2.1 Measurements & Errors

Question Paper

Course	CIE A Level Physics (9702) 2019-2021
Section	2. Measurement Techniques
Topic	2.1 Measurements & Errors
Difficulty	Medium

Time allowed: **10**

Score: **/10**

Percentage: **/100**

Question 1

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.

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

The spring constant is 100 ± 2 N m^{-1} and the extension is 0.050 ± 0.002 m.

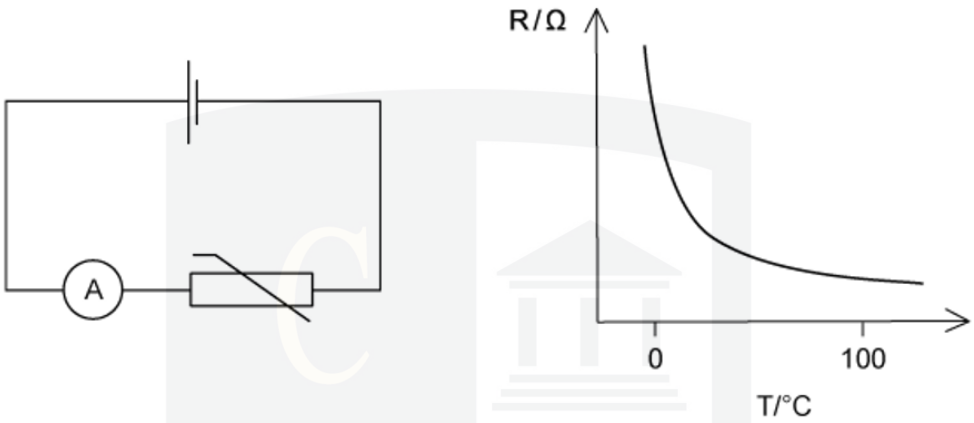
What is the percentage uncertainty in the calculated value of W?

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

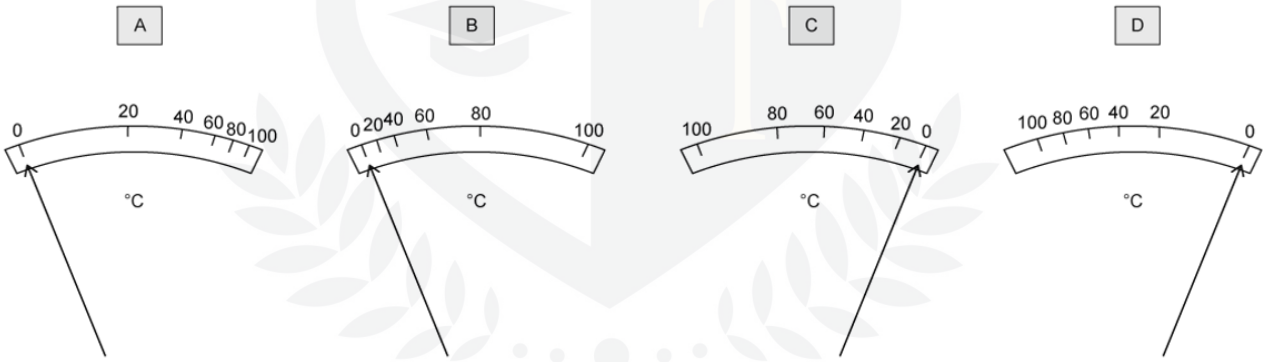
[1 mark]

Question 2

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



Which diagram could represent the temperature scale on the ammeter?

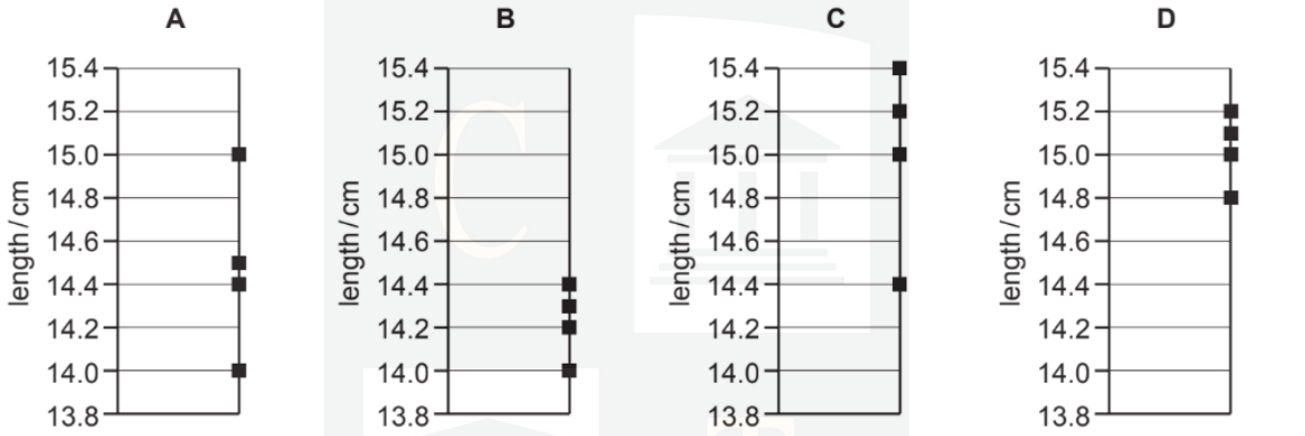


[1 mark]

Question 3

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

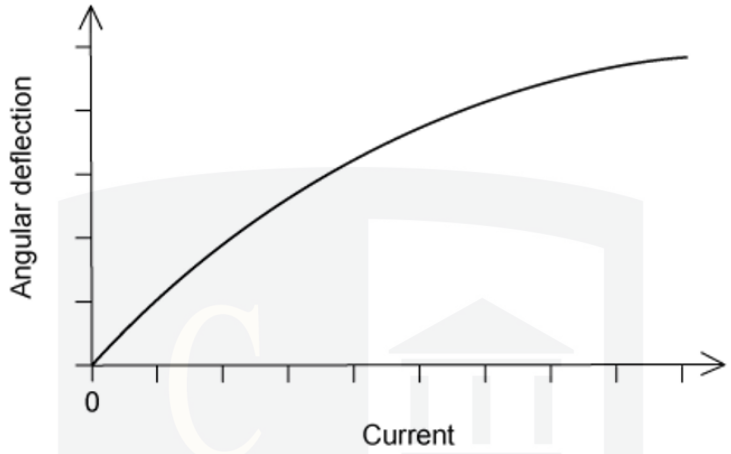
Which chart shows measurements that are precise but **not** accurate?



[1 mark]

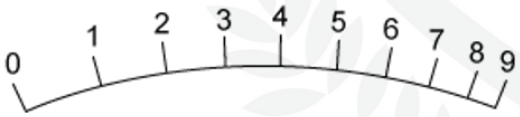
Question 4

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



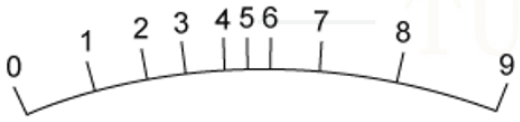
Which diagram could represent the appearance of the scale on this meter?

A

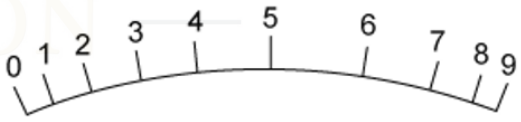


B

C



D



[1 mark]

Question 5

The Young modulus of the material of a wire is to be found. The Young modulus E is given by the equation below.

$$E = \frac{4Fl}{\pi d^2 x}$$

The wire is extended by a known force and the following measurements are made.

Which measurement has the largest effect on the uncertainty in the value of the calculated Young modulus?

	measurement	symbol	value
A	length of wire before force applied	*l*	2.043 ± 0.002 m
B	diameter of wire	*d*	0.54 ± 0.02 mm
C	force applied	*F*	19.62 ± 0.01 N
D	extension of wire with force applied	*x*	5.2 ± 0.2 mm

[1 mark]

Question 6

A steel rule can be read to the nearest millimetre. It is used to measure the length of a bar whose true length is 895 mm. Repeated measurements give the following readings.

length / mm	892, 891, 892, 891, 891, 892

Are the readings accurate and precise to within 1 mm?

	results are accurate to within 1 mm	results are precise to within 1 mm
A	no	no
B	no	yes
C	yes	no
D	yes	yes

[1 mark]

Question 7

Which experimental technique reduces the systematic error of the quantity being investigated?

A adjusting an ammeter to remove its zero error before measuring a current

B measuring several internodal distances on a standing wave to find the mean internodal distance

C measuring the diameter of a wire repeatedly and calculating the average

D timing a large number of oscillations to find a period

[1 mark]

Question 8

Four students each made a series of measurements of the acceleration of free fall *g*. The table shows the results obtained.

Which set of results could be described as precise but not accurate?

	g / ms^{-2}			
A	9.81	9.79	9.84	9.83
B	9.81	10.12	9.89	9.94
C	9.45	9.21	8.99	8.76
D	8.45	8.46	8.50	8.41

[1 mark]

Question 9

In an experiment, a radio-controlled car takes 2.50 ± 0.05s to travel 40.0 ± 0.1m. What is the car's average speed and the uncertainty in this value?

A 16 ± 1 m s^{-1}

B 16.0 ± 0.2 m s^{-1}

C 16.0 ± 0.4 m s^{-1}

D 16.00 ± 0.36 m s^{-1}

[1 mark]

Question 10

The measurement of a physical quantity may be subject to random errors and systematic errors.

Which statement is correct?

A random errors can be reduced by taking the average of several measurements

B random errors are always caused by the person taking the measurement

C a systematic error cannot be reduced by adjusting the apparatus

D a systematic error results in a different reading each time the measurement is taken

[1 mark]