

Mark scheme for Extension Worksheet – Topic 1, Worksheet 1

- 1 The mass of water is about $m = \rho V = 10^3 \times 1.5 \times 10^{-3} = 1.5 \text{ kg}$ so assuming a 70 kg adult the
ratio is $\frac{\text{mass of water}}{\text{mass of person}} = \frac{1.5}{70} \approx 10^{-2}$, so **B**. [1]
- 2 $V = \pi R^2 h$ so $\frac{\Delta V}{V} = 2 \frac{\Delta R}{R} + \frac{\Delta h}{h} = 2 \times 3\% + 2\% = 8\%$, so **B**. [1]
- 3 The perimeter is $4a = 4 \times (12.5 \pm 0.1 \text{ mm}) = 50.0 \pm 0.4 \text{ mm}$, so **B**. [1]
- 4 With $T = cL^{3/2}$ a graph of T versus $L^{3/2}$ will give a straight line with slope c , so **B**. [1]
- 5 The magnitude of the resultant cannot be more than the sum of the two magnitudes, i.e. cannot be 8.0 N, so **D**. [1]
- 6 The radius r ; since it is raised to the fourth power and so contributes four times as much to the total fractional error. [2]
- 7 There is a non-zero component of velocity along the line for all positions of the particle except when it is directly across in which case the component is zero. Hence the component must decrease and then increase again, so **D**. [1]
- 8 $C = \varepsilon \frac{A}{d}$ so $\varepsilon = \frac{Cd}{A} = \frac{Cd}{\pi r^2} = \frac{161 \times 10^{-12} \times 1.25 \times 10^{-3}}{\pi (8.50 \times 10^{-2})^2} = 8.8664 \times 10^{-12} \text{ F m}^{-1}$;
 $\frac{\Delta \varepsilon}{\varepsilon} = \frac{\Delta C}{C} + \frac{\Delta d}{d} + 2 \times \frac{\Delta r}{r} = \frac{5}{161} + \frac{0.02}{1.25} + 2 \times \frac{0.01}{8.50} = 0.04941$ and so
 $\Delta \varepsilon = \varepsilon \times 0.04941 = 8.8664 \times 10^{-12} \times 0.04941 = 4.381 \times 10^{-13} \approx 0.4 \times 10^{-12}$ to 1 s.f.; hence
the final answer must be quoted as $\varepsilon = (8.9 \pm 0.4) \times 10^{-12} \text{ F m}^{-1}$. [3]