x-axis. [3]

(ii) Draw the straight line of best fit. [1]

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

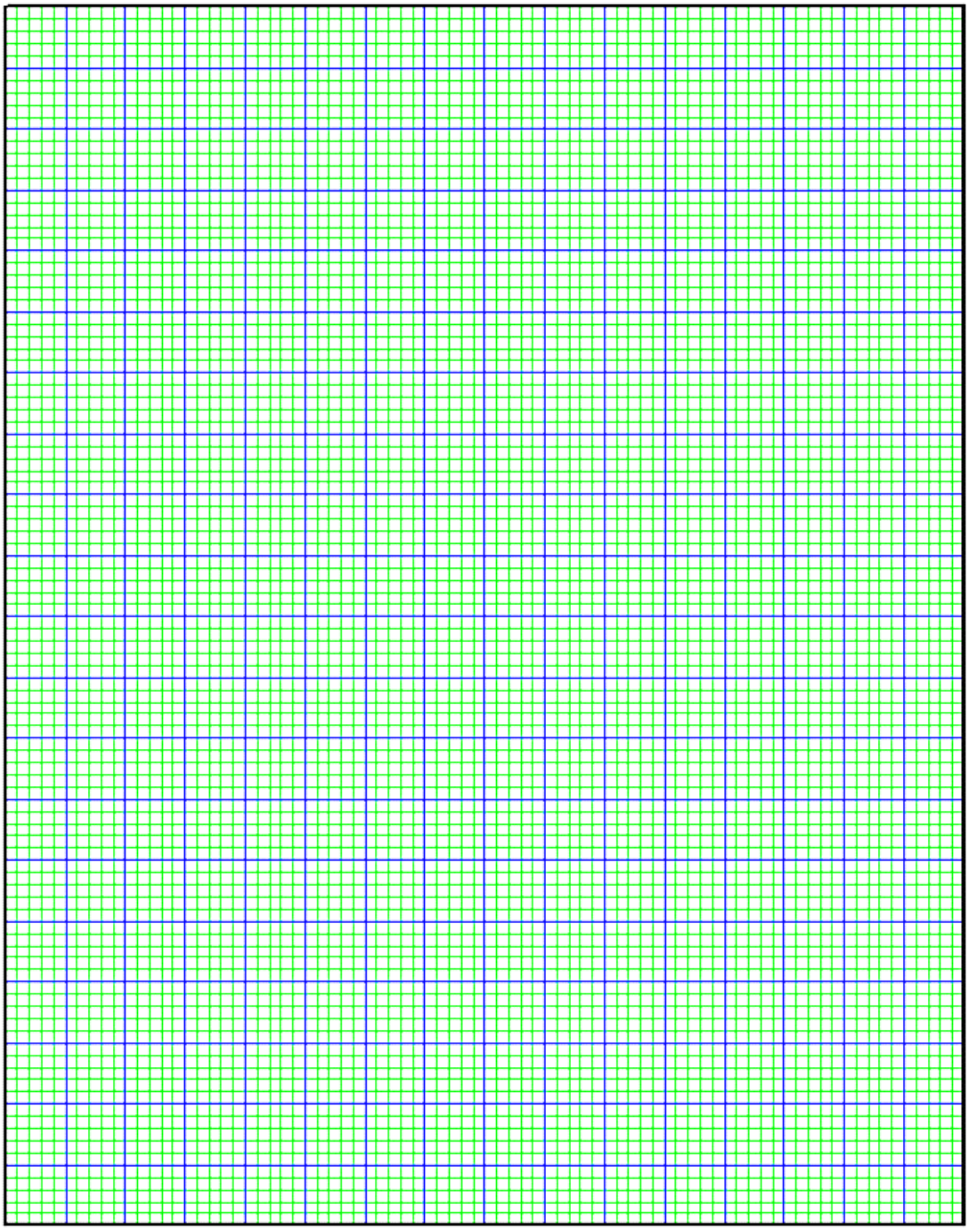
y-intercept = ...

(d) It is suggested that the quantities E and x are related by the equation $\frac{1}{E^4} = ax + b$ where a and b are constants.

Use your answers in (c)(iii) to determine the values of a and b. Give appropriate units.

a = ...

b = ...



Lab. 2. Center of gravity

Student name: ……

HUST ID:……TROY ID:……

Group:……..Time/date:……

I. Purpose of the experiment

In this experiment, you will investigate the equilibrium of a card. You have been provided with a card.

II. Experimental plan

2.1. Tools and Materials

- Grid A and Grid B (on transparent films)
- Ruler (mm scale)
- scissors, pen, …
- A wire
- Calculator
- Nails

2.2. Lab Procedure and Report

(a) The card has one edge of length h and another edge of length x, as shown in Fig. 2.1.

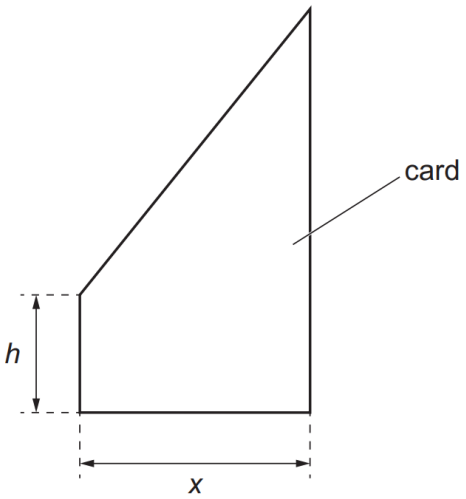


Fig. 2.1

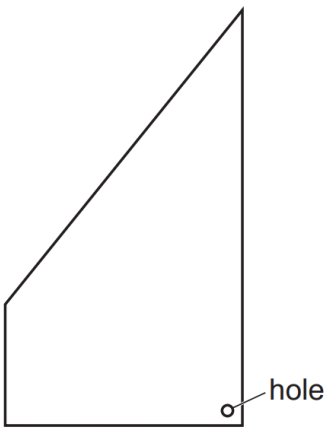


Fig. 2.2

(i) Measure and record h and x.

h = ... cm

x = ... cm

(ii) Calculate the area A of the card, where $A = hx + \frac{5x^2}{8}$.

A = ...cm^2

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

.....

.....

.....

(b) (i) ● Use the nail to make a hole close to one corner of the card, as shown in Fig. 2.2.

● Set up the apparatus as shown in Fig. 2.3

● Push the nail through the hole in the card.

● Fix the nail in the boss.

● Ensure that the card swings freely from the nail.

● Use the set square and the ruler to draw a vertical line on the card below the nail.

● Repeat using two more holes close to two other corners of the card

Fig. 2.4 shows an example of the card with three lines drawn on it. The three lines cross at distances c and d from the two edges of the card shown in Fig. 2.4

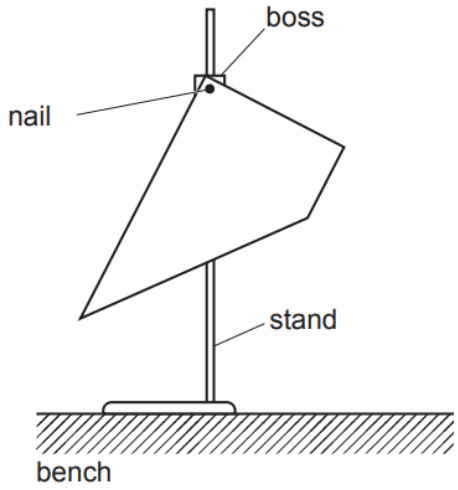


Fig. 2.3

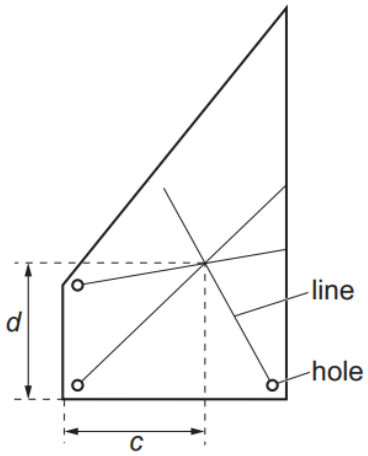


Fig. 2.4

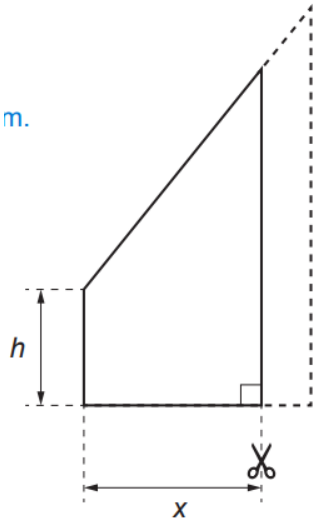


Fig. 2.5

Measure and record c and d.

c = ... cm

d = ... cm

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

percentage uncertainty = ... %

(c) (i) ● Cut the card as shown in Fig. 2.5 so that x is approximately 7.5 cm

● Measure and record x.

x = ... cm

(ii) Repeat (a)(ii) and (b)(i).

A = ... cm^2

c = ... cm

d = ... cm

(d) It is suggested that the relationship between *c, A, h* and x is $\boldsymbol{cA = \frac{hx^2}{2} + kx^3}$ where k is a constant. Using your data, calculate two values of k.

first value of *k* = ...

second value of *k* = ...

(e) It is suggested that the percentage uncertainty in the values of k is 5%. Using this uncertainty, explain whether your results support the relationship in (d).

.....

.....

.....

.....

(f) (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 .....

.....

(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 .....

.....

Lab. 3. Interference patterns

Student name: ……

HUST ID:……TROY ID:……

Group:……..Time/date:……

I. Purpose of the experiment

In this experiment, you will investigate the interference patterns produced by overlaid grids.

II. Experimental plan

2.1. Tools and Materials

- Grid A and Grid B (on transparent films)
- Ruler (mm scale)
- Protractor or angular scale
- Calculator

2.2. Lab Procedure and Report

(a) Grid A is the grid of parallel, equally spaced lines shown in Fig.3.1.

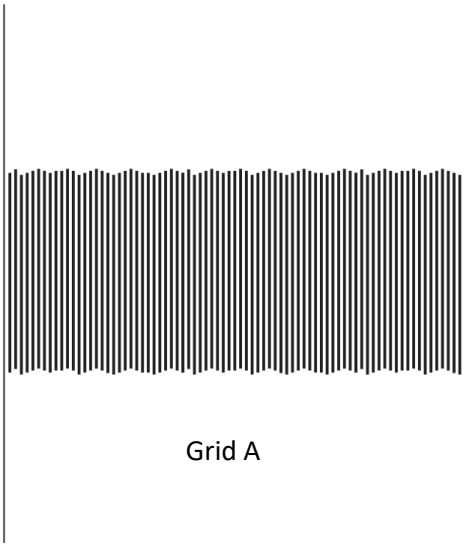


Fig. 3.1.

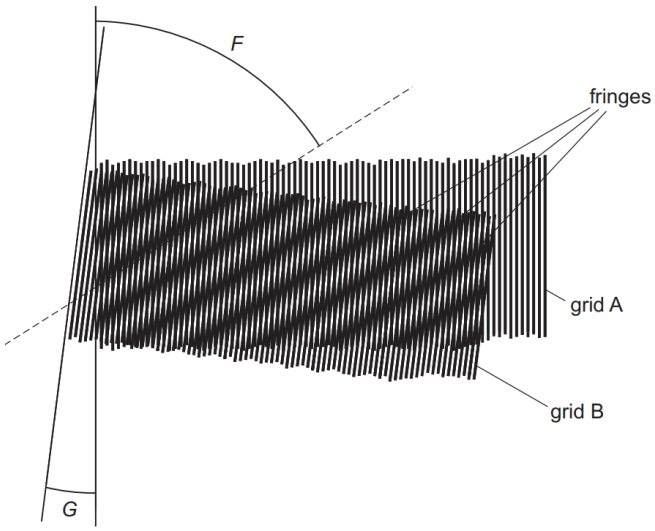


Fig. 3.2.

Take measurements to determine the average spacing s_A between the centres of the lines on grid A.

s_A = ...mm

(b) You have been provided with a second grid (labelled grid B) printed on a transparent sheet.

● Place grid B on top of grid A in Fig. 3.1.

● Turn grid B so that there is a small angle *G* between the grids. A pattern of fringes will be produced, as shown in the example in Fig. 3.2

● **Do not take measurements from Fig. 3.2.**

Measure and record your value of *G* from Fig. 3.1.

G = ... °

● The fringes make an angle F with grid A, as shown in Fig. 3.2. Measure and record your value of F from Fig. 3.1.

F = ... °

(c) Rotate grid B and repeat (b) until you have six sets of values of *G* and *F*.

Use values of *G* in the range 0° to 20°.

Record your results in a table. Include values of sin*F* and sin(*F*–*G*) in your table.

No.	Angle G (°)	Angle F (°)	F – G (°)	sin*F*	sin(*F*–*G*)
1					
2					
3					
4					
5					
6					

(d) (i) Plot a graph of sin(*F*–*G*) on the y-axis against sin*F* on the x-axis.

(ii) Draw the straight line of best fit.

(iii) Determine the gradient and y-intercept of this line.

gradient = ...

y-intercept = ...

(e) It is suggested that the quantities *F* and *G* are related by the equation

$$\boldsymbol{sin(F-G) = psin\,F + q}$$

where *p* and *q* are constants. Use your answers in **(d)(iii)** to determine the values of *p* and *q*.

p = ...

q = ...

(f) The constant p is related to the spacing of the lines of grids A and B by $\boldsymbol{p = \frac{s_B}{s_A}}$ where $\boldsymbol{s_B}$ is the line spacing of grid B. Use your values of p and $\boldsymbol{s_A}$ to calculate $\boldsymbol{s_B}$.

$\boldsymbol{s_B}$ = ...mm [1]