# 1.2 Uncertainties & Errors

## Hard

# PHYSICS

# IB HL

# 1.2 Uncertainties & Errors

## Question Paper

| Course | DP IB Physics |
|---|---|
| Section | 1. Measurement & Uncertainties |
| Topic | 1.2 Uncertainties & Errors |
| Difficulty | Hard |

Time allowed:     20

Score:     /10

Percentage:     /100

## Question 1

In an experiment to determine the acceleration of free fall $g$, a student presents their calculated value as $9.7835 \, \text{m s}^{-2}$ and states their value is only accurate to ± 5%.
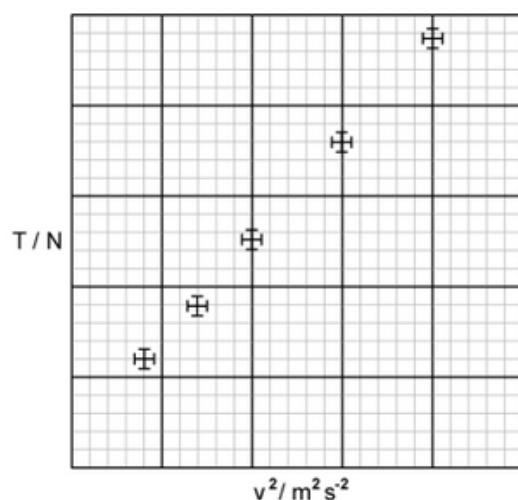
Which of the following gives their calculated value to an appropriate number of significant figures?

A. $10 \, \text{m s}^{-2}$

B. $9.8 \, \text{m s}^{-2}$

C. $9.78 \, \text{m s}^{-2}$

D. $9.785 \, \text{m s}^{-2}$

[1 mark]

## Question 2

A small conker is attached to a string and whirled overhead in a horizontal circle. The tension in the string $T$ is measured for a variety of different linear speeds $v$ and the following graph is obtained.
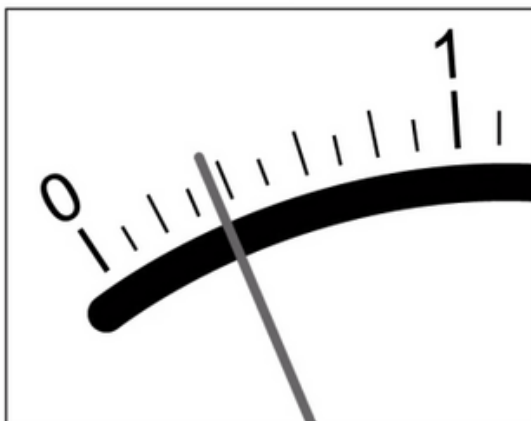


These experimental results suggest that there is...

A. a systematic error in $v$ and small random error

B. a systematic error in $T$ and small random error

C. a random error in $v$ and small systematic error

D. a random error in $T$ and small systematic error

[1 mark]

## Question 3

Analogue meters often have a mirrored or metallic strip behind the pointer.



What is the main purpose of this strip?

    A. To magnify the reading indicated by the pointer

    B. To enable the pointer to be seen from different angles

    C. To minimise the risk of parallax error

    D. To reflect as much light as possible on the reading indicated by the pointer

[1 mark]

## Question 4

Two lengths, $n$ and $n - 2$ have an uncertainty of $\Delta n$. The uncertainty $\Delta n$ is much less than $n$.

In which of the following quantities is the percentage uncertainty the largest?

    A. $n(n-2)$

    B. $\dfrac{n}{n-2}$

    C. $n + (n-2)$

    D. $n - (n-2)$

[1 mark]

## Question 5

Which of the following experimental techniques does not reduce the random error associated with the quantity being measured?

    A. Calibrating the Y-sensitivity of the oscilloscope before measuring a voltage

    B. Timing a large number of oscillations to determine the periodic time

    C. Using the gradient of a graph of current against voltage to determine the resistance of an ohmic conductor

    D. Measuring the distance between a large number of nodes on a standing wave to determine the wavelength of the wave

**[1 mark]**

## Question 6

The length and breadth of a rectangular card was found to be $(5.0 \pm 0.2)$ cm and $(3.0 \pm 0.2)$ cm respectively. The area of the card cannot be more than:

    A. $5 \text{ cm}^2$

    B. $8 \text{ cm}^2$

    C. $15 \text{ cm}^2$

    D. $18 \text{ cm}^2$

**[1 mark]**

## Question 7

An object dropped from the edge of a cliff is timed to take $(10.0 \pm 0.1)$ s to fall to the surface of the sea. If the acceleration due to free fall is $(10.0 \pm 0.2)$ m s$^{-2}$, the calculated height of the cliff from which the object was released should be quoted as:

    A. $(500 \pm 2.0)$ m

    B. $(500 \pm 20.0)$ m

    C. $(500 \pm 2)$ m

    D. $(50 \pm 2) \times 10^1$ m

**[1 mark]**

## Question 8

A certain rule can be read to the nearest millimetre. It is used to measure the length of a piece of string whose true length is 50 mm. Repeated measurements of the string give the following readings:

| Reading | Length / mm |
|---------|-------------|
| 1 | 52 |
| 2 | 52 |
| 3 | 51 |
| 4 | 52 |
| 5 | 51 |
| 6 | 51 |

Are the readings accurate and precise to within 1 mm?

| | Readings are accurate to within 1 mm | Readings are precise to within 1 mm |
|---|---|---|
| A. | No | No |
| B. | No | Yes |
| C. | Yes | No |
| D. | Yes | Yes |

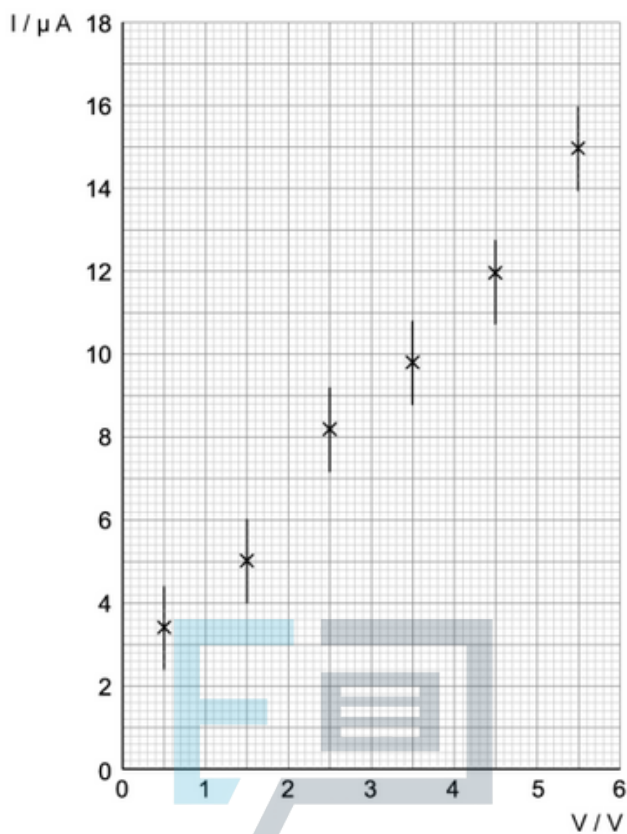[1 mark]

## Question 9

A researcher plots a graph to investigate the variation of current and potential difference of a resistor.



After realising they have read the manufacturers label of their electrical equipment incorrectly, they determine the size of the error bars shown should decrease.

Which row correctly describes how this will affect the value of the maximum gradient $G_{max}$, the minimum gradient $G_{min}$, and the resistance of the resistor $R$?

| | $G_{max}$ | $G_{min}$ | $R$ |
|---|---|---|---|
| A. | increase | increase | increase |
| B. | decrease | decrease | decrease |
| C. | increase | decrease | no change |
| D. | decrease | increase | no change |

[1 mark]

## Question 10

A mass is dropped from rest and falls through a distance of 2.0 m in a vacuum. An observer records the time taken for the mass to fall through this distance using a manually operated stopwatch and repeats the measurements a further two times.

The average result of these measured times, displayed in the table below, was used to determine a value for the acceleration of free fall. This was calculated to be 9.8 m s$^{-2}$.

|        | first measurement | second measurement | third measurement | average |
|--------|-------------------|--------------------|-------------------|---------|
| time/ s | 0.6 | 0.73 | 0.59 | 0.64 |

Which statement **best** describes the quality of the measurements taken for this experiment?

A. The measurements are precise and accurate with no evidence of random errors.

B. The measurements are not accurate and not always recorded to the degree of precision of the measuring device but the calculated experimental result is accurate.

C. The measurements are not always recorded to the degree of precision of the measuring device but are accurate. Systematic errors may be present.

D. The range of results shows that there were random errors made but the calculated value is correct so the experiment was successful.

**[1 mark]**