Higher Uncertainties Questions

1. What is meant by uncertainties caused by **'Systematic Effects'**?

2. a) What is meant by the term **'Random Uncertainty'**?

   b) State the equation used to calculate random uncertainty.

3. a) How would you estimate the uncertainty from an **analogue scale**?

   b) How would you estimate the uncertainty from a **digital scale**?

4. A 100m sprinter recorded the following times over the course of a season:

   9.83 s, 10.03 s, 9.96 s, 10.14 s, 10.20 s and 10.08 s.

   Calculate:

   a) Mean time of the sprinter.

   b) Random uncertainty in the times recorded.

   c) Mean time ± Random Uncertainty.

5. A golfer drives his shots off the tee and achieves the following distances:

   230 m, 243 m, 223 m, 248 m, 252 m, 235 m, 263 m and 234 m.

   Calculate:

   a) Mean range of the golf balls.

   b) Random uncertainty in the range of the golf balls.

   c) Mean Range ± Random Uncertainty.

6. A pupil measures the speed of a trolley at the bottom of a slope with a QED and light gate arrangement.

The following speeds were recorded **0.89 ms^{-1}, 0.93 ms^{-1}, 0.85 ms^{-1}, 0.87 ms^{-1} and 0.91 ms^{-1}.**

Calculate:

a) Mean speed of the trolley.

b) Random uncertainty in the speeds recorded.

c) Mean Speed ± Random Uncertainty.

7. The following readings were taken during an Ohms Law experiment to measure resistance:

Voltage = (14.00 ± 0.05) V
Current = (2.5 ± 0.1) mA.

Calculate:

a) Resistance.

b) % Uncertainty in Resistance.

c) Resistance ± Absolute Uncertainty.

8. The following readings were taken in an experiment to calculate the unbalanced force on an object:

Mass = (250 ± 1) g
Acceleration = (5.00 ± 0.05) ms^{-2}.

Calculate:

a) Unbalanced Force.

b) % Uncertainty in the unbalanced force.

c) Unbalanced Force ± Absolute Uncertainty.

9. The following readings were taken to calculate the Electrical Work Done on a charge in an electric field, where

Electrical Work Done = Charge x Voltage:

Charge = $(1.6 \pm 0.1) \times 10^{-19}$ C
Voltage = (2500 ± 50) V.

Calculate:

a) Electrical Work Done.

b) Percentage Uncertainty in the Electrical Work Done.

c) Electrical Work Done ± Absolute Uncertainty.

10. A trolley is released from rest at a point X at the top of a ramp and passes a point Y half way down the slope.
The distance travelled by the trolley XY is measured with a metre ruler and the times are measured with a stopwatch.

Distance XY = (0.25 ± 0.01) m.
Times = 1.41s, 1.38 s, 1.36 s, 1.42 s, 1.37 s, 1.49 s, 1.43 s, 1.40 s, 1.38 s and 1.44 s.

Calculate:

a) Mean Time.

b) Random uncertainty in the mean-time recorded.

c) Mean Time ± Random Uncertainty.

d) Average speed of the trolley.

e) % uncertainty in the average speed.

f) Average Speed ± Absolute Uncertainty.