The University of Jordan
Department of Mechanical Engineering
Faculty of Engineering and Technology, spring 2014-2015

Mechanics of Materials*– Course # ME*094372 **First Midterm Examination**

Instructors:

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Time allowed: 60 min

Date: March 15, 2015

Student Name			ID#	Section #
Problem No.	**Q1 (3pts)**	**Q2, 3,4 (3pts)**	**Q5, 6, 7 (9pts)**	**Q8,9 (6pts)**
Course Outcome	4	12, 13	4, 14	2, 6
Student Outcome	SO1, 5	SO1, 2, 5	SO1, 5	SO1, 3, 5, 9
Problems Grade	3	7	10	6
		Total Grade out of 26		

Please insert your answer in the table below. Show clearly your detailed solution. *Answers without detailed solution will not be weighted*.

Problem number	**Prob.1**	**Prob.2**	**Prob.3**	**Prob.4**	**Prob.5**	**Prob.6**	**Prob.7**	**Prob.8**	**Prob.9**
Answer									

Problem.1 (3- points) The pin shown is made of a material having a failure shear stress of $\tau_{fail} = 144\,MPa$. If we apply a factor of safety of (F.S. = 2.25) against shear failure, then the minimum required diameter of the pin is:

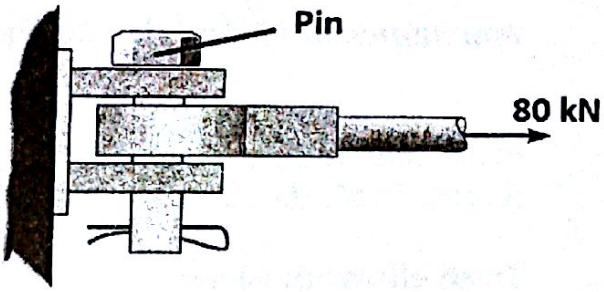
A) d=26.90 mm

B) d=30.00 mm

C) d=28.21 mm

D) d=29.74 mm

E) d=31.19 mm



Problem.2 (3- points) A tension test was performed on a specimen; the resulting stress–strain diagram is shown in the figure. The yield strength based on a 0.1% strain offset method is:

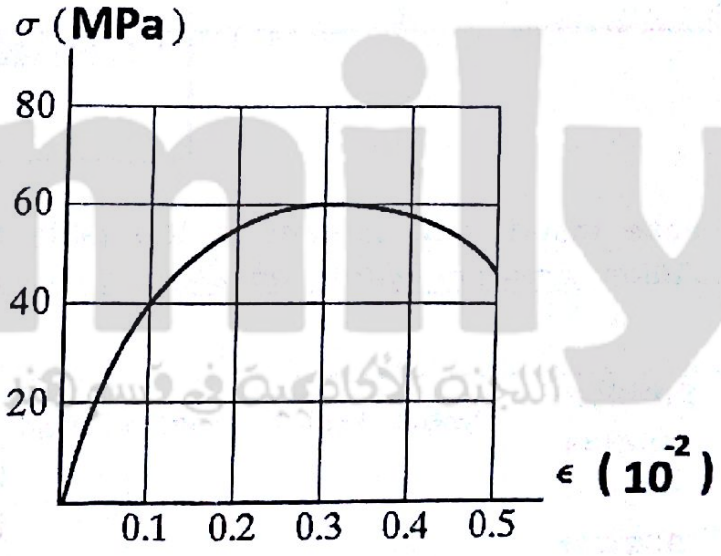
A) $\sigma_Y = 63\,MPa$

B) $\sigma_Y = 44\,MPa$

C) $\sigma_Y = 55\,MPa$

D) $\sigma_Y = 40\,MPa$

E) $\sigma_Y = 35\,MPa$



Problem.3 (2- points) After applying the force P to a circular solid rod, its diameter becomes 19.9837 mm and it elongates by 1.5 mm. Assume that the material is linearly elastic, and then the modulus of elasticity (E) of the material is:

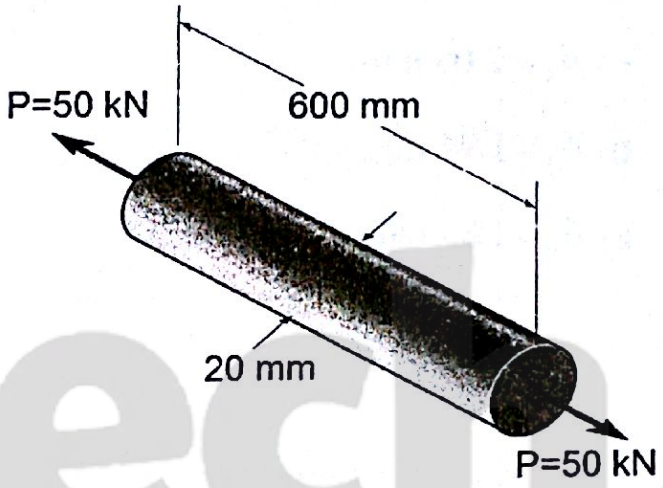
A) $E = 59.68$ GPa

B) $E = 63.66$ GPa

C) $E = 68.21$ GPa

D) $E = 56.17$ GPa

E) $E = 75.21$ GPa



Problem.4 (2- points) For the previous problem, the Poisson's ratio of the material is:

A) $\nu = 0.273$

B) $\nu = 0.288$

C) $\nu = 0.306$

D) $\nu = 0.326$

E) $\nu = 0.349$

Problem.5 (4- points) If the 20-mm-diameter rod is made of A-36 steel ($E=180\,\text{GPa}$) and the stiffness of the spring is $k=55\ \text{MN/m}$. When a force $P=60\ \text{kN}$ is applied as shown, the displacement of the end A is:

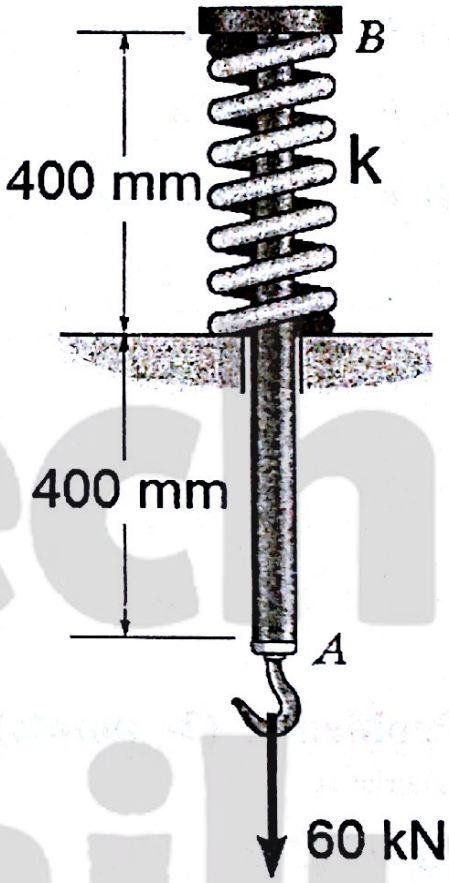
A) $\delta_A=2.18\ \text{mm}$

B) $\delta_A=1.20\ \text{mm}$

C) $\delta_A=2.05\ \text{mm}$

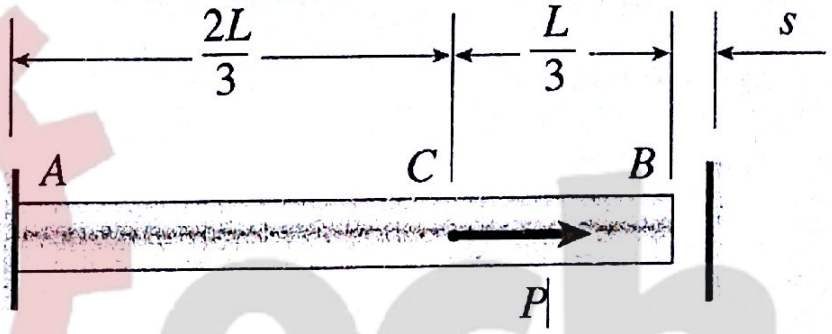
D) $\delta_A=1.94\ \text{mm}$

E) $\delta_A=1.85\ \text{mm}$



Problem.6 (3- points) A bar AB ($\alpha = 12\times10^{-6}\,1/C^{o}$) is fixed at end A and at the other end a small gap of dimension s exists between the end of the bar and a rigid wall. A load $P = 80$ kN acts on the bar at point C with a temperature increase of $\Delta T = 60\,C^{o}$. If the support reactions produced by the load P and by the increase in ΔT are to be equal in magnitude, then: The reactions at the fixed supports are?

A) $R_A = R_B = 50\,\text{kN}$
B) $R_A = R_B = 40\,\text{kN}$
C) $R_A = R_B = 30\,\text{kN}$
D) $R_A = R_B = 60\,\text{kN}$
E) $R_A = R_B = 20\,\text{kN}$

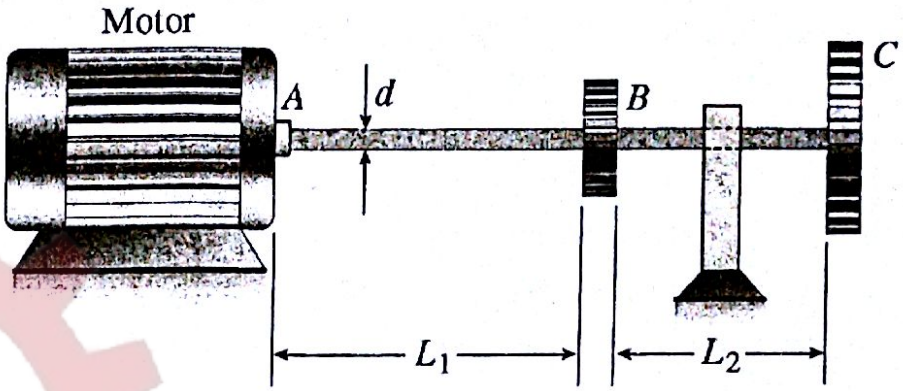


E= 140 GPa, L=3 m, A=1500 mm^2

Problem.7 (3- points) For the previous problem, the size s of the gap is?

A) $s = 2.35$ mm
B) $s = 2.40$ mm
C) $s = 2.45$ mm
D) $s = 2.30$ mm
E) $s = 2.25$ mm

Problem.8 (3- points) A motor delivers 200 kW at 1200 rpm to the end of a shaft (see figure). The gears at B and C take out 90 and 110 kW, respectively. Assume G=80 GPa, L_1 =1.8 m, and L_2 = 1.2 m. if the allowable shear stress is 50 MPa, then the required diameter of the shaft is:



A) $d = 58$ mm

B) $d = 55$ mm

C) $d = 62$ mm

D) $d = 69$ mm

E) $d = 60$ mm

Problem.9 (3- points) For the previous problem, if d = 60 mm, then the angle of twist between the motor and gear C is:

A) $\theta = 2.64^o$

B) $\theta = 2.20^o$

C) $\theta = 3.31^o$

D) $\theta = 4.41^o$

E) $\theta = 2.80^o$