Determination of spring constant

Stretching a spring

Using the formula F = kx (k = F/x)

Mass /g	Force /N	Length (cm)	Extension /m x10^{-2}
100	**0.98**	17.2	**0**
150	**1.47**	19.3	**2.1**
200	**1.96**	21.5	**4.3**
250	**2.45**	23.6	**6.4**
300	**2.94**	25.6	**8.4**
350	**3.43**	27.6	**10.4**
400	**3.92**	29.7	**12.5**

From the graph $\Delta F/\Delta x = 2.5/10.6 \times 10^{-2}$

Spring constant k = 23 Nm^{-1} (Result given to 2 sig fig – relates to raw data (or is it 3?))

Acceptable column headings

Minimum of 6 observations

Consistent significant figure and decimal places

Readings taken over a wide range with sensible intervals

Note the use of a fiducial marker.

The ruler is precise to 0.1cm.

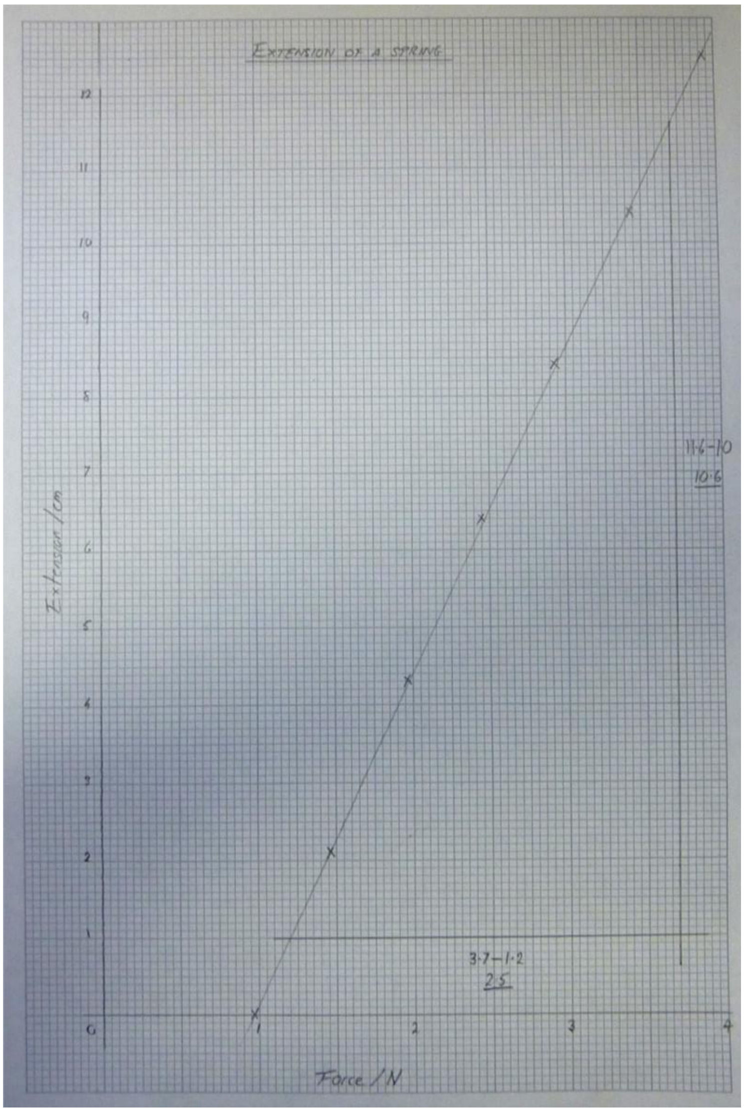
Readings should have been repeated and an average taken

Mass should have been measured to 0.1g using an electronic balance

Sensible axis on graph covering at least 50% of the graph paper in each direction

Line of best fit passes close to all of the points. The scatter shows that the work has been done carefully. Y-intercept important

Calculation of gradient



Determination of spring constant
Oscillating spring

Time for 10 bounces/sec			Av time/sec
8.12	8.22	8.12	0.81

Mass of masses, hanger, spring and blutac = 406.5g

(Time was measured to a precision of 0.01s, This is probably incorrect and should be 0.1s)

$T = 2\pi \sqrt{(m/k)}$

$k = 4\pi^2 m / T^2$

Spring constant k = 24.2 kgs^{-2} (3 sig figs - relates to raw data (or is it 2?))

N.B. Units are homogeneous

Percentage uncertainty

Average percentage uncertainty in measuring the length = 0.1 x 100 / 23.45 = ±0.43%
(average length used)

Percentage uncertainty in measuring mass = 0.1 x 100 / 406.5 = ±0.02%

Percentage uncertainty in measuring time = 0.1 x 100 / 8 = ±1.25%
(time for 10 swings used)

The electronic balance is the most precise piece of equipment used here

It is not possible to calculate the % uncertainty for the first experiment as we have no indication of the precision of the quoted mass values

It would be possible to use the uncertainty of the gradient of the graph using maximum and minimum gradients but the scatter is too small.

The % uncertainty of the second experiment is the sum of the % uncertainty in measuring the mass (±0.02%) plus 2 x the % uncertainty in measuring the period (T^2) (2 x ±1.25%)

% uncertainty = ±2.52%