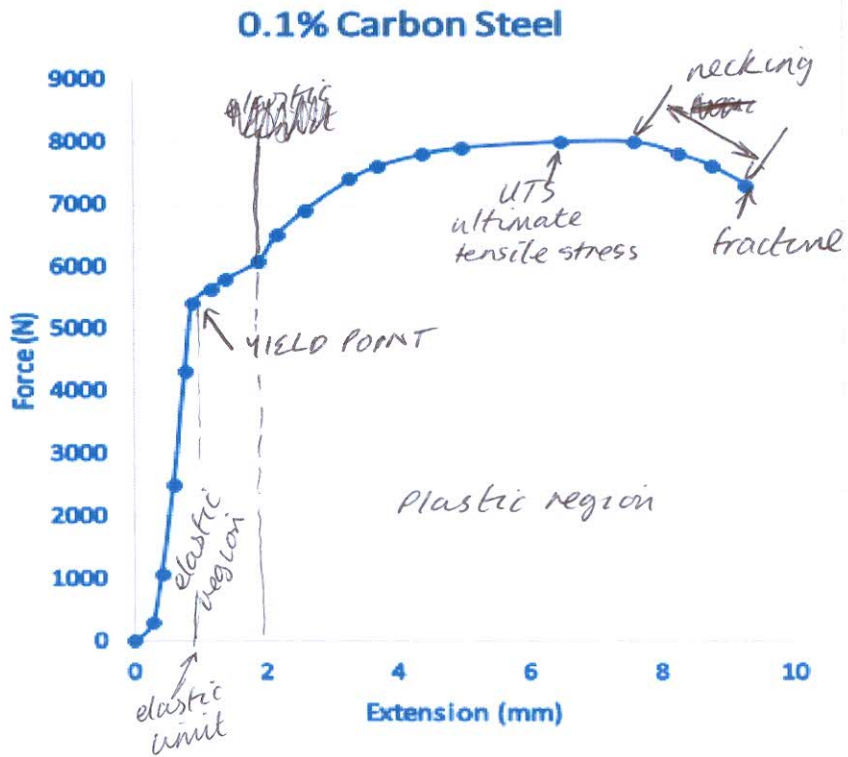


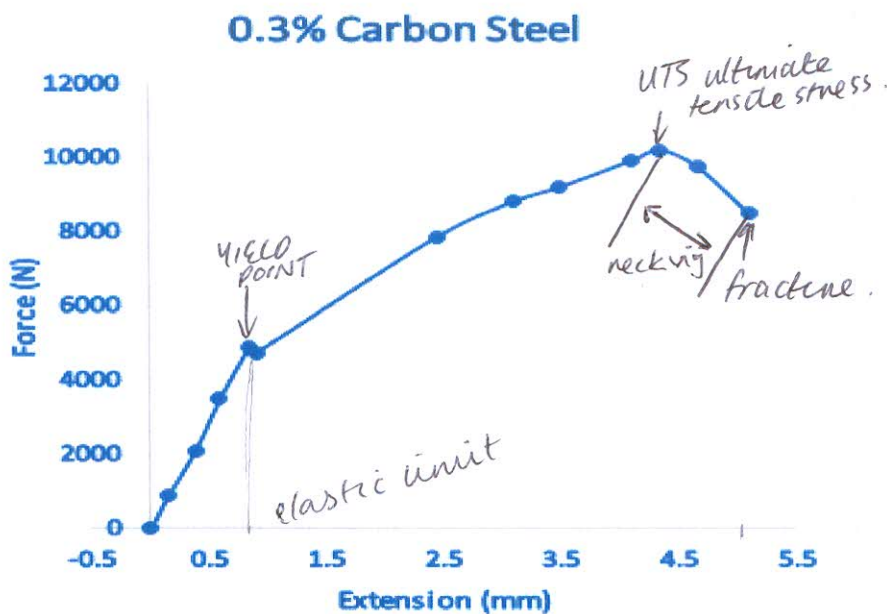
THIS PAGE MUST BE SUBMITTED WITH YOUR ANSWER BOOK

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1810356.

Graphs for question 3



Load (N)	Ext (mm)
0	0
300	0.28
1080	0.42
2500	0.6
4300	0.78
5400	0.9
5650	1.19
5800	1.4
6100	1.9
6500	2.17
6900	2.6
7400	3.3
7600	3.7
7800	4.4
7900	5
8000	6.5
8000	7.6
7800	8.3
7600	8.8
7300	9.3



Load (N)	Ext (mm)
0	0
900	0.15
2100	0.38
3500	0.59
4900	0.85
4750	0.9
7850	2.45
8800	3.1
9200	3.5
9900	4.1
10200	4.35
9750	4.67
8500	5.1

END OF EXAMINATION PAPER

Elastomers - virtually the same as thermoset plastics but they have a high degree of elasticity and although they stretch, they spring back into shape. Their molecules tend to straighten under tension but spring back when released.

4). a)

Normalising - a process in which a metal is heated to a specific heat and left to cool naturally in the air to relieve stresses, making it more ductile.

Annealing - a heat treatment process that changes the physical and sometimes chemical properties of a material to increase ductility and reduce the hardness to make it more workable.

Hardening - heating to a sufficiently high temperature to dissolve solute rich precipitates. Then it is rapidly cooled to avoid reprecipitation, often by quenching in water or oil.

Tempering - Heat treatment to improve toughness of hard brittle steels so they can hold up during processing.

b) **Thermoplastic** - Heating the polymer vibrates the molecules and if they ~~cross-link~~ are not cross linked, the distance between the molecules will increase and the van der Waal forces ~~decrease~~ will be reduced. This makes the polymer softer so these types can be re-moulded.

Thermoset - These set into a hard state by initiating a chemical reaction either by heating or mixing with a catalyst. This process called curing makes the molecules become cross-linked forming a more rigid structure. Reheating will not change the properties of soften the polymer.

3) a) Yield load - 0.1% steel = 5500 N 0.3% steel = 5000 N

2) Yield extension -

3) Yield stress - $\frac{\text{Yield point}}{\text{area}} = \frac{6000}{0.00002} = 300 \text{ MPa (0.1\%)} \quad \frac{4800}{0.00002} = 240 \text{ MPa (0.3\%)}$

4) Ultimate tensile load - 0.1% = 8000 N 0.3% = 10000 N

5) ~~UTS~~ UTS = $\frac{F}{A} = 0.1\% = \frac{8000}{20 \text{ mm}^2} = \frac{8000}{0.00002} = 400 \text{ MPa}$

0.3% = $\frac{10000}{20 \text{ mm}^2} = \frac{10000}{0.00002} = 500 \text{ MPa}$

6)

(0.1%) % Elongation - $\frac{\text{change in length}}{\text{original}} \times 100 = \frac{9.1 \text{ mm}}{25 \text{ mm}} \times 100 = 36.4\%$

(0.3%) — " — - $\frac{\text{change in length}}{\text{original}} \times 100 = \frac{4.2 \text{ mm}}{25 \text{ mm}} \times 100 = 16.8\%$

b) Increasing the carbon content in steel, increases the hardness and tensile strength but ~~the~~ the ductility is reduced making it a lot more difficult to machine. The higher the content the harder they become to weld. Very high carbon contents used for cutting tools ect, they require heat treating before, during and after welding to maintain material properties.

c) Mild Steel = roughly between 0.16% and 0.29%.

Medium carbon steel = between 0.30% and 0.60%.

High carbon steel = between 0.61% and 1.5%.

23/03/21 Structural mechanics exam.

Huke Penny - 1810356

a) A cylinder with a thickness is less than $1/10$ to $1/20$ of its diameter is classed as a thin cylinder and above $1/20$ its diameter is a thick walled cylinder. To analyse the stress in a thin walled cylinder you use the hoop and circumferential stress. The cylinder is rolled out to work out the overall area and the stresses can be worked out. Thick walled cylinders are worked out on internal and external pressures.

b) Thin = $t < \frac{D}{20}$ thick $t > \frac{D}{20}$

c). find 't'

$$P = 36 \text{ MPa}$$

$$\sigma_{\max} = 12 \text{ MPa}$$

$$D = 100 \text{ mm}$$

$$\sigma_h = \frac{Pd}{2t} \quad t = \frac{Pd}{2(\sigma_h)} = \frac{(36 \times 10^3)(0.1)}{2(12)} = \underline{0.15 \text{ mm}}$$

2. a). C_c = critical damping ($\sqrt{4mk}$) - the minimum value of damping that prevents oscillation
 ω_n = natural frequency ($\sqrt{\frac{k}{m}}$) - the frequency at which a system oscillates when not subjected to a continuous force.
 $\xi = \left(\frac{C}{C_c}\right)$ damping - the damping ratio, this can vary from undamped ($\xi=0$), underdamped ($\xi < 1$) and overdamped ($\xi > 1$).
critical damping.

$$b). i) 4.7746 \text{ Hz} \times 2\pi = 29.99 \text{ rad/s}$$

$$2) \omega_n = \sqrt{\frac{k}{m}} = \sqrt{\frac{10000}{5}} = 44.72 \text{ rad/s}$$

$$3) C_c = \sqrt{4mK} = \sqrt{(4)(5)(10000)} = 447.2 \text{ N/s/m}$$

$$4) \frac{C}{C_c} = \frac{150}{447.2} = 0.335$$

$$5) A^2 = \left(\frac{40}{5}\right)^2 \left[\frac{1}{(44.72^2 - 29.99^2) + ((2 \times 0.335)(29.99)(44.72))^2} \right] = 7.915 \times 10^{-5}$$
$$A = \sqrt{7.915 \times 10^{-5}} = 8.896 \times 10^{-3}$$