B6 Stress, Strain and Young's Modulus

Preliminary question: A wire has a cross sectional area of 1.5 mm^2. What is its cross sectional area in m^2? Answer: 1.5×10^{-6} m^2. If you can't see why this is true, ask your teacher before continuing with this section.

B6.1 Complete the questions in the table. All samples have a circular cross section.

Diameter /mm	Cross sectional area /m^2	Tension /N	Stress /MPa
1.0	(a)	15.0	(b)
3.2	(c)	420	(d)
0.30	(e)	(f)	320

B6.2 A rubber band was 8.4 cm long before it was stretched. It is then stretched until its strain is 2.45. Calculate its new total length.

B6.3 A copper wire is put under tension. It was 1.52 m long to begin with, and then stretches by 3.2 mm. Calculate its strain.

B6.4 A brass pin has a cross sectional area of 0.50 cm^2. Brass has a tensile strength of 190 MPa. Calculate the maximum tensile force it ought to be able to withstand without breaking.

B6.5 Mild steel has a breaking strength of 500 MPa. If you want to support a 200 kg piano using a single steel wire, what is the minimum diameter of wire you require?

B6.6 A bolt is needed to attach an actor's harness to a wire across a stage. The bolt is 5.0 cm long with a 0.25 cm^2 cross sectional area, and must extend by no more than 0.02 mm when supporting a 900 kg mass. Calculate the minimum value of Young's modulus of a material if it is to be suitable.

Assuming that all of the materials obey Hooke's Law and that they are circular in cross section, find the specified values in the table:

	Diameter /mm	Cross sectional area /m^2	Original length /m	Tension /N	Extension /mm	Stress /MPa	Strain	Young's modulus /GPa
B6.7	1.0		56	890	32	(a)	(b)	(c)
B6.8			7.36		(a)	500	(b)	211
B6.9	(a)	(b)		9.8		(c)	0.40%	130
B6.10		1.5×10^{-6}	(a)		5.0	70	(b)	130