Obligatorisk innlevering nr. 4 i MAS144

Oppgave 1

a) Which material is stiffer: one with a high or low Young's modulus (E)?
b) What is meant by Poisson's ratio?
c) Describe the difference between elasticity and anelasticity.
d) Define the yield strength at 0.2% strain.
e) What is the difference between engineering (nominal) stress and true stress?
f) How are yield strength, tensile strength, fracture toughness, and elastic modulus affected when the hardness of a metal is increased?
g) Describe how hardness is measured in a material.
h) If a steel specimen has a Brinell hardness of 500, what is its Rockwell C hardness?
i) Name five factors that affect the results in materials testing.
j) Which three factors influence the determination of the safety factor?

Oppgave 2

A specimen of stainless steel, with a diameter of 12.8 mm and a gauge length of 50.8 mm, is subjected to a tensile test. The data from the test are shown in the table below.

Load (N)	Length (mm)
0	50.800
12,700	50.825
25,400	50.851
38,100	50.876
50,800	50.902
76,200	50.952
89,100	51.003
92,700	51.054
102,500	51.181
107,800	51.308
119,400	51.562
128,300	51.816
149,700	52.832
159,000	53.848
160,400	54.356
159,500	54.864
151,500	55.880
124,700	56.642
Fracture	

Remember that English books write numbers like this: for example, 4,740 = 4740

a) Create a working diagram showing stress (σ) on the y-axis and strain (ε) on the x-axis.

Hint: This is an excellent exercise to do in a spreadsheet, but in any case, it is useful to arrange the values in the following table:

Last [N]	Lengde [mm]	ΔL [mm]	Tøyning ε	E-modul [Gpa]	Spenning [Mpa]	Sann spenning [Mpa]

Finn følgende verdier basert på testen som er gjennomført.

b) Young's modulus (E).

c) Yield strength (YS) at a normal strain of 0.002 (0.2%).

d) Tensile strength.

e) Ductility as % elongation (%EL).

f) Modulus of resilience U_r in J/m³.

g) The actual (final) length of the specimen after fracture.

h) True stress and true strain up to the onset of necking (contraction).

Oppgave 3

For a given metal alloy, a true stress of 415 MPa produces a true strain of 0.475. What will be the elongation of this alloy when it is subjected to a true stress of 325 MPa, given that it has an original length of 300 mm? Assume that the strain-hardening exponent *n* is 0.25.

Oppgave 4

a) A Brinell hardness tester with a ball diameter of 10 mm and an applied load of 500 kg produces an indentation with a diameter of 1.62 mm in a steel alloy. Calculate the Brinell hardness (HB) of the steel alloy.

b) What will be the diameter of the indentation in the steel alloy when it has a Brinell hardness of 450, using an applied load of 500 kg?

Oppgave 5

Assume that a thin-walled cylindrical vessel with a radius of 65 mm and a length of 1 m is to be used to transport gas under pressure. The internal pressure is 10.13 MPa, and the external pressure is 0.2026 MPa. Calculate the required wall thickness and the cost in US dollars for each of the alloys listed in the table below. Use a safety factor of 3.5.

Alloy	*Yield Strength, σ_y (MPa)*	*Density, ρ (g/cm^3)*	*Unit Mass Cost, $\overline{c}$ ($US/kg)*
Steel (plain)	*375*	*7.8*	*1.65*
Steel (alloy)	*1000*	*7.8*	*4.00*
Cast iron	*225*	*7.1*	*2.50*
Aluminum	*275*	*2.7*	*7.50*
Magnesium	*175*	*1.80*	*15.00*

Hint. Dette er også en ypperlig oppgave å løse på regneark, sett opp verdiene etter følgende tabell:

Materiale	YS [Mpa]	Tetthet [g/cm^3]	Kost [$/kg]	Nødvendig tykkelse	Nødvendig volum	Masse	Kostnad

NOTE: Translated using ChatGPT. In case of any inconsistencies, please check against the Norwegian version.