SMART EXAM RESOURCES
9702 PHYSICS TOPIC QUESTIONS
TOPIC: PHYSICAL QUANTITIES AND UNITS
SUB-TOPIC: ERRORS AND UNCERTAINITIES
SUB-SUB-TOPIC: CALCULATE PERCENTAGE AND ABSOLUTE UNCERTAINITY

1 One end of a wire is connected to a fixed point. A load is attached to the other end so that the wire hangs vertically.

The diameter d of the wire and the load F are measured as

$d = 0.40 \pm 0.02\,\text{mm}$,
$F = 25.0 \pm 0.5\,\text{N}$.

The stress σ in the wire is calculated by using the expression

$$\sigma = \frac{4F}{\pi d^2}.$$

(i) Show that the value of σ is $1.99 \times 10^8\,\text{N m}^{-2}$.

[1]

(ii) Determine the percentage uncertainty in σ.

percentage uncertainty = ...% [2]

(iii) Use the information in **(b)(i)** and your answer in **(b)(ii)** to determine the value of σ, with its absolute uncertainty, to an appropriate number of significant figures.

σ = ... ± ..... N m^{-2} [2]

MARKING SCHEME:

)(i)	$\sigma = 4 \times 25/[\pi \times (0.40 \times 10^{-3})^2] = 1.99 \times 10^8\ \text{N m}^{-2}$ **or** $\sigma = 25/[\pi \times (0.20 \times 10^{-3})^2] = 1.99 \times 10^8\ \text{N m}^{-2}$	**A1**
)(ii)	$\%F = 2\%$ **and** $\%d = 5\%$ **or** $\Delta F/F = \frac{0.5}{25}$ **and** $\Delta d/d = \frac{0.02}{0.4}$	**C1**
	$\%\sigma = 2\% + (2 \times 5\%)$ **or** $\%\sigma = [0.02 + (2 \times 0.05)] \times 100$ $\%\sigma = 12\%$	**A1**
(iii)	absolute uncertainty $= (12/100) \times 1.99 \times 10^8$ $= 2.4 \times 10^7$	**C1**
	$\sigma = 2.0 \times 10^8 \pm 0.2 \times 10^8\ \text{N m}^{-2}$ **or** $2.0 \pm 0.2 \times 10^8\ \text{N m}^{-2}$	**A1**

2 The potential difference across a resistor is measured as 5.0 V ± 0.1 V. The resistor is labelled as having a resistance of 125 Ω ± 3%.

(i) Calculate the power dissipated by the resistor.

power = ... W [2]

(ii) Calculate the percentage uncertainty in the calculated power.

percentage uncertainty = ... % [2]

(iii) Determine the value of the power, with its absolute uncertainty, to an appropriate number of significant figures.

power = ... ± ..... W [2]

MARKING SCHEME:

(i)	$P = V^2/R$ **or** $P = VI$ and $V = IR$	**C1**
	$P = 5.0^2/125$ **or** 5.0×0.04 **or** $(0.04)^2 \times 125$ $= 0.20\,\text{W}$	**A1**
(ii)	$\%V = 2\%$ **or** $\Delta V/V = 0.02$	**C1**
	$\%P = (2 \times 2\%) + 3\%$ **or** $\%P = (2 \times 0.02 + 0.03) \times 100$ $= 7\%$	**A1**
(iii)	absolute uncertainty in $P = (7/100) \times 0.20$ $= 0.014$	**C1**
	power $= 0.20 \pm 0.01\,\text{W}$ **or** $(2.0 \pm 0.1) \times 10^{-1}\,\text{W}$	**A1**