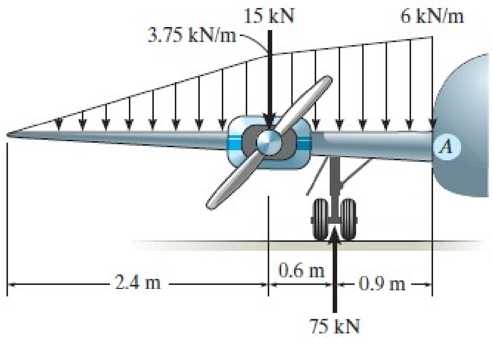
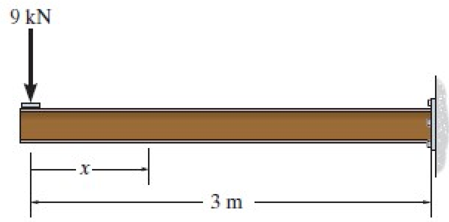
6–2. The dead-weight loading along the centerline of the airplane wing is shown. If the wing is fixed to the fuselage at A, determine the reactions at A,



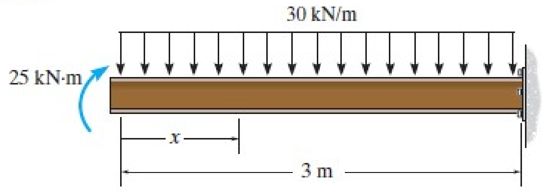
In each case, express the shear and moment functions in terms of x, and then draw the shear and moment diagrams for the beam.

F6–2.



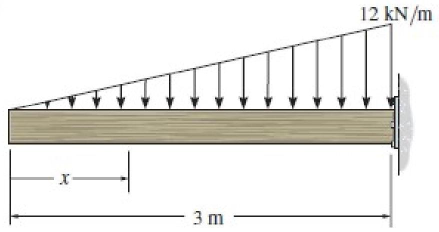
Prob. F6–2

F6–3.



Prob. F6–3

F6–4.



Prob. F6–4

EXAMPLE

Draw the shear and moment diagrams for the beam shown in Fig. 6–7*a*.

SOLUTION

Support Reactions. The reactions at the supports are shown on the free-body diagram of the beam, Fig. 6–7*d*.

Shear and Moment Functions. Since there is a discontinuity of distributed load and also a concentrated load at the beam's center, two regions of x must be considered in order to describe the shear and moment functions for the entire beam.

$0 \le x_1 < 5$ m, Fig. 6–7*b*:

$$+\uparrow \Sigma F_y = 0; \qquad 5.75 \text{ kN} - V = 0$$

$$V = 5.75 \text{ kN} \qquad (1)$$

$$\circlearrowleft + \Sigma M = 0; \qquad -80 \text{ kN}\cdot\text{m} - 5.75 \text{ kN } x_1 + M = 0$$

$$M = (5.75x_1 + 80) \text{ kN}\cdot\text{m} \qquad (2)$$

$5 \text{ m} < x_2 \le 10$ m, Fig. 6–7*c*:

$$+\uparrow \Sigma F_y = 0; \quad 5.75 \text{ kN} - 15 \text{ kN} - 5 \text{ kN/m}(x_2 - 5 \text{ m}) - V = 0$$

$$V = (15.75 - 5x_2) \text{ kN} \qquad (3)$$

$$\circlearrowleft + \Sigma M = 0; \quad -80 \text{ kN}\cdot\text{m} - 5.75 \text{ kN } x_2 + 15 \text{ kN}(x_2 - 5 \text{ m})$$

$$+ 5 \text{ kN/m}(x_2 - 5 \text{ m})\left(\frac{x_2 - 5 \text{ m}}{2}\right) + M = 0$$

$$M = (-2.5x_2^2 + 15.75x_2 + 92.5) \text{ kN}\cdot\text{m} \qquad (4)$$

Shear and Moment Diagrams. Equations 1 through 4 are plotted in Fig. 6–7*d*.

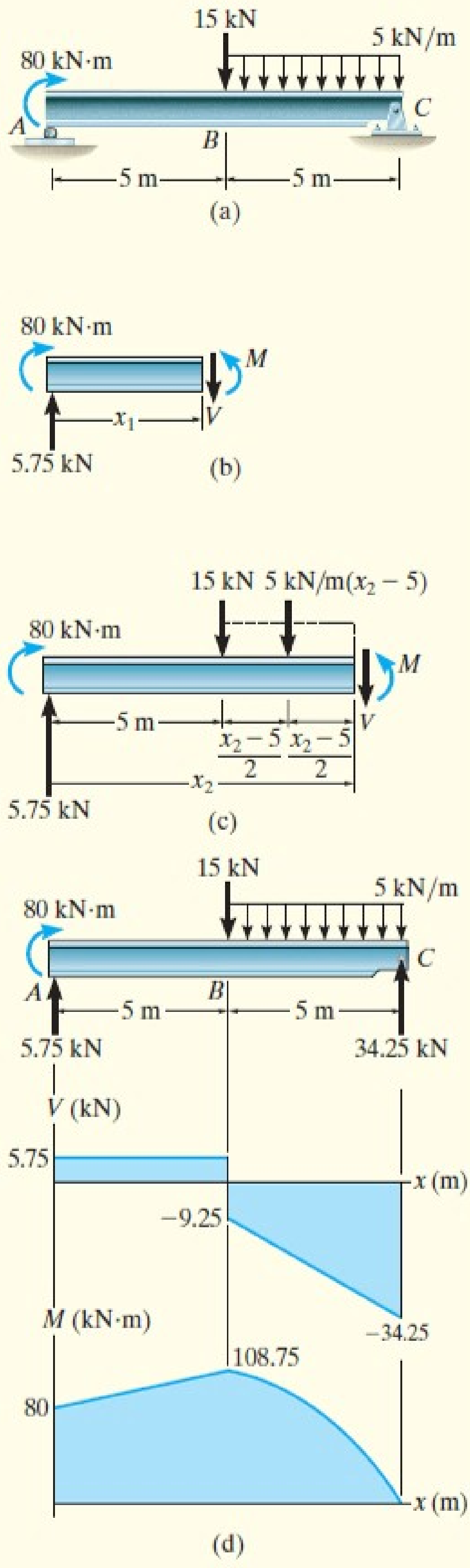


Fig. 6–7

EXAMPLE

Draw the shear and moment diagrams for the beam shown in Fig. 6–4*a*.

SOLUTION

Support Reactions. The support reactions are shown in Fig. 6–4*c*.

Shear and Moment Functions. A free-body diagram of the left segment of the beam is shown in Fig. 6–4*b*. The distributed loading on this segment is represented by its resultant force $(3x)$ kN, which is found only *after* the segment is isolated as a free-body diagram. This force acts through the centroid of the area under the distributed loading, a distance of $x/2$ from the right end. Applying the two equations of equilibrium yields

$$+\uparrow \Sigma F_y = 0; \qquad 6\text{ kN} - (3x)\text{ kN} - V = 0$$

$$V = (6 - 3x)\text{ kN} \qquad (1)$$

$$\circlearrowright + \Sigma M = 0; \qquad -6\text{ kN}(x) + (3x)\text{ kN}\left(\tfrac{1}{2}x\right) + M = 0$$

$$M = (6x - 1.5x^2)\text{ kN}\cdot\text{m} \qquad (2)$$

Shear and Moment Diagrams. The shear and moment diagrams shown in Fig. 6–4*c* are obtained by plotting Eqs. 1 and 2. The point of *zero shear* can be found from Eq. 1:

$$V = (6 - 3x)\text{ kN} = 0$$

$$x = 2\text{ m}$$

NOTE: From the moment diagram, this value of x represents the point on the beam where the *maximum moment* occurs, since by Eq. 6–2 (see Sec. 6.2) the *slope* $V = dM/dx = 0$. From Eq. 2, we have

$$M_{\max} = [6\,(2) - 1.5\,(2)^2]\text{ kN}\cdot\text{m}$$

$$= 6\text{ kN}\cdot\text{m}$$

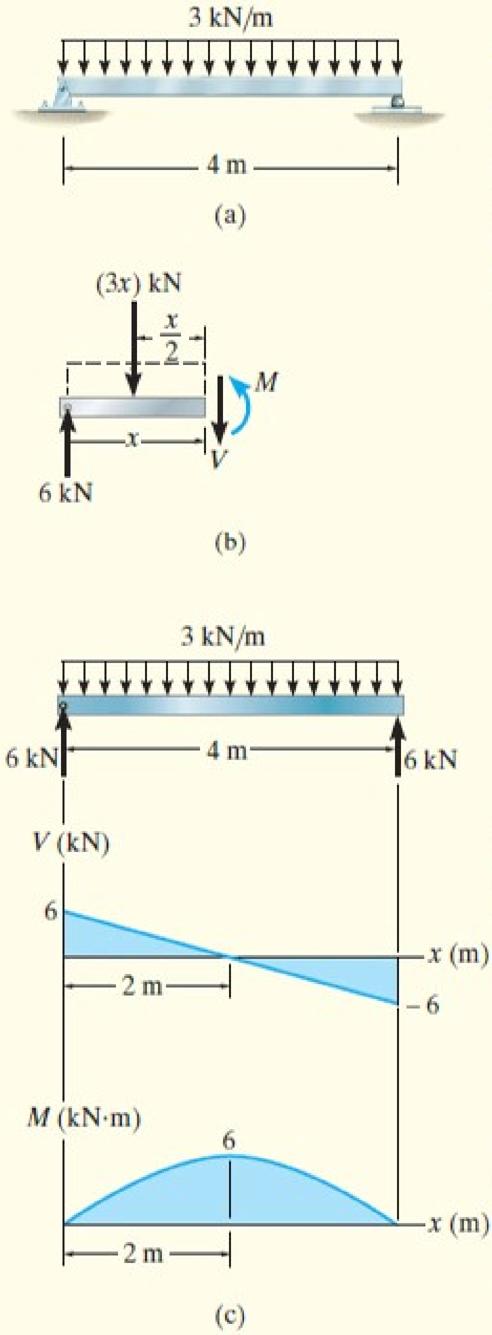
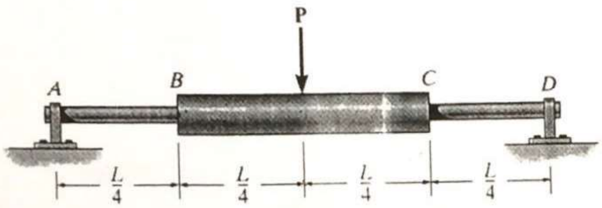


Fig. 6–4

Q1:

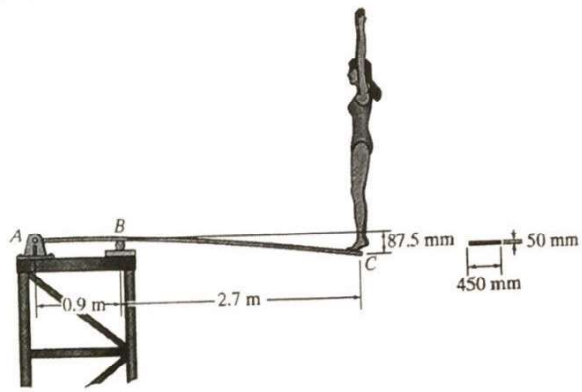
12-14. The simply supported shaft has a moment of inertia of $2I$ for region BC and a moment of inertia I for regions AB and CD. Determine the maximum deflection of the shaft due to the load **P**.



Probs. 12-14

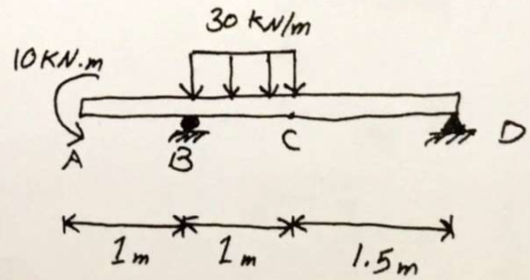
Q2:

12-2. When the diver stands at end C of the diving board, it deflects downward 87.5 mm. Determine the mass of the diver. The board is made of material having a modulus of elasticity of $E = 10\,\text{GPa}$.

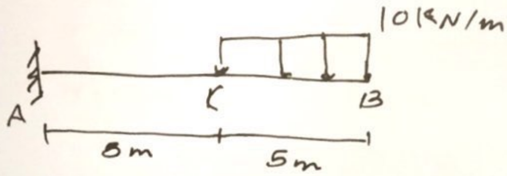


Q3: Determine the deflection at point C for the Beam below.

2017 $EI = 1.1\ MN.m^2$



Method 1

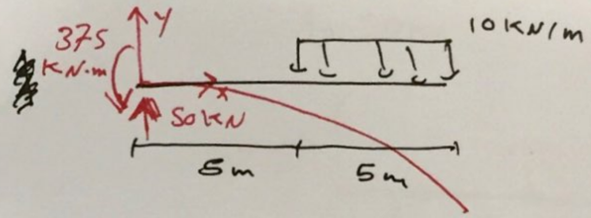


- Reactions $+\circlearrowleft \sum M_{@A} = 0$

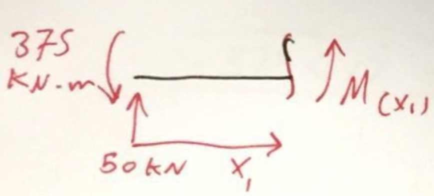
$$(10*5)(7.5) = M_A = 375 \text{ kN.m}$$

$$+\uparrow \sum F_y = 0$$

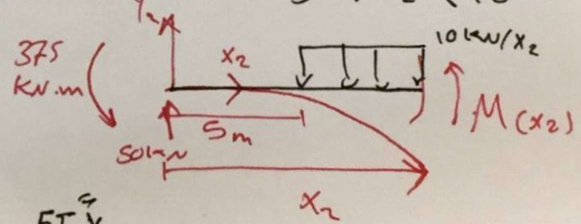
$$A_y = 50 \text{ kN} \uparrow$$



For $0 < x_1 < 5$



For $5 < x_2 < 10$



$$EI\,y''_{1(x_1)} = -375 + 50x_1$$

$$EI\,y'_{(x_1)} = -375x_1 + 25x_1^2 + C_1$$

$$EI\,y_{(x_1)} = -\frac{375}{2}.x_1^2 + \frac{25}{3}.x_1^3 + C_1x_1 + C_2$$

When $x_1 = 0$; $y_1 = 0$; $y_1' = 0$

$\boxed{C_1 = 0}$; $\boxed{C_2 = 0}$

$$EI\,y''_{2(x_2)} = -375 + 50x_2 - 10(x_2-5)\frac{(x_2-5)}{2}$$

$$= -375 + 50x_2 - 5(x_2-5)^2$$

$$EI\,y'_{2(x_2)} = -375x_2 + 25x_2^2 - \frac{5}{3}(x_2-5)^3 + C_3$$

$$EI\,y_{2(x_2)} = -\frac{375}{2}x_2^2 + \frac{25}{3}.x_2^3 - \frac{5}{12}.(x_2-5)^4 + C_3x_2 + C_4$$

When $x_1 = x_2 = 5m$; $y_1 = y_2$; $y_1' = y_2'$

$\therefore \boxed{C_3 = 0}$; $\boxed{C_4 = 0}$

Max Slope $y'_{2(x_2=10)} = \left[-3750 + 2500 - \frac{625}{3}\right]/EI = -\frac{1458.34}{EI}$

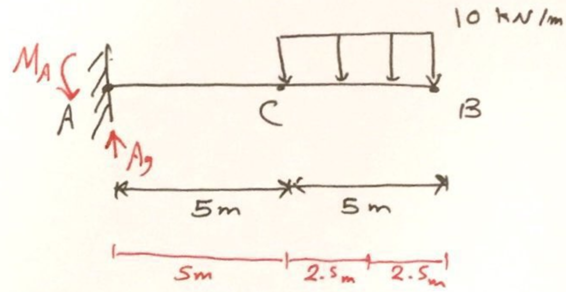
Max Deflection $y_{2(x_2=10)} = \left[-\frac{37500}{2} + \frac{25000}{3} - \frac{3125}{12}\right]/EI = -\frac{10\,677.08}{EI}$ m

Max Bending Stress$_{t,c}$ $= \frac{MY}{I} = \frac{375 * 0.1}{I} = \frac{37.5}{I_{(m^4)}}$ kN/m²

Method 2

- Reactions

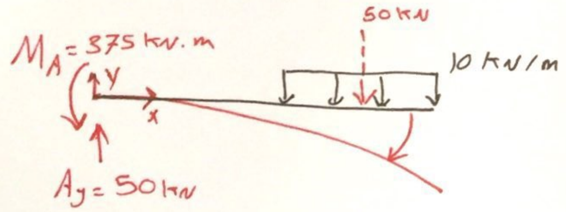
$\circlearrowleft^{+} \sum M_{@A} = 0$



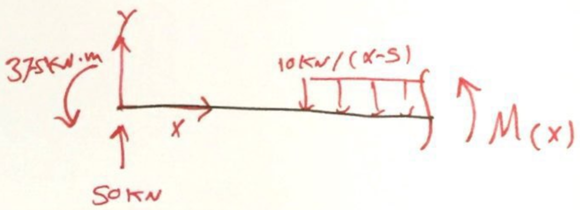
$M_A - (10*5)(5+\frac{5}{2}) = 0$

$M_A = 375 \ kN.m \circlearrowleft$

$\sum F_y = 0 \Longrightarrow A_y = 10*5 = 50 \ kN \uparrow$



$$M_{(x)} = -375 \langle x \rangle^0 + 50 \langle x \rangle^1 - \frac{10 \langle x-5 \rangle^2}{2}$$



$$EI\ddot{Y}_{(x)} = -375 \langle x \rangle^0 + 50 \langle x \rangle^1 - 5 \langle x-5 \rangle^2$$

$$EI\bar{Y}_{(x)} = -375 \langle x \rangle^1 + 25 \langle x \rangle^2 - \frac{5}{3} \langle x-5 \rangle^3 + C_1$$

$$EIY_{(x)} = -\frac{375}{2} \langle x \rangle^2 + \frac{25}{3} \cdot \langle x \rangle^3 - \frac{5}{12} \cdot \langle x-5 \rangle^4 + C_1 x + C_2$$

For $x=0$; $Y=0$; $\bar{Y}=0$

$\therefore$ $\boxed{C_2 = 0}$ and $\boxed{C_1 = 0}$

1. Maximum deflection and slope are located at the free end of the cantilever beam, where $x = 10$

- Max. Slope $\bar{Y}_{(x=10)} = -375(10) + 25(10)^2 - \frac{5}{3}(10-5)^3 / EI = -\frac{1458.34}{EI}$

- Max. Deflection $Y_{(x=10)} = -\frac{375}{2} \cdot (10)^2 + \frac{25}{3} \cdot (10)^3 - \frac{5}{12}(10-5)^4 / EI = -\frac{10667.08}{EI} m$

2. Maximum Bending stress depends on max. value of bending moment, which in our case, is located at the fixed support ($M_{max} = -375$ kN.m), mean the negative bending moment leads the upper fibers are under tension and lower fibers are under compression.

$$\sigma_{max \ t,c} = \frac{M_{max} \cdot Y}{I} = \frac{375 * 10^3 * 0.1}{I} = \frac{37500}{I_{(m^4)}} \ N/m^2$$

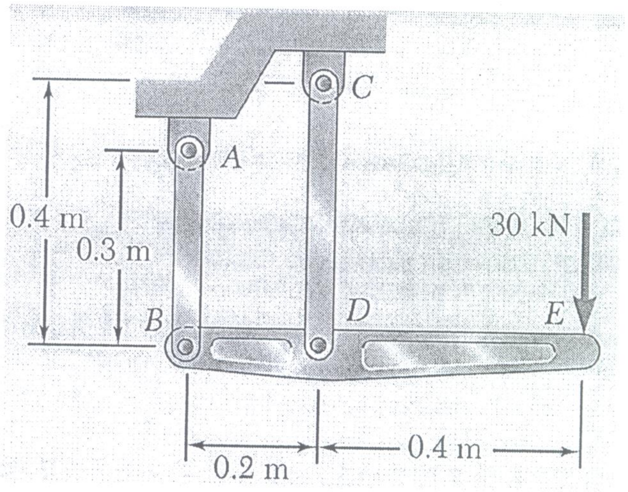
Subject: **Strength of Materials, 2nd Year**
Examiners: **Dr. Hassan & Dr. Mohsin**

Exam Time: **Three Hours**
Date: 5/6/2016

Answer **Four** Questions Only

*Q*1. The rigid bar *BDE* is supported by two links *AB* and *CD* (Figure 1). Link *AB* is made of aluminum (E = 70 GPa) and has a cross-sectional area of 500 mm^2. Link *CD* is made of steel (E = 200 GPa) and has a cross-sectional area of 600 mm^2. For the 30-kN force shown, determine the deflection (*a*) of *B*, (*b*) of *D*, and (*c*) of *E*.

Figure 1



*Q*2. An aluminum tubing of 63.5×101 mm rectangular cross section was fabricated by extrusion. Determine the shearing stress in each of the four walls of a portion of such tubing when it is subjected to a torque of 2.7 kN m, assuming (*a*) a uniform 4 mm wall thickness (Figure 2*a*), (*b*) that, as a result of defective fabrication, walls *AB* and *AC* are 3 mm thick, and walls *BD* and *CD* are 5 mm thick (Figure 2*b*).

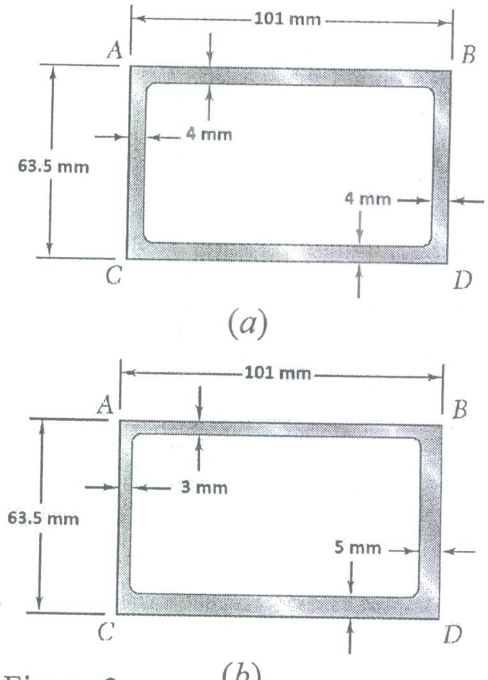
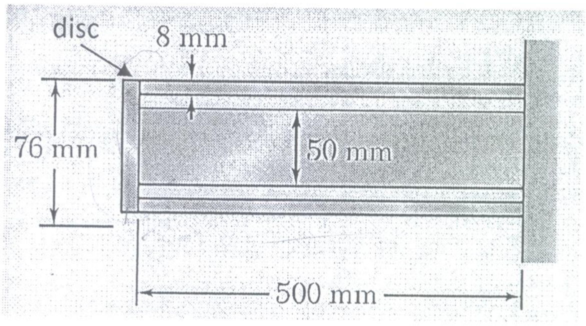


Figure 2

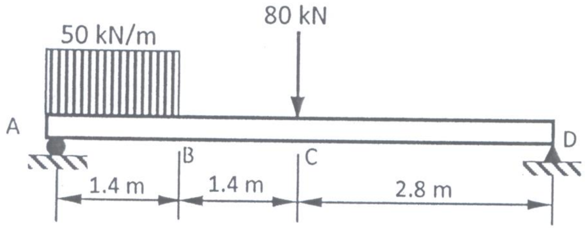
*Q*3. A steel shaft and an aluminum tube are connected to a fixed support and to a rigid disc as shown in the cross section (Figure 3). Determine the maximum torque T_o that can be applied to the rigid disc, if the allowable shear stresses are 120 MPa in the steel shaft and 70 MPa in the aluminum tube. Use G = 77 GPa for the steel shaft and G = 27 GPa for the aluminum tube.

Figure 3



*Q*4. For the beam shown in Figure 4 determine the following:

1. Draw the shear force and bending moment diagrams.
2. The maximum bending stress in the beam.



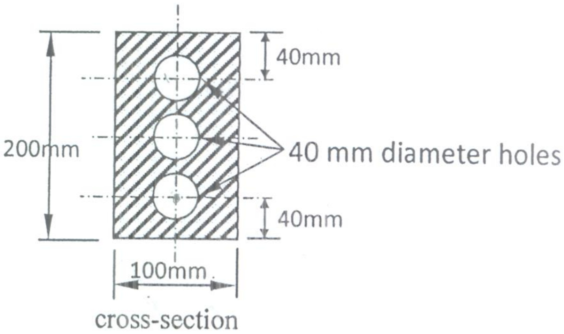


Figure 4

*Q*5. For the overhanging beam in Figure 5, determine the deflection at point *E*. Use EI= 0.91 MN.m^2.

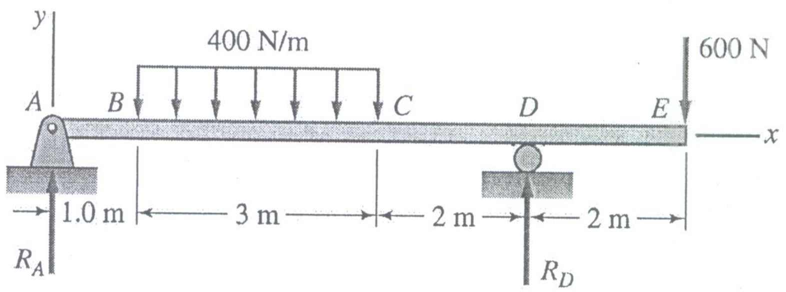


Figure 5

Good Luck

UNIVERSITY OF TECHNOLOGY
MECHANICAL ENGINEERING DEPARTMENT
FINAL EXAMINATION 2014/2015-1ST ATTEMPT

SUBJECT: STRENGTH OF MATERIALS, 2ND YEAR — EXAM TIME: THREE HOURS
EXAMINERS: DR. HASSAN & DR. MOHSIN — DATE: 14/6/2015

ANSWER FOUR QUESTIONS ONLY

Q1. The rigid bar *AOB* is pinned at *O* and connected to aluminum and steel rods, as shown in Figure 1. If the bar is horizontal at a given temperature, determine the ratio of the areas of the two rods so that the bar will be horizontal at any temperature changes (ΔT).

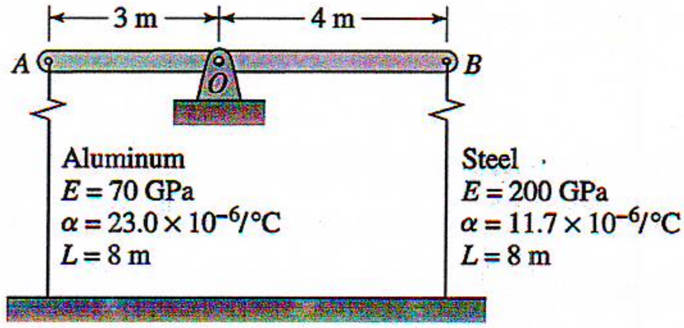


Figure 1

Q2. A 90 N.m torque is applied to a hollow shaft having the cross section shown in Figure 2. The length of the shaft is 1.1 m. Determine (1) the shearing stress at points *a* and *b*; (2) the total angle of twist. Use $G = 28$ GPa.

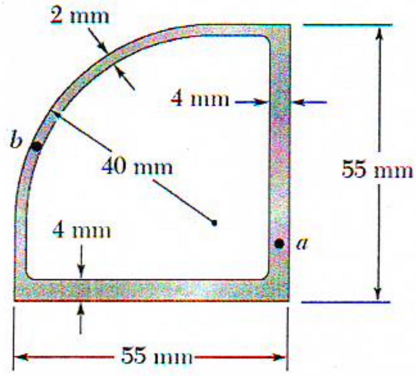


Figure 2

Q3. Determine the deflection at the free end for the cantilever beam shown in Figure 3. Use $EI = 1.85$ MN.m^2.

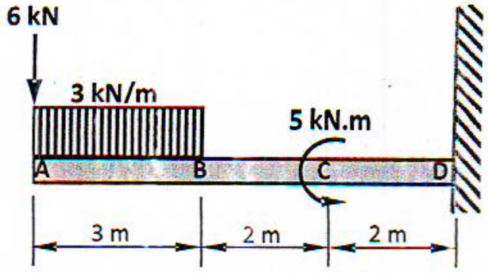


Figure 3

Q4. For the beam shown in Figure 4 do the following:-

1. Draw the shear force and bending moment diagrams.
2. Determine the maximum bending stress in the beam.

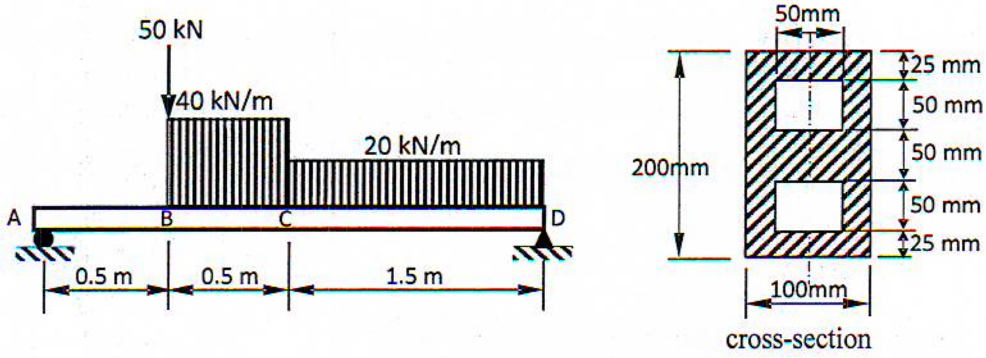


Figure 4

Q5. The state of plane stress at a point with respect to the *xy*-axes is shown in Figure 5. Using Mohr's circle, determine (1) the principal stresses and principal planes; (2) the maximum shear stress; and (3) the equivalent state of stress with respect to the *x'y'*-axes.

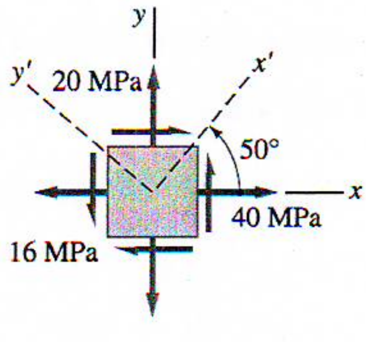


Figure 5

GOOD LUCK

UNIVERSITY OF TECHNOLOGY
MECHANICAL ENGINEERING DEPARTMENT
FINAL EXAMINATION 2013/2014-1ST ATTEMPT
SUBJECT: STRENGTH OF MATERIALS, 2ND YEAR
EXAMINERS: DR. HASSAN & DR. MOHSIN
EXAM TIME: THREE HOURS
DATE: 10/6/2014

ANSWER FOUR QUESTIONS ONLY

Q1. Find the maximum allowable value of P for the column shown in Figure 1. The maximum allowable stress in steel is 120 MPa, in timber is 12 MPa and in concrete is 16 MPa.

Also, find the change in length in each part if the modulus of elasticity of steel E_s=200 GPa, for timber E_t=8.2 GPa and for concrete E_c=17 GPa.

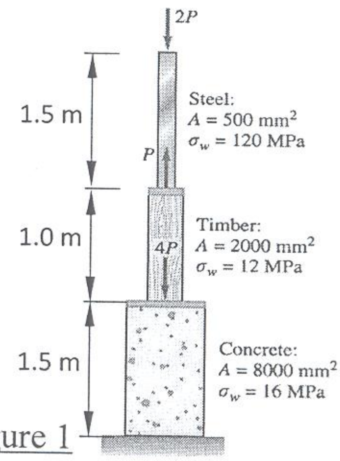


Figure 1

Q2. Both ends of the steel shaft are attached to rigid supports at A and B (Figure 2). Find the distance a where the torque T must be applied so that the reactive torques at A and B are equal.

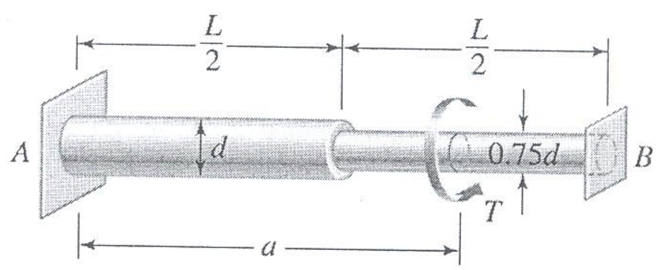


Figure 2

Q3. Determine the deflection at the free end for the cantilever beam shown in Figure 3. Use EI= 2.05 MN.m².

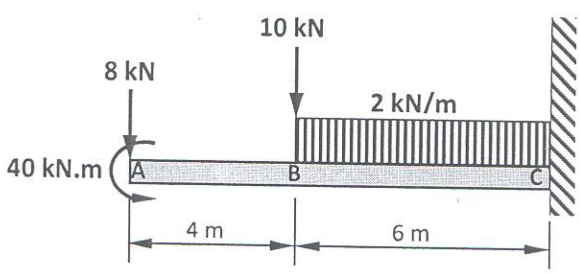


Figure 3

Q4. For the beam shown in Figure 4 do the following:-

1. Draw the shear force and bending moment diagrams.
2. Determine the maximum bending stress in the beam.

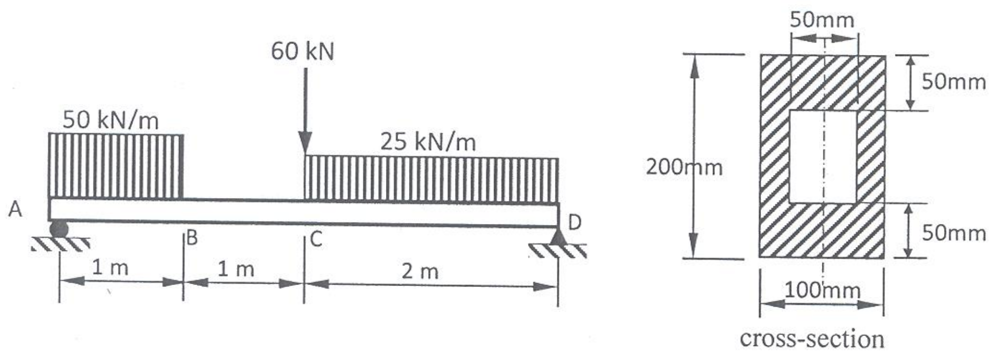


Figure 4

Q5. Find the largest clamping force that can be applied by the cast iron C-clamp (Figure 5) if the allowable normal stresses on section *m-n* are 15 MPa in tension and 30 MPa in compression.

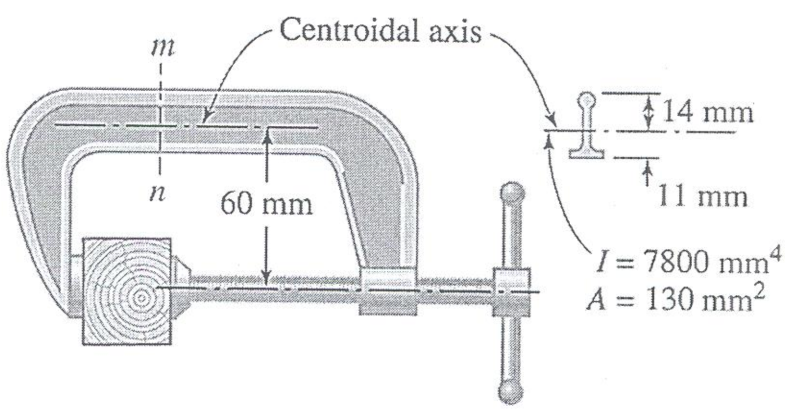


Figure 5

GOOD LUCK

University of Technology
Department of Machines and Equipment Engineering
Final Examination 2012/2013

Subject: Strength of materials
Division: all branches
Examiner(s):Dr. Hassan &Dr. Muthanna

Year: Second
Exam Time: 3 Hrs.
Date: 20 / 6 / 2013

Answer only five questions

Q.1:

The rigid bar AC, attached to two vertical rods as shown in (Fig.1). It is in a horizontal position before the load P is applied. Determine the vertical movement of P if its magnitude is 50 kN.

(12 marks)

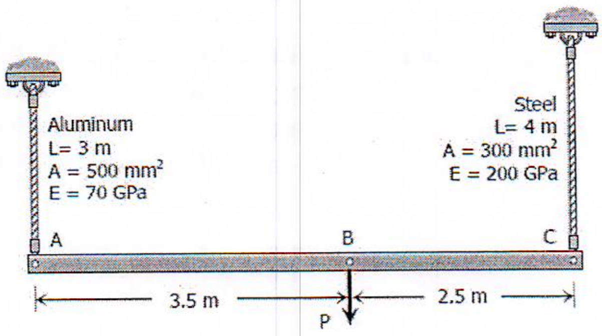
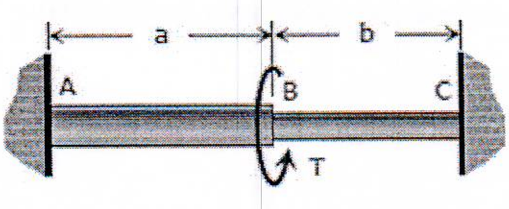


Fig.(1)

Q.2:

The compound shaft shown in fig.(2) is attached to rigid supports. For the bronze segment AB, the diameter is 75 mm, $\tau \leq 60$ MPa, and G = 35 GPa. For the steel segment BC, the diameter is 50 mm, $\tau \leq$ 80 MPa, and G = 83 GPa. If a = 2 m and b = 1.5 m, compute the maximum torque T that can be applied.



(12 marks)

Fig.(2)

Q.3:

A simply supported beam of a span "length" L carries a uniformly distributed load of 6000 N/m and has the cross section as shown in Fig.(3). Find L to cause a maximum flexural stress of 16 MPa. What is the maximum shearing stress developed in the beam?

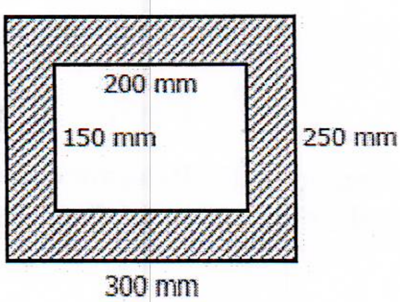
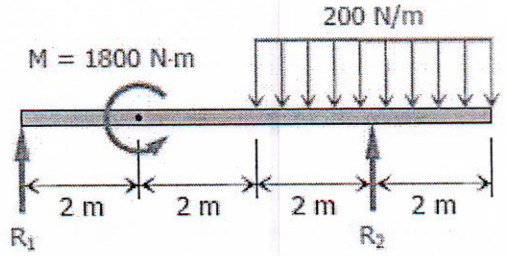


Fig.(3)

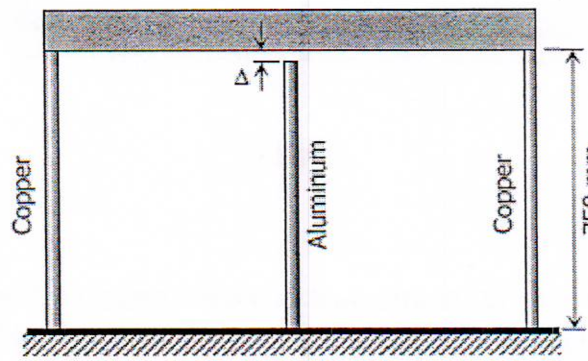
(12 marks)

Q.4: **Determine the deflection of midway between the supports and the maximum slope for the beam loaded as shown in Fig.(4).Take EI=constant.**



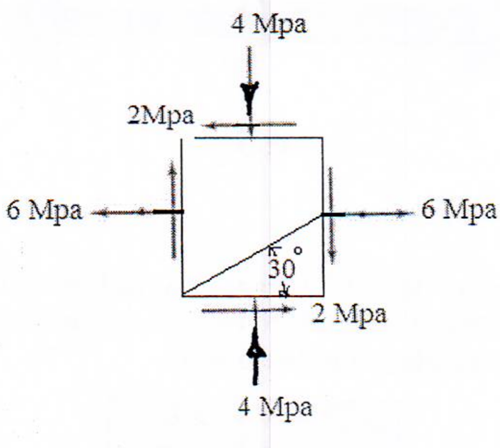
Fig(4) **(12 marks)**

Q.5 **As shown in Fig.(5), there is a gap between the aluminum bar and the rigid slab that is supported by two copper bars. At 10°C, $\Delta = 0.18$ mm. Neglecting the mass of the slab, calculate the stress in each rod when the temperature in the assembly is increased to 95°C. For each copper bar, $A = 500\ mm^2$, $E = 120$ GPa, and $\alpha = 16.8\ \mu m/(m\cdot°C)$. For the aluminum bar, $A = 400\ mm^2$, $E = 70$ GPa, and $\alpha = 23.1 \mu m/(m\cdot°C)$.**



Fig(5) **(12 marks)**

Q.6 The stresses shown on the element as shown in Fig.(6):



Fig(6)

Find: (a)The values of σ_α and τ_α when α=30°.(b) Determine the stresses and its directions on principal plane. (c) Determine the stresses and its directions on maximum shear plane. (by using Mohr's circle or by equations)

(12 marks)

University of Technology
Department of Machines and Equipment Engineering
First Term Examination 2012/2013
Subject: Strength of materials | Year: Second year
Division: all branches | Exam Time: 1.5 Hrs.
Examiner(s):Dr. Hassan &Dr. Muthanna | Date: 29 / 1 / 2013

Q.1: For the beam loaded as shown in the fig.(1) and its cross-sectional area as shown in fig.(2),determine the following:

(a) Draw the shear force and bending moment diagrams.

(b)The second moment of area (moment of inertia).

(c) The maximum tensile and compressive bending stresses. (6 marks)

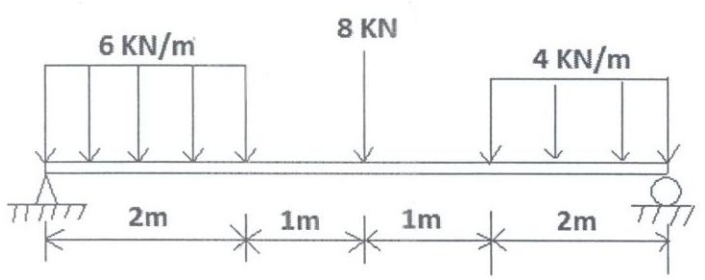


Fig.(1)

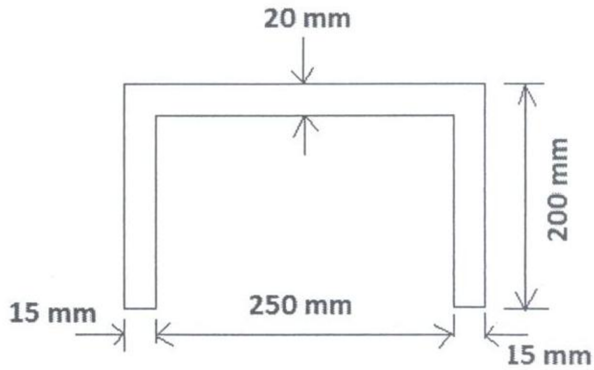


Fig.(2)

Answer only one question from the following

Q.2: A composite bar made up of aluminum and steel is rigidly fixed between two supports as shown in fig.(3).The system is initially at 60C° .Find the stresses in each bar when the temperature increases to 100 C°. Assuming that, the supports are un yielding.

Take: α_{st} =12x10^{-6} (m/m C°) α_{Al}=24x10^{-6} (m/m C°)

E_{st} =200Gpa E_{Al}=70Gpa (4 marks)

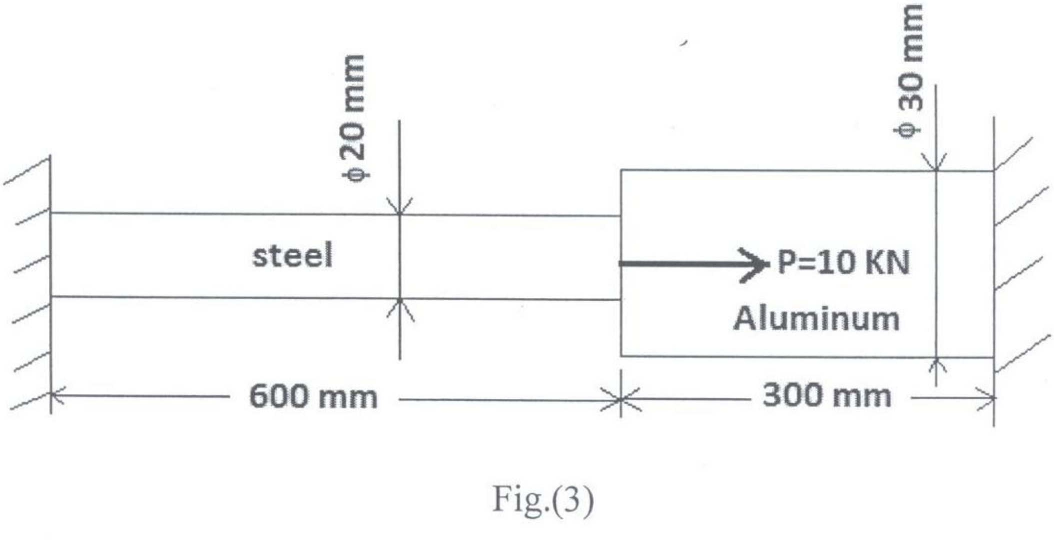


Fig.(3)

Q.3: A motor develops 150Kw of power at 800 r.p.m which is transmitted to the gears C & D. Gear C receives 70% of the torque and gear D receives 30% of the torque. The shaft (BCDE) diameter is 100mm.determine the maximum shear stresses in each segment of the shaft and the angle of twist of gear D relative to B. (Take: G=80Gpa)

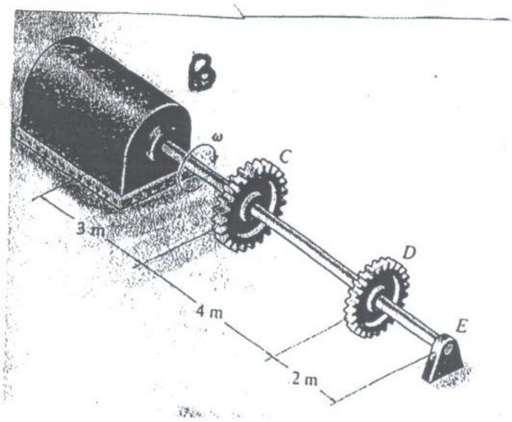


Fig. (4)

ANSWER FOUR QUESTIONS ONLY

Q1. A solid steel bar of diameter d_1=25 mm is enclosed by a steel tube of outer diameter d_3=37.5 mm and inner diameter d_2=30 mm, as shown in Figure 1. Both bar and tube are held rigidly by a support at end A and joined securely to a rigid plate at end B. The composite bar, which has a length L=550 mm, is twisted by a torque T=400 Nm acting on the end plate.

(a) Determine the maximum shear stresses in the bar and tube.

(b) Determine the angle of rotation (in degrees) of the end plate, assuming that the shear modulus of the steel is G=80GPa.

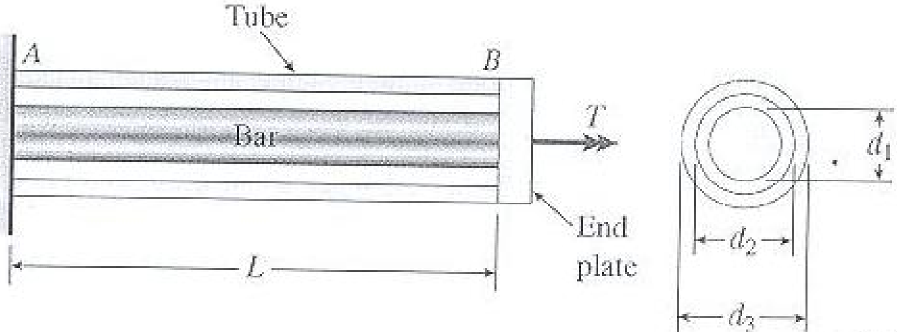


Figure 1

(15 Marks)

Q2. The horizontal rigid beam $ABCD$ is supported by vertical bars BE and CF and is loaded by vertical force P_1=400 kN acting at point A, and hinged at D, as shown in Figure 2. Bars BE and CF are made of steel (E=200 GPa) and have cross-sectional areas A_{BE}=11100 mm^2 and A_{CF}=9280 mm^2. Determine the vertical displacement δ_A of point A.

(15 Marks)

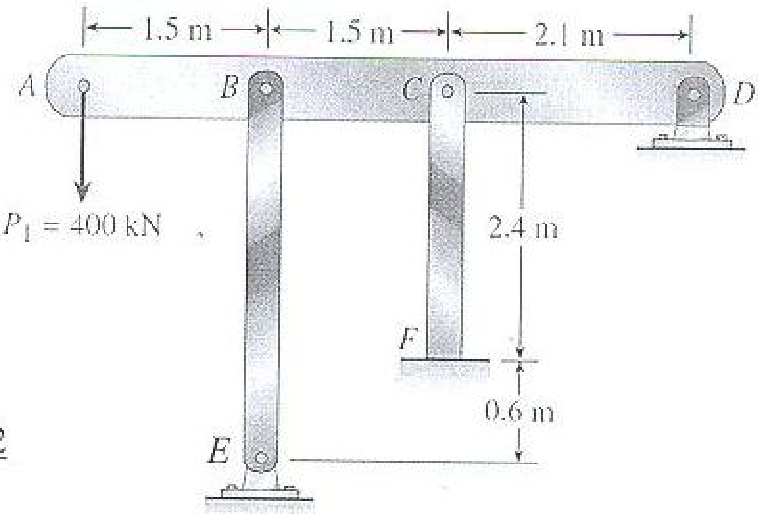


Figure 2

Q3. Two uniformly distributed loads are placed symmetrically on the simply supported beam, as shown in Figure 3. Calculate the maximum value of the deflection for the beam. Use EI=0.65 MN.m^2.

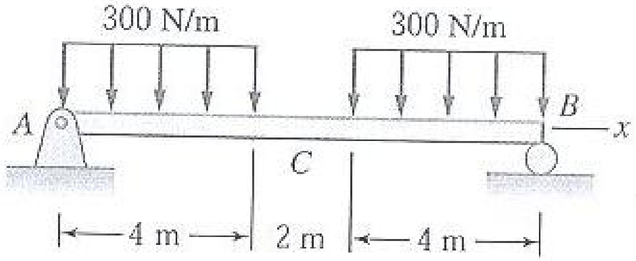


Figure 3

(15 Marks)

Q4. The channel section carries a uniformly distributed load of 1.5W (N/m) and two concentrated loads of magnitude W, as shown in Figure 4. Do the followings:

(a) Find the second moment of area of the cross-section about the neutral axis.

(b) Determine the maximum allowable value for W if the working stresses are 40 MPa in tension, 80 MPa in compression, and 24 MPa in shear.

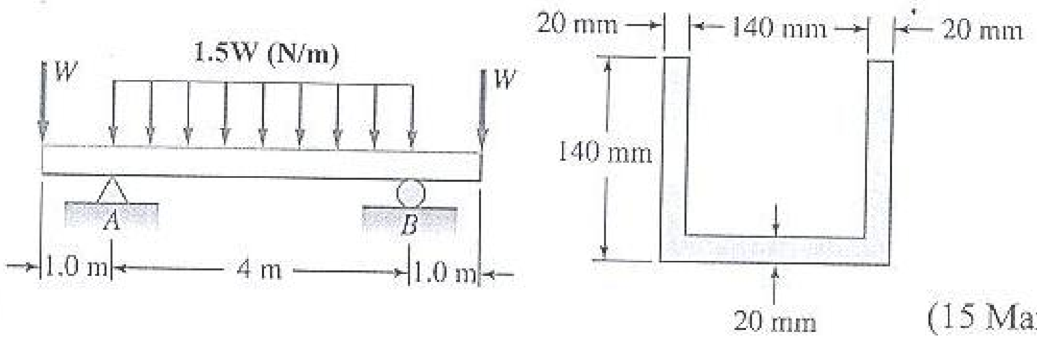


Figure 4

(15 Marks)

Q5. The square timber used as a railroad tie carries two uniformly distributed loads, each of 240 kN/m, as shown in Figure 5. The reaction from the ground is uniformly distributed w (N/m). Do the followings:

(a) Draw the shear force and bending moment diagrams

(b) Determine the smallest allowable dimension b of the section if the bending stress in timber is limited to 8 MPa.

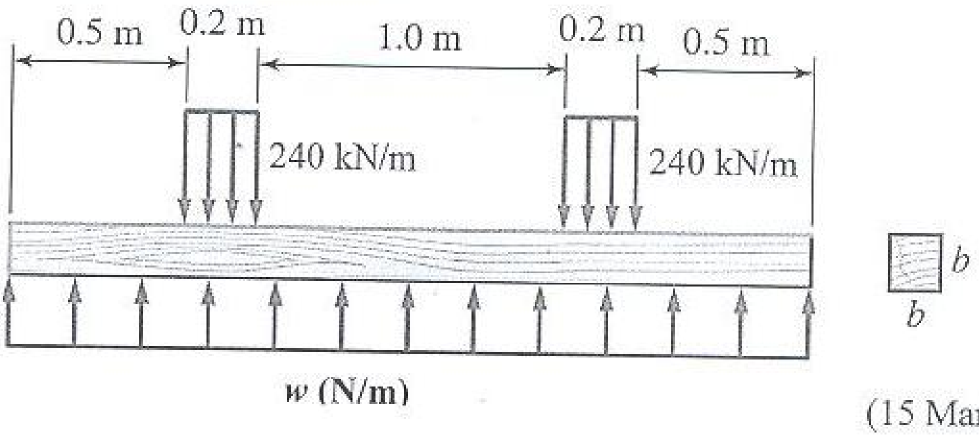


Figure 5

(15 Marks)

GOOD LUCK

الجامعة التكنولوجية

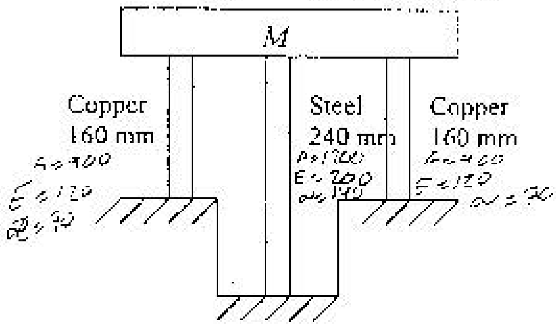
قسم هندسة المكائن والمعدات

المادة: مقاومة المواد	الامتحان النهائي	الزمن: ٣ ساعات
مدرس المادة: د. زيد سالم - د. عماد ناطق	٢٠٠٣ - ٢٠٠٤	التاريخ: ٨/٦/٢٠٠٤

أجب عن خمسة أسئلة فقط

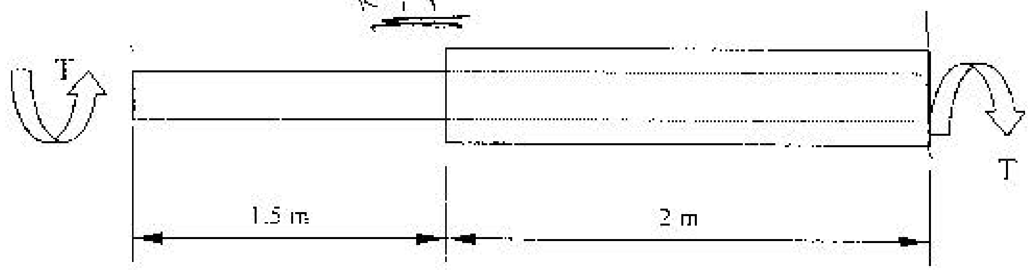
Q1

A rigid block of mass M is supported by three symmetrically spaced rods as shown. Each copper rod has an area of 900 mm^2 ; E= 120 GPa ; and the allowable stress is 70 MPa. The steel rod has an area of 1200 mm^2 ; E= 200 GPa; and the allowable stress is 140 MPa. Determine the largest mass M that can be supported.



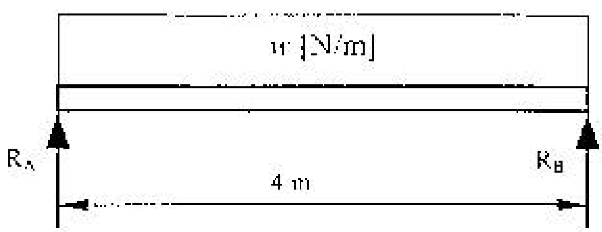
Q2

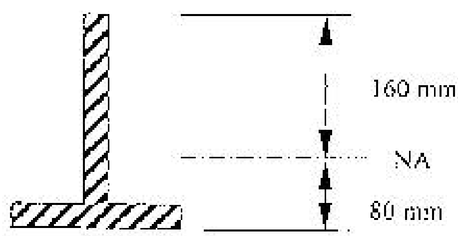
A stepped steel shaft consists of a hollow shaft 2 m long, with an outside diameter of 100 mm and an inside diameter of 70 mm, rigidly attached to a solid shaft 1.5 m long, and 70 mm in diameter. Determine the maximum torque that can be applied without exceeding a shearing stress of 70 MN/m^2 or a twist of 2.5 deg in the 3.5-m length. Use G= 83 GN/m^2.



Q3

The inverted T section of a 4-m simply supported beam has the properties shown in the figure. The beam carries a uniformly distributed load w over its entire length. Determine w if σ_t 30 MPa and σ_c 70 MPa.

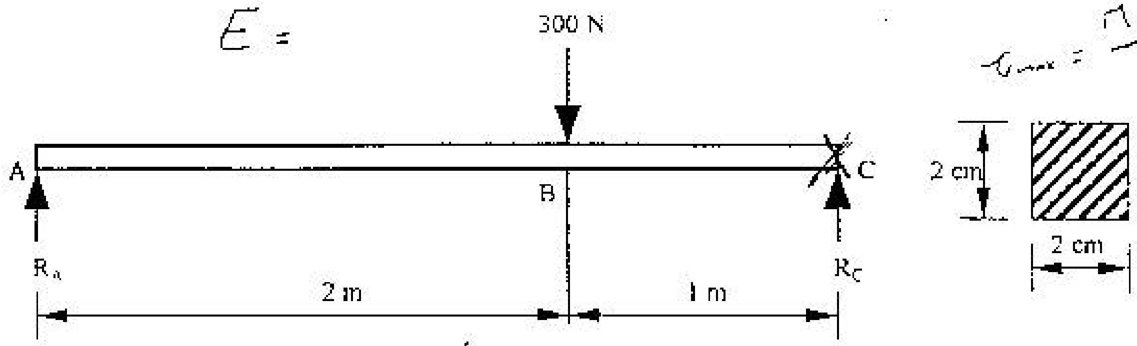




$I_{NA}=20*10^6$ mm^4

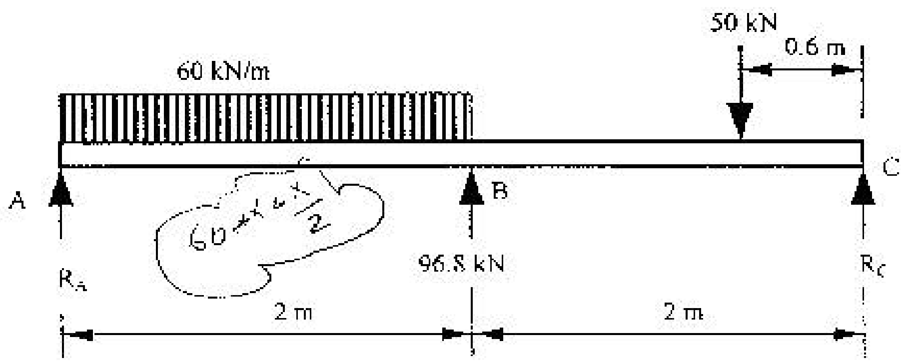
Q4

A concentrated load of 300 N is supported as shown in the figure. Determine (a) the deflection under the load, and (b) the maximum shear stress at point C. The beam has a square cross-section of 2 cm*cm and a modulus of elasticity of 200 GPa.



Q5

Draw the shear force and bending moment diagrams for the beam loaded as shown in the figure.



Q6

At a point in a material under stress there is a compressive stress of 200 MN/m^2 and a shear stress of 300 MN/m^2 acting on the same plan. Determine the principal stresses and the directions of planes on which they act. If the yield stress for this material is 400 MPa, use the maximum shear stress failure theory to check if the material has reached the yield point or not.

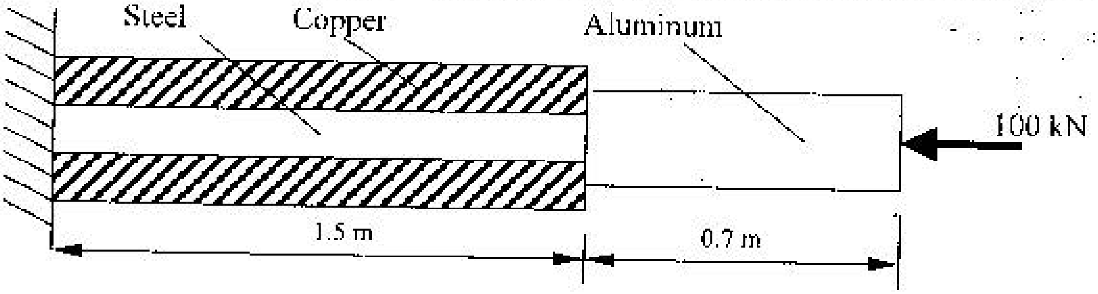
الجامعة التكنولوجية
قسم هندسة المكائن والمعدات

المادة: مقاومة المواد	الفصل الأول	الزمن: ساعة و نصف
مدرس المادة: د. زيد سالم - د. عماد ناطق	٢٠٠٥-٢٠٠٤	التاريخ: ٢٠٠٥/١/١٥

Q1

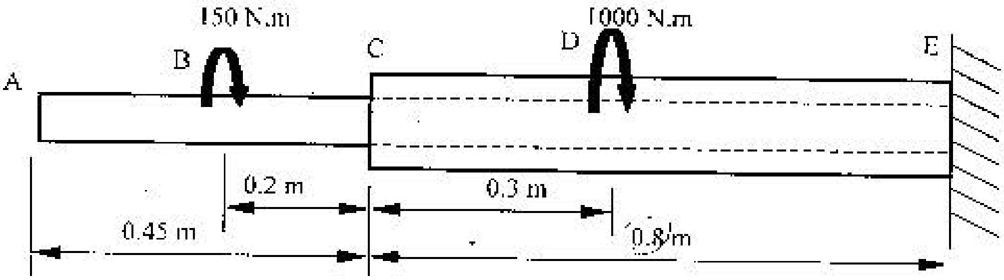
A steel rod of cross-sectional area 600 mm^2 and a coaxial copper tube of cross-sectional area 1000 mm^2 are firmly attached at their end to an aluminum rod of cross-sectional area 800 mm^2 to form a compound bar as shown. Determine the stress in each material and total contraction of the bar when an axial 100 kN compression force is applied.

Take E = 200 GPa For steel, E = 100 GPa for copper, and E = 70 GPa for aluminum.



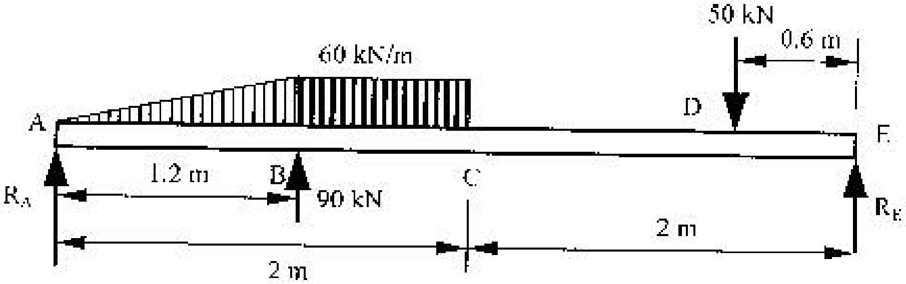
Q2

A Stepped shaft consists of hollow shaft (0.8 m long and 50 mm outside diameter and 25 mm inside diameter) and a solid shaft (0.45 m long and 25 mm diameter), is loaded by two torques at *B* and at *D* acting in the same direction and fixed at *E* as shown. Determine the rotation of end *A*. Take G=80 GPa.



Q3

Draw the shear force and bending moment diagrams for the beam loaded as shown in the figure using the semi-graphical area method.



الجامعة التكنولوجية
قسم هندسة المكائن والمعدات
الامتحان النهائي
٢٠٠٥-٢٠٠٤

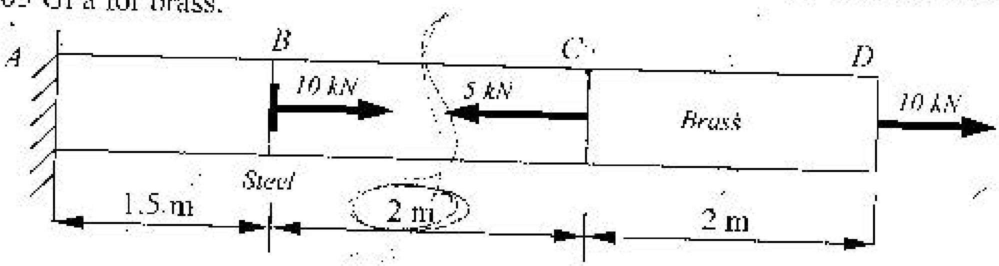
الزمن: ٣ ساعات
التاريخ: ٦/٦/٢٠٠٥

المادة: مقاومة المواد
مدرس المادة: لجنة الميكانيك التطبيقي

أجب عن خمسة أسئلة فقط

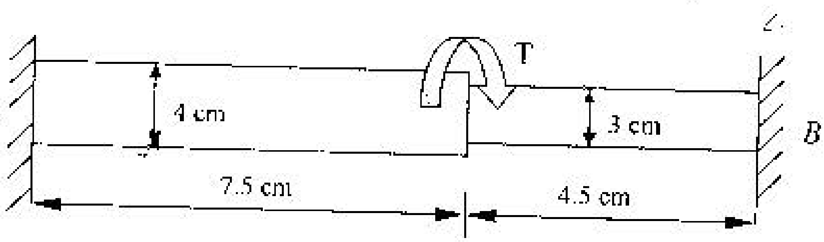
Q1

A seen in the figure, a steel rod AC of cross-sectional area of 100 mm^2 and a brass rod CD of the same cross-sectional area are joined at point C to form the 5.5 m rod ACD. Calculate the displacements of points B and D. Take E= 200 GPa for steel and E= 105 GPa for brass.



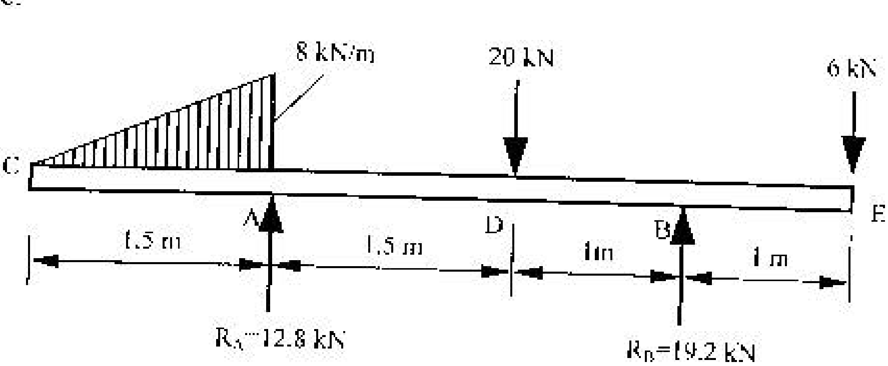
Q2

A solid steel shaft is built in at A and B as shown in the figure. Determine the allowable torque T if the shear stress is limited to100 Mpa.



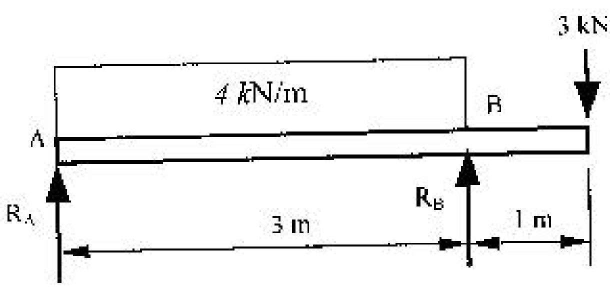
Q3

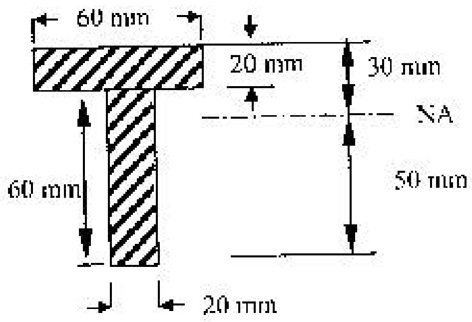
Draw the shear force and bending moment diagrams for the beam loaded as shown in the figure.



Q4

An overhanging beam of T-shaped cross section is loaded as shown in the figure. At point B determine: (a) the maximum tensile and compressive stresses (b) maximum shearing stresses.

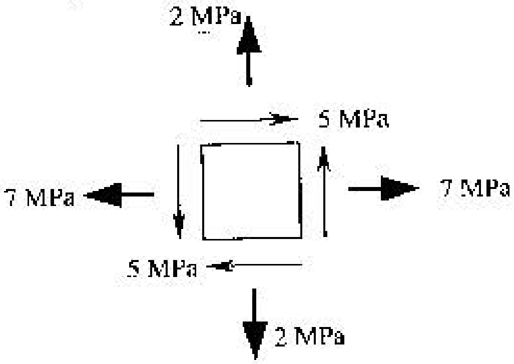




$I_{NA}=136*10^4\ mm^4$

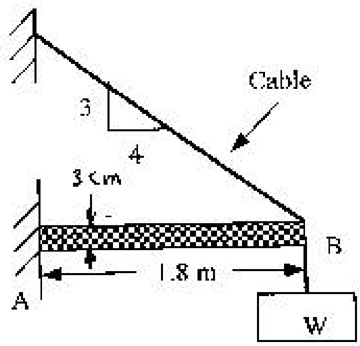
Q5

A state of plane stress is described in the figure shown. Construct Mohr's circle and determine (a) the principal stresses (b) the maximum shearing stress (c) the normal stress at plane of maximum shear stress (d) the yielding stress of the material according to maximum normal stress theory (e) the yielding stress of the material according to maximum shearing stress theory.



Q6

In the structure shown in the figure, a rectangular steel bar AB is constructed of 2 cm by 3 cm section. What is the load W that would cause buckling in the column? Take E=200 GPa and assume that bar AB is hinged from both ends (free to rotate).



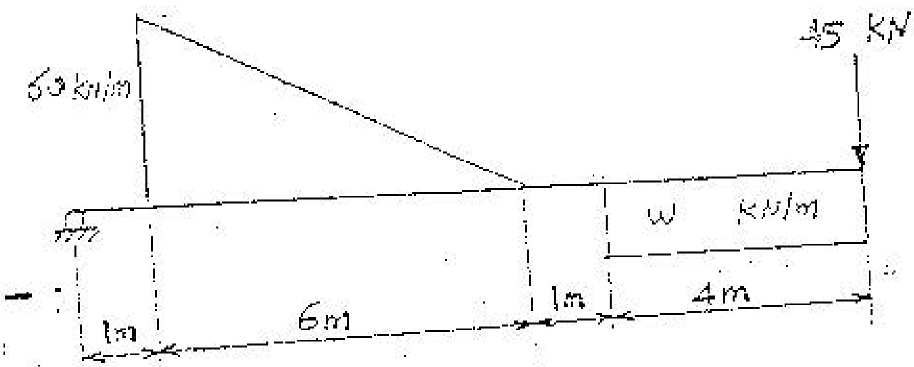
Al-Mustansiriya University
College of Engineering
Dept. Mech. Eng.

« Strength of Materials »

Class: 2 nd Year
Time: 3 hrs.
Date: 25 / 5 / 2004

Note: Answer Five questions only.

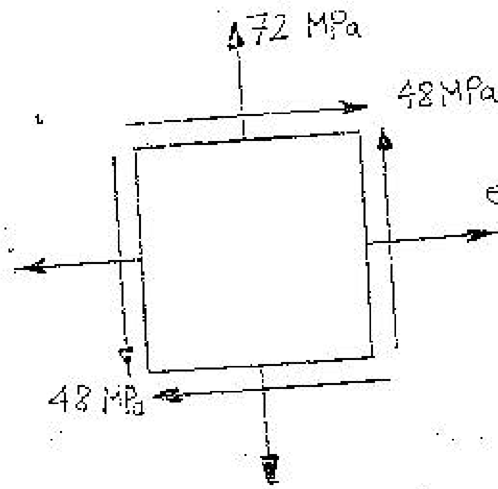
Q1: For the beam loaded as shown in the figure, plot the shear force and the bending moment diagrams.



Q2: The state of stress at a point is as shown in the figure. The maximum shearing stress is 60 MPa. Using Mohr's stress circle, find:

(a) The value of (σ_x).

(b) The principal stresses and the principal planes.

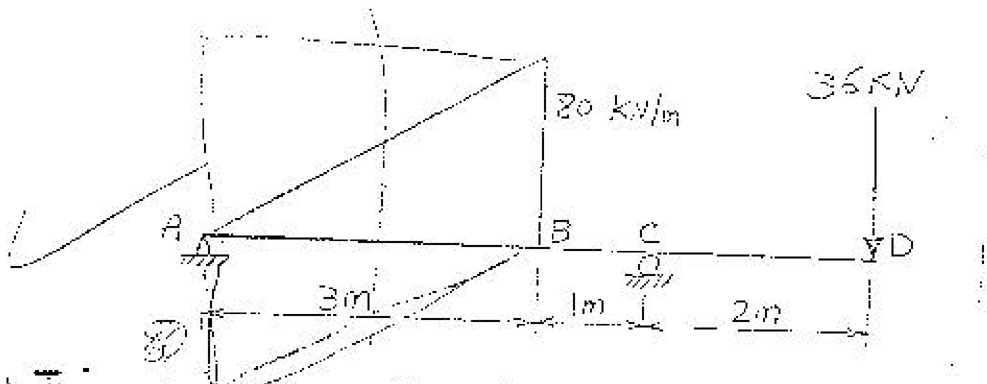


Q3: A thin-walled cylindrical pressure vessel has an inside diameter of 1.3 m, 5 m long and a wall thickness of 25 mm. The length of the cylinder is changed by 0.273 mm when the cylinder is subjected to an internal pressure of 1.4 MPa. If the modulus of elasticity is 120 GPa, find:

(a) [illegible] ratio (ν).

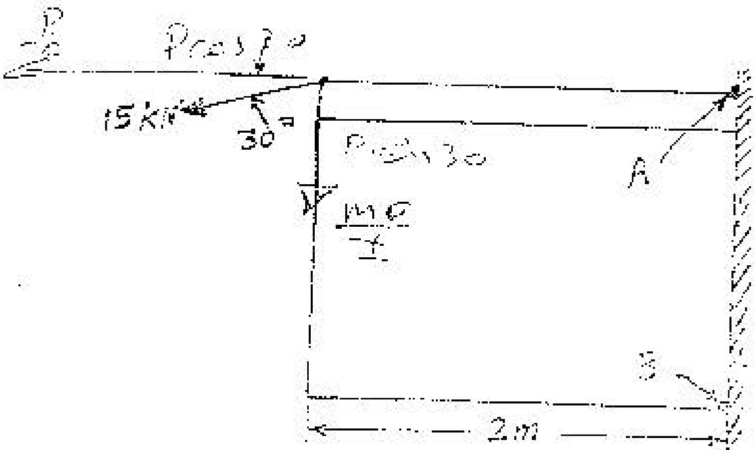
(b) The change [illegible] internal diameter (δd).

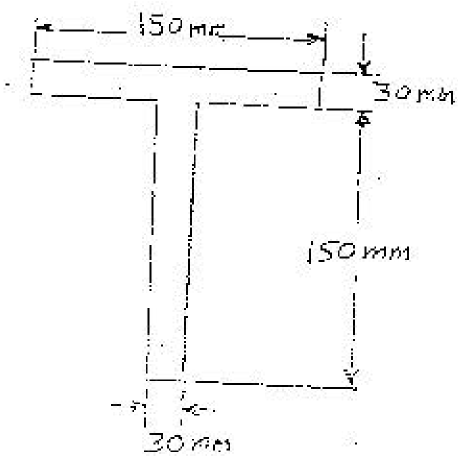
Q4: For the beam loaded as shown in the figure, calculate the [illegible] of points B and D. Use [illegible] N.m



Q5: A hollow shaft transmits 6 MW at 150 rev/min. The maximum shearing stress in the shaft is limited to 76 MPa and the angle of twist to 0.9° in a length of 2.5 m. If the outside diameter of the shaft is 300 mm, determine the minimum thickness of the hollow shaft. Take G = 83 GPa.

Q6: For the cantilever beam shown in the figure, calculate the normal stresses at points A and B.





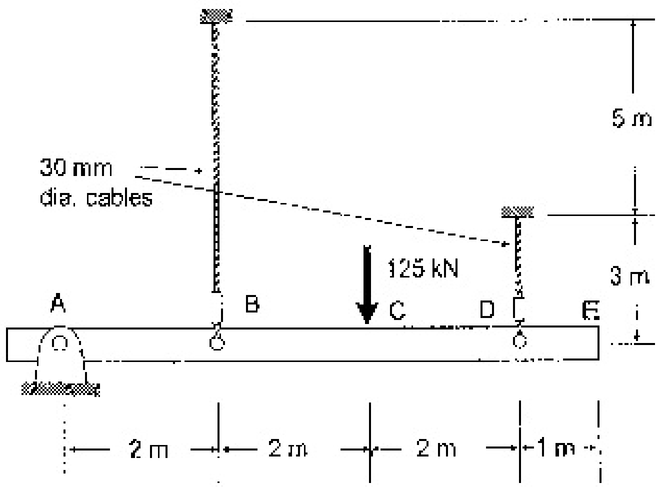
0000000055

SUBJECT: STRENGTH OF MATERIALS, 2ND YEAR — EXAM TIME: THREE HOURS
EXAMINERS: DR. HASSAN & DR. MUHSIN — DATE: 18/9/2011

ANSWER FOUR QUESTIONS ONLY

Q1. A rigid bar is supported by a pin at A and two 30 mm diameter cables at points B and D, as shown in Figure 1. The cables are made of steel with an elastic modulus of 200 GPa. Determine the movement at the end of the bar (point E). (15 Marks)

Figure 1



Q2. A composite bar is constructed from steel rod of 25 mm diametr surrounded by a copper tube of 50 mm outside diameter and 25 mm inside diameter. The rod and tube are joined by two 20 mm diameter pins, as shown in Figure 2. Find the shear stress set up in the pins if, after pinning, the temperature is raised by 50°C. For steel E=210 GPa and $\alpha=11\times10^{-6}$ per °C. For copper E=105 GPa and $\alpha=17\times10^{-6}$ per °C. (15 Marks)

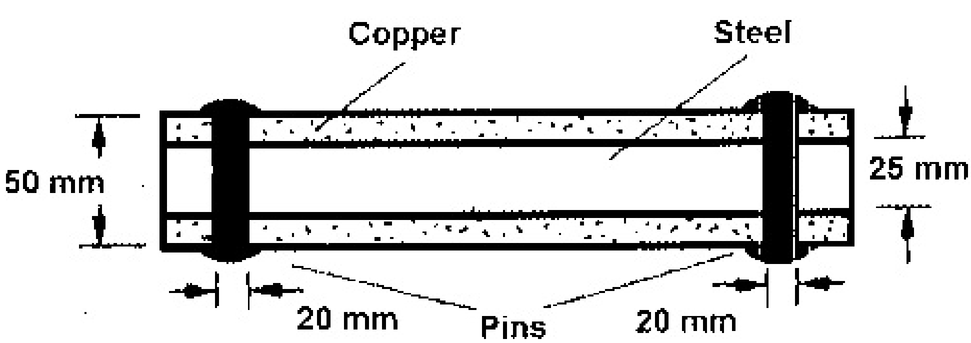


Figure 2

Q3. The circular shaft shown in Figure 3 is subjected to torques at C and D of values **3T** and T, respectively. Determine the value of T if the angle of twist at D is not to exceed 1°, and the maximum allowable shearing stress in the shaft is 70 MPa. Given $G_{brass} = 40$ GPa, $G_{steel} = 80$ GPa, (15 Marks)

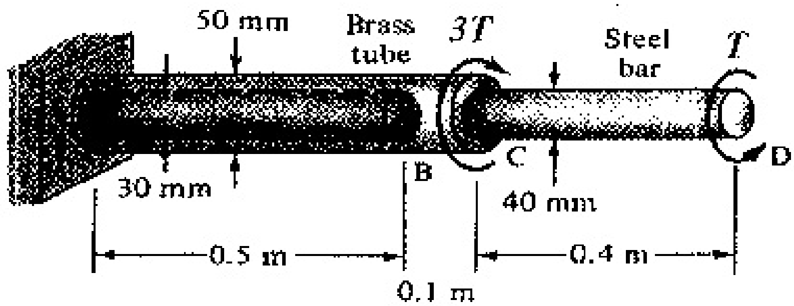


Figure 3

Q4. Determine the deflection at point *D* for the beam shown in Figure 4. Use $EI = 5.1$ MN.m^2. (15 Marks)

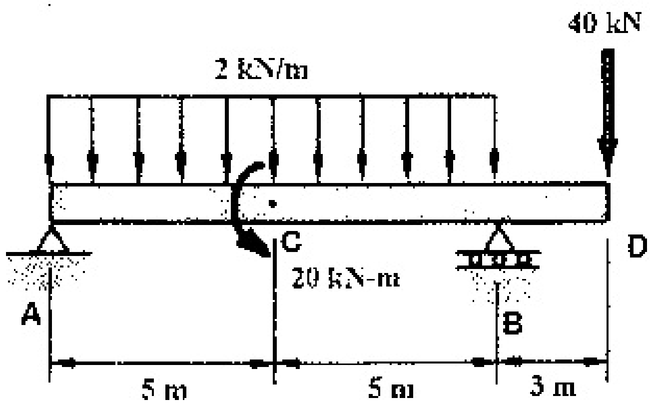


Figure 4

Q5. For the beam shown in Figure 5 determine the following:-

1. Draw the shear force and bending moment diagrams.
2. The maximum bending stress in the beam.

(15 Marks)

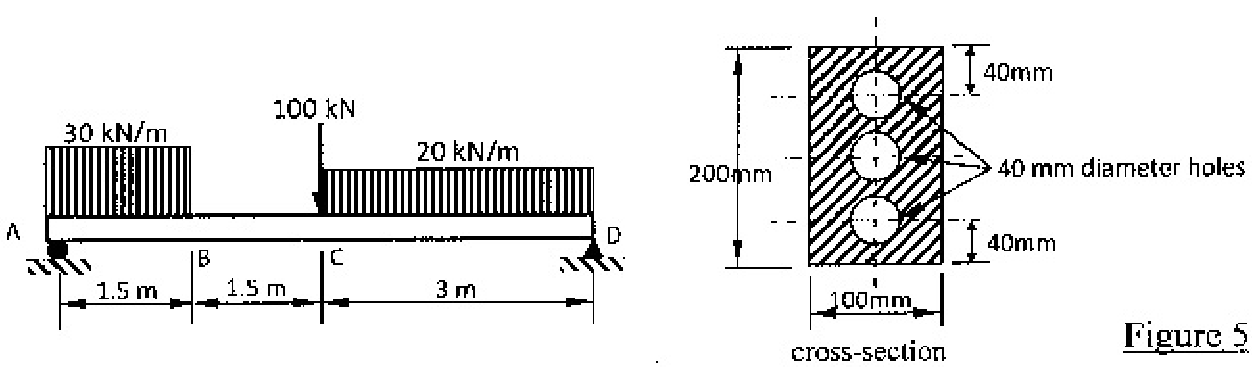


Figure 5

GOOD LUCK

الجامعة التكنولوجية

قسم هندسة المكائن والمعدات

المادة : مقاومة المواد | امتحان الدور الأول | الزمن : 3 ساعات

أجب عن خمسة أسئلة فقط

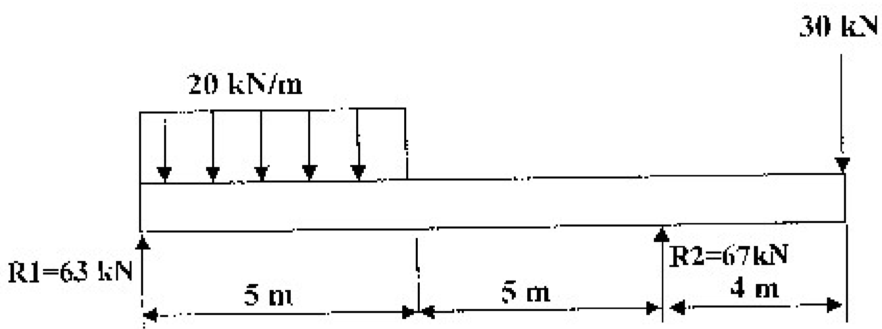
Q1: A steel bar 50 mm in diameter and 2 m long surrounded by a shell of cast iron 5 mm thick. Compute the load that will compress by combined bar a total of 1 mm in length of 2m . For steel m, E=200 Gpa, and the cast iron , E=100 Gpa.

Q2:

A steel wire 10 m long, hanging vertically supports a tensile load of 2000 N. Neglecting the weight of the wire, determine the required diameter if the stress is not exceed 140 MPa and the total elongation is not exceed 5 mm. Assume E= 200 GPa.

Q3:

Write shear and moment equations for the following beam loaded. And sketch the shear and moment diagrams.



Q4:

Drive the simply supported beam deflections formula (Double integration Method).

Q5: A cast iron link is 40 mm wide by 200 mm high by 500 mm long The allowable stresses are 40 MN/m^2~~m~~ in tension and 80 MN/m^2~~m~~ in compression. Compute the largest compressive load that can be applied To the ends of link along longitudinal axis that is located 150mm above the bottom of the link.

Q6:

At a certain point in a stressed body, the principle stresses are(80) Mpa in x-axis and (– 40) MPa in y-axis . Determine the normal and shear stresses on the planes whose normals are at (+30) deg. And (+120) deg. With the x-axis . Show your results on a sketch of a differential element.

الجامعة التكنولوجية
قسم هندسة المكائن والمعدات
امتحان الفصل الأول

الزمن: 90 دقيقة
الصف: الثاني ميكانيك
المادة مقاومة المواد

Q1 :

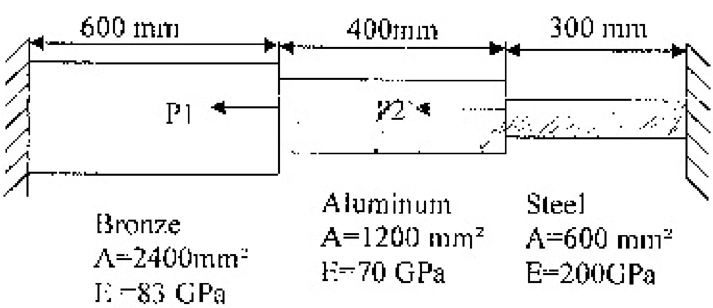
A rod is composed of three segments as shown in fig. (1) and carries the axial loads p1= 120 kN and p2= 50 kN . Determine the stress in each material if the walls are rigid.

Q2:

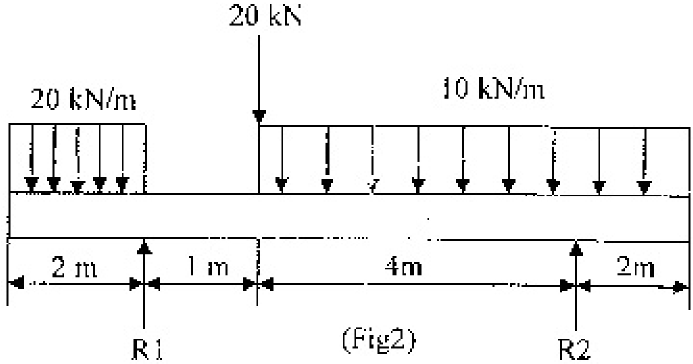
A hollow steel shaft of 400 mm external diameter transmits 9 MW and 120 rev/min.If the angle of twist measured over a length of 2 m is 0.45 deg.and G is 80 GN/m² ,estimate the internal diameter of the shaft.

Q3:

Write the shear and moment equations of the beam loaded as shown in fig.2.Also sketch the shear and moment diagrams.



(Fig.1)



(Fig2)