L-2/T-2/ChE **Date : 01/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **MATH 223** (Numerical Analysis and Statistics)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols used to have their usual meaning.

1. (a) What are the advantages of the numerical method over analytical method? Find a solution of the equation $x^3 + 4x^2 - 10 = 0$ correct to four significant figures using fixed point iteration method. **(18)**

   (b) Use Newton-Raphson method to find the roots (second approximation) of the simultaneous equation $x^2 + y^2 - 50 = 0$, $xy - 25 = 0$. **(17)**

2. (a) Define interpolation and extrapolation. Derive Newton's general interpolation formula. **(18)**

   (b) Find *ln* 9.2, using Lagrange's interpolation formula from the following tabulated values. **(17)**

x	9.0	9.5	10.0	11.0
lnx	2.197	2.251	2.302	2.397

3. (a) Derive general quadrature formula for equidistant ordinates and hence find Simpson's $\frac{1}{3}$ as well as Simpson's $\frac{3}{8}$ formulas. **(18)**

   (b) Use the method of least squares to fit the curve $y = \frac{a}{x} + b\sqrt{x}$ to the following table of values: **(17)**

x	0.1	0.2	0.4	0.5	1	2
y	21	11	7	6	5	6

4. (a) Find the first and second derivatives of $f(x)$ at $x = 1.2$ from the following tabulated values. **(17)**

x	1	2	3	4	5
$f(x)$	0	1	5	6	8

   (b) Find an approximate value of $\int_0^{0.5} \frac{1}{\sqrt{1-x^2}}\,dx$ taking 12 subintervals by (i) Simpson's $\frac{1}{3}$ rule

   (ii) Simpson's $\frac{3}{8}$ rule and (iii) Weddle's rule. **(18)**

Contd P/2

MATH 223(CHE)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Use Picard's methods to approximate y, when x = 0.2, given that y = 1 when x = 0 and $\frac{dy}{dx} = x - y$. **(17)**

   (b) Use Range-Kutta method to approximate y, when x = 0.1 and x = 0.2, given that $\frac{dy}{dx} = x + y,\ y(0) = 1$. **(18)**

6. (a) In a survey, data on daily wages paid to workers of two factors A and B are as follows: **(17)**

Daily wages	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Factory A	15	30	44	60	30	14	7
Factory B	25	40	60	35	20	15	5

   Find out: (i) Which factory pays higher average wages? (ii) Which factory has greater variability about paying wages?

   (b) Define skewness and kurtosis. Using moments calculate the coefficient of skewness and kurtosis from the following distribution given below and comment on the result obtained. **(18)**

Profit (in Tk.)	10-20	20-30	30-40	40-50	50-60
No. of Companies	18	20	30	22	10

7. (a) A box X contains 2 white and 4 black balls. Another box Y contains 5 white and 7 black balls. A ball is transferred from the box X to the box Y. Then a ball is drawn from the box Y. Find the probability that the ball is white. **(12)**

   (b) What is a regression coefficient? How does it differ from a correlation coefficient? Explain positive correlation and negative correlation. When do you call a correlation to be perfect? Show that correlation coefficient lies between –1 and 1. **(11)**

   (c) A box contains 100 transistors, 20 of which are defective, 10 are selected for inspection. Indicate what is the probability that **(12)**

   (i) all 10 are defective

   (ii) all 10 are non defective

   (iii) at least one is defective, and

   (iv) at the most 3 are defective?

8. (a) Telephone calls enter a switch board on the average of two every 3-minute interval. What is the probability of five or more calls arriving in a 9-minute period? **(12)**

   (b) Write short notes on (i) Null hypothesis, (ii) Level of significance, (iii) Type-1 error, Type-2 error and (iv) Degrees of freedom. **(8)**

Contd P/3

MATH 223(CHE)

Contd ... Q. No. 8

(c) The Edison Electric Institute has published figures on the annual number of kilowatt-hours expended by the various home appliances. It is claimed that a vacuum cleaner expends an average of 46 kilowatt-hours per year. If a random sample of 12 homes included in a planned study indicates that vacuum cleaners expend an average of 42 kilowatt-hours per year with a standard deviation of 11.9 kilowatt-hours, does this suggest at the 0.05 level of significance that vacuum cleaner expend, on the average, less than 46 kilowatt-hours annually? (Given that at $\nu = 11$, $t_{0.05} = 1.796$) **(15)**

L-2/T-2/ChE **Date : 07/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **CHEM 221** (Organic Chemistry)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Show the mechanism that all the five membered heterocycles undergo electrophilic substitution reaction preferentially at position C – 2. **(12)**

   (b) Staring with the five membered heterocycle furan give an outline of the commercial method for the synthesis of Nylon 6, 6. **(8)**

   (c) How furfural undergoes the following reactions: **(5×2=10)**

   (i) Benzoin condensation (ii) Claisen Schemidt condensation.

   (d) Explain why pyridine is less basic than trimethylamine but more basic than pyrrole. **(5)**

2. (a) What are condensed ring heterocycles? Describe the Bischler – Napieralski synthesis for β - γ - benzopyridine with a probable mechanism. **(3+7=10)**

   (b) Write with reactions how would you bring out the following conversions: **(3×2=6)**

   (i) 2-Aminoquinoline from quinoline (ii) Decahydro isoquinoline from isoquinoline .

   (c) What is indigo? Give a commercial method for the synthesis of indigo dye. Which isomer of indigo is more stable? **(3+7+2=12)**

   (d) Illustrate the mechanism of vat dying with indigo. **(7)**

3. (a) What are alkaloids? Give a classification of alkaloids. Mention some important function of alkaloids. **(2+8+4=14)**

   (b) Draw the structures of the following alkaloids and write down their major physiological activities. (i) Coniine (ii) Nicotine (iii) Papavarine **(6)**

   (c) Give the structural elucidation of the alkaloid nicotine. **(7)**

   (d) What are the various degradation methods for the determination of the structure of alkaloids? Describe one of the degradation method of alkaloids in brief. **(2+6=8)**

4. (a) Discuss the general mechanism of electrophilic aromatic substitution reaction. Explain the sulphonation of benzene. **(6+6=12)**

   (b) Write with mechanism the Fridel-Craft's acylation reaction. Mention its major advantages over Fridel-Craft's alkylation reaction. **(6+4=10)**

Contd P/2

CHEM 221(ChE)

Contd ... Q. No. 4

(c) Write down the structures of the following sweetening agents: **(6)**

(i) Saccharin (ii) Cyclamate (iii) Nectarin

(d) How will you synthesize sodium salt of saccharin starting from toluene? **(7)**

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Discuss the mechanism of chlorination of methane. If our goal is to synthesize CCl_4 for maximum yield, this can be accomplished by using a large excess of chlorine. Explain. **(15)**

(b) How will you distinguish between enantiomers and diastereomers? Write the enantiomeric forms of 1-chloro-2-methylbutane and assign each enantiomer its correct (R) or (S) designation. **(10)**

(c) Draw the structures of the following compounds: **(10)**

(i) 4-vinylcyclopentene

(ii) 8-methylbicyclo [3-2-1] octane

(iii) 4-methylpent – 3 – en – 20 |

(iv) 3, 5 – dimethylcyclohexene

(v) 7 – methylspiro [4-5] decane

6. (a) What do you mean by polar protic and polar aprotic solvents? **(12)**

Which SN^2 reaction would you expect to take place more rapidly in a polar protic solvent? Explain your answer.

(i) $CH_3CH_2CH_2Cl + CH_3CH_2\overline{O} \rightarrow CH_3CH_2CH_2OCH_2CH_3 + Cl^-$

or

(ii) $CH_3CH_2CH_2Cl + CH_3CH_2OH \rightarrow CH_3CH_2CH_2OCH_2CH_3 + HCl$

(b) Discuss the mechanism of E2 and E1 reaction of alkyl halides. **(15)**

(c) Although ethyl bromide and isobutyl bromide are both primary halides, ethyl bromide undergoes SN^2 reactions more than 10 times faster than isobutyl bromide does. When each compound is treated with a strong base/nucleophile ($CH_3CH_2O^-$), isobutyl bromide gives a greater yield of elimination products than substitution products, whereas with ethyl bromide this behavior is reversed. What factor accounts for these results? **(8)**

7. (a) Give the structure and names of the products you would expect when 2-methyl-1-butene is subjected to (i) acid-catalyzed hydration, (ii) hydration by oxymercuration-demercuration, and (iii) hydration by hydroboration-oxidation. **(9)**

Contd P/3

CHEM 221(ChE)

Contd ... Q. No. 7

(b) Write a note on 'Williamson synthesis of ethers'. How will you prepare isopropyl methyl ether by this method? **(11)**

(c) Treating 3, 3 – dimethyl -1-butene with dilute sulfuric acid is largely unsuccessful as a method for preparing 3, 3 – dimethyl-2-butanol because an isomeric compound is the major product. **(15)**

(i) What is the isomeric product, and how is it formed? Give a detailed mechanism.

(ii) What reaction conditions would you use to obtain 3, 3 –dimethyl-2-butanol from 3, 3-drimethyl-1-butene?

8. (a) Starting with benzene, outline a synthesis of each of the following compounds. **(12)**

(i) 1-bromo-2-trichloromethyl benzene.

(ii) m-chlorobenzoic acid

(iii) 1-bromo-3-trichloromethyl benzene

(b) Use resonance theory to explain why the hydroxyl group of phenol is an activating group and an ortho-para director. Illustrate your explanation by showing the arenium ions formed when phenol reacts with a Br^+ ion at the ortho, meta and para positions. **(12)**

(c) Write a note on 'Baeyer strain theory.' **(11)**

L-2/T-2/CHE **Date: 11/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **HUM 103** (Economics)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Symbols indicate their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Clarify the concept of 'utility' in Economics and state the assumptions of the cardinal approach to utility analysis. Is there any limitations with these assumptions? If yes, identify. How are these limitations overcome in ordinal approach? **(15)**

   (b) Explain the law of diminishing marginal utility with numerical as well as graphical presentations. Prove that the equilibrium conditions are identical with both cardinal approach and ordinal (indifference-curve) approach to utility analysis. **(20)**

2. (a) Explain the substitution effect and income effect of a price change with numerical examples. **(15)**

   (b) Define different types of elasticity of demand and describe their importance in economics. Given the demand function of a commodity X **(20)**

$$Q_{dx} = 1180 - 18P_x + 0.007M + 3.5P_y - 5.8P_z$$

   Where, price of X, P_x = Tk. 24, price of Y, P_y = Tk. 36, price of Z, P_z = Tk. 28 and income, M = Tk. 55000.

   (i) Find the cross-price elasticities and income elasticity of X.

   (ii) What are the implications of the results you have obtained?

3. (a) How is demand for factors determined in a classical economy? Explain the concept using demand for labor. **(15)**

   (b) "In the Solow Model, the steady state represents the long-run equilibrium of the economy" — justify the statement. **(10)**

   (c) What is the Golden Rule level of capital? Explain with the help of a diagram. **(10)**

4. Write short notes on any THREE of the following: **(35)**

   (a) 'Change in demand' and 'change in quantity demanded'

   (b) Factors affecting supply of a commodity in general

   (c) Determinants of the size of the coefficient of elasticity of demand

   (d) Relationship between marginal rate of substitution (MRS) and marginal utility (MU).

Contd P/2

HUM 103/CHE

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What are the assumptions of a perfectly competitive market? Explain. **(10)**

(b) Explain the long run equilibrium of a firm under perfect competition. **(15)**

(c) From the following revenue and cost functions, calculate the profit maximizing level of output and maximum profit. **(10)**

$$R = 100Q - Q^2$$

$$C = \frac{1}{3}Q^3 - 7Q^2 + 111Q + 90$$

6. (a) When does a firm emerge as a monopolist? **(10)**

(b) Explain the short run equilibrium of a firm under monopoly. **(10)**

(c) What is the relation among marginal revenue (MR), price (P) and price elasticity of demand(e)? **(10)**

(d) What are the conditions of profit maximization? **(5)**

7. (a) Define fixed cost and variable cost. **(5)**

(b) How would you derive the long run average cost (LAC) curve of a firm from its short run average cost curves? Explain graphically. **(10)**

(c) What is the relation among various short run average cost curves? **(10)**

(d) A manufacturer has a fixed cost of $40,000 and a variable cost of $1.60 per unit made and sold. Selling price is $2 per unit. **(10)**

(i) Find the revenue, cost and profit functions using q for the number of units.

(ii) Compute profit if 150000 units are made and sold.

(iii) Compute profit if 1500 units are made and sold.

(iv) Find the break-even quantity.

(v) Construct the break-even chart. Label the cost and revenue lines, the fixed cost line, and the break-even point.

8. (a) What is National Income Accounts Identity? Briefly describe the components of aggregate expenditure. **(10)**

(b)Derive IS curve using the Keynesian Investment Function. How does IS Curve shift in response to an increase in government purchase? **(12)**

(c) Derive LM curve from the Theory of Liquidity Preference. What will be the change in interest rate and output/income if the Central Bank takes a Contractionary Monetary Policy? Show the scenario diagrammatically. **(13)**

L-2/T-2/CHE **Date: 27/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **CHE 205** (Fluid Mechanics)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Assume reasonably if additional data is required.

1. (a) Explain shortly the benefits and limitations of Dimensional Analysis. Also discuss why Buckingham π theorem method is preferred over Rayleigh method for carrying out a dimensional analysis. **(5+3=8)**

(b) Models are to be built of the following prototypes. For dynamic similarity, indicate which single dimensionless ratio will govern, give reasons. **(4×3=12)**

(i) Oil flowing through a pipeline,

(ii) Flow over the spillway of a dam,

(iii) An airplane flying at low speed.

(c) By Buckingham π theorem dimensional analysis, determine the expression for the shear stress at the wall when an incompressible fluid flows in a pipe under pressure. The significant parameters are velocity of flow V, diameter of pipe D, and viscosity μ and density ρ of the fluid. **(15)**

2. In the context of centrifugal and axial-flow pumps— **(3×3=9)**

(a) Explain the significance of:

(i) NPSH (ii) Pump Priming (iii) Shutoff Head

(b) Demonstrate graphically the disposition of power in a pump operating at variable head and constant speed. **(8)**

(c) List the alternatives which complicate the choice of a pump (or pumps) for a particular situation. **(6)**

(d) Select the specific speed and type of the pump or pumps required to lift 425 L/s of water 114 m through 3000 m of 90 cm-diameter pipe (f = 0.020). The pump rotative speed is to be 1750 rpm. Consider the following cases: **(12)**

(i) single pump (ii) two pumps in series (iii) two pumps in parallel.

Contd P/2

CHE 205

3. (a) With the derivation of required equation, demonstrate how the velocity and pressure of subsonic and supersonic compressible flow change with the variation of flow area. **(12)**

(b) The pressure, velocity, and temperature just upstream of a normal shock wave in air are 70 kPa, abs, 660 m/s and –5°C. Determine the pressure, velocity, and temperature just downstream of the wave. [For air, gas constant R = 287 N.m/(kg.K) and specific heat ratio k = 1.40] **(9)**

(c) In the context of dispersed multiphase flow—

(i) Explain briefly the flow classification by regime. **(8)**

(ii) State the conditions for the application of Eulerian Lagrangian and Eulerian-Eulerian models. **(6)**

4. (a) In the context of "Unsteady Flow of Incompressible Fluids in Pipes"—

(i) Write down the general energy equation. How does it differ from that of steady flow? **(5)**

(ii) Show H.G.L for both possible conditions of unsteady flow in a horizontal pipe of constant diameter. **(8)**

(b) Consider that an air bubble is rising in a stationary liquid. **(22)**

(i) List all the fluid properties and flow variables which are relevant and important in this flow phenomenon.

(ii) Propose and state working-principle of the most appropriate measurement device for each fluid properly and flow variable listed above.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Explain briefly the concept of continuum. **(8)**

(b) Two conduits, one circular and one square, have the same cross-sectional area. Which one has the larger equivalent diameter, and by what percentage? **(9)**

(c) See the Figure for Question No. 5(c). A velocity distribution is shown in the diagram, which is a parabola having its vertex 10 cm from the bottom surface. Calculate the velocity gradients for y = 0 and 2.5 cm. Also calculate the shear stresses at these points if the fluid viscosity is 40 cP. **(18)**

Contd P/3

CHE 205

6. (a) Describe (i) Stream-lines and (ii) Streak-lines by using appropriate examples and diagrams. **(8)**

(b) The pressure inside a soap-bubble is higher than the outside (due to surface tension effect). Develop the expression for the pressure difference in terms of surface tension co-efficient and bubble diameter. **(17)**

(c) Write a short note on "Cavitation". **(10)**

7. (a) Derive the general energy equation for steady flow of any fluid. Reduce the general equation to Bernoulli's equation. State all the assumptions clearly. **(17)**

(b) The gate MN in Figure for Question No. 7(c) rotates about an axis through N. If the width perpendicular to the plane of the figure is 2 ft, what minimum force need to be applied at point P to hold the gate closed? **(18)**

8. A steel pipe (roughness = 0.065 mm) 250 m long is to convey oil (sp. Gr. = 0.82, viscosity = 5.2×10^{-5} m^2/s) at 50 liter/s from one tank to another with surface elevation difference of 7 m. Both inlet and outlet connections are flush with tank walls and square-edged. Theoretically, what pipe size is required? **(35)**

[Note: You have to take care for the minor losses as well as the pipe friction loss. For your convenience, the following equations are copied from the textbook.

Blasius equation: $f = \frac{0.316}{R^{0.25}}$

Von Karman equation: $\frac{1}{\sqrt{f}} = 2\log\frac{D}{e} + 1.14$

You may also use the Moody diagram.]

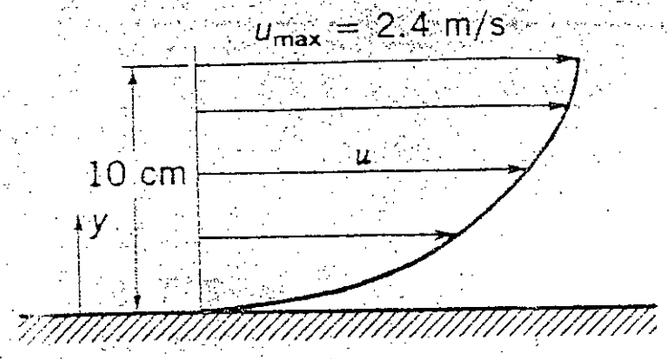


Figure for Question No. 5.(c)

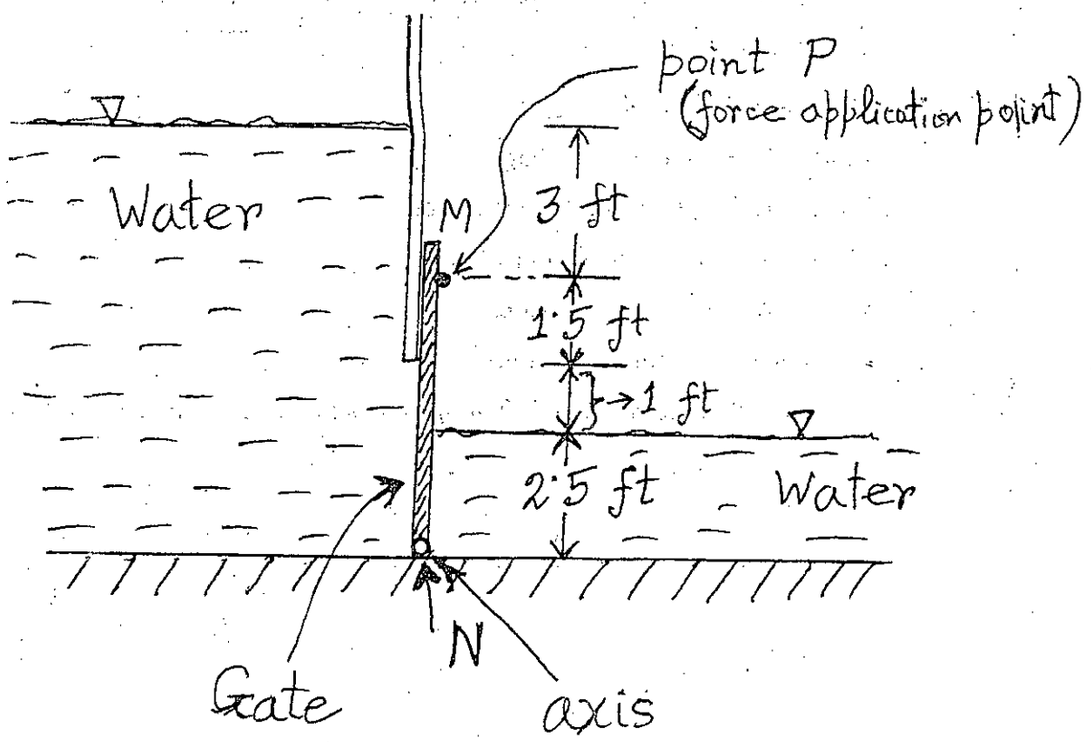


Figure for Question No. 7.(c)

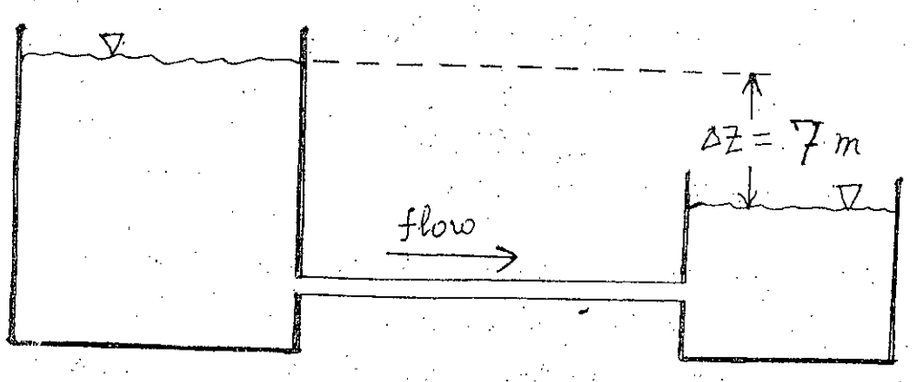
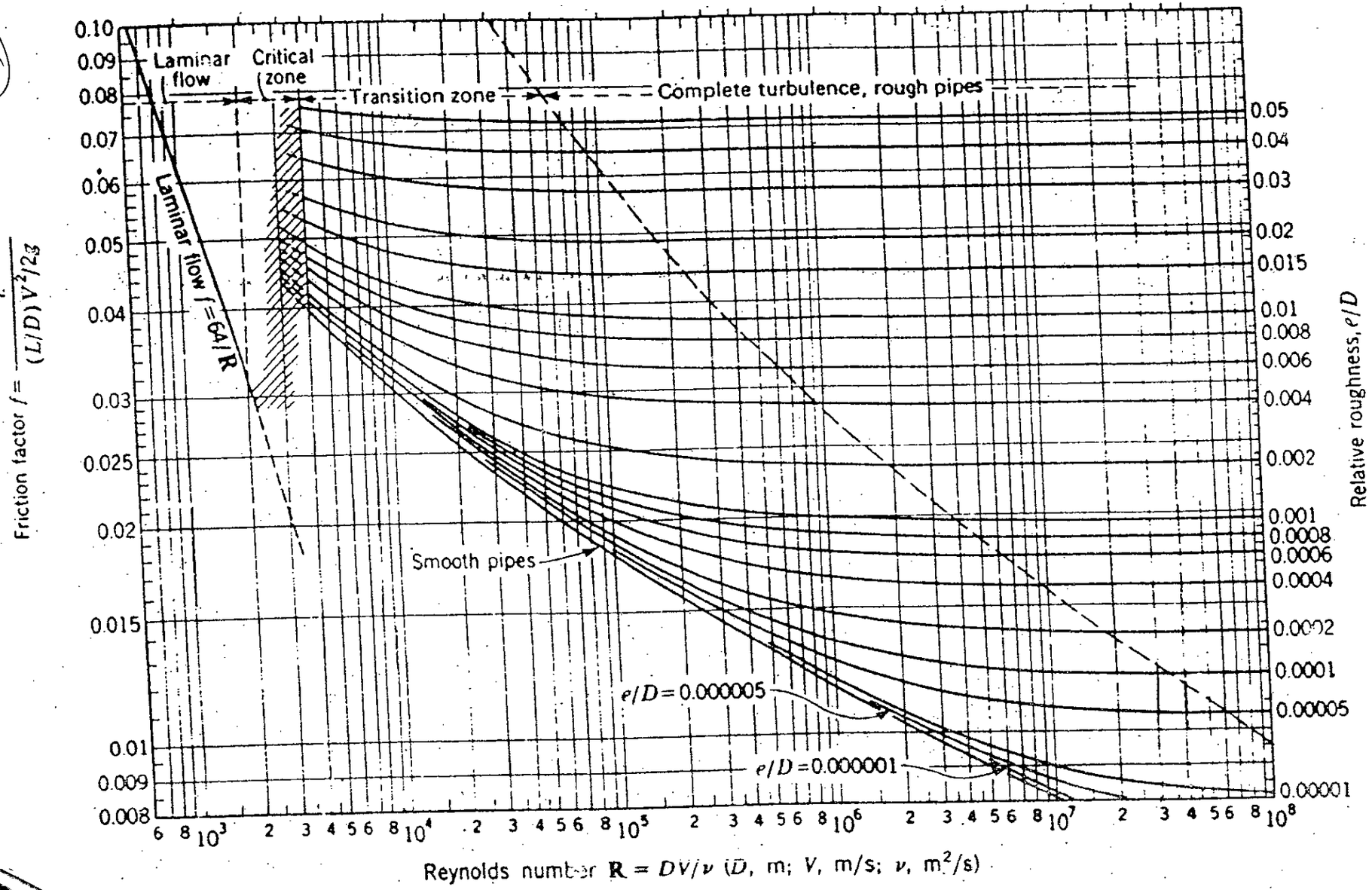


Figure for Question No. 8.



Friction factor for pipes (Moody diagram)

L-2/T-2/CHE **Date: 16/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **ME 243** (Mechanics of Solids)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

Symbols have their usual meaning.

1. (a) The splined ends and gears attached to the steel shaft are subjected to the torques as shown in Fig. for question no 1(a). Determine the angle of twist of end B with respect to end A. The shaft has a diameter of 40 mm. Modulus of rigidity of the material is 79 GPa. **(15)**

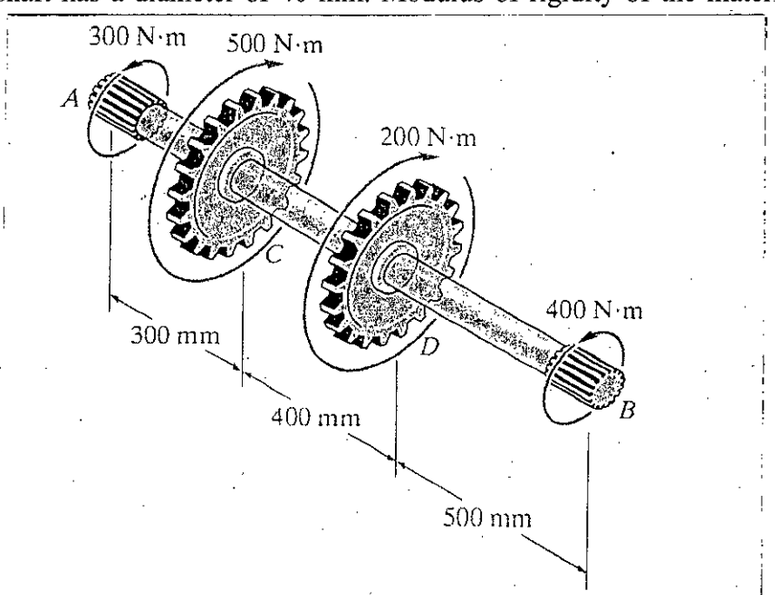


Fig for question no 1(a)

(b) A rigid bar, hinged at one end, is supported by two identical springs as shown in Fig. for question no 1(b). Each spring consists of 20 turns having a mean coil diameter of 150 mm and wire diameter is 10 mm. Compute the maximum shearing stress in the springs. Neglect the mass of the rigid bar. **(20)**

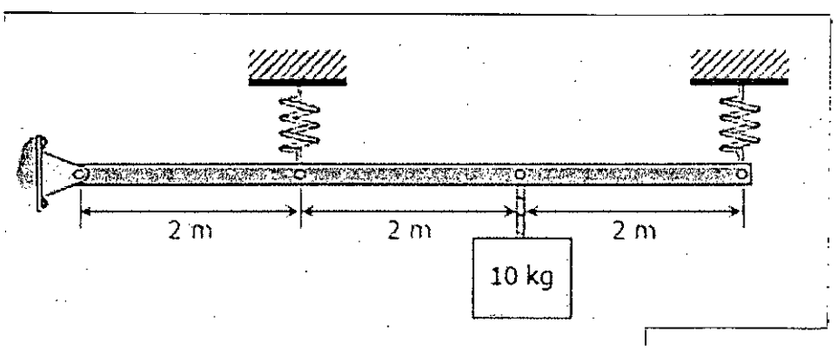


Fig for question no 1(b)

Contd P/2

ME 243/CHE

2. Draw stress versus slenderness ratio curve for steel column and identify the region in the curve where Euler's formula can be applied. Using the attached table select the lightest *W* shape for a fixed ends column of length 6 m that carries an axial load of 145 kN. Yield strength and modulus of elasticity of the material are 360 MPa and 200 GPa respectively. **(35)**

3. (a) For the state of plane stress as shown in Fig. for question no 3(a), determine (i) the principal planes and the principal stresses, (ii) the stress components exerted on the element obtained by rotating the given element counterclockwise through 30°. Show the results on complete sketches of differential elements. **(20)**

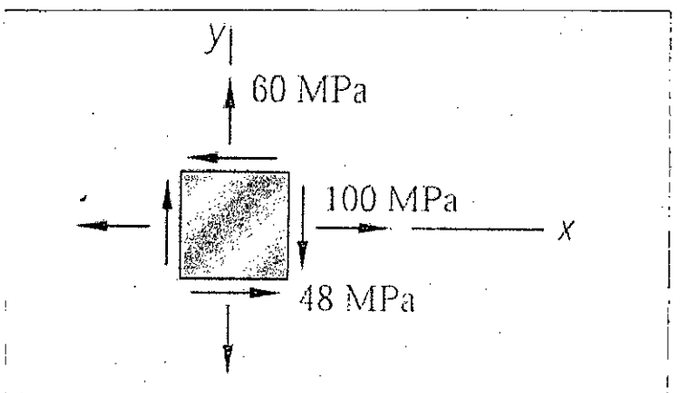


Fig for question no 3(a)

(b) Design a concrete beam with balanced stress-reinforcement to resist a bending moment of 100 kNm. Consider the allowable stress in concrete, f_c = 12 MPa and that in steel, f_s = 150 MPa. Assume d = 1.5b and n = 8. **(15)**

4. (a) An aluminum-alloy cylindrical pressure vessel has an outside diameter of 200 mm and a wall thickness of 6 mm. **(20)**

   (i) Assuming the vessel as thin walled, what pressure can the cylinder carry if the permissible stress is 82 MPa?

   (ii) On the basis of the pressure found in part (i), compute the stress components at the inner surface using the theory for thick-walled cylinders.

(b) A 60° strain rosette attached to the aluminum skin of the airplane fuselage measures the following strains: $\varepsilon_a = 300\times10^{-6}$, $\varepsilon_b = -400\times10^{-6}$ and $\varepsilon_c = 100\times10^{-6}$. If E = 200 GPa and v = 0.3, compute the principal stresses and their directions. **(15)**

Contd P/3

ME 243/CHE

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) The rigid bar AC, attached to two vertical rods as shown in Fig. for Q. 5(a), is horizontal before the load P is applied. Determine the vertical movement of P if its magnitude is 50 kN. **(17)**

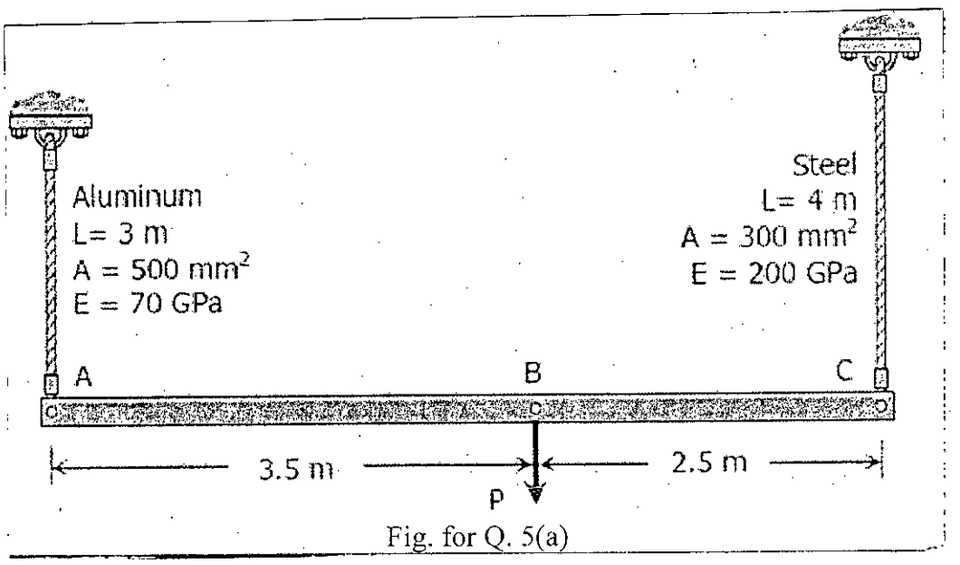


Fig. for Q. 5(a)

(b) The assembly in Fig. for Q. 5(b) consists of a light rigid bar AB, pinned at O, that is attached to the steel and aluminum rods. In the position shown, bar AB is horizontal and there is a gap, $\Delta = 5$ mm, between the lower end of the steel rod and its pin support at C. Compute the stress in the aluminum rod when the lower end of the steel rod is attached to its support. **(18)**

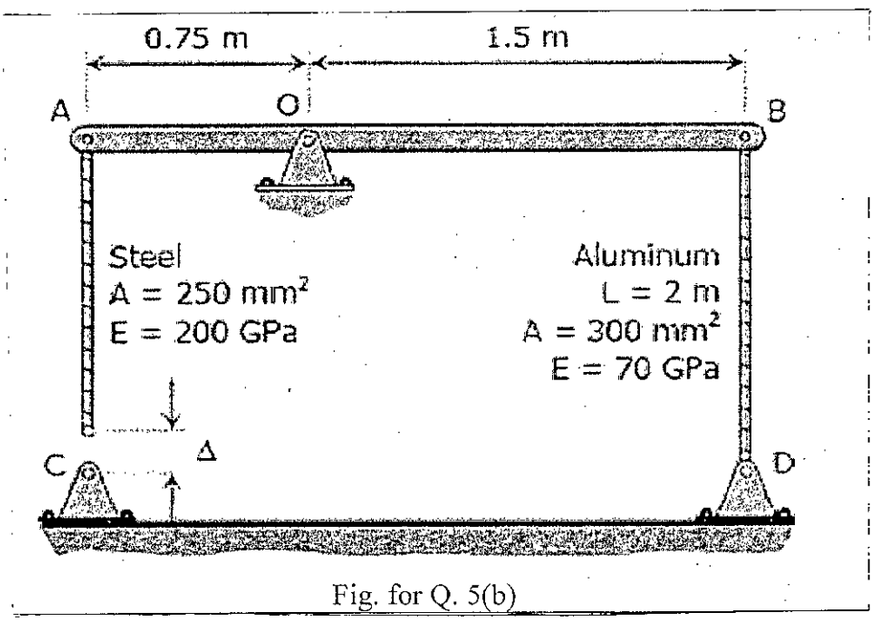


Fig. for Q. 5(b)

Contd P/4

ME 243/CHE

6. (a) The circular ring as shown in Fig. for Q. 6(a) has a rectangular cross section with a width of 100 mm and thickness of 50 mm. Compute the stresses at A and B. **(17)**

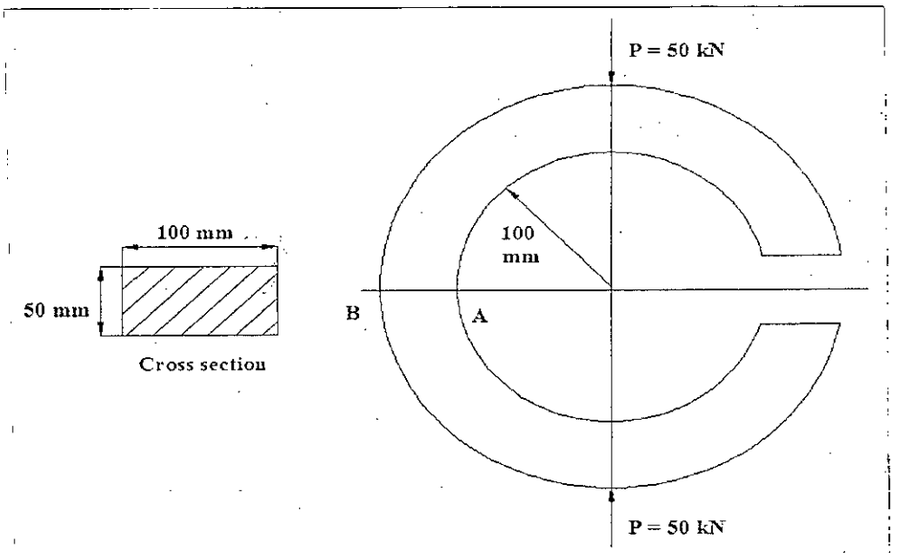


Fig. for Q. 6(a)

(b) A rigid horizontal bar of negligible mass is connected to two rods as shown in Fig. for Q. 6(b). If the system is initially stress-free, calculate the temperature change that will cause a tensile stress of 90 MPa in the brass rod. Assume that both rods are subjected to the change in temperature. **(18)**

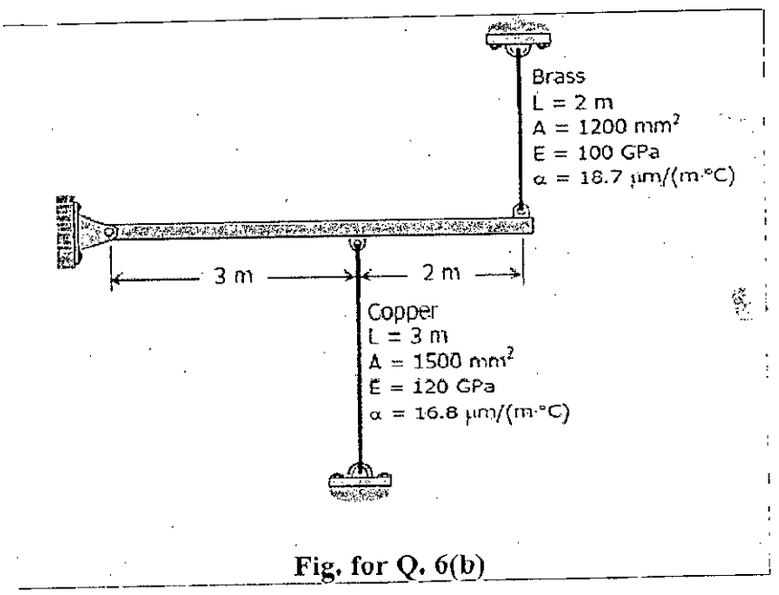


Fig. for Q. 6(b)

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7. (a) The beam is subjected to the uniform distributed load as shown in Fig. for Q. 7(a). Draw the shear and bending moment diagrams for the beam. Specify values at all change of loading positions. Also specify the value of maximum bending moment and location where it occurs. **(17)**

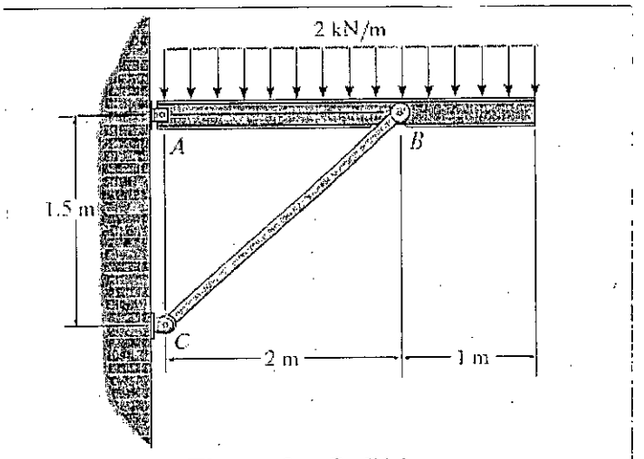

Figure for Q. 7(a)

(b) A fiberglass pipe is lifted by a sling, as shown in Fig. for Q. 7(b). The outer diameter of the pipe is 0.15 m, its thickness is 0.006 m, and its weight density is 1467 kg/m^3. The length of the pipe is L = 11 m and the distance between lifting points is S = 3.35 m. Determine the maximum bending stress in the pipe due to its own weight. **(18)**

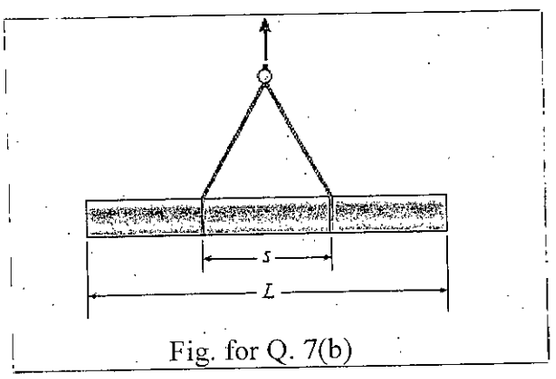

Fig. for Q. 7(b)

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8. (a) Using double integration method, compute the value of EIδ at midspan for the beam loaded as shown in Fig. for Q. 8(a). If E = 10 GPa, what value of I is required to limit the midspan deflection to 1/360 of the span. **(20)**

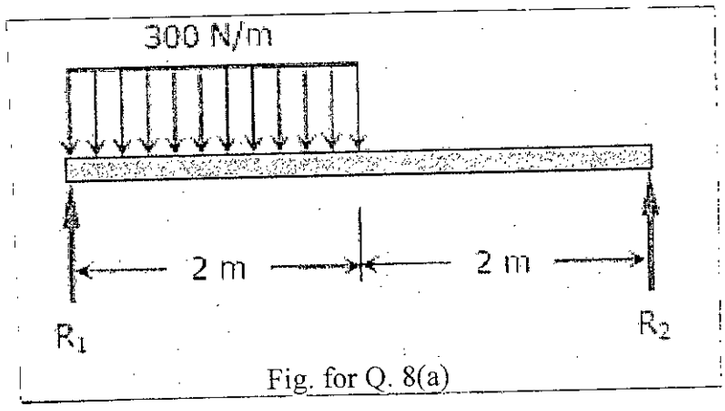


Fig. for Q. 8(a)

(b) Using area-moment method, determine the maximum deflection of the loaded cantilever beam as shown in Fig. for Q. 8(b). **(15)**

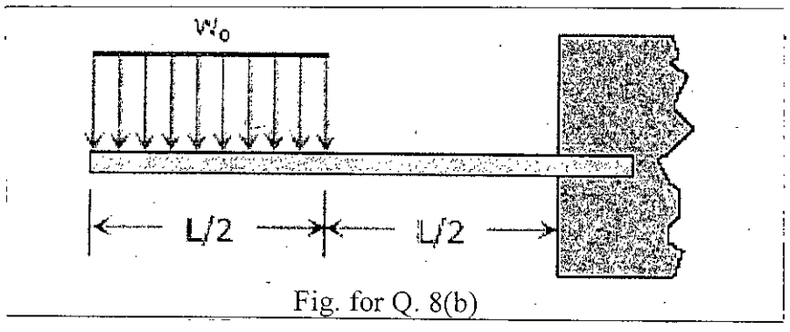
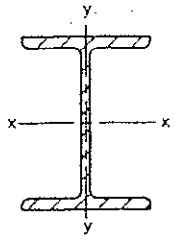
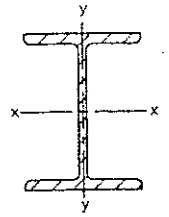


Fig. for Q. 8(b)



Properties of *W* Shapes (Wide- Flange Sections)

Designation	Theoretical Mass, m (kg/m)	Area, A (mm^2)	Depth, h (mm)	Flange		Web Thickness t (mm)	Axis x-x			A:		
				Width, b (min)	Thickness, t (mm)		I_x ($10^6 mm^4$)	Z_x ($10^3 mm^3$)	$k_x = \sqrt{\frac{I_x}{A}}$ (mm)	I_y ($10^6 mm^4$)	Z_y ($10^3 mm^3$)	$k_y = \sqrt{\frac{I_y}{A}}$ (mm)
W310 × 60	59.6	7590	303	203	13.1	7.5	129	849	130	18.3	180	49.1
× 52	52.3	6670	317	167	13.2	7.6	118	747	133	10.3	123	39.3
× 45	44.6	5690	313	166	11.2	6.6	99.2	634	132	8.55	103	38.8
× 39	38.7	4940	310	165	9.7	5.8	85.1	549	131	7.27	88.1	38.4
× 33	32.8	4180	313	102	10.8	6.6	65.0	415	125	1.92	37.6	21.4
× 28	28.4	3610	309	102	8.9	6.0	54.3	351	123	1.58	31.0	20.9
× 24	23.8	3040	305	101	6.7	5.6	42.7	280	119	1.16	22.9	19.5
× 21	21.1	2690	303	101	5.7	5.1	37.0	244	117	0.983	19.5	19.1
W250 × 167	167.4	21300	289	265	31.8	19.2	300	2080	119	98.8	746	68.1
× 149	148.9	19000	282	263	28.4	17.3	259	1840	117	86.2	656	67.4
× 131	131.1	16700	275	261	25.1	15.4	221	1610	115	74.5	571	66.8
× 115	114.8	14600	269	259	22.1	13.5	189	1410	114	64.1	495	66.3
× 101	101.2	12900	264	257	19.6	11.9	164	1240	113	55.5	432	65.6
× 89	89.6	11400	260	256	17.3	10.7	143	1100	112	48.4	378	65.2
× 80	80.1	10200	256	255	15.6	9.4	126	982	111	43.1	338	65.0
× 73	72.9	9280	253	254	14.2	8.6	113	891	110	38.8	306	64.7
× 67	67.1	8550	257	204	15.7	8.9	104	806	110	22.2	218	51.0
× 58	58.2	7420	252	203	13.5	8.0	87.3	693	108	18.8	186	50.3
× 49	49.0	6250	247	202	11.0	7.4	70.6	572	106	15.1	150	49.2
× 45	44.9	5720	266	148	13.0	7.6	71.1	534	111	7.03	95.1	35.1
× 39	38.7	4920	262	147	11.2	6.6	60.1	459	111	5.94	80.8	34.7
× 33	32.7	4170	258	146	9.1	6.1	48.9	379	08	4.73	64.7	33.7
× 28	28.5	3630	260	102	10.0	6.4	40.0	307	105	1.78	34.8	22.1
× 25	25.3	3230	257	102	8.4	6.1	34.2	266	103	1.49	29.2	21.5
× 22	22.4	2850	254	102	6.9	5.8	28.9	227	101	1.23	24.0	20.8
× 18	17.9	2270	251	101	5.3	4.8	22.4	179	99.3	0.913	18.1	20.1



Properties of *W* Shapes (Wide- Flange Sections)

Designation	Theoretical Mass, m (kg/m)	Area, A (mm^2)	Depth, h (mm)	Flange		Web Thickness t (mm)	Axis x-x			Axis y-y		
				Width, b (mm)	Thickness, t (mm)		I_x ($10^6 mm^4$)	Z_x ($10^3 mm^3$)	$k_x = \sqrt{\frac{I_x}{A}}$ (mm)	I_y ($10^6 mm^4$)	Z_y ($10^3 mm^3$)	$k_y = \sqrt{\frac{I_y}{A}}$ (mm)
W200 × 100	99.5	12700	229	210	23.7	14.5	113	989	94.3	36.6	349	53.7
× 86	86.7	11100	222	209	20.6	13.0	94.7	853	92.4	31.4	300	53.2
× 71	71.5	9110	216	206	17.4	10.2	76.6	709	91.7	25.4	246	52.8
× 59	59.4	7560	210	205	14.2	9.1	61.1	582	89.9	20.4	199	51.9
× 52	52.3	6660	206	204	12.6	7.9	52.7	512	89.0	17.8	175	51.7
× 46	46.0	5860	203	203	11.0	7.2	45.5	448	88.1	15.3	151	51.1
× 42	41.7	5310	205	166	11.8	7.2	40.9	399	87.7	9.00	108	41.2
× 36	35.9	4580	201	165	10.2	6.2	34.4	342	86.7	7.64	92.6	40.8
× 31	31.4	4000	210	134	10.2	6.4	31.4	299	88.6	4.10	61.1	32.0
× 27	26.6	3390	207	133	8.4	5.8	25.8	249	87.2	3.30	49.4	31.2
× 22	22.4	2860	206	102	8.0	6.2	20.0	194	83.6	1.42	22.3	22.3
× 19	19.4	2480	203	102	6.5	5.8	16.6	163	81.8	1.15	22.6	21.5
× 15	15.0	1900	200	100	5.2	4.3	12.7	127	81.8	0.869	17.4	21.4
W150 × 37	37.1	4730	162	154	11.6	8.1	22.2	274	68.5	7.07	91.8	38.7
× 30	29.8	3790	157	153	9.3	6.6	17.2	219	67.4	5.56	72.6	38.3
× 22	22.3	2850	152	152	6.6	5.8	12.1	159	65.2	3.87	50.9	36.8
× 24	24.0	3060	160	102	10.30	6.6	13.4	168	66.2	1.83	35.8	24.5
× 18	18.0	2290	153	102	7.1	5.8	9.16	120	63.2	1.26	24.7	23.5
× 14	13.6	1730	150	100	5.5	4.4	6.87	91.5	63.0	0.918	18.4	23.0
W130 × 28	28.1	3580	131	128	10.9	6.9	10.9	167	55.2	3.81	59.6	32.6
× 24	23.6	3010	127	127	9.1	6.1	8.80	139	54.1	3.11	49.0	32.1
W100 × 19	19.4	2470	106	103	8.8	7.1	4.76	89.9	43.9	1.61	31.2	25.5