Practice Question Set For A-Level
Subject : Physics
Paper-2 Topic : 4_Materials

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Name of the Student:____

Max. Marks : 24 Marks **Time : 24 Minutes**

Mark Schemes

Q1.

Question Number	Acceptable Answer	Additional Guidance	Mark
	An explanation that makes reference to the following points: • A thin wire has a large stress (for a given load) (1) • A long/thin wire has a large extension (for a given stress) (1) • Hence the percentage uncertainty in the length/extension is reduced (1)		3

Q2.

Question Number	Acceptable Answer	Additional Guidance	Mark
	• Calculates A (1) • Determine gradient (1) • Substitutes $\sigma = \frac{F}{A}$ and $\varepsilon = \frac{\Delta x}{x}$ into $E = \frac{\sigma}{\varepsilon}$ (1) • Uses $E = \frac{1}{\text{gradient}} \times \frac{x}{A}$ (1) • $E = 1.1 \times 10^{11}\ \text{N m}^{-2}$ (1)	Example of calculation $A = \frac{\pi \times (5.60 \times 10^{-4}\text{m})^2}{4} = 2.46 \times 10^{-7}\text{m}^2$ $E = \frac{F/A}{\Delta x/x} = \frac{F}{\Delta x} \times \frac{x}{A}$ $\text{Grad} = \frac{\Delta x}{F}\ \therefore E = \frac{1}{\text{gradient}} \times \frac{x}{A}$ $\text{Grad} = \frac{(3.6 - 0.75) \times 10^{-3}\text{m}}{(32.0 - 5)\ \text{N}} = 1.06 \times 10^{-4}\ \text{m N}^{-1}$ $\therefore E = \frac{1}{1.06 \times 10^{-4}\ \text{m N}^{-1}} \times \frac{2.75\ \text{m}}{2.46 \times 10^{-7}\text{m}^2}$ $\therefore E = 1.057 \times 10^{11}\ \text{N m}^{-2}$	5

Q3.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• Changes (in recorded length) due to the support bending are minimised **Or** changes (in recorded length) due to temperature are minimised **Or** it allows use of a vernier scale (to determine extension) (1)		1
(ii)	• To keep the reference wire taut/straight **Or** to keep the reference wire under tension (1)		1

Q4.

Question Number	Acceptable Answer	Additional Guidance	Mark
(i)	• (For linear section of graph) area under graph = $\frac{1}{2}$ stress × strain (1) • Use of stress = F/A and strain = $\Delta x/x$ to show that area = $\frac{1}{2} \times \frac{F}{A} \times \frac{\Delta x}{x} = \frac{F_{av}.\Delta x}{V} = \frac{E}{V}$ (1)	Candidates who only use the graph to show that the area has units J m^{-3} can score a maximum 1 mark Accept F_{av} for $\frac{1}{2}F$	2

(ii)	• Area under graph up to 0.075 calculated (1) • Energy per unit volume = 7.1×10^5 J m^{-3} (1) • This is much less than the value given in (a), and so belt does not absorb all the KE. (1) **OR** • Graph used to determine stress when strain is 0.075 and $\sigma = \frac{F}{A}$ used to calculate force (1) • $\epsilon = \frac{\Delta x}{x}$ used to calculate extension and $W = \frac{1}{2}F\Delta x$ used to calculate energy (1) • Statement that this energy is much less than the value in (a), and so belt does not absorb all the kinetic energy (1)	Example of calculation: When strain is 0.075 Area = $\frac{1}{2}\times19\times10^6\text{Pa}\times0.075=7.13\times10^5$ J m^{-3}	3

Q5.

Question Number	Answer		Mark
(a) (i)	Each row of the table contains a suitable method. One mark for each column, do not allow a mix and match of methods (rows)	**(1)** **(1)** **(1)** **(1)**	

Distance measured with the metre rule	**Corresponding time**	**Correct use of measurements referred to in columns 1 and 2**	**To calculate g use:** (formula/expression seen)
Record the position on the **rule** for each frame	Time between frames	Plot distance against t^2	g = 2 x gradient
Measure distance between (successive) frames against a metre **rule**	Time between frames	Calculate the speed each frame using distance /time and plot against time	g = gradient
Use metre **rule** to measure: (total) distance ball falls through **Or** height from which the ball was dropped (e.g. 1 m)	Number of frames × time between frame **Or** total time of journey recorded/found	Use of: $s = ut + ½ at^2$ **Or** $s = ½ at^2$ **Or** $s = ½ gt^2$	$g = 2s/t^2$ **Or** Re-arrange $s = ½ gt^2$ substituting in s and t to find g.
Measure distance between frames (at beginning and) end of drop using the **rule**	Time between frames known and count frames **Or** if stated $u = 0$ then time for ball to fall and the time between frames.	Use speed = $\Delta s/\Delta t$ to find their final velocity using correct time interval [may take u as 0]	$g = (v-u)/t$ **Or** $a = (v-u)/t$
Record the position on the **rule** each frame	Time between frames	Calculate the speed each frame using d/t and plot a graph of v^2 against s.	Gradient/2 = acceleration

Accept metre stick or ruler in place of metre rule
(The candidate may refer to the acceleration of free fall as '*a*' or 'g')

(a) (ii)	Ball may be released between 1st and 2nd images (so times used all too long because they include a short time before it is dropped) **Or** ball released before the 1st image so u is not 0 **Or** the ruler is not vertical/straight **Or** the idea that the camera has not been calibrated correctly i.e. runs too fast/slow **Or** the idea that there is a parallax error from camera to object (Parallax alone is insufficient) (Do not award a mark for air resistance)	(1)	1
(b)	Small / dense / streamlined shape / smooth surface / shiny Correct explanation, e.g.: Small surface area– minimise drag Dense – weight > upthrust **Or** weight > drag Streamlined /aerodynamic– minimise drag **Or** ensure laminar flow Smooth surface – minimise drag **Or** ensure laminar flow Shiny – easy to see on the recording Small – easier to read scale (precisely) (Sphere is not acceptable for a property but statement such as 'sphere to minimise drag' can score 2nd mark)	(1) (1)	2
(c)	Advantage Explanation (to score both marks the explanation must be linked to the advantage. Accept reverse arguments. Human error is not sufficient for reaction time).	(1) (1)	2

Advantage	Explanation
No reaction time	Reduces uncertainties **Or** (time recorded) more precise/accurate
Can be paused /stopped to take readings.	Measurements taken at exact times **Or** positions against rule recorded more accurately. **Or** velocities can be calculated frame by frame (more readings
Allows repeated playback **Or** rewinding	Allows values to be checked/confirmed **Or** values obtained are more reliable