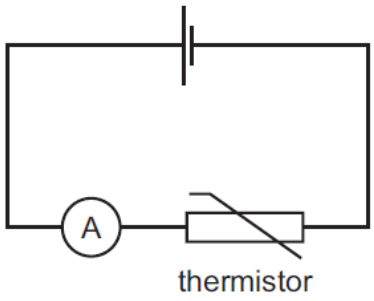
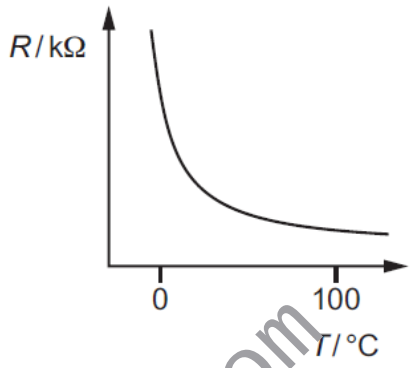
Measurements techniques - 2018

1. 9702/11/M/J/18/No.4

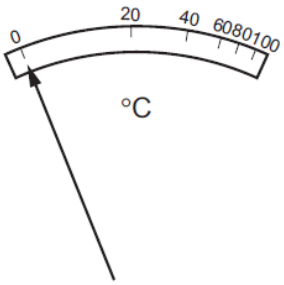
In the circuit shown, an analogue ammeter is to be recalibrated as a thermometer. The ammeter is connected in series with a thermistor. The thermistor is a component with a resistance that varies with temperature. The graph shows how the resistance R of the thermistor changes with temperature T.



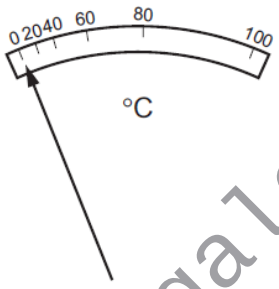


Which diagram could represent the temperature scale on the ammeter?

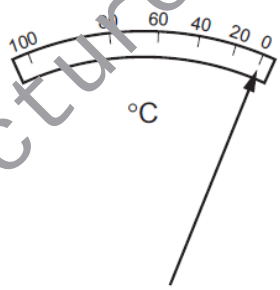
A



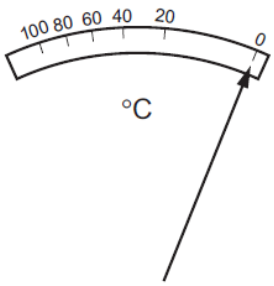
B



C



D



2. 9702/11/M/J/18/No.5

The sides of a cube are measured with calipers.

The measured length of each side is (30.0 ± 0.1) mm.

The measurements are used to calculate the volume of the cube.

What is the percentage uncertainty in the calculated value of the volume?

A 0.01% **B** 0.3% **C** 1% **D** 3%

3. 9702/12/M/J/18/No.3

A student measures the current through a resistor and the potential difference (p.d.) across it. There is a 4% uncertainty in the current reading and a 1% uncertainty in the p.d. reading. The student calculates the resistance of the resistor.

What is the percentage uncertainty in the calculated resistance?

A 0.25% **B** 3% **C** 4% **D** 5%

4. 9702/12/M/J/18/No.4

A student applies a potential difference V of $(4.0 \pm 0.1)\,\text{V}$ across a resistor of resistance R of $(10.0 \pm 0.3)\,\Omega$ for a time t of $(50 \pm 1)\,\text{s}$.

The student calculates the energy E dissipated using the equation below.

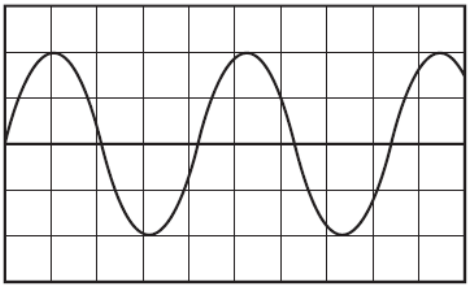
$$E = \frac{V^2 t}{R} = \frac{4.0^2 \times 50}{10.0} = 80\,\text{J}$$

What is the absolute uncertainty in the calculated energy value?

A 1.5 J **B** 3 J **C** 6 J **D** 8 J

5. 9702/12/M/J/18/No.23

The diagram shows the screen of a cathode-ray oscilloscope (c.r.o.) displaying a wave.



The time-base of the c.r.o. is set at 10 ms / division.

What is the frequency of the wave?

A 0.24 Hz **B** 4.2 Hz **C** 12 Hz **D** 24 Hz

6. 9702/13/M/J/18/No.4

What will reduce the systematic errors when taking a measurement?

A adjusting the needle on a voltmeter so that it reads zero when there is no potential difference across it

B measuring the diameter of a wire at different points and taking the average

C reducing the parallax effects by using a marker and a mirror when measuring the amplitude of oscillation of a pendulum

D timing 20 oscillations, rather than a single oscillation, when finding the period of a pendulum

7. 9702/13/M/J/18/No.5

In an experiment to determine the Young modulus E of the material of a wire, the measurements taken are shown.

mass hung on end of wire	$m = 2.300 \pm 0.002\,\text{kg}$
original length of wire	$l = 2.864 \pm 0.005\,\text{m}$
diameter of wire	$d = 0.82 \pm 0.01\,\text{mm}$
extension of wire	$e = 7.6 \pm 0.2\,\text{mm}$

The Young modulus is calculated using

$$E = \frac{4mgl}{\pi d^2 e}$$

where g is the acceleration of free fall.

The calculated value of E is $1.61 \times 10^{10}\,\text{N m}^{-2}$.

How should the calculated value of E and its uncertainty be expressed?

A $(1.61 \pm 0.04) \times 10^{10}\,\text{N m}^{-2}$

B $(1.61 \pm 0.05) \times 10^{10}\,\text{N m}^{-2}$

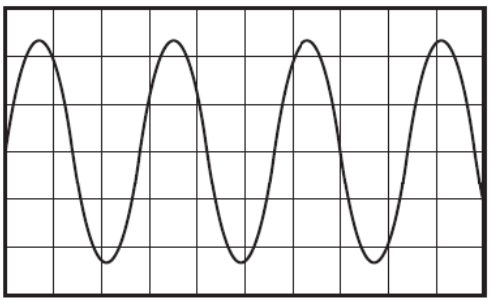
C $(1.61 \pm 0.07) \times 10^{10}\,\text{N m}^{-2}$

D $(1.61 \pm 0.09) \times 10^{10}\,\text{N m}^{-2}$

8. 9702/13/M/J/18/No.22

A cathode-ray oscilloscope (c.r.o.) is used to determine the frequency of a sound wave.

The diagram shows the waveform on the screen.



The time-base setting is 5.0 ms / div.

What is the frequency of the sound wave?

A 57 Hz **B** 71 Hz **C** 114 Hz **D** 143 Hz

9. 9702/12/F/M/18/No.5

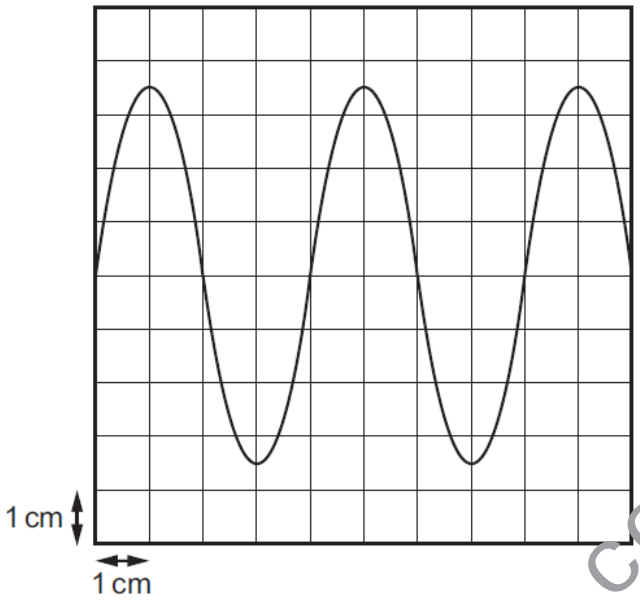
A person calculates the potential difference across a wire by using the measurements shown.

Which measured quantity has the greatest contribution to the percentage uncertainty in the calculated potential difference?

	quantity	value	uncertainty
A	current / A	5.0	±0.5
B	diameter of wire / mm	0.8	±0.1
C	length of wire / m	150	±5
D	resistivity of metal in wire / Ω m	1.6×10^{-8}	$\pm 0.2 \times 10^{-8}$

10. 9702/12/F/M/18/No.6

A cathode-ray oscilloscope (c.r.o.) is connected to an alternating voltage. The following trace is produced on the screen.



The oscilloscope time-base setting is 0.5 ms cm^{-1} and the Y-plate sensitivity is 2 V cm^{-1}.

Which statement about the alternating voltage is correct?

A The amplitude is 3.5 cm.

B The frequency is 0.5 kHz.

C The period is 1 ms.

D The wavelength is 4 cm.