Part I
Force, Motion, Energy

Chapter 1. Making measurements

1.1 Physical quantities and measurement techniques

Core

1 Describe the use of rulers and measuring cylinders to find a length or a volume

2 Describe how to measure a variety of time intervals using clocks and digital timers

3 Determine an average value for a small distance and for a short interval of time by measuring multiples (including the period of oscillation of a pendulum)

1.4 Density

Core

1 Define density as mass per unit volume; recall and use the equation

$$\rho = \frac{m}{V}$$

2 Describe how to determine the density of a liquid, of a regularly shaped solid and of an irregularly shaped solid which sinks in a liquid (volume by displacement), including appropriate calculations

3 Determine whether an object floats based on density data

Supplement

4 Determine whether one liquid will float on another liquid based on density data given that the liquids do not mix

1.1 Measuring length

1 Fig 1.1 shows part of a measuring instrument.

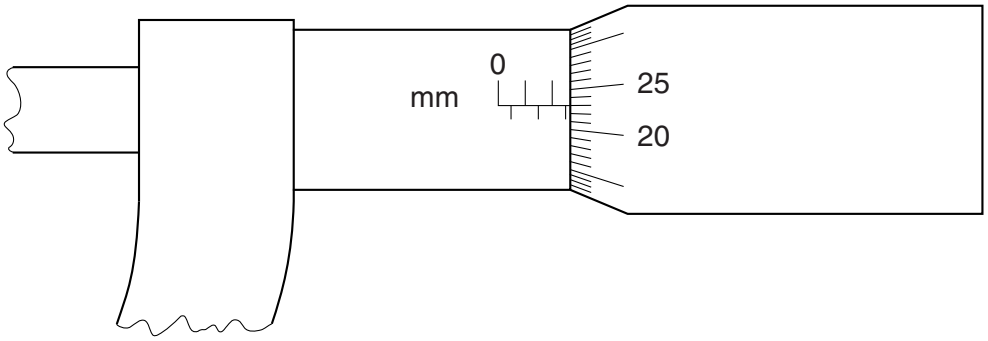

Fig. 1.1

(a) State the name of this instrument.

..... [1]

(b) Record the reading shown in Fig. 1.1.

..... [1]

(c) Describe how you would find the thickness of a sheet of paper used in a magazine.

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..... [3]

[Total: 5]

1-2 A piece of string wraps around a cylinder 8 times.

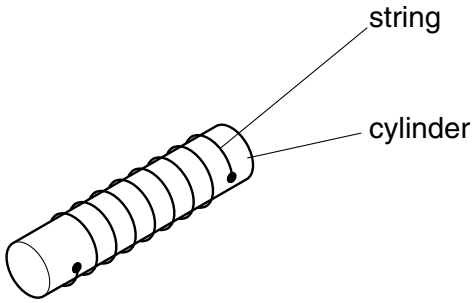

Fig. 1.1

Fig.1.2 shows the string laid along a 30 cm ruler.

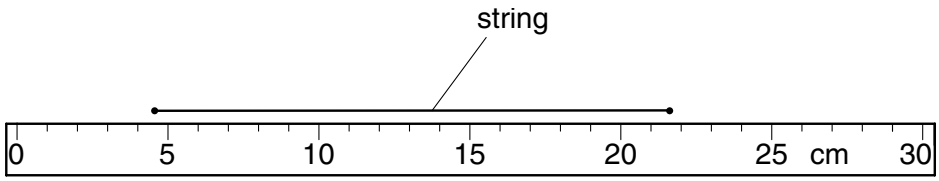

Fig. 1.2

(a) How long is the string?

length of string = ... cm [2]

(b) Calculate the circumference (distance once round) the cylinder.

circumference of cylinder = ... cm [2]

[Total: 4]

2 A laboratory technician has ten pieces of plastic, all cut from the same thin sheet.

The technician wishes to find the thickness of a piece of plastic as accurately as possible.

(a) Name the instrument that should be used.

..... [1]

(b) Describe how the instrument should be used to find the thickness.

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.....

..... [3]

[Total: 4]

1.2 Measuring density

1 A student is given the following apparatus in order to find the density of a piece of rock.

100 g mass
metre ruler
suitable pivot on which the rule will balance
measuring cylinder that is big enough for the piece of rock to fit inside
cotton
water

The rock has a mass of approximately 90 g.

(a) (i) In the space below, draw a labelled diagram of apparatus from this list set up so that the student is able to find the mass of the piece of rock.

(ii) State the readings the student should take and how these would be used to find the mass of the rock.

.....

.....

.....
[5]

(b) Describe how the volume of the rock could be found.

.....

.....

.....[2]

(c) The mass of the rock is 88 g and its volume is 24 cm^3.
Calculate the density of the rock.

density of rock = ... [2]

2 A scientist needs to find the density of a sample of rock whilst down a mine. He has only a spring balance, a measuring cylinder, some water and some thread.

(a) In the space below, draw two labelled diagrams, one to show the spring balance being used and the other to show the measuring cylinder being used with a suitable rock sample. [2]

(b) The spring balance is calibrated in newtons. State how the mass of the rock sample may be found from the reading of the spring balance.

.....[1]

(c) State the readings that would be taken from the measuring cylinder.

.....

.....[1]

(d) State how the volume of the rock would be found from the readings.

.....[1]

(e) State in words the formula that would be used to find the density of the sample.

density =

[1]

3 The list below gives the approximate densities of various metals.

gold	19 g/cm^3
lead	11 g/cm^3
copper	9 g/cm^3
iron	8 g/cm^3

At an antiques market, a collector buys what is advertised as a small ancient gold statue. When the collector tests it in the laboratory, he finds its mass is 600 g and its volume is 65 cm^3.

(a) In the space below, describe how the volume of the statue could be measured. You may draw diagrams if you wish.

[3]

(b) Use the figures given above to decide whether the statue was really made of gold. Show your working.

Was the statue made of gold? (Tick one box.)

yes	
no	

[3]

[Total: 6]

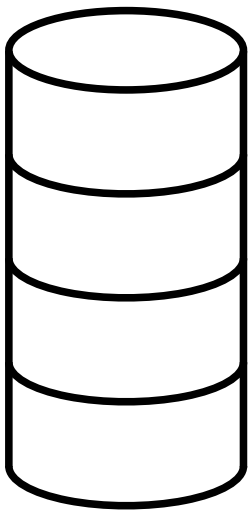
3-2 Four different liquids are poured into a 100 cm^3 measuring cylinder 10 cm in height. Each liquid has a different density and colour.

(a) Fill in the missing values below.

liquid colour	liquid	mass / g	volume / cm^3	density / g/cm^3
clear	ethanol	_____	20.00	0.79
red	gylcerin	20.00	_____	1.26
green	olive oil	25.90	25.80	_____
blue	turpentine	30.00	35.30	_____

[4]

(b) Using data from (a), write down the colour of the liquid you expect to find in each layer, noting the expected thickness, in cm, in the space to the right of the diagram.



[2]

[Total: 6]

1.3 Measuring time

1 An engineering machine has a piston which is going up and down approximately 75 times per minute.

Describe carefully how a stopwatch may be used to find accurately the time for one up-and-down cycle of the piston.

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..... [4]

[Total: 4]

2 A weight attached to one end of a short length of string is swinging from side to side. The highest points in the swing are A and B, as shown in Fig. 1.1.

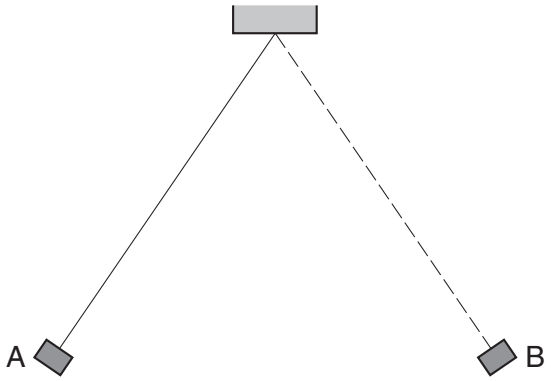

Fig. 1.1

(a) With reference to Fig. 1.1, state what is meant by the amplitude of the oscillations.

..... [2]

(b) Describe how the amplitude of the oscillations could be measured.

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..... [3]

[Total: 5]

3 The period of the vertical oscillations of a mass hanging from a spring is known to be constant.

(a) A student times single oscillations with a stopwatch. In 10 separate measurements, the stopwatch readings were:

1.8 s, 1.9 s, 1.7 s, 1.9 s, 1.8 s, 1.8 s, 1.9 s, 1.7 s, 1.8 s, 1.8 s.

What is the best value obtainable from these readings for the time of one oscillation? Explain how you arrive at your answer.

best value = ...

explanation .....

.....

..... [1]

(b) Describe how, using the same stopwatch, the student can find the period of oscillation more accurately.

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..... [4]

[Total: 5]