

Length and time

Measuring length:

S.I. unit of length: meter(m)

Instrument : Measuring tape, a ruler, micrometer screw guage

Instrument	Use	Smallest possible measurement
Measuring tape	It is a flexible rule used to measure lengths of curved objects apart from linear lengths	1mm or 0.1cm
Meter Rule	It is used to measure length of linear objects such as floor length, cloth etc	0.1cm/0.5cm or 1cm
Micrometer screw guage	It is used to measure very small lengths, example the thickness of a coin etc.	0.001cm or 0.01mm

Method of measuring with a rule:

- Place the scale right next to the object being measured.
- Place one end of the object at zero and place your eye exactly perpendicular to the other end where the object ends to avoid parallax error.
- It is fine to place the object on any other reading other than zero but do make careful calculations.

1 The diagram shows part of a ruler. The ruler is used to find the length of a nail.

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What is the length of the nail?

A 2.2 cm B 2.7 cm C 3.2 cm D 3.7 cm

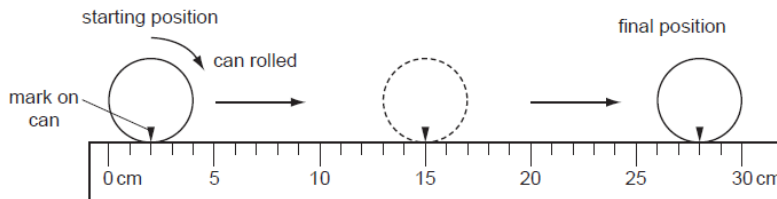
Example: In this example, the nail is placed beginning at 1cm. Hence the length of the nail will be $3.7 - 1 = 2.7\text{cm}$

This is because it is placed 1cm ahead of the zero mark.

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1 A cylindrical can is rolled along the ruler shown in the diagram.

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The can rolls over twice.

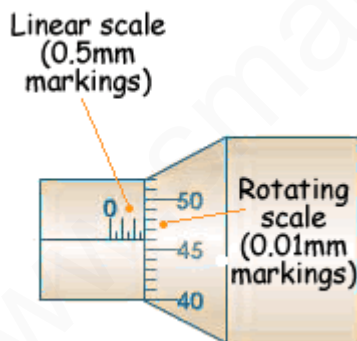
What is the circumference (distance all round) of the can?

- A 13 cm B 14 cm C 26 cm D 28 cm

In this case, the object is 2cm ahead of the zero mark, so from the final position of the arrow deduct 2cm. Hence the final reading is $28 - 2 = 26$ cm. Also the cylinder is rolled twice so it covered

2 circumferences. Hence 1 circumference = $26 / 2 = 13$ cm

Measuring smaller lengths-Screw guage:



- **Procedure:** Place the wire between the anvil and spindle end as indicated in the diagram.
- Rotate the thimble until the wire is firmly held between the anvil and the spindle.
- The ratchet is provided to avoid excessive pressure on the wire.
- It prevents the spindle from further movement and squashing the wire.

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To take a reading

- First look at the main scale. This has a linear scale reading on it. The long lines are every millimetre and the shorter ones denote half a millimetre in between.
- On the diagram this reading is 2.5 mm
- Now look at the rotating scale. That denotes 46 divisions - each division is 0.01mm so we have 0.46mm from this scale.

The diameter of the wire is the sum of these readings: $2.5 + 0.46 = 2.96$ mm

Precautions:

- If you have to measure the thickness of a sheet for example, remember to take the thickness of the sheet at several different places. Then take the average thickness.
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APPLICATION BASED QUESTIONS

MCQ:

- 1 Two digital stopwatches X and Y, which record in minutes and seconds, are used to time a race.

The readings of the two stopwatches, at the start and at the end of the race, are shown.

	start	end
stopwatch X	00:00	00:40

	start	end
stopwatch Y	01:30	02:20

Which statement about the time of the race is correct?

- A Both stopwatches record the same time interval.
- B Stopwatch X recorded 10 s longer than stopwatch Y.
- C Stopwatch Y recorded 10 s longer than stopwatch X.
- D Stopwatch Y recorded 50 s longer than stopwatch X.

- 2 A student uses a stopwatch to time a runner running around a circular track. The runner runs two laps (twice around the track). The diagrams show the reading on the stopwatch when the runner starts running, at the end of the first lap, and at the end of the second lap.



reading when runner starts



reading at end of first lap



reading at end of second lap

What is the time taken for the runner to run the second lap?

- A 0 min 50 s
- B 1 min 10 s
- C 1 min 13 s
- D 2 min 03 s

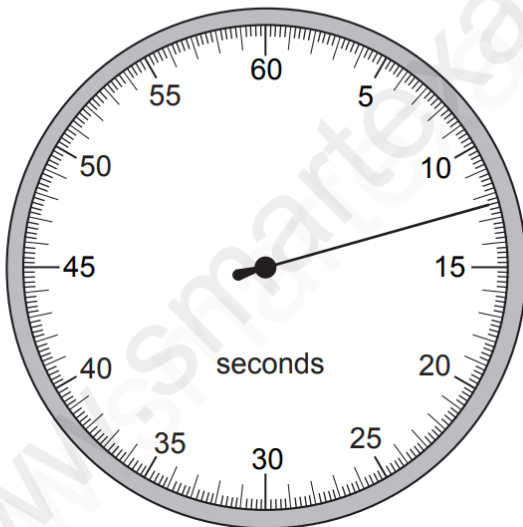
- 3 Two digital stopwatches X and Y, which record in minutes and seconds, are used to time a race. The readings of the two stopwatches, at the start and at the end of the race, are shown.

	start	end
stopwatch X	00:00	00:40

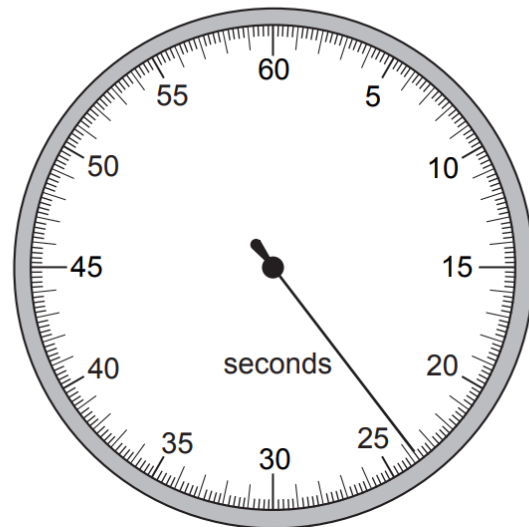
	start	end
stopwatch Y	01:30	02:20

Which statement about the time of the race is correct?

- A Both stopwatches record the same time interval.
 - B Stopwatch X recorded 10 s longer than stopwatch Y.
 - C Stopwatch Y recorded 10 s longer than stopwatch X.
 - D Stopwatch Y recorded 50 s longer than stopwatch X.
- 4 A stopwatch is used to time an athlete running 100 m. The timekeeper forgets to reset the watch to zero before using it to time another athlete running 100 m.



stopwatch at end of first athlete's run



stopwatch at end of second athlete's run

How long does the second athlete take to run 100 m?

- A 11.2 s
- B 11.4 s
- C 12.4 s
- D 23.8 s

EXTENDED THEORY QUESTIONS

2 A student has 500 identical, rectangular sheets of paper. The mass of 1.0m^2 of the paper is 0.080kg .

(a) Using a metre rule, she measures the length of one sheet of paper and its width. The length is 0.300m and the width is 0.210m .

(i) Calculate the mass of one sheet of paper.

mass =[1]

(ii) The student makes a single pile of the 500 sheets of paper.

With a metre rule, she measures the height of the pile. The height of the pile is 0.048m .

Calculate the density of the paper.

density =[3]

(b) A second student has only 5 sheets of the same type of paper.

Suggest how this student determines the density of the paper to a similar accuracy. Additional apparatus may be used.

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.....
.....
.....[2]

[Total: 6]

MARKING SCHEME:

MARKING SCHEME:

- (a) (i) $5.0(4) \times 10^{-3}$ OR 0.0050(4)kg OR 5.0(4)g B1
- (ii) $(\rho =) m/V$ OR $0.00504/(0.30 \times 0.21 \times 0.048)$ OR $0.080/(1 \times 0.048)$ C1
 $0.00504 \times 500/(0.30 \times 0.21 \times 0.048)$ OR $0.080/(1 \times 0.048/500)$ C1
 $8.3(3333) \times 10^2 \text{ kg/m}^3$ A1
- (b) micrometer OR screw gauge OR digital/electronic caliper B1
practical detail of use of micrometer OR micrometer (much) more precise than rule B1
OR repeat and average OR measure mass with balance/scale B1
- OR
tear into 500 pieces (B1)
pile up **and** press down OR measure mass with balance/scale (B1)

[Total: 6]

Measuring time

Instrument: Stopwatch

Common lab experiments include:

- Measuring period of a simple pendulum.
- Measuring the time for gathering data for creating motion time graphs

While recording the time of a simple pendulum, note the time for 20 oscillations and divide the total time by 20 to get the average time for one oscillation.

Example:

MCQ:

- 1 Two digital stopwatches X and Y, which record in minutes and seconds, are used to time a race

The readings of the two stopwatches, at the start and at the end of the race, are shown.

	start	end	
stopwatch X	00:00	00:40	0625/01/O/N/08
stopwatch Y	01:30	02:20	

Which statement about the time of the race is correct?

- A Both stopwatches record the same time interval.
 - B Stopwatch X recorded 10 s longer than stopwatch Y.
 - C Stopwatch Y recorded 10 s longer than stopwatch X.
 - D Stopwatch Y recorded 50 s longer than stopwatch X.
- 1 A pendulum is set in motion and timed. The time measured for 20 complete swings is 30 s.
- What is the time for one complete swing of the pendulum? **0625/13/O/N/12**
- A 0.67 s B 0.75 s C 1.5 s D 3.0 s

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- 1 A cook wants to prepare some food to be cooked by 1.15p.m. He uses an oven with an automatic timer that can be set to switch on and off at certain times. The oven needs to be switched on for 2 hours 10 minutes.

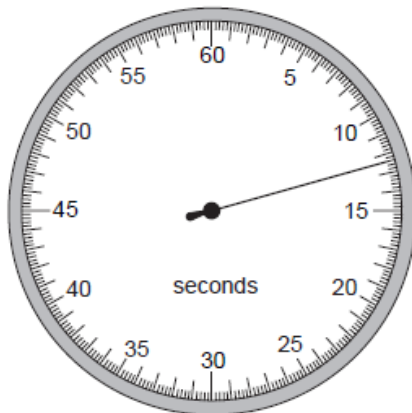
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At which time does the oven need to switch on?

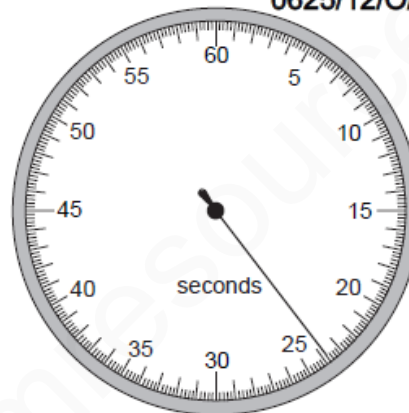
- A 11.05 a.m. B 11.25 a.m. C 3.05 p.m. D 3.25 p.m.
-

- 3 A stopwatch is used to time an athlete running 100 m. The timekeeper forgets to reset the watch to zero before using it to time another athlete running 100 m.

0625/12/O/N/09



stopwatch at
end of first
athlete's run



stopwatch at
end of second
athlete's run

How long does the second athlete take to run 100m?

- A 11.2 s B 11.4 s C 12.4 s D 23.8 s
-

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