1. Motion, forces and energy

1.1 Physical quantities and measurement techniques

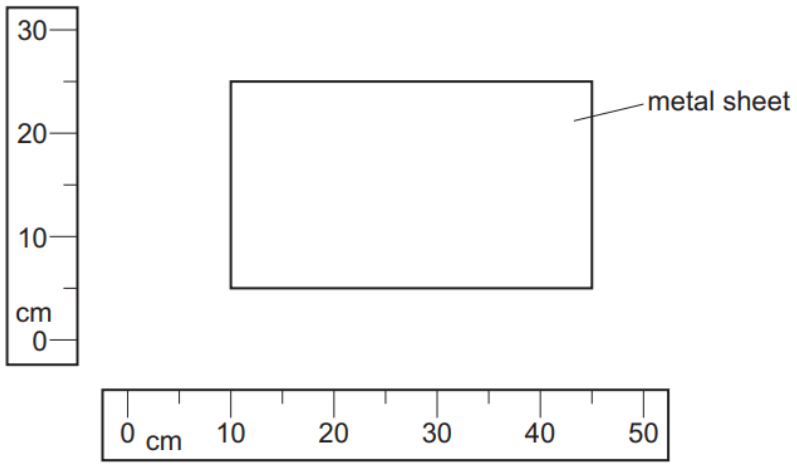
Paper 1 and 2

Question Paper

Paper 1

Questions are applicable for both core and extended candidates

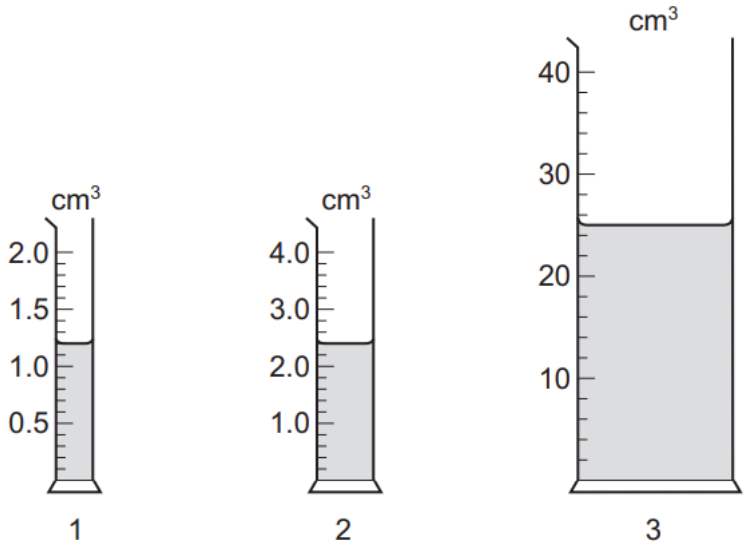
1 The diagram shows a rectangular metal sheet close to two rulers.



What is the area of the metal sheet?

A 700 cm^2 **B** 875 cm^2 **C** 900 cm^2 **D** 1125 cm^2

2 A student measures the volumes of three liquids using three different measuring cylinders.



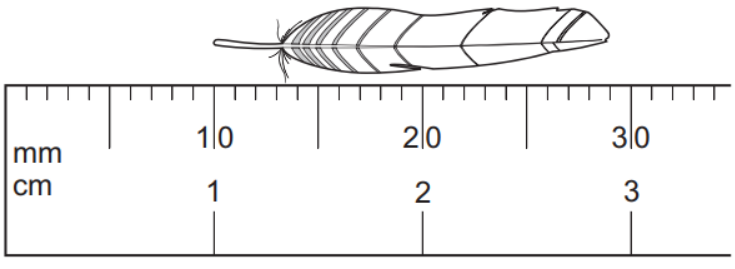
The table shows the volumes recorded by the student.

measuring cylinder	volume / cm^3
1	1.2
2	2.2
3	25

Which readings are correctly recorded?

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 1 only

3 The diagram shows an enlarged drawing of the end of a metre ruler. It is being used to measure the length of a small feather.



What is the length of the feather?

A 19 mm **B** 29 mm **C** 19 cm **D** 29 cm

4 Four athletes run twice around a track. The table shows their times at the end of each lap.

Which athlete runs the second lap the fastest?

	time at end of first lap / s	time at end of second lap / s
A	22.99	47.04
B	23.04	47.00
C	23.16	47.18
D	23.39	47.24

5 In order to determine the period of a pendulum, a student times one complete swing of the pendulum using an analogue stop-watch with a second hand.

Which change of method produces the greatest improvement in accuracy?

A asking a friend with a shorter reaction time to take the measurement

B measuring the time for 100 swings of the pendulum and dividing it by 100

C measuring the time for a half swing of the pendulum and doubling it

D using a digital timer

6 A student investigates the oscillation of a mass suspended from a spring.

The student pulls the mass down from its rest position P and then releases it so that it oscillates vertically.

The student then follows the instructions listed to find the period of the oscillating mass.

1 Count 10 complete oscillations.

2 Divide the time on the stop-watch by 10.

3 Start the stop-watch as the mass passes upwards through point P.

4 Stop the stop-watch.

What is the correct order of these instructions?

A $1 \rightarrow 3 \rightarrow 4 \rightarrow 2$

B $3 \rightarrow 1 \rightarrow 4 \rightarrow 2$

C $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

D $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

7 Which single apparatus is used to find the volume of a solid cube and which single apparatus is used to find the volume of a quantity of liquid?

	volume of solid cube	volume of liquid
A	balance	balance
B	balance	measuring cylinder
C	ruler	balance
D	ruler	measuring cylinder

8 The times for 10 swings of a pendulum are measured.

measurement	time for 10 swings / s
1	10.12
2	10.48
3	10.24

What is the average time for **one** swing?

A 1.028 s **B** 1.036 s **C** 1.042 s **D** 10.28 s

9 Which measuring instrument can be used to find the volume of a small stone?

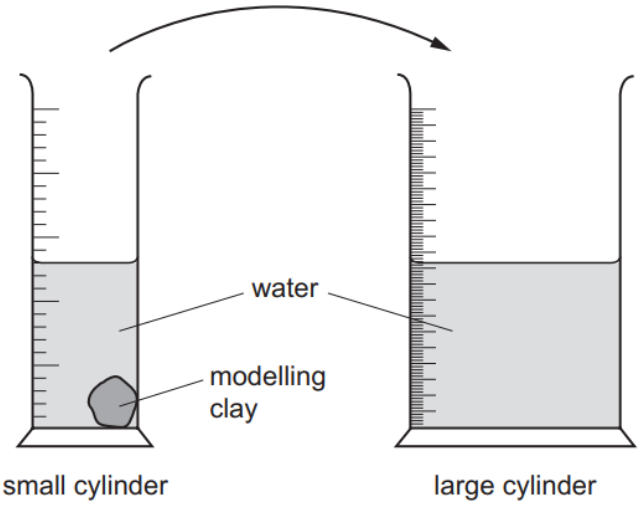
A measuring cylinder partly filled with water

B measuring tape

C metre rule

D protractor

10 A lump of modelling clay is moved from a small measuring cylinder to a large measuring cylinder that has twice the diameter.



The reading on the small measuring cylinder goes down by 20 cm^3.

By how much does the reading on the large cylinder go up?

A 10 cm^3 **B** 20 cm^3 **C** 40 cm^3 **D** 80 cm^3

11 A student measures the volume of a quantity of water.

Which apparatus is suitable?

A a balance

B a measuring cylinder

C a ruler

D a thermometer

12 Which list places units of length in increasing order of magnitude (size)?

A cm → mm → m

B mm → cm → m

C mm → m → cm

D m → mm → cm

13 The diagram shows a stone of irregular shape.

Which property of the stone can be found by lowering it into a measuring cylinder half-filled with water?

A length

B mass

C volume

D weight

14 Which piece of apparatus is the most suitable for measuring the mass of a pencil sharpener?

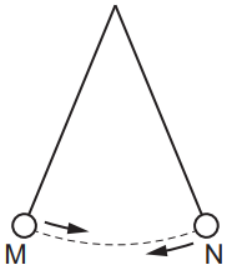
A digital balance

B measuring cylinder

C newton meter

D ruler

15 The diagram shows a pendulum. The pendulum bob swings repeatedly between points M and N.



A student starts a stop-watch when the bob reaches point M.

He counts each time the bob changes direction and stops the watch on the tenth change in direction.

The watch shows a time of 12.0 seconds.

What is the period of the pendulum?

A 0.60 s **B** 1.2 s **C** 2.4 s **D** 12.0 s

16 A pendulum makes 50 complete swings in 2 min 40 s.

What is the time period for 1 complete swing?

A 1.6 s **B** 3.2 s **C** 4.8 s **D** 6.4 s

17 Five athletes P, Q, R, S and T compete in a race. The table shows the finishing times for the athletes.

athlete	P	Q	R	S	T
finishing time / s	22.50	24.40	25.20	26.50	23.20

Which statement is correct?

A Athlete P won the race and was 0.70 s ahead of the athlete in second place.

B Athlete P won the race and was 1.90 s ahead of the athlete in second place.

C Athlete S won the race and was 1.30 s ahead of the athlete in second place.

D Athlete S won the race and was 2.10 s ahead of the athlete in second place.

18 A student measures the volume of a small irregularly-shaped stone.

Which apparatus must be used?

A a measuring cylinder containing water and a ruler only

B a measuring cylinder containing water only

C an empty measuring cylinder and a ruler only

D a ruler only

19 A measuring cylinder contains 10 cm^3 of water.

A piece of steel is lowered into the measuring cylinder until it is fully submerged. The volume reading increases to 12 cm^3.

A second piece of steel is lowered into the measuring cylinder so that it is also fully submerged. The volume reading increases to 15 cm^3.

Which row shows the volumes of the two pieces of steel?

	volume of first piece of steel / cm^3	volume of second piece of steel / cm^3
A	2	3
B	2	5
C	12	3
D	12	15

20 A digital stop-clock measures time in minutes and seconds.

The stop-clock reads 00:50 when it is started (i.e. 00 minutes 50 seconds).

It reads 02:10 when it is stopped.

What is the shortest possible time that has elapsed between starting and stopping the stop-clock?

A 1 minute 20 seconds

B 2 minutes 00 seconds

C 2 minutes 10 seconds

D 3 minutes 00 seconds

21 Diagram 1 shows a measuring cylinder containing water. A metal weight with a cork attached by a thread is held above the water.

Diagram 2 shows the apparatus after the weight has been lowered into the water.

Diagram 3 shows the apparatus after the weight and the cork have been submerged.

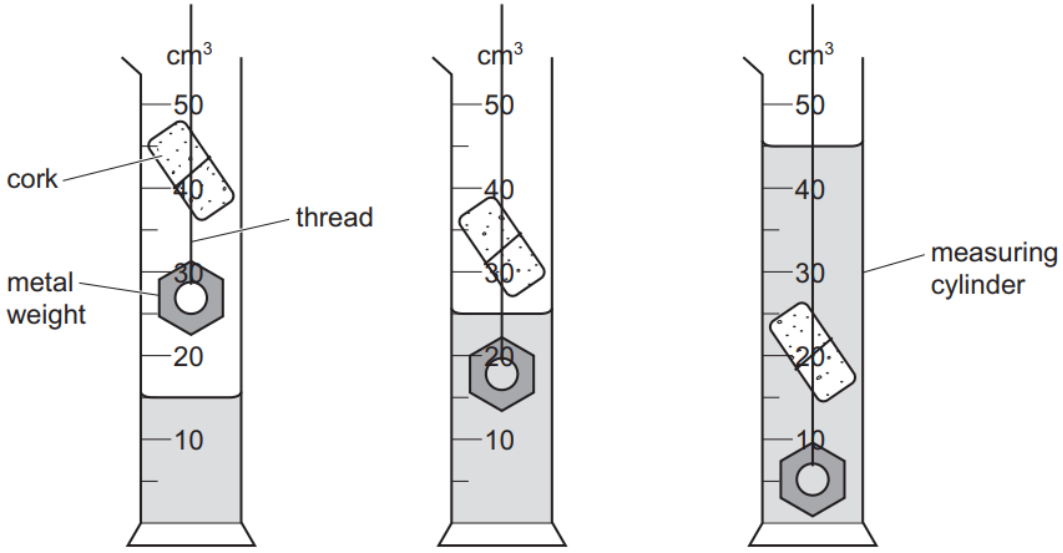


diagram 1 diagram 2 diagram 3

What is the volume of the cork?

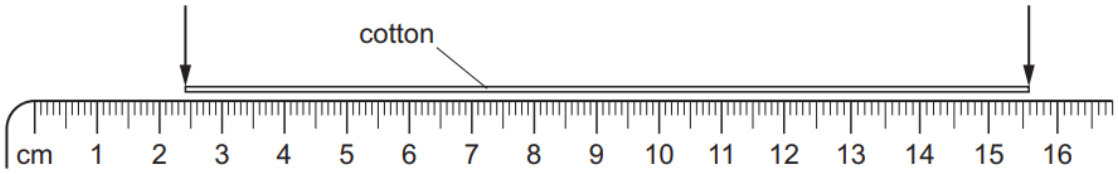
A 20 cm^3 **B** 30 cm^3 **C** 45 cm^3 **D** 70 cm^3

22 A pendulum is set in motion and timed. The time measured for 20 complete swings is 30 s.

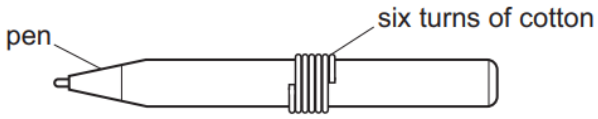
What is the time for one complete swing of the pendulum?

A 0.67 s **B** 0.75 s **C** 1.5 s **D** 3.0 s

23 A length of cotton is measured between two points on a ruler.



When the length of cotton is wound closely around a pen, it goes round six times.



What is the distance once round the pen?

A 2.2 cm **B** 2.6 cm **C** 13.2 cm **D** 15.6 cm

Paper 2

Questions are applicable for both core and extended candidates unless indicated in the question

24 A student uses a metre ruler to measure the length of a sheet of paper.

Which measurement is shown to the nearest millimetre?

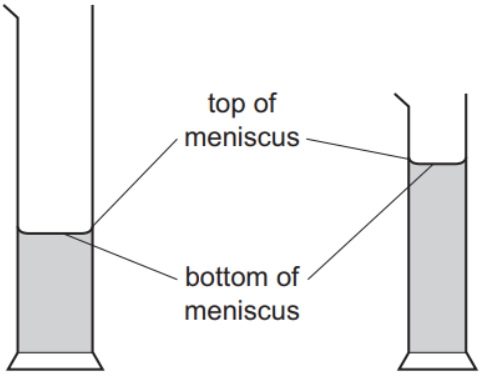
A 0.2932 m **B** 0.293 m **C** 0.29 m **D** 0.3 m

25 In which row are quantities correctly categorised into scalar quantities and vector quantities?

(extended only)

	scalar quantities	vector quantities
A	mass and energy	weight and acceleration
B	gravitational field strength and time	force and electric field strength
C	speed and momentum	distance and force
D	distance and energy	velocity and temperature

26 A student wishes to measure accurately the volume of approximately 40 cm^3 of water. She has two measuring cylinders, a larger one that can hold 100 cm^3, and a smaller one that can hold 50 cm^3. The water forms a meniscus where it touches the glass.



Which cylinder and which water level does the student use to ensure an accurate result?

	cylinder	water level
A	larger one	bottom of meniscus
B	larger one	top of meniscus
C	smaller one	bottom of meniscus
D	smaller one	top of meniscus

27 Which is a vector quantity? **(extended only)**

A density

B mass

C pressure

D weight

28 Which quantity is a scalar quantity? **(extended only)**

A acceleration

B force

C time

D velocity

29 A student measures the average speed of a cyclist in a race.

Which quantities must she measure? **(extended only)**

A the total time taken to complete the race and the time taken for the cyclist to reach her highest speed

B the total time taken to complete the race and the total distance travelled by the cyclist at her highest speed

C the total time taken to complete the race and the total distance travelled by the cyclist

D the time taken to reach her highest speed and the total distance travelled by the cyclist

30 Which measuring instrument is used to measure the diameter of a thin metal wire?

A 30 cm rule

B measuring tape

C metre rule

D micrometre screw gauge

31 Which measuring devices are most suitable to determine the volume of about 200 ml of liquid and the diameter of a thin wire?

	volume of about 200 ml of liquid	diameter of a thin wire
A	measuring cylinder	micrometer screw gauge
B	measuring cylinder	ruler
C	ruler	measuring cylinder
D	ruler	micrometer screw gauge

32 Which measuring devices are most suitable for determining the length of a swimming pool and the thickness of aluminium foil?

	length of a swimming pool	thickness of aluminium foil
A	ruler	measuring cylinder
B	tape measure	micrometer screw gauge
C	tape measure	ruler
D	ruler	micrometer screw gauge

33 Which instrument is most suitable for measuring the thickness of a single sheet of paper?

A 15 cm rule

B balance

C metre rule

D micrometer screw gauge

34 A student is taking some measurements.

Which measurement is taken directly using a micrometer screw gauge?

A $0.52\,g/mm^2$ **B** $0.52\,g/mm^3$ **C** $0.52\,mm$ **D** $0.52\,mm^2$

35 Which row describes speed and velocity? **(extended only)**

	speed	velocity
A	scalar	scalar
B	scalar	vector
C	vector	scalar
D	vector	vector

36 For which one of the following measurements would a micrometer screw gauge be most suitable?

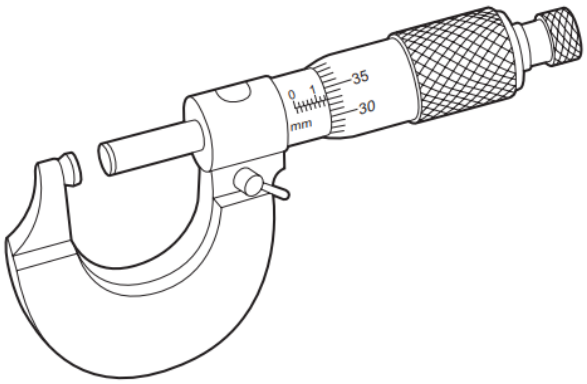
A length of this page

B length of a pencil

C diameter of a wire

D diameter of an atom

37 The diagram shows a measuring device.



For which measurement is this device suitable?

A diameter of a cylinder of aluminium of about 20 cm

B distance between two molecules of zinc

C length of a rod of iron of about 1 m

D thickness of a sheet of copper of about 1.5 mm

38 Which quantity is a vector? **(extended only)**

A acceleration

B distance

C speed

D mass

39 A student measures the diameter of a pencil.

Which measuring instrument will give the most precise reading?

A a measuring tape

B a metre rule

C a micrometer screw gauge

D a ruler

40 A student measures the dimensions of a cylindrical glass beaker.

For which measurement should she use a micrometer screw gauge?

A circumference of the beaker

B diameter of the beaker

C height of the beaker

D thickness of the glass wall of the beaker

41 Which quantity can be measured directly using a micrometer screw gauge?

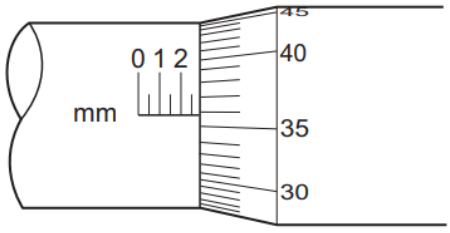
A the area of a sheet of paper

B the mass of a sheet of paper

C the thickness of a sheet of paper

D the volume of a sheet of paper

42 The diagram shows part of a micrometer screw gauge.



What is the smallest reading that can be achieved using this micrometer screw gauge?

A 0.0001 mm **B** 0.01 mm **C** 0.1 mm **D** 1 mm

43 Which quantities are both vectors? **(extended only)**

A acceleration and force

B acceleration and pressure

C density and force

D density and pressure