系名_____ 专业_____ 年级、班_____ 学号_____ 姓名_____ 密 封 线

# Chongqing University

## Mechanics of Materials Terminal Examination

June 28, 2005

| question number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | total |
|---|---|---|---|---|---|---|---|---|---|
| mark | | | | | | | | | |

1. Multiple-Choice (Choose one from four) (4×3=12marks)

1-1. About the bending of beams, ( ) is correct in the following statements.

(A) Only when V=0, M≠0 for all of the cross sections of the beam, this beam has pure bending segment.

(B) Only when the beam is bent symmetrically, such bending will be called plane bending.

(C) For plane bending, the plane on which all loads act will not intersect obliquely with one of the principal centroidal axes of cross sections.

(D) For a segment of the beam, if $\tau \neq 0$, $\sigma \neq 0$ on the cross sections, sometimes we say that such bending is pure bending.

1-2 About the mechanical properties of low-carbon steel (mild steel) and cast iron, ( )is correct in the following statements.

(A) The low-carbon steel does not have brittleness at any situation.

(B) The $\sigma$ - $\varepsilon$ curve of compressed cast iron has four phases obviously.

(C) For a low-carbon steel specimen in torsion, failure will occur in tension along a helix(螺旋线) inclined at 45° to the axis.

(D) If there is no strain-hardening occurred before, the ultiniate stress of low-carbon steel is yield stress.

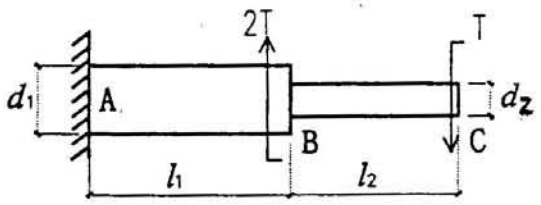
1-3 About the calculation of the internal force in a twisted shaft as shown. ( ) is correct in the following results.

(A) If the diameter $d_2$ of the segment BC increases by two times, the torque $M_1$ of the segment BC is still T.

(B) When $l_1$ and $l_2$ change, the torques of the segment AB and BC will change respectively.

(C) The torque of segment AB is positive and the torque of segment BC is negative.

(D) If the torques of these two segments have the same signs, the torque of segment BC is positive.



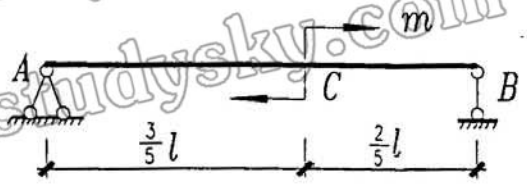

2. Fill in the following blanks (4×2=8 marks)

2-1. A beam with the length $l$ is subjected a couple m at section C. The moment of bending on a little left of section C $M_{c(left)}$ = _____

The moment of bending on a little right of section C $M_{c(right)}$ = _____

The shear force on a little left of section C $V_{c(left)}$ = _____

The shear force on a little right of section C $V_{c(right)}$ = _____



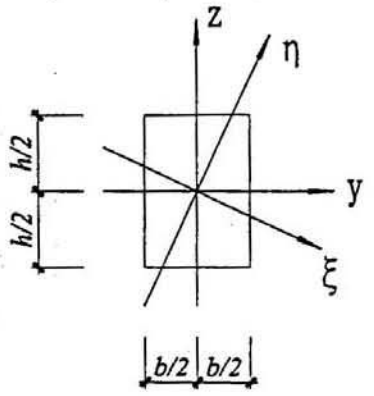



2-2 The rectangle as shown has h>b. The product of inertia $I_{y,z}$ = _____.

and please compare the following moments of inertia and product of inertia:

$I_z$ _____ $I_\xi$, $I_\eta$ _____ $I_y$, $I_{\xi\eta}$ _____ 0

(please fill ≠、=、<、> in last three blanks)



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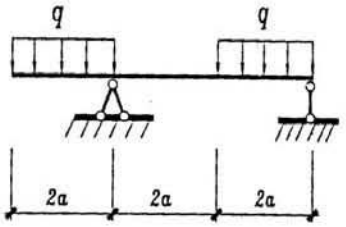
3. (8 marks)

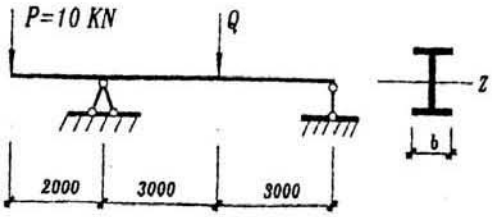
Draw the shear and moment diagrams for the beam as shown.





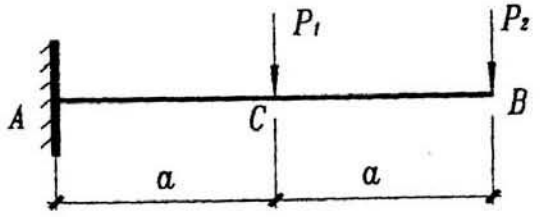

4. (15 marks)

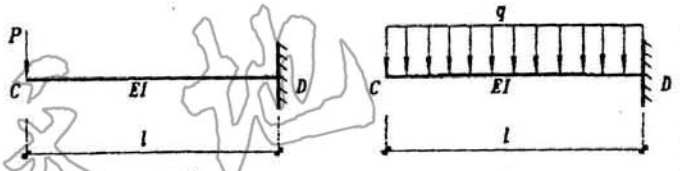
A overhanging beam has the wide flange section of I16 (the height of the section is 160mm). If the moment of inertia $I_z = 0.113\times10^{-4}\,m^4$ .and the allowable stress $[\sigma]=160$ Mpa. Determine the maximum safe value of Q by the normal stress stength.



5. (15 marks)

A Cantilevered beam ACB has the flexural rigidity 2EI. If $P_1=P_2=P$, Determine the deflection $v_B$ and the slope $\theta_B$. (Can use the results given)



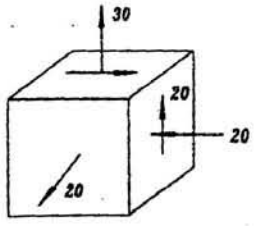




$$v_c=\frac{Pl^3}{3EI} \qquad v_c=\frac{ql^4}{8EI}$$

$$\theta_c=-\frac{Pl^2}{2EI} \qquad \theta_c=-\frac{ql^3}{6EI}$$

6. (15 marks)

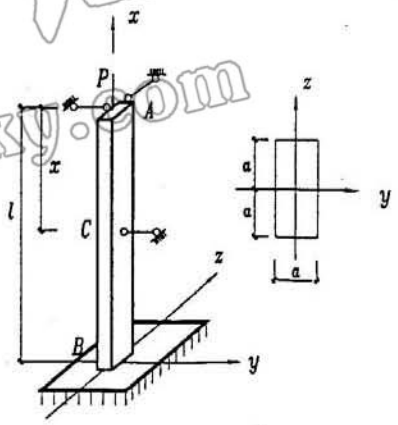
The state of stress at a point is shown on the element. Determine i) the three principal stresses, ii) the three principal directions and iii) compute the equivalent stress of the fourth strength theory.




(unit: MPa)

7. (12 marks)

A centrally compressed bar with length *l* has a rectangular cross section of a×2a. At the top there are two roller supports in direction y and direction z respectively. At section C it is supported by one roller support in direction y, and it is fixed at the bottom. Assume the bar is slender bar and modulus of elasticity is E. Determine i) the reasonable x=?. ii) the expression of corresponding critical load.



8. (15 marks)

A horizontal bracket ABC is fixed at end A and free at end C. Member AB and member BC are circular shafts of diameter d, and member BC is perpendicular to the member AB. Assume the modulus of elasticity is E and the shear modulus of elasticity is G.

i) Find the vertical deflection $\delta_c$ due to the vertical load P by Castigliano's second theorem.

ii) If the load P is replaced by free-drop impacting of a body with weight P Determine the maximum height h of the body by strength condition. (The allowable maximum impacting force $P_d = 5P$ ).