



















(ii) Estimate the percentage uncertainty in your value of  $x$ .

percentage uncertainty = ..... [1]

- (b) (i)
- Pull magnet A down through a short distance.
  - Release the magnet. The magnet will oscillate.
  - Determine the period  $T_1$  of these oscillations.

$T_1 = \dots\dots\dots$  s [2]

- (ii)
- Reverse magnet B in the G-clamp so that its S pole is at the top.
  - Adjust the position of the wooden rod until  $x$  has the same value as in (a)(i).
  - Determine the period  $T_2$  of the oscillations of magnet A.

$T_2 = \dots\dots\dots$  s [1]

(iii) Calculate  $T_2 - T_1$ .

$T_2 - T_1 = \dots\dots\dots$  s [1]

- (c) • Reverse magnet B so that its N pole is at the top.
- Adjust the position of the wooden rod until  $x$  is approximately 10 cm.
  - Measure and record  $x$ .

$x =$  .....

- Repeat (b) using this value of  $x$ .

$T_1 =$  ..... s

$T_2 =$  ..... s

$T_2 - T_1 =$  ..... s  
[3]

- (d) It is suggested that the relationship between  $T_1$ ,  $T_2$  and  $x$  is

$$T_2 - T_1 = \frac{k}{x^3}$$

where  $k$  is a constant.

- (i) Using your data, calculate two values of  $k$ .

first value of  $k =$  .....

second value of  $k =$  .....

(ii) Justify the number of significant figures that you have given for your values of  $k$ .

.....  
.....  
..... [1]

(iii) Explain whether your results in (d)(i) support the suggested relationship.

.....  
.....  
.....  
..... [1]



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

- 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]

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