B

BITS PILANI DUBAI CAMPUS
Knowledge Village, Dubai
I Semester 2006-07

Course No: ES UC221
Date: 27.09.06
Max Marks: 10

Quiz 1-Regular

Course title: Mechanics of Solids
Duration: 30 Min
Weightage: 10%

Name:

ID No:

Section:

- All questions carry equal marks
- Tick ✓ for correct answer. Do not overwrite

S. No.	a)	b)	c)	d)
1				
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7				
8				
9				
10				

Q1. The reactions at A and B for the beam shown in Fig. Q1 are ________

a) R_{ay}=2.667 kN, R_{by}=1.333 kN

b) R_{ax}=1.333 kN, R_{by}=1.333 kN

c) R_{ax}=2.667 kN, R_{by}=1.333 kN

d) R_{ay}= 1.333 kN, R_{by}=2.667 kN

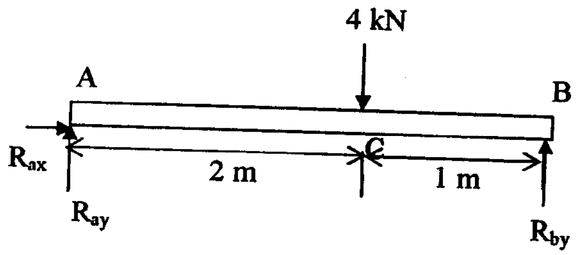


Fig. Q1

Q2. The magnitude of forces in the members AC and BC of the pin jointed truss shown in Fig. Q2 are

a) F_{ac}=6.928 kN, F_{bc}=8 kN

b) F_{ac}=6.928 kN, F_{bc}=6.928 kN

c) F_{ac}=8 kN, F_{bc}=6.928 kN

d) F_{ac}=8 kN, F_{bc}=8 kN

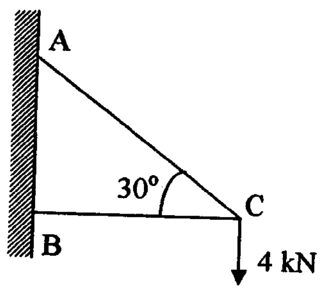


Fig. Q2

B

Q3. Friction forces are set up whenever a ________ force is applied to a body pressed ________ against the surface of another

a) tangential, normally
b) normal, tangentially
c) tensile, relatively
d) none of the above

Q4. The system of forces shown in Fig. Q4 reduced to a force and moment at B are ________

a) 70 N and 205 N m

b) 70 N and 305 N m

c) 70 N and 105 N m

d) 70 N and 405 N m

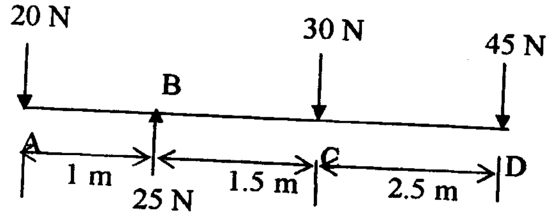


Fig. Q4

Q5. The free body diagram of the lower cylinder (cylinder I), shown in Fig. Q5 is________

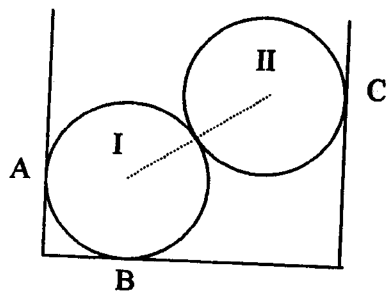
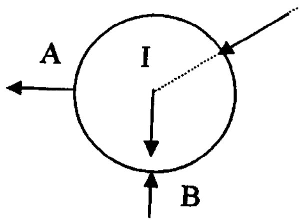
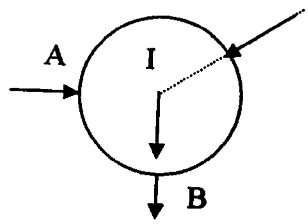


Fig. Q5

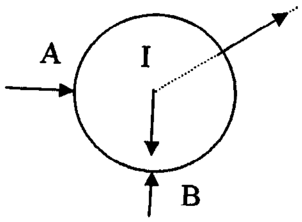
a)



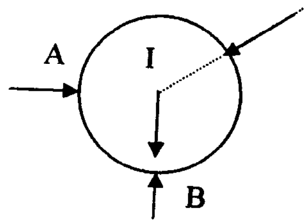
b)



c)



d)



B

Q6. The resultant of two forces F_1 and F_2=30 N shown in Fig. Q6 is R=20 N. The magnitude and direction of force F_1 is ______

a) F_1=56.35 N, α=52.76°

b) F_1=66.35 N, α=42.76°

c) F_1=46.35 N, α=62.76°

d) None of the above

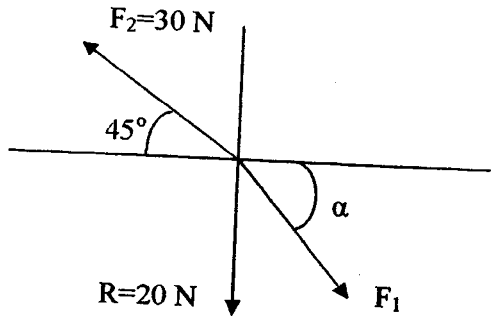


Fig. Q6

Q7. The resultant of forces shown in Fig. Q7 acts at a distance of ________ from A.

a) 2.85 m

b) 2.25 m

c) 3.55 m

d) 3.75 m

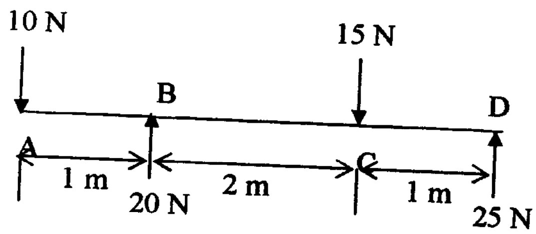


Fig. Q7

Q8. Fig. Q8 shows that a force of 100 N can barely hold the block of weight W=600 N from sliding down the inclined plane of slope 30°. The coefficient of static friction is ______

a) 0.284

b) 0.484

c) 0.384

d) None of the above

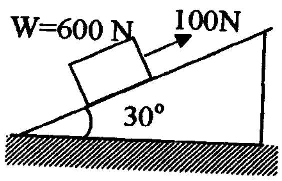


Fig. Q8

Q9.
1. Statically determinate systems are those in which forces can be determined without reference to deformation
2. Statically indeterminate systems are those in which forces cannot be determined without considering the deformations

a) Both 1 and 2 are false
b) 1 is true and 2 is false
c) 1 is false and 2 is true
d) Both 1 and 2 are true

Q10. For a nonlinear spring
1. the potential energy is given by the area under force deflection curve
2. the complementary energy is given by the area above the stress-strain curve

a) both 1 and 2 are true
b) 1 is false, 2 is true
c) 1 is true, 2 is false
d) none of the above

B

BITS-PILANI, DUBAI CAMPUS
First Semester 2006-07
COMPREHENSIVE EXAMINATION (CLOSED BOOK)

Course Name: Mechanics of Solids
Date: 26.12.2006
Max Marks: 40

Course No: ES UC221
Weightage: 40%
Duration: 3Hrs

Note: Answer Section A in main answer book and Section B and Section C separately in additional answer books.

SECTION A

Q1. A body of weight 600 N is pulled up an inclined plane as shown in Fig. Q1. If coefficient of static friction is equal to 0.23, find the force 'T' required to just pull the body up the inclined plane.

[4M]

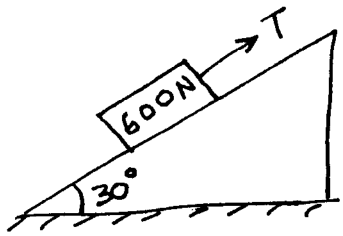


Fig Q1

Q2. Determine the forces in all the members of the truss shown in Fig. Q2.

[5M]

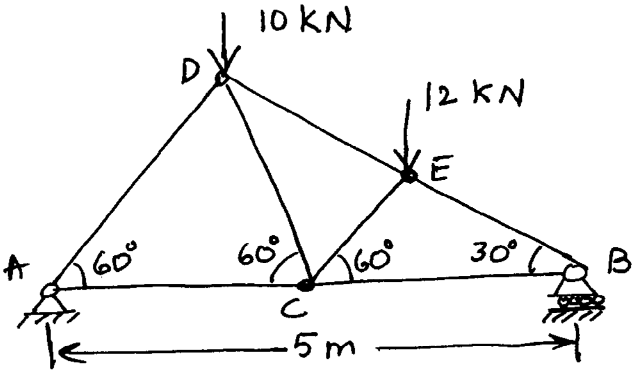


Fig. Q2

Q3. For the given loading pattern, shown in Fig. Q3, draw the shear force and bending moment diagrams. Indicate the sign convention employed.

[4M]

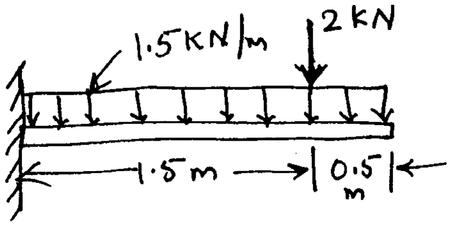


Fig. Q3

SECTION B

Q4. Figure Q4 shows a uniform homogeneous circular shaft of diameter 50 mm and length 2m, subjected simultaneously to an axial tensile force 'P=40 kN' and a twisting moment 'M_t=5 kNm'. Find the principal stresses.

[4M]

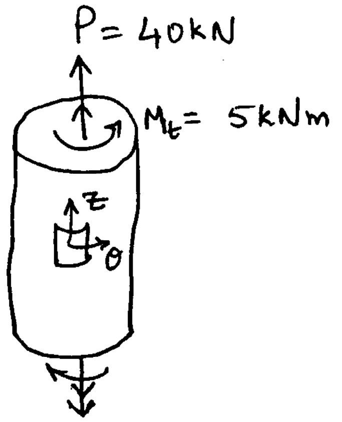


Fig-Q4

Q5. A batch of copper alloy yields in uniaxial tension at stress σ_o=69 MPa. If this material is subjected to the following state of stress, will it yield according to (a) Mises criterion, (b) Maximum shear stress criterion.

σ_x=30 MPa, σ_y= -15 MPa, σ_z=0, τ_{xy}=30 MPa, τ_{yz}=0, τ_{xz}=0.

[4M]

Q6. A composite shaft shown in Fig. Q6, is made up of an inner cylinder of elastic material with shear modulus 25 GN/m^2 and an outer circular annulus of elastic material with shear modulus 78 GN/m^2. The materials are bonded securely at the interface. Find (a) the angle of twist, and (b) maximum shear stress in the inner circular cylinder and outer circular annulus.

[5M]

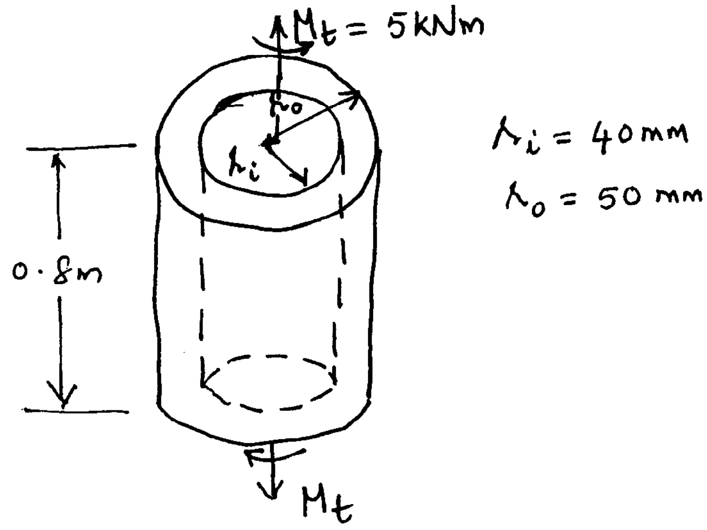


Fig Q6

SECTION C

Q7. A steel cantilever beam 5 m long, whose cross section and loads acted upon the beam are shown in Fig. Q7. Find the maximum bending stress.

[5M]

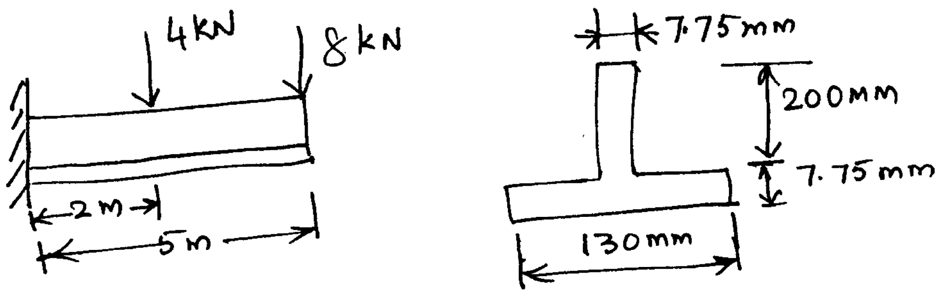


Fig Q7

Q8. Figure Q8 shows a uniform simply supported beam. By using Castigliano's theorem, find the deflection at the center of the beam due to the distributed load. Take E=120 GN/m^2.

[5M]

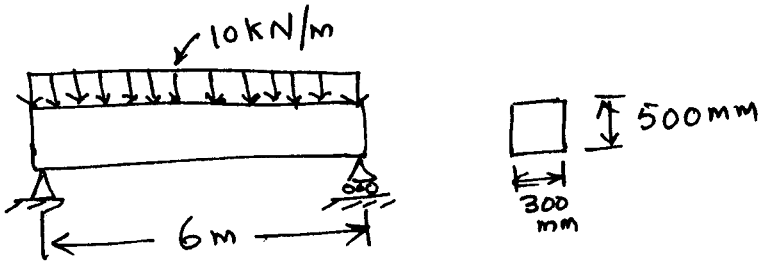


Fig Q8

Q9. Determine the critical load for buckling of a 3.7 m long and 75 mm diameter column (E=210 GN/m^2) under the following end conditions. (a) both ends are clamped and (b) both ends are hinged.

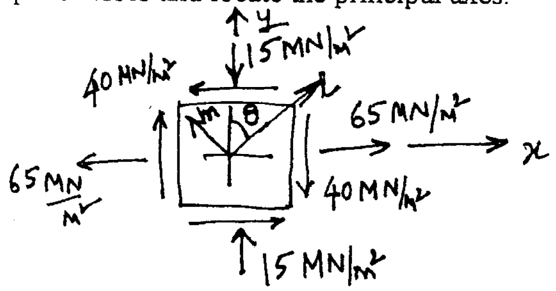
[4M]

BITS PILANI DUBAI CAMPUS
Knowledge Village, Dubai
I Semester 2006-07

Course No: ES UC221 Date: 19.11.06 Max Marks: 20	Test 2-Regular (Open Book)	Course title: Mechanics of Solids Duration: 50 Min Weightage: 20%

Q1. Consider a thin sheet pulled in its own plane so that the stress components with respect to the *xy* axes are as given in Fig. Q1. (a) Find the stress components with respect to the *lm* axes (σ_l, σ_m, τ_{lm}). (b) Find the principal stresses and locate the principal axes.

[6]



θ = 30°

Fig. Q1

Q2. The three principal stresses at a point are: σ_1= -80 MN/m^2, σ_2= 30 MN/m^2, and σ_3= 55 MN/m^2. Evaluate the stress components on the planes of maximum shear.

[4]

Q3. A rigid horizontal bar is supported by three rods, where the outer rods are made from steel alloy and the middle rod from Aluminum alloy, as shown in Fig. Q3. If the bar remains in horizontal position after the temperature of all three rods is raised by 50 °C, determine the stresses in the rods along the axial direction.

For Steel alloy	For Aluminum alloy
Area of cross section (A_s)=2 x 10^{-3} m^2	Area of cross section (A_a)=3 x 10^{-3} m^2
Elastic modulus (E_s)=2 x 10^{11} N/m^2	Elastic modulus (E_a)=0.7 x 10^{11} N/m^2
Coefficient of linear expansion (α_s)= 15 x 10^{-6} /°C	Coefficient of linear expansion (α_a)= 25 x 10^{-6} /°C

[6]

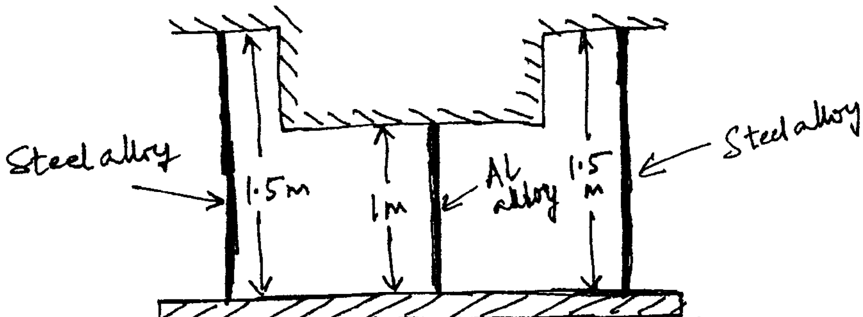


Fig Q3.

Q4. A batch of 2024-T4 aluminum alloy yields in uniaxial tension at the stress σ_o= 330 MN/m^2. Determine the value of τ_{xy} required to cause yielding according to Mises criterion, if this material is subjected to the following state of stress: σ_x= 150 MN/m^2, σ_y= σ_z= τ_{yz}= τ_{xz}=0.

[4]

BITS PILANI DUBAI CAMPUS
Knowledge Village, Dubai
I Semester 2006-07

B

Course No: ES UC221
Date: 08.11.06
Max Marks: 10

Quiz 2-Regular

Course title: Mechanics of Solids
Duration: 30 Min
Weightage: 10%

Name: **ID No:** **Section:**

- All questions carry equal marks
- Tick ✓ for correct answer. Do not overwrite

S. No.	a)	b)	c)	d)
1				
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Q1. For the state of stress shown in the Fig. Q1, the normal stress acting on the plane of maximum shear stress is

(a) 25 MPa
(b) 50 MPa
(c) 75 MPa
(d) 100 MPa

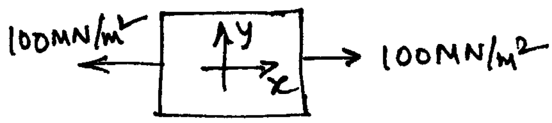


Fig Q1

Q2. Axes of maximum shear are inclined at ________

(a) 30° with respect to the principal axes
(b) 60° with respect to the principal axes
(c) 45° with respect to the principal axes
(d) 90° with respect to the principal axes

Q3. Consider a thin sheet pulled in its own plane so that the stress components with respect to xy axes are as shown in Fig. Q3. The shear stress component with respect to ab axes which are inclined at 15° to the xy axes are ___________

(a) 25 MPa
(b) 12.5 MPa
(c) 50 MPa
(d) 100 MPa

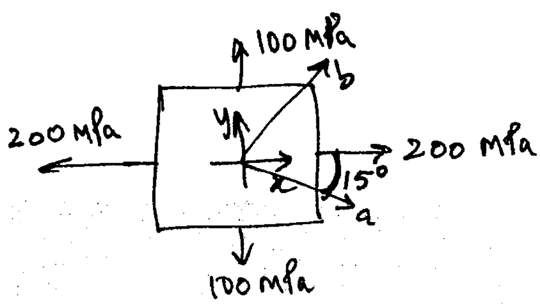


Fig Q3

Q4. The strain components with respect to the xy axes are: $\varepsilon_x = \varepsilon_y = 0$, $\gamma_{xy} = 800\text{x}10^{-6}$. If I and II axes are the principal axes of strain, then θ_I= _____ (as shown in Fig. Q4)

(a) 30°

(b) 45 °

(c) 60°

(d) 90°

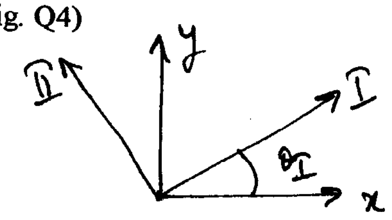


Fig Q4

Q5. Strain components related to a set of xy axes are $\varepsilon_x = -1000\text{x}10^{-6}$, $\varepsilon_y = 200\text{x}10^{-6}$, $\gamma_{xy} = 0$. The magnitude of the maximum shear strain is _________

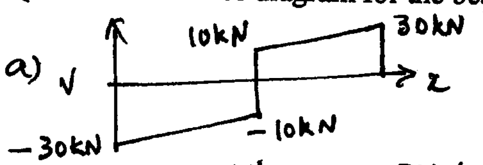
(a) $400\text{x}10^{-6}$

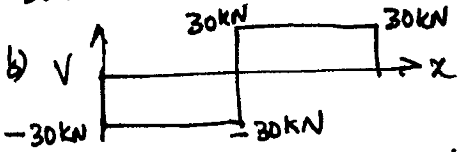
(b) $600\text{x}10^{-6}$

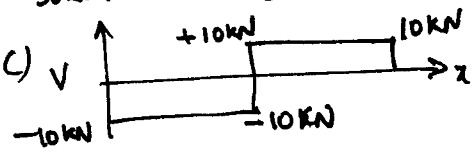
(c) $800\text{x}10^{-6}$

(d) $1200\text{x}10^{-6}$

Q6. The shear force diagram for the beam loaded as shown in Fig. Q6 is







d) None of These

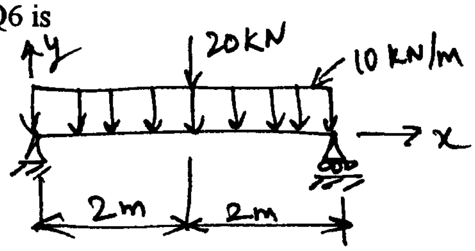
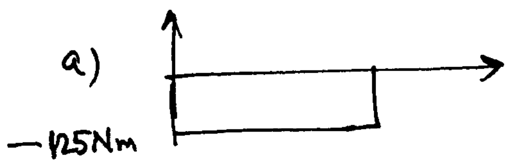
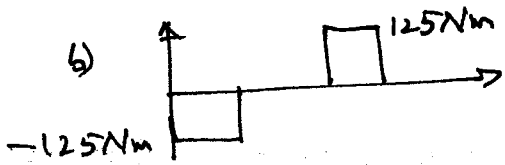


Fig Q6

Q7. A beam simply supported at 0.125 mm from each end carries a concentrated load of 1 kN at each extreme end as shown in Fig. Q7. The bending moment diagram for the beam is





d) None of these

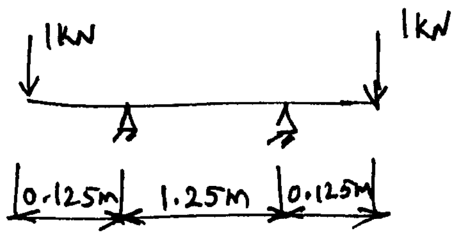


Fig Q 7

Q8. For the beam loaded as shown in Fig. Q8, the bending moment is maximum at _____

a) $x = 0$

b) $x = 2m$

c) $x = 3m$

d) $x = 4m$

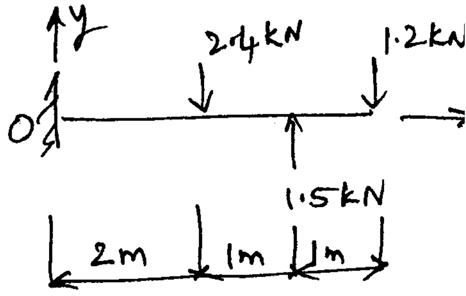


Fig Q8

Q9. The magnitude of the maximum bending moment of the cantilever beam AB with a linearly varying distributed load as shown in Fig. Q9 is _________

a) $\frac{w_0 L^4}{6}$

b) $\frac{w_0 L}{6}$

c) $\frac{w_0 L^3}{6}$

d) $\frac{w_0 L^2}{6}$

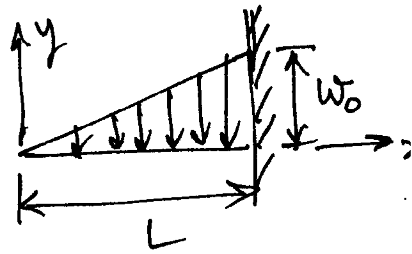


Fig Q9

Q10. The equation for shear force using singularity function at any point in the beam is ________ in kN

(Refer Fig Q10)

a) $V = -2\langle x\rangle^0 + 2\langle x-1\rangle^1 - 2\langle x-3\rangle^1 + 2\langle x-4\rangle^1$

b) $V = 2\langle x\rangle^0 - 2\langle x-1\rangle^1 + 2\langle x-3\rangle^0 - 2\langle x-4\rangle^0$

c) $V = -2\langle x\rangle^0 + 2\langle x-1\rangle^1 - 2\langle x-3\rangle^1 - 2\langle x-4\rangle^0$

d) None of these

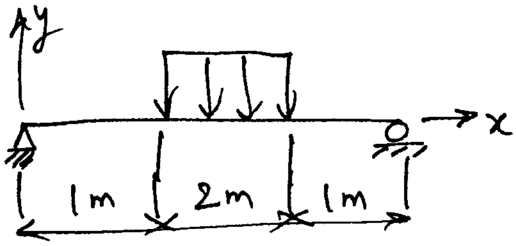


Fig Q10

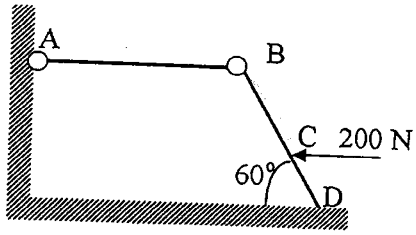
BITS PILANI DUBAI CAMPUS
Knowledge Village, Dubai
I Semester 2006-07

Course No: ES UC221
Date: 08.10.06
Max Marks: 20

Test 1-Regular (Closed Book)

Course title: Mechanics of Solids
Duration: 50 Min
Weightage: 20%

Q1. A horizontal force 200 N is applied to the bar BCD whose bottom rests on a smooth horizontal plane as shown in Fig. Q1. Its upper end is pinned at B to the horizontal bar AB which has a pinned support at A. What is the magnitude of the pin reaction at B? What couple must be applied at A to hold the system in equilibrium? Assume the bars to be weightless and pins at A and B to be smooth. L_{AB}= 1.6 m, L_{BC}=0.8m, L_{CD}=0.4 m.



[2+2]

Fig. Q1

Q2 In the pin jointed frame shown in Fig. Q2, find:
(a) force in members AC and BC.
(b) vertical and horizontal deflection of the loaded joint C.
For the rod AC: diameter = 20 mm, length = 5 m, elastic modulus = 103 GN/m^2.
For the rod BC: diameter = 50 mm, length = 5 m, elastic modulus = 200 GN/m^2.

[2+4]

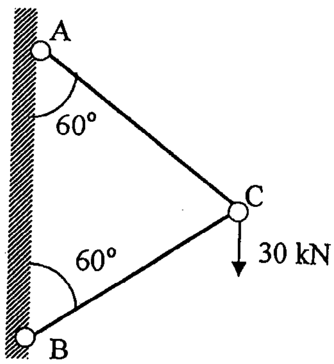


Fig. Q2

Q3. A composite hoop shown in Fig. Q3 consists of a cast iron (CI) hoop of 200 mm internal radius and 4 mm thickness, and an aluminum (Al) hoop of 204 mm internal radius and 8 mm radial thickness. Both hoops are 8 mm thick normal to the plane of the hoop. If a radial pressure of 1.6 MN/m^2 is put in the cast iron hoop, estimate the tangential forces in both the hoops. E_{CI}=115 GN/m^2, E_{Al}=70 GN/m^2.

[4]

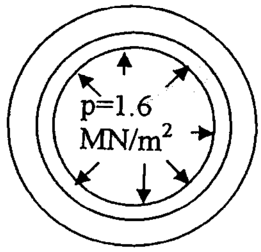


Fig. Q3

Q4. Draw the shear force and bending moment diagram for the cantilever beam shown in Fig. Q4. Indicate the sign convention employed and label important values.

[3+3]

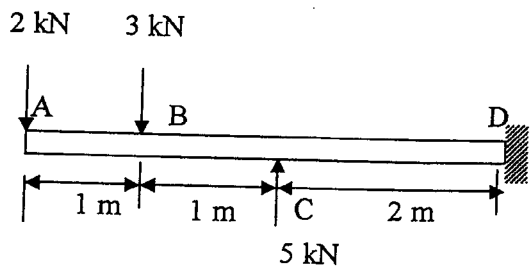


Fig. Q4