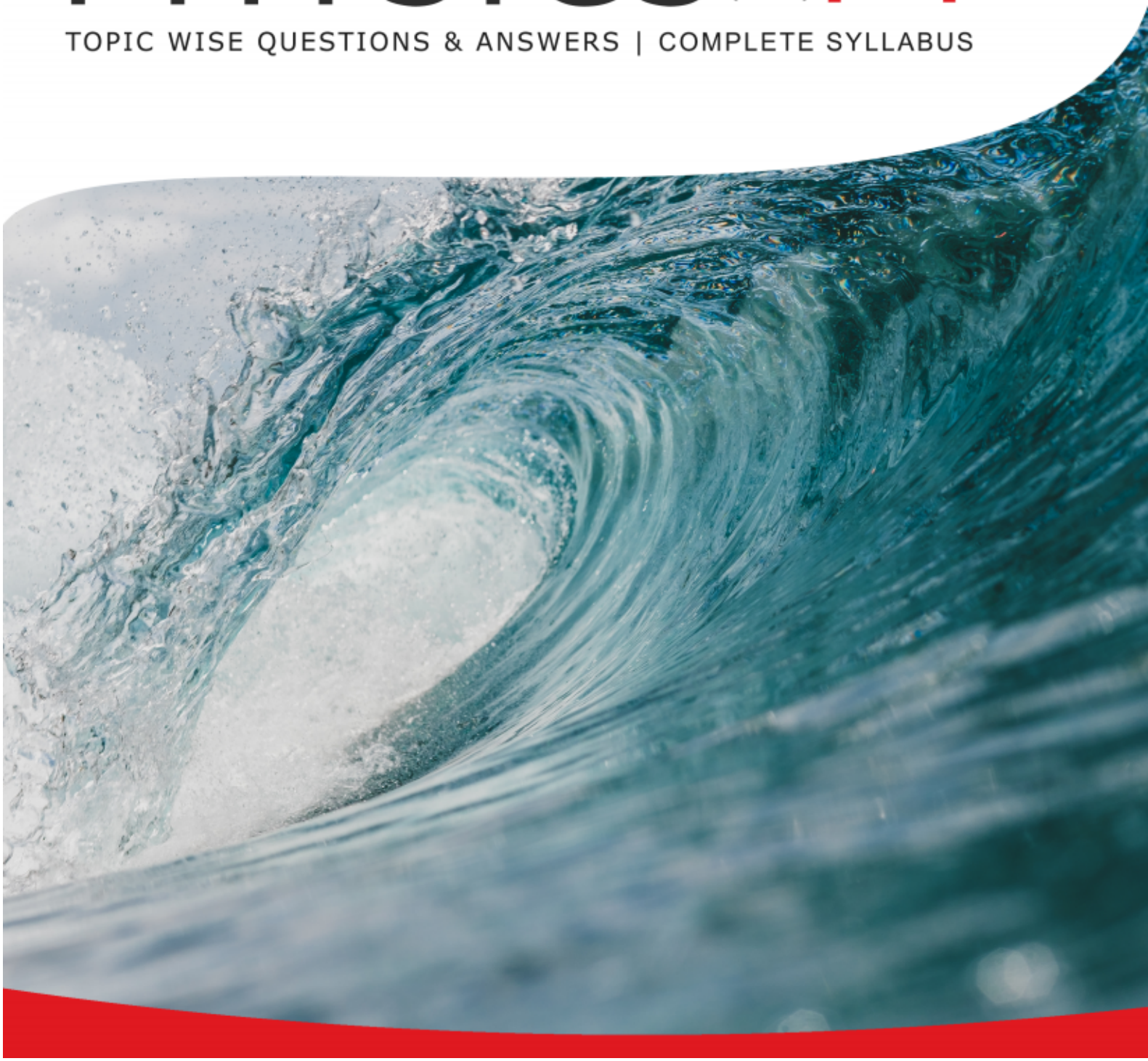
Cambridge International AS & A Level

PHYSICS (9702) P1

TOPIC WISE QUESTIONS & ANSWERS | COMPLETE SYLLABUS



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Chapter 2

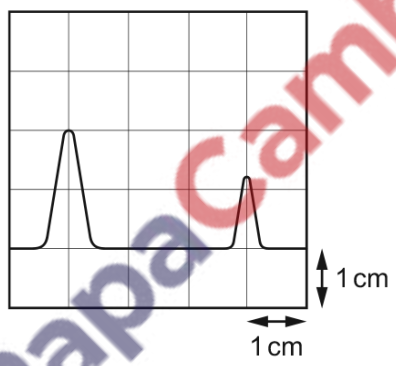
Measurement techniques

2.1 Measurements

104. 9702_m20_qp_12 Q: 4

A transmitter emits a pulse of electromagnetic waves towards a reflector. The pulse is reflected and returns to the transmitter.

A detector is located at the transmitter. The emitted pulse and the reflected pulse are displayed on a cathode-ray oscilloscope (CRO) as shown.



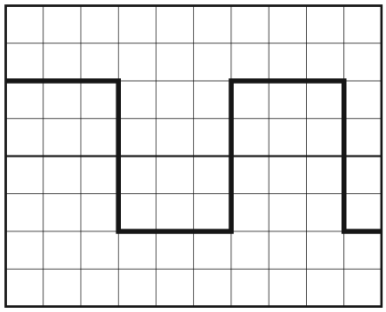
The pulse takes 6.3 μs to travel from the transmitter to the reflector.

What is the time-base setting of the CRO?

A 2.1 μs cm^{-1} **B** 3.2 μs cm^{-1} **C** 4.2 μs cm^{-1} **D** 6.3 μs cm^{-1}

105. 9702_s20_qp_11 Q: 4

A cathode-ray oscilloscope displays a square wave, as shown.



The time-base setting is 0.20 ms per division.

What is the frequency of the square wave?

A 0.83 Hz **B** 830 Hz **C** 1300 Hz **D** 1700 Hz

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106. 9702_s20_qp_12 Q: 3

A galvanometer of resistance 5 Ω is to be used in a null method.

In order to protect the galvanometer from damage due to an excessive initial current, resistors of resistance 0.5 Ω and 1 kΩ are available.

Which arrangement would provide this protection?

A the 0.5 Ω resistor in series with the galvanometer

B the 0.5 Ω resistor in parallel with the galvanometer and this combination placed in series with the 1 kΩ resistor

C the 1 kΩ resistor in parallel with the galvanometer

D the 1 kΩ resistor in parallel with the galvanometer and this combination placed in series with the 0.5 Ω resistor

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107. 9702_s20_qp_13 Q: 4

A circuit is set up in order to determine the resistance of a 12 V, 1.2 W lamp when operating normally. An analogue ammeter and an analogue voltmeter are used.

Which ranges for the meters would be most suitable?

	ammeter range / A	voltmeter range / V
A	0–0.5	0–20
B	0–0.5	0–100
C	0–10	0–20
D	0–10	0–100

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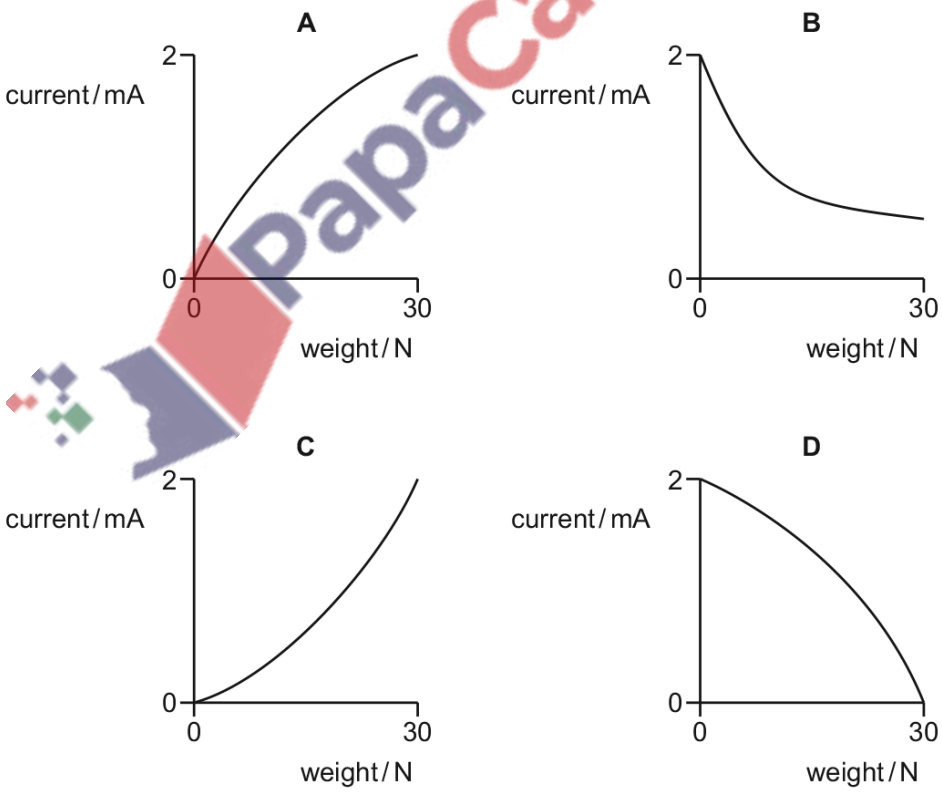
108. 9702_m19_qp_12 Q: 4

A digital balance is used to weigh ingredients in a laboratory. When a weight is applied to the digital balance, an electronic circuit generates a current which is then converted into a digital readout on the display.

The electronic circuit gives a current of 2.0 mA when a weight of 30 N is applied, and a current of 0.5 mA when a weight of 5 N is applied.

Which calibration curve could represent this circuit?



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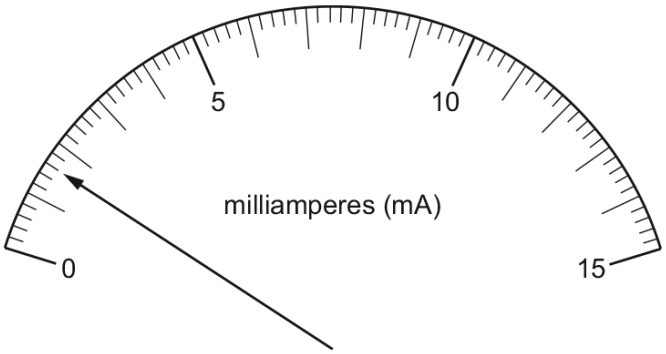
109. 9702_s19_qp_13 Q: 5

The diagram shows the reading on an analogue ammeter.



Which digital ammeter reading is the same as the reading on the analogue ammeter?

	display units	display reading
A	μA	1600
B	μA	160
C	mA	16.0
D	A	1.60

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110. 9702_w19_qp_11 Q: 4

A student intends to measure accurately the diameter of a wire (known to be approximately 1 mm) and the internal diameter of a pipe (known to be approximately 2 cm).

What are the most appropriate instruments for the student to use to make these measurements?

	wire	pipe
A	calipers	calipers
B	calipers	micrometer
C	micrometer	calipers
D	micrometer	micrometer

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111. 9702_w19_qp_12 Q: 4

A micrometer is used to measure the 28.50 mm width of a plastic ruler. The micrometer reads to the nearest 0.01 mm.

What is the correct way to record this reading?

A $0.02850 \pm 0.01\,\text{m}$

B $0.0285 \pm 0.001\,\text{m}$

C $(2.850 \pm 0.001) \times 10^{-2}\,\text{m}$

D $(2.850 \pm 0.001) \times 10^{-3}\,\text{m}$

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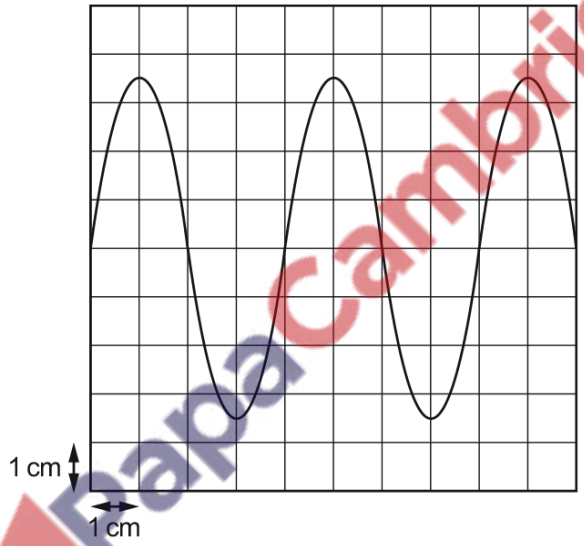
112. 9702_m18_qp_12 Q: 6

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 $0.5\,\text{ms}\,\text{cm}^{-1}$ and the Y-plate sensitivity is $2\,\text{V}\,\text{cm}^{-1}$.

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.

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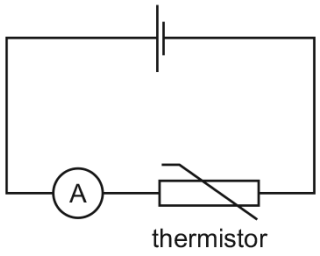
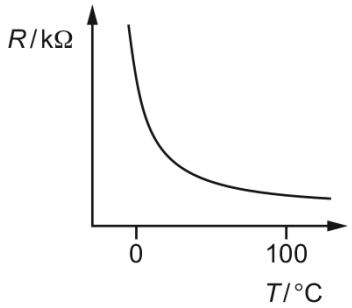
113. 9702_s18_qp_11 Q: 4

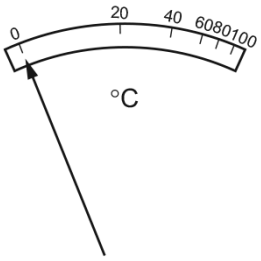
In the circuit shown, an analogue ammeter is to be recalibrated as a thermometer. The ammeter is connected in series with a thermistor. The thermistor is a component with a resistance that varies with temperature. The graph shows how the resistance R of the thermistor changes with temperature T.



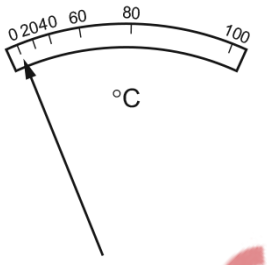


Which diagram could represent the temperature scale on the ammeter?

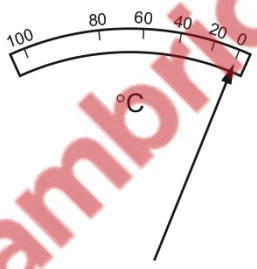
A



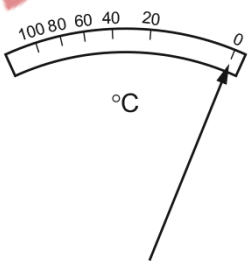
B



C



D



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114. 9702_w18_qp_11 Q: 4

A micrometer screw gauge is used to measure the diameter of a copper wire.

The reading with the wire in position is shown in diagram 1. The wire is removed and the jaws of the micrometer are closed. The new reading is shown in diagram 2.

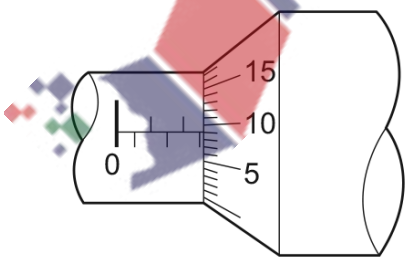

diagram 1

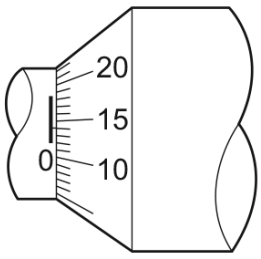

diagram 2

What is the diameter of the wire?

A 1.90 mm **B** 2.45 mm **C** 2.59 mm **D** 2.73 mm

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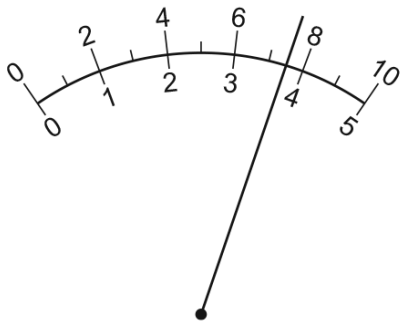
115. 9702_w18_qp_13 Q: 4

An ammeter is calibrated so that it shows a full-scale deflection when it measures a current of 2.0 A.

The diagram shows the display of this ammeter when it is measuring a current.



Which current is the ammeter measuring?

A 0.75 A **B** 1.5 A **C** 3.8 A **D** 7.5 A

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116. 9702_m17_qp_12 Q: 4

A student is investigating an electrical signal using a cathode-ray oscilloscope (c.r.o).

The frequency of the signal is 50 kHz.

Which time-base setting on the oscilloscope should be used?

A 50 ms cm^{-1} **B** 1 ms cm^{-1} **C** 10 μs cm^{-1} **D** 0.5 μs cm^{-1}

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117. 9702_m17_qp_12 Q: 5

A student wishes to measure a distance of about 10 cm to a precision of 0.01 cm.

Which measuring instrument should be used?

A metre rule

B micrometer

C tape measure

D vernier calipers

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118. 9702_s17_qp_11 Q: 3

The speed v of a liquid leaving a tube depends on the change in pressure ΔP and the density ρ of the liquid. The speed is given by the equation

$$v = k\left(\frac{\Delta P}{\rho}\right)^n$$

where k is a constant that has no units.

What is the value of n?

A $\frac{1}{2}$ **B** 1 **C** $\frac{3}{2}$ **D** 2

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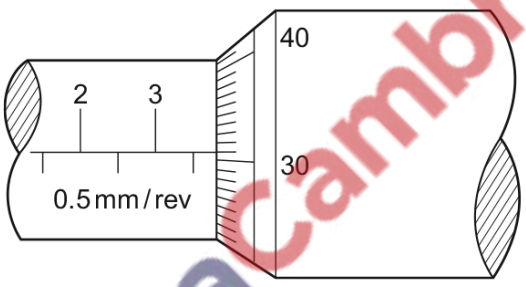
119. 9702_s17_qp_12 Q: 5

The diameter of a cylindrical metal rod is measured using a micrometer screw gauge.

The diagram below shows an enlargement of the scale on the micrometer screw gauge when taking the measurement.



What is the cross-sectional area of the rod?

A 3.81 mm^2 **B** 11.4 mm^2 **C** 22.8 mm^2 **D** 45.6 mm^2

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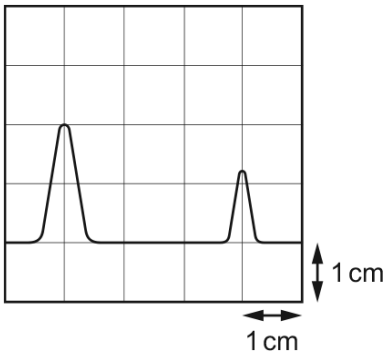
120. 9702_w17_qp_12 Q: 5

A transmitter emits a pulse of electromagnetic waves towards a reflector. The pulse is reflected and returns to the transmitter.

A detector is located at the transmitter. The emitted pulse and the reflected pulse are displayed on a cathode-ray oscilloscope (c.r.o.) as shown.



The pulse takes 6.3 μs to travel from the transmitter to the reflector.

What is the time-base setting of the c.r.o.?

A 2.1 μs cm^{-1} **B** 3.2 μs cm^{-1} **C** 4.2 μs cm^{-1} **D** 6.3 μs cm^{-1}

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121. 9702_w17_qp_13 Q: 4

A school has a piece of aluminium that it uses for radioactivity experiments. Its thickness is marked as 3.2 mm. A student decides to check this value. He has vernier calipers which give measurements to 0.1 mm and a micrometer which gives measurements to 0.01 mm.

Which statement **must** be correct?

A The micrometer gives a more accurate measurement.

B The micrometer gives a more precise measurement.

C The vernier calipers give a more accurate measurement.

D The vernier calipers give a more precise measurement.

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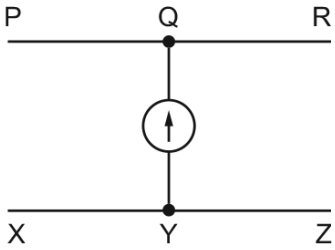
122. 9702_m16_qp_12 Q: 5

PQR and XYZ are wires in a circuit. A galvanometer connects Q and Y as a null indicator.



When the galvanometer reads zero, which statement is correct?

A The potential difference between Q and Y is infinite.

B The potential difference between Q and Y is zero.

C The resistance between Q and Y is infinite.

D The resistance between Q and Y is zero.

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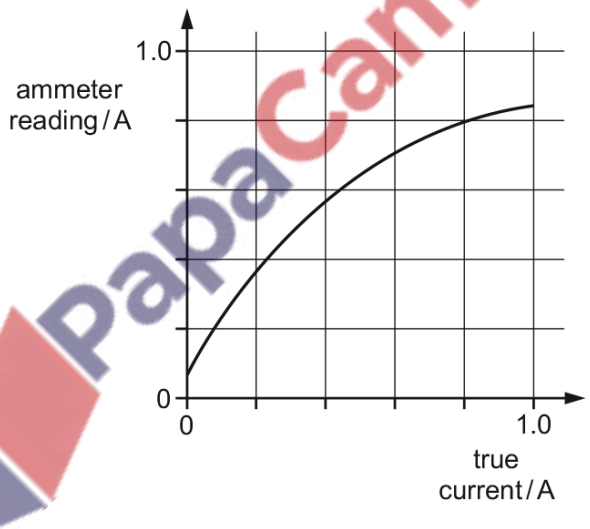
123. 9702_s16_qp_11 Q: 5

A calibration graph is produced for a faulty ammeter.



Which ammeter reading will be nearest to the true current?

A 0.2 A **B** 0.4 A **C** 0.6 A **D** 0.8 A

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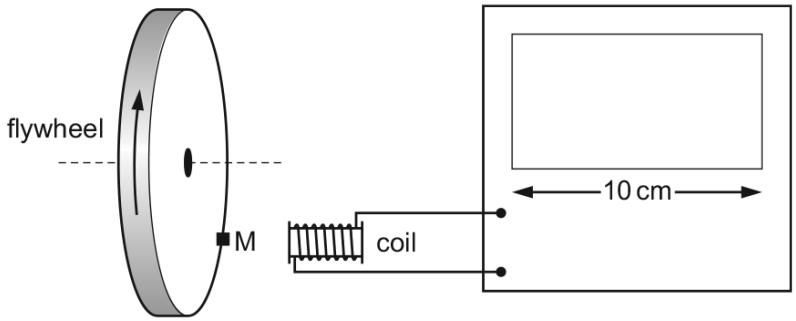
124. 9702_s16_qp_12 Q: 4

The diagram shows a cathode-ray oscilloscope (c.r.o.) being used to measure the rate of rotation of a flywheel.



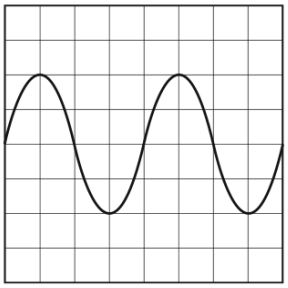
The flywheel has a small magnet M mounted on it. Each time the magnet passes the coil, a voltage pulse is generated, which is passed to the c.r.o. The display of the c.r.o. is 10 cm wide. The flywheel is rotating at 3000 revolutions per minute.

Which time-base setting will display clearly separate pulses on the screen?

A $1\,s\,cm^{-1}$ **B** $10\,ms\,cm^{-1}$ **C** $100\,\mu s\,cm^{-1}$ **D** $1\,\mu s\,cm^{-1}$

125. 9702_s16_qp_13 Q: 5

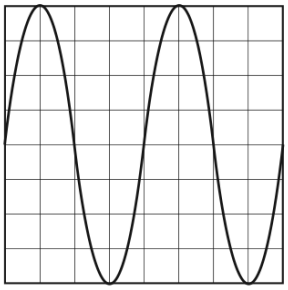
The following trace is seen on the screen of a cathode-ray oscilloscope.



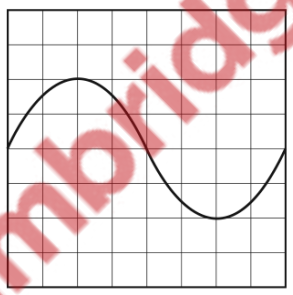
The setting of the time-base is then changed from $10\,\text{ms}\,\text{cm}^{-1}$ to $20\,\text{ms}\,\text{cm}^{-1}$ and the Y-plate sensitivity remains constant.

Which trace is now seen on the screen?

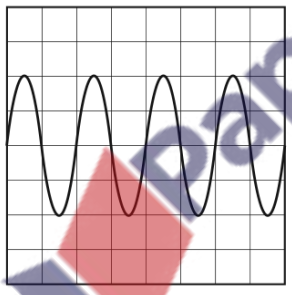
A



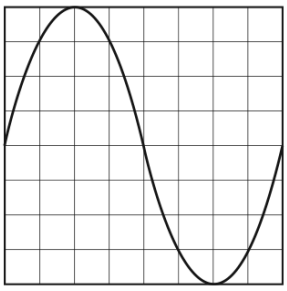
B



C



D

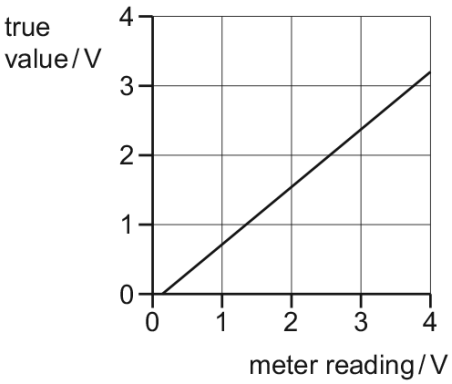


126. 9702_w16_qp_11 Q: 4

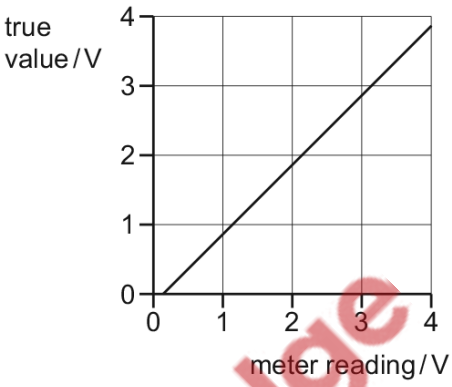
A voltmeter gives readings that are larger than the true values and has a systematic error that varies with voltage.

Which graph shows the calibration curve for the voltmeter?

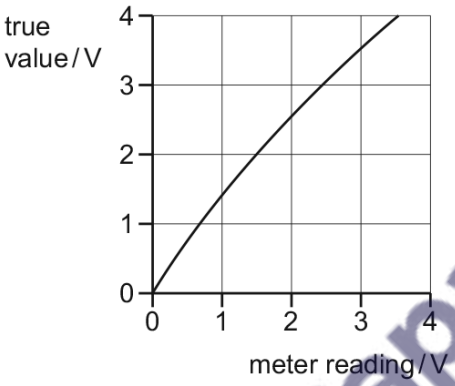
A



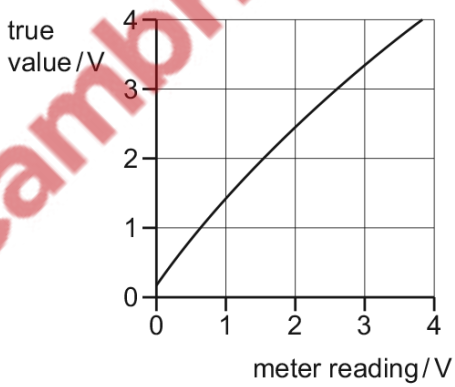
B



C

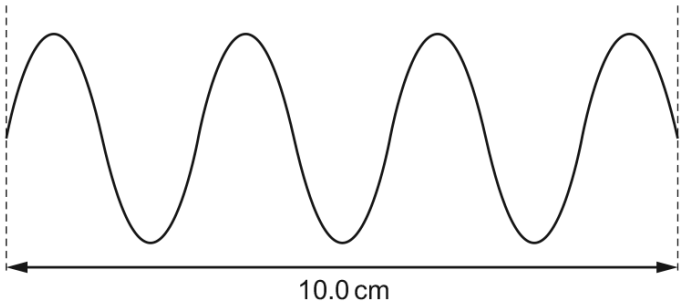


D



127. 9702_w16_qp_11 Q: 5

A student uses a cathode-ray oscilloscope (c.r.o.) to measure the period of a signal. She sets the time-base of the c.r.o. to $5\,\text{ms}\,\text{cm}^{-1}$ and observes the trace illustrated below. The trace has a length of 10.0 cm.



What is the period of the signal?

A $7.1 \times 10^{-6}\,\text{s}$ **B** $1.4 \times 10^{-5}\,\text{s}$ **C** $7.1 \times 10^{-3}\,\text{s}$ **D** $1.4 \times 10^{-2}\,\text{s}$

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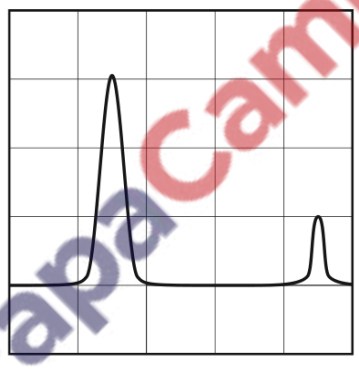
128. 9702_w16_qp_12 Q: 4

A cathode-ray oscilloscope (c.r.o.) displays a waveform as shown.



The time interval between two adjacent peaks of the waveform is 0.006 s.

What is the time-base setting of the c.r.o.?

A 2 μs / division

B 20 μs / division

C 2 ms / division

D 3 ms / division

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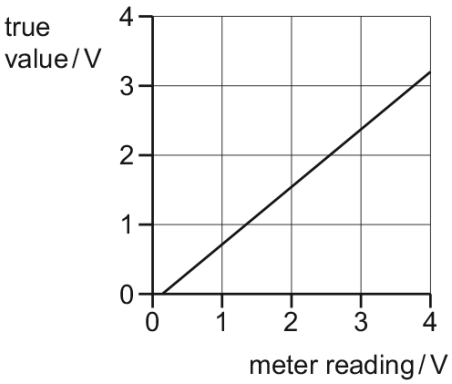
129. 9702_w16_qp_13 Q: 4

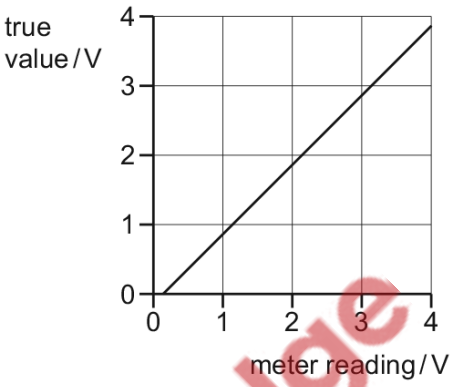
A voltmeter gives readings that are larger than the true values and has a systematic error that varies with voltage.

Which graph shows the calibration curve for the voltmeter?

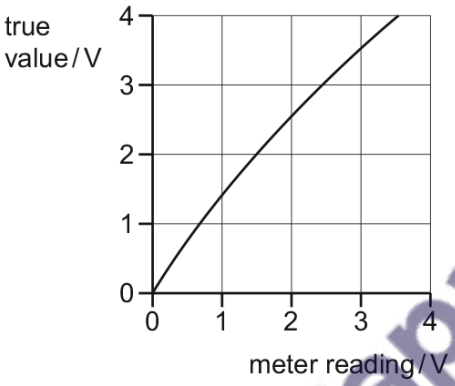
A



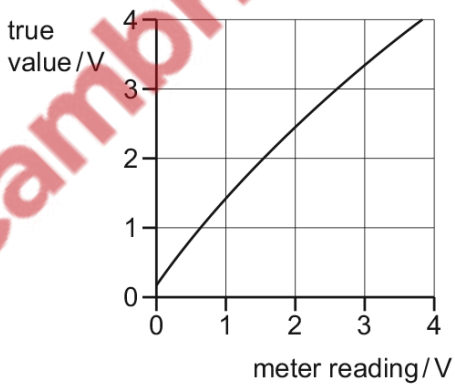
B



C

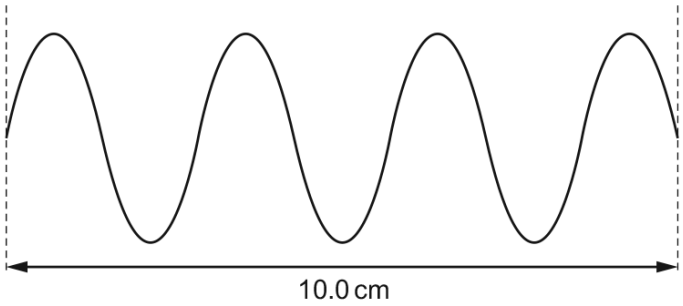


D



130. 9702_w16_qp_13 Q: 5

A student uses a cathode-ray oscilloscope (c.r.o.) to measure the period of a signal. She sets the time-base of the c.r.o. to 5 ms cm^{-1} and observes the trace illustrated below. The trace has a length of 10.0 cm.



What is the period of the signal?

A 7.1×10^{-6} s **B** 1.4×10^{-5} s **C** 7.1×10^{-3} s **D** 1.4×10^{-2} s

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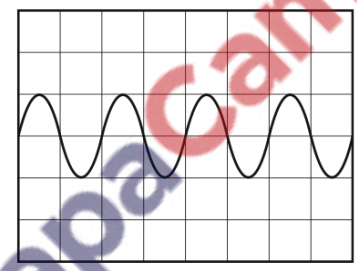
131. 9702_s15_qp_11 Q: 4

A whale produces sound waves of frequency 5 Hz. The waves are detected by a microphone and displayed on an oscilloscope.



What is the time-base setting on the oscilloscope?

A 0.1 ms div^{-1} **B** 1 ms div^{-1} **C** 10 ms div^{-1} **D** 100 ms div^{-1}

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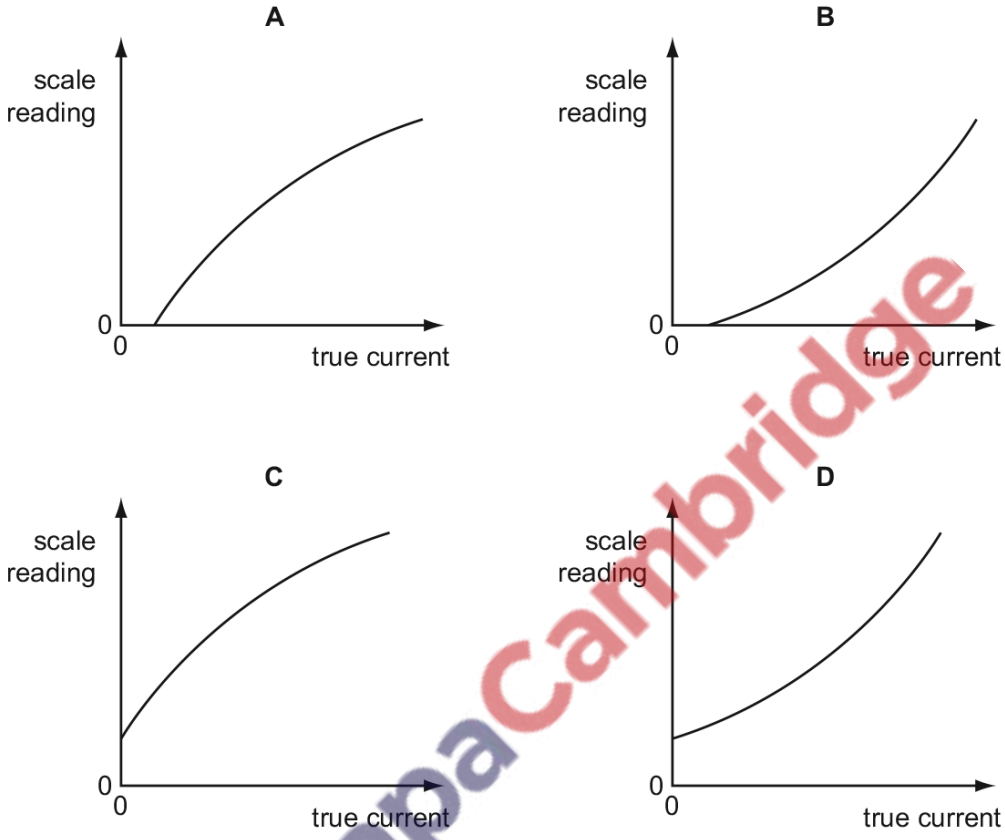
132. 9702_s15_qp_12 Q: 3

An analogue ammeter has a pointer which moves over a scale. Following prolonged use, the pointer does not return fully to zero when the current is turned off and the meter has become less sensitive at higher currents than it is at lower currents.

Which diagram best represents the calibration graph needed to obtain an accurate current reading?



133. 9702_s15_qp_13 Q: 4

A student is given a reel of wire of diameter less than 0.2 mm and is asked to find the density of the metal.

Which pair of instruments would be most suitable for finding the **volume** of the wire?

A balance and micrometer

B metre rule and micrometer

C metre rule and vernier calipers

D micrometer and vernier calipers

2.2 Errors and uncertainties

134. 9702_m20_qp_12 Q: 5

A micrometer is used to measure the diameters of two cylinders.

diameter of first cylinder = (12.78 ± 0.02) mm

diameter of second cylinder = (16.24 ± 0.03) mm

The difference in the diameters is calculated.

What is the uncertainty in this difference?

A 0.01 mm **B** 0.02 mm **C** 0.03 mm **D** 0.05 mm

---

135. 9702_s20_qp_11 Q: 5

A measurement is taken correctly but with a ruler at a significantly higher temperature than that at which the ruler was calibrated. The higher temperature causes the ruler to expand.

What describes the effect on the measurement caused by the higher temperature and how the measurement may be improved?

A The measurement will be subject to a random error. The measurement can be made more accurate by taking the average of several repeated measurements.

B The measurement will be subject to a random error. The measurement can be made more precise by taking the average of several repeated measurements.

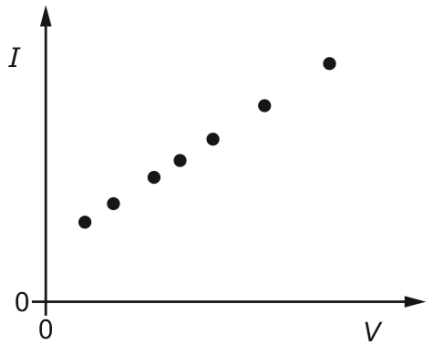
C The measurement will be subject to a systematic error. The measurement can be made more accurate by taking the average of several repeated measurements.

D The measurement will be subject to a systematic error. The measurement can be made more precise by taking the average of several repeated measurements.

---

136. 9702_s20_qp_12 Q: 4

Readings are made of the current I for different voltages V across a fixed resistor. The results are plotted on a graph to show the variation of I with V.



What is the best description of the errors in the readings?

A both systematic and random

B neither systematic nor random

C random only

D systematic only

---

137. 9702_s20_qp_13 Q: 5

Two liquid-in-glass thermometers in a well-mixed liquid are individually observed by 10 different students. All agree that one thermometer reads 21 °C and the other thermometer reads 23 °C.

What is a possible explanation for the difference?

A The liquid is not all at the same temperature.

B The readings are not precise.

C There is a random error affecting the readings.

D There is a systematic error affecting the readings.

---

138. 9702_m19_qp_12 Q: 5

Four students measure a time interval that is known to be 1.734 s.

The measurement recorded by each student is shown.

Which measurement is the most accurate?

A 1 s **B** 1.7 s **C** 1.83 s **D** 1.604 s

---

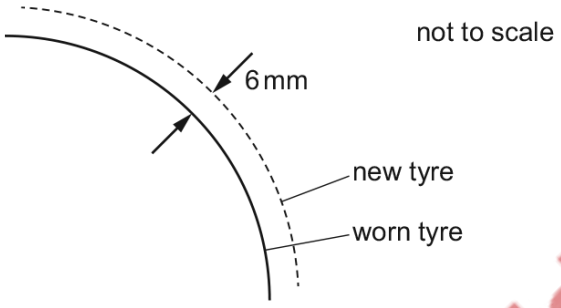
139. 9702_s19_qp_11 Q: 5

The speed shown on a car's speedometer is proportional to the rate of rotation of the tyres.

The variation of the diameter of a tyre as it wears introduces an error in the speed shown on the speedometer.

A car has new tyres of diameter 600 mm. The speedometer is accurately calibrated for this diameter.

The tyres wear as shown, with 6 mm of material being removed from the outer surface.



What is the error in the speed shown on the speedometer after this wear has taken place?

A The speed shown is too high by 1%.

B The speed shown is too high by 2%.

C The speed shown is too low by 1%.

D The speed shown is too low by 2%.

---

140. 9702_s19_qp_12 Q: 5

A student wishes to determine the density ρ of lead. She measures the mass and diameter of a small sphere of lead:

$$\text{mass} = (0.506 \pm 0.005)\,\text{g}$$

$$\text{diameter} = (2.20 \pm 0.02)\,\text{mm}.$$

What is the best estimate of the percentage uncertainty in her calculated value of ρ?

A 1.7% **B** 1.9% **C** 2.8% **D** 3.7%

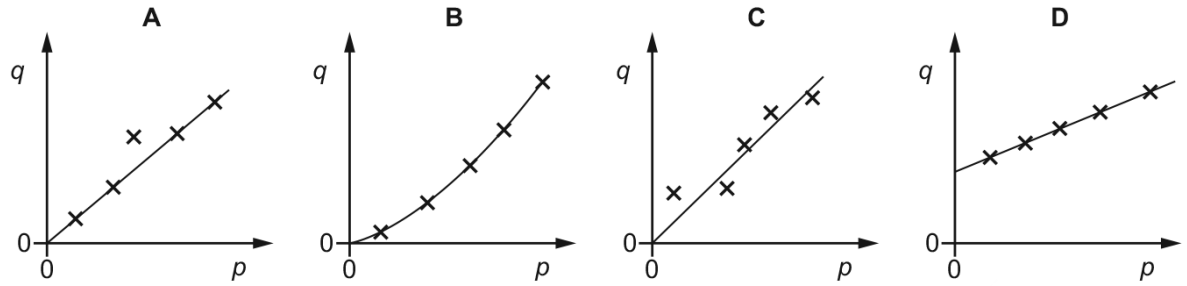
---

141. 9702_s19_qp_12 Q: 6

Two quantities p and q are directly proportional to each other.

Experimental results are taken and plotted in a graph of q against p.

Which graph shows there were random errors in the measurements of p and q?



---

142. 9702_s19_qp_12 Q: 7

A man of mass 75.2 kg uses a set of weighing scales to measure his mass three times. He obtains the following readings.

	mass / kg
reading 1	80.2
reading 2	80.1
reading 3	80.2

Which statement best describes the precision and accuracy of the weighing scales?

A not precise to ± 0.1 kg and accurate to ± 0.1 kg

B not precise to ± 0.1 kg and not accurate to ± 0.1 kg

C precise to ± 0.1 kg and accurate to ± 0.1 kg

D precise to ± 0.1 kg and not accurate to ± 0.1 kg

---

143. 9702_s19_qp_13 Q: 6

A micrometer screw gauge is used to measure the diameter of a small uniform steel sphere. The micrometer reading is 5.00 mm ± 0.01 mm.

What will be the percentage uncertainty in a calculation of the volume of the sphere, using these values?

A 0.2% **B** 0.4% **C** 0.6% **D** 1.2%

---

144. 9702_w19_qp_11 Q: 5

The power P dissipated in a resistor of resistance R is calculated using the expression

$$P = \frac{V^2}{R}$$

where V is the potential difference (p.d.) across the resistor. The percentage uncertainty in V is 5% and in R is 2%.

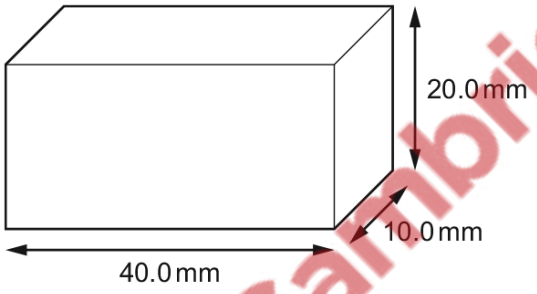
What is the percentage uncertainty in P?

A 3% **B** 7% **C** 8% **D** 12%

---

145. 9702_w19_qp_12 Q: 5

The sides of a wooden block are measured with calipers. The lengths of the sides are measured as 20.0 mm, 40.0 mm and 10.0 mm.



The calipers can measure with an absolute uncertainty of ±0.1 mm.

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

A 0.3% **B** 1.8% **C** 3.8% **D** 30%

---

146. 9702_w19_qp_13 Q: 4

What could reduce systematic errors?

A averaging a large number of measurements

B careful calibration of measuring instruments

C reducing the sample size

D repeating measurements

---

147. 9702_w19_qp_13 Q: 5

The power loss P in a resistor is calculated using the formula $P = \frac{V^2}{R}$.

The percentage uncertainty in the potential difference V is 3% and the percentage uncertainty in the resistance R is 2%.

What is the percentage uncertainty in P?

A 4% **B** 7% **C** 8% **D** 11%

---

148. 9702_s18_qp_11 Q: 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%

---

149. 9702_s18_qp_12 Q: 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%

---

150. 9702_s18_qp_12 Q: 4

A student applies a potential difference V of (4.0 ± 0.1) V across a resistor of resistance R of $(10.0 \pm 0.3)\Omega$ for a time t of (50 ± 1) 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

---

151. 9702_s18_qp_13 Q: 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

---

152. 9702_s18_qp_13 Q: 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 $(1.61 \pm 0.09) \times 10^{10}\,\text{N m}^{-2}$

---

153. 9702_w18_qp_11 Q: 5

A digital meter has an accuracy of ±1%.

The meter is used to measure the current in an electrical circuit.

The reading on the meter varies between 3.04 A and 3.08 A.

What is the value of the current, with its uncertainty?

A (3.06 ± 0.02) A

B (3.06 ± 0.04) A

C (3.06 ± 0.05) A

D (3.06 ± 0.07) A

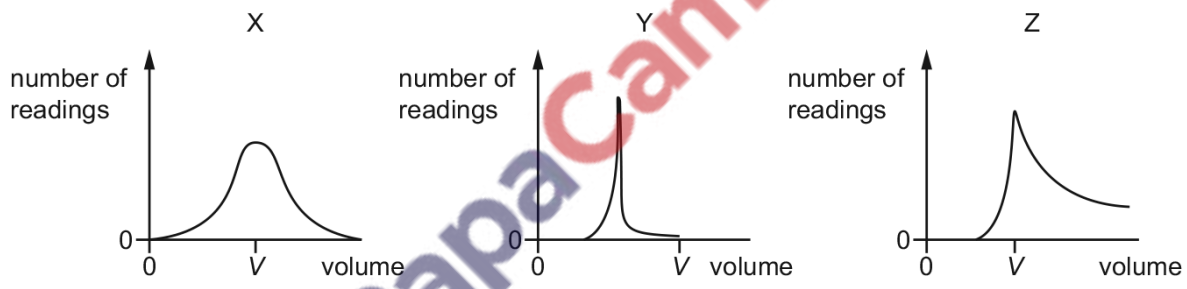
---

154. 9702_w18_qp_12 Q: 5

Students take readings of the volume of a liquid using three different pieces of measuring equipment X, Y and Z.

The true value of the volume of the liquid is *V*.

The students' results are shown.



How many pieces of equipment are precise and how many are accurate?

	number of precise pieces of equipment	number of accurate pieces of equipment
A	1	1
B	1	2
C	2	1
D	2	2

---

155. 9702_w18_qp_13 Q: 5

The width of a table is measured as (50.3 ± 0.1) cm. Its length is measured as (1.40 ± 0.01) m.

What is the area of the table and its absolute uncertainty?

A $(0.7 \pm 0.1)\,m^2$

B $(0.704 \pm 0.006)\,m^2$

C $(0.704 \pm 0.011)\,m^2$

D $(70.4 \pm 0.6)\,m^2$

---

156. 9702_s17_qp_11 Q: 9

A student attempts to find the density ρ of aluminium by taking measurements of a rectangular sheet.

mass $m = 51.6 \pm 0.1$ g

length $l = 100.0 \pm 0.1$ cm

width $w = 10.0 \pm 0.1$ cm

thickness $t = 0.20 \pm 0.01$ mm

He uses the equation $\rho = \frac{m}{wlt}$ to calculate the density.

What is the calculated value of density with its uncertainty?

A $0.26 \pm 0.01\,g\,cm^{-3}$

B $0.26 \pm 0.02\,g\,cm^{-3}$

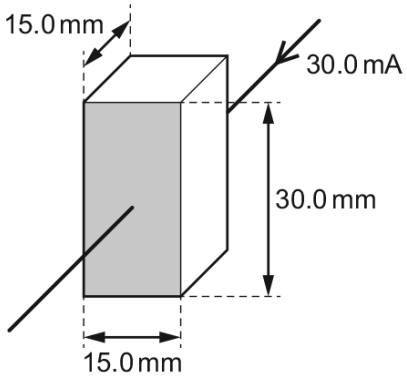
C $2.6 \pm 0.1\,g\,cm^{-3}$

D $2.6 \pm 0.2\,g\,cm^{-3}$

---

157. 9702_s17_qp_12 Q: 4

The current in a block of semiconductor is 30.0 mA when there is a potential difference (p.d.) of 10.0 V across it. The dimensions of the block and the direction of the current in it are as shown.



The electrical meters used are accurate to ± 0.1 mA and ± 0.1 V. The dimensions of the block are accurate to ± 0.2 mm.

What is the resistivity of the semiconductor?

A 10.0 ± 0.2 Ω m

B 10.0 ± 0.3 Ω m

C 10.0 ± 0.5 Ω m

D 10.0 ± 0.8 Ω m

---

158. 9702_s17_qp_13 Q: 4

A voltage is carefully measured with a high-quality instrument and found to be 2.321 V.

Two students, using two different methods, conclude that the voltage is 2.33 V and 2.344 V respectively.

Which statement is correct?

A 2.33 V is less accurate and less precise than 2.344 V.

B 2.33 V is less accurate and more precise than 2.344 V.

C 2.33 V is more accurate and less precise than 2.344 V.

D 2.33 V is more accurate and more precise than 2.344 V.

---

159. 9702_w17_qp_12 Q: 4

A quantity y is to be determined from the equation shown.

$$y = \frac{px}{q^2}$$

The percentage uncertainties in p, x and q are shown.

	percentage uncertainty
p	6%
x	2%
q	4%

What is the percentage uncertainty in y?

A 0.5% **B** 0.75% **C** 12% **D** 16%

---

160. 9702_w17_qp_13 Q: 5

Four possible sources of error in a series of measurements are listed.

1 an analogue meter whose scale is read from different angles

2 a meter which always measures 5% too high

3 a meter with a needle that is not frictionless, so the needle sometimes sticks slightly

4 a meter with a zero error

Which errors are random and which are systematic?

	random error	systematic error
A	1 and 2	3 and 4
B	1 and 3	2 and 4
C	2 and 4	1 and 3
D	3 and 4	1 and 2

---

161. 9702_m16_qp_12 Q: 4

Quantity X has a fractional uncertainty of x. Quantity Y has a fractional uncertainty of y.

What is the fractional uncertainty in $\frac{X}{Y^2}$?

A $x + y$ **B** $x - y$ **C** $x + 2y$ **D** $x - 2y$

---

162. 9702_s16_qp_11 Q: 4

When performing an experiment, a student should minimise the uncertainty of any measurement.

In which case is the student reducing the systematic error in a measurement?

A adjusting a voltmeter needle pointer to the zero position before using it to measure a potential difference

B measuring the diameter of a wire at several points and orientations

C measuring the mass of 100 paperclips to determine the mass of one paperclip

D timing 20 oscillations of a mass on a spring to determine the period of one oscillation

---

163. 9702_s16_qp_12 Q: 5

A student determines the density ρ of steel by taking measurements from a steel wire.

mass $m = 6.2 \pm 0.1$ g

length $l = 25.0 \pm 0.1$ cm

diameter $d = 2.00 \pm 0.01$ mm

He uses the equation $\rho = \frac{4m}{\pi d^2 l}$.

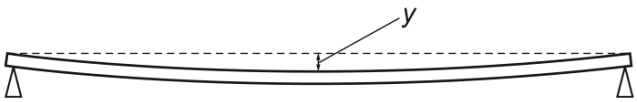
What is the percentage uncertainty in his calculated value of density?

A 1.1% **B** 1.8% **C** 2.5% **D** 3.0%

---

164. 9702_s16_qp_13 Q: 4

A metre rule is supported horizontally by two pivots as shown.



The vertical displacement y at the centre of the rule is given by the equation

$$y = \frac{kML^3}{wt^3}$$

where

k is a constant,

L is the distance between the pivots,

M is the mass of the rule,

t is the thickness of the rule and

w is the width of the rule.

In an experiment, the following results are obtained:

$L = (80.0 \pm 0.2)\,\text{cm}$

$M = (60 \pm 1)\,\text{g}$

$t = (6.0 \pm 0.1)\,\text{mm}$

$w = (23.0 \pm 0.5)\,\text{mm}$.

Which measurement contributes most to the uncertainty in the calculated value of y?

A L **B** M **C** t **D** w

---

165. 9702_w16_qp_12 Q: 5

A value for the acceleration of free fall on Earth is given as $(10 \pm 2)\,\text{m s}^{-2}$.

Which statement is correct?

A The value is accurate but not precise.

B The value is both precise and accurate.

C The value is neither precise nor accurate.

D The value is precise but not accurate.

---

166. 9702_w16_qp_12 Q: 6

An experiment to determine atmospheric pressure P uses the equation $P = \rho gh$ where

$\rho = (13\,600 \pm 100)\,\text{kg m}^{-3}$,

$g = (9.81 \pm 0.02)\,\text{m s}^{-2}$,

$h = (0.762 \pm 0.005)\,\text{m}$.

What is the value of P, with its uncertainty, when stated to an appropriate number of significant figures?

A $(1.0166 \pm 0.0162) \times 10^5\,\text{Pa}$

B $(1.017 \pm 0.016) \times 10^5\,\text{Pa}$

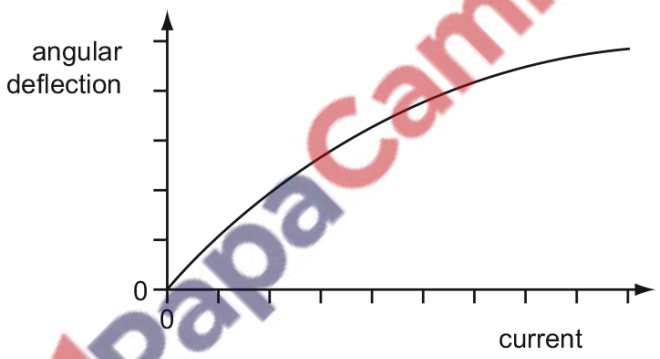
C $(1.017 \pm 1.6\%) \times 10^5\,\text{Pa}$

D $(1.02 \pm 0.02) \times 10^5\,\text{Pa}$

---

167. 9702_s15_qp_11 Q: 5

The angular deflection of the needle of an ammeter varies with the current in the ammeter as shown in the graph.



Which diagram could represent the appearance of the scale on this meter?

A

B

C

D

---

168. 9702_s15_qp_11 Q: 6

The strain energy W of a spring is determined from its spring constant k and extension x. The spring obeys Hooke's law and the value of W is calculated using the equation shown.

$$W = \tfrac{1}{2}kx^2$$

The spring constant is $100 \pm 2\,\text{N m}^{-1}$ and the extension is $0.050 \pm 0.002\,\text{m}$.

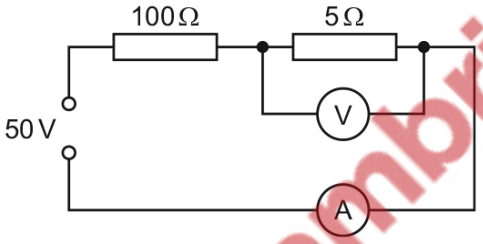
What is the percentage uncertainty in the calculated value of W?

A 6% **B** 10% **C** 16% **D** 32%

---

169. 9702_s15_qp_12 Q: 5

A power supply of electromotive force (e.m.f.) 50 V and negligible internal resistance is connected in series with resistors of resistance 100 Ω and 5 Ω, as shown.



A voltmeter measures the potential difference (p.d.) across the 5 Ω resistor and an ammeter measures the current in the circuit.

What are suitable ranges for the ammeter and for the voltmeter?

	ammeter range / A	voltmeter range / V
A	0 – 0.1	0 – 1
B	0 – 0.1	0 – 3
C	0 – 1.0	0 – 1
D	0 – 1.0	0 – 3

---

170. 9702_s15_qp_12 Q: 6

A single sheet of aluminium foil is folded twice to produce a stack of four sheets. The total thickness of the stack of sheets is measured to be (0.80 ± 0.02) mm. This measurement is made using a digital caliper with a zero error of (−0.20 ± 0.02) mm.

What is the percentage uncertainty in the calculated thickness of a single sheet?

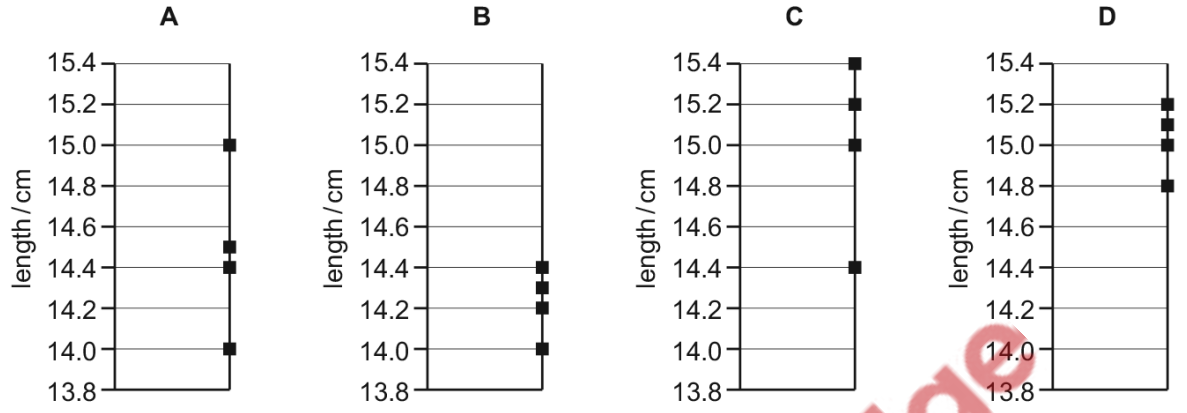
A 1.0% **B** 2.0% **C** 4.0% **D** 6.7%

---

171. 9702_s15_qp_13 Q: 5

Four different students use a ruler to measure the length of a 15.0 cm pencil. Their measurements are recorded on four different charts.

Which chart shows measurements that are precise but **not** accurate?



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172. 9702_s15_qp_13 Q: 6

In a simple electrical circuit, the current in a resistor is measured as (2.50 ± 0.05) mA. The resistor is marked as having a value of 4.7 Ω ± 2 %.

If these values were used to calculate the power dissipated in the resistor, what would be the percentage uncertainty in the value obtained?

A 2 % **B** 4 % **C** 6 % **D** 8 %
