# Examzone 2 Materials

**1** Sensible scale **(1)**
Plotted correctly **(1)**
Best fit line **(1)**
Indication on the graph of letter P the limit of proportionality **(1)**

$$\sigma = \frac{T}{A}$$

$$= \frac{28.5 \times 10^{3}\,\text{N}}{1.3 \times 10^{-4}\,\text{m}^{2}} \quad (\pm 1)\ \textbf{(1)}$$

$$= 2.2 \times 10^{8}\,\text{N m}^{-2}\ \textbf{(1)}$$

$$\varepsilon = \frac{x}{l} = \frac{6.9 \times 10^{-6}\,\text{m}}{6.5 \times 10^{-2}\,\text{m}} \quad (\pm 1)\ \textbf{(1)}$$

$$E = \frac{\sigma}{\varepsilon} = \frac{2.2 \times 10^{8}\,\text{N m}^{-2}}{1.1 \times 10^{-3}}$$

$$= 2.0 \times 10^{11}\,\text{N m}^{-2}\ \textbf{(1)}$$

Steeper, shorter **(1)**
No 'bend' [or very little] **(1)**

**2**

| | Desirable | Not desirable | Reason |
|---|---|---|---|
| Elastic | **(1)** | | Rod returns to original shape/position on unloading **(1)** |
| Brittle | | **(1)** | Rod should not snap/shatter (when lifting a heavy fish) **(1)** |
| Hard | **(1)** | | Rod will not scratch/dent with a large force **(1)** |
| Tough | **(1)** | | Rod can withstand a sudden impact or dynamic load **(1)** |

[**Two marks for each line**]

**3** **Complete table**:
**Plastic**: Not desirable **(1)**
Reason: Would remain deformed (once load is removed) **(1)**

**Tough**: Desirable **(1)**
Reason: To withstand dynamic loads/impacts/shocks **(1)**

**Brittle**: Not desirable **(1)**
Reason: Would crack / shatter / snap / break with no (plastic) deformation **(1)**

# Examzone 2 Materials (cont.)

**Calculate stress**:

Use of $m \times g$ **(1)**

[$g = 10\,\text{m s}^{-2}$ will **not** be penalised]

Correct answer [$1.9 \times 10^4\,\text{Pa}$] **(1)**

e.g. Force $= 80 \times 9.81 = 785\,\text{N}$

$\sigma = \frac{F}{A}$ $= 785/4.2 \times 10^{-2}$

$= 18686 = 1.9 \times 10^4\,\text{Pa}$

[allow $1.8–2.0 \times 10^4\,\text{Pa}$ and allow $\text{N m}^{-2}$ as units]

**Running athlete**:

On one foot / part of foot **(1)**

As less (surface) area **(1)**

OR

When landing/pushing off **(1)**

As the force is greater **(1)**

**(Total 10 marks)**

**4 Weight**

$mg = 70 \times 9.81 = 690\,\text{N}$ **(1)**

**Meaning of upthrust**

There is an upward force **(1)**

in a fluid / equal to weight of air displaced **(1)**

**Upthrust in newtons**

Upthrust = mass of air displaced $\times g$

= volume of air displaced × density of air $\times g$ **(1)**

$= V \times 1.29 \times 9.81 = 12.65\,\text{V}$ **(1)**

**Weight of helium**

Volume × density $\times g = 0.18\,V\text{g}$ $(= 1.77\,\text{V})$ **(1)**

**Total volume of balloons**

Upthrust = weight of man + weight of helium **(1)**

$12.65V = 690 + 0.18Vg$ **(1)**

$10.88V = 690$

$V = 63\,\text{m}^3$ [Allow e.c.f.] **(1)**

**Why viscous force can be ignored**

Any two from:

- Quote of $6\pi\eta r\upsilon$
- $\upsilon$ is small
- $\eta$ is small **(2)**

**(Total 11 marks)**