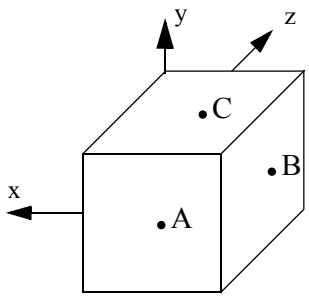
EXAM 1 MEEM2150 Feb. 16, 2011

1.

(i) Show the non-zero stress components on the A,B, and C faces of the cube. Use the coordinate system that is given only.

$$\begin{bmatrix} \sigma_{xx} = 0 & \tau_{xy} = -60\text{MPa} & \tau_{xz} = 40\text{MPa} \\ \tau_{yx} = -60\text{MPa} & \sigma_{yy} = 100\text{MPa(C)} & \tau_{yz} = 0 \\ \tau_{zx} = 40\text{MPa} & \tau_{zy} = 0 & \sigma_{zz} = 50\text{MPa(T)} \end{bmatrix}$$



In problems (ii) through (x) **circle** the correct answer.

(ii) Stress at a point in plane stress has 4 non-zero components but only 3 are independent. True / False

(iii) Stress components have the same signs on the two opposite surfaces of an imaginary cut. True / False

(iv) A stress element can be drawn to any scale. True / False

(v) If the left end of a rod moves more than the right end in the negative x direction, then the normal strain in the x direction will be negative. True / False

(vi) When angle increases from right angle we obtain positive shear strain. True / False

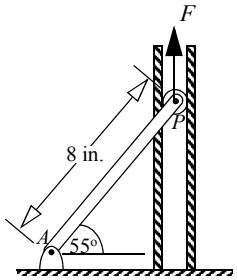
(vii) In Lagrangian strain the deformed geometry is used as the reference geometry. True / False

(viii) In anisotropic materials the stress and strain relationship is same in all directions. True / False

(ix) Ductile materials show large elastic deformation but small plastic deformation before fracture. True / False

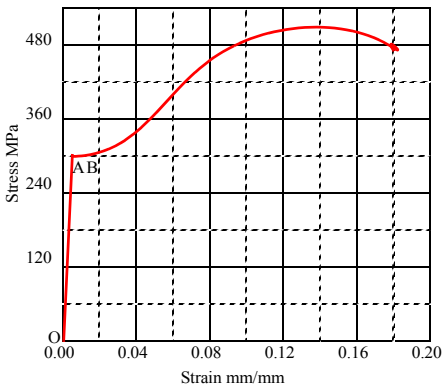
(x) An isotropic material has 3 independent material constants that relate stress and strain linearly. True / False

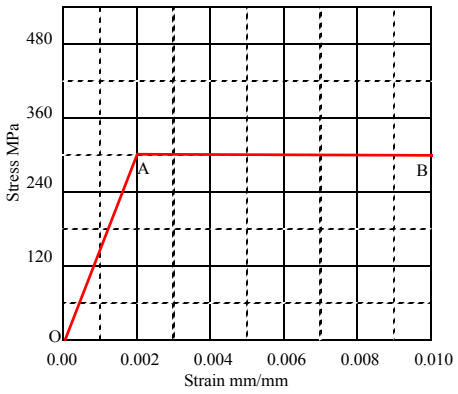
(xi) The modulus of elasticity of bar *AP* is 30,000 ksi and the area of cross-section is 0.5 in^2. If due to the force *F* the roller is seen to move by 0.024 inch upwards, determine the force *F*.



2. A tensile test specimen having a diameter of 10 mm and a gage length of 50 mm was tested to fracture. The stress-strain curve from the tension test is shown below. The right plot is the expanded region OAB of the left plot.

Showing your points and construction on graphs and the associated calculations, determine the following quantities.





NAME----------

(i) Modulus of elasticity.

(ii) Ultimate stress.

(iii) Fracture stress.

(iv) Offset yield stress at 0.2% offset strain.

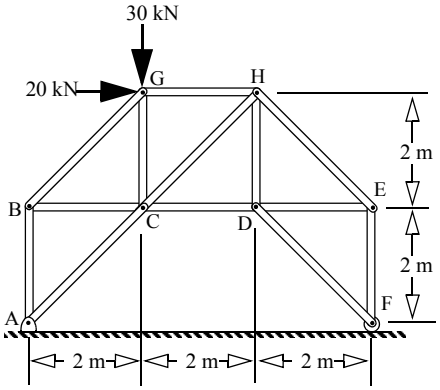
(v) Secant modulus at stress level of 420 MPa

(vi) The plastic strain at stress level of 420 MPa.

(vii) Determine the Poisson's ratio if the shear modulus of elasticity of the material is 55GPa

(viii) Determine the axial force acting on the specimen when it is extended by 0.2 mm

3. A truss is constructed using circular bars of diameter 15 mm, modulus of elasticity 200 GPa, Poisson's ratio of 0.28, yield stress of 200 MPa, and ultimate stress 600 MPa. Determine (a) the axial stress in members *AC* and *GH*. (b) the factor of safety in bar *AC* if yielding is to be avoided.



ANSWERS

1 (ii) through (x) T,T,T,F,F,F,F,F; (xi) F = 30.2 kips;

2. (i) 150Gpa; (ii) 510 MPa; (iii) 480 MPa; (iv) 300 MPa; (v) 6.46 GPa (vi) 0.0622; (vii) 0.3636; (viii) 23.56 kN

3. σ_{AC}= 160 MPa (T); σ_{GH}= 264.4 MPa (C); K_{safety} = 1.25