

*Am***SECTION - A**There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Discuss the differences in microstructures and properties one would expect if a hypoeutectoid steel is annealed and normalized from the same temperature. (10)
- (b) Normalising produces a finer and more abundant pearlite in the structure than is obtained by annealing — why? (10)
- (c) Is it possible to prepare a cutting tool of good machinability from a full annealed hypereutectoid steel? — justify your answer. (10)
If not, then suggest an alternative way.
- (d) Write a short note on dezincification of brass. (05)

2. (a) Describe the structural changes that occur during quenching of steel. (10)
- (b) What are the advantages of nitriding compared with carburizing? Which compounds are responsible for the properties provided by a nitrided case? (08)
- (c) What do you mean by the terms fatigue limit, fatigue strength and fatigue life? (10)
- (d) Describe composition, properties, and uses of austenitic stainless steel. (07)

3. (a) What are the effects of tempering on structure and properties of quenched steel? (07)
- (b) Differentiate between cyaniding and carbonitriding. (06)
- (c) Write short notes on shock resisting tool steel and high speed tool steel. (12)
- (d) What is the difference between the proportional limit and the elastic limit? Why the true stress-strain curve is different from engineering stress-strain curve? Explain. (10)

4. (a) Define solvus line. (05)
- (b) For a Fe-C alloy containing 0.45 wt% C at a temperature just below the eutectoid determine the following: (18)
 - (i) The fraction of ferrite and cementite phases.
 - (ii) The fraction of pro-eutectoid ferrite and pearlite.
 - (iii) The fraction of eutectoid ferrite.

MME 293/NAME

Contd... Q. No. 4(b)

In Fe-Fe₃C diagram Fe₃C contains 6.67% C. The solubility of ferrite is about 0.025% at eutectoid temp. Eutectoid point is at 0.76% C.

- (c) Describe the microstructural changes that would occur when a 1.2% carbon steel is slowly cooled from fully austenitic region to room temperature. (07)
- (d) Draw the room temperature microstructure of eutectoid (0.76% C) steel. (05)

SECTION – B

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

5. (a) Give a neat sketch of iron blast furnace showing different zones. Mention the reactions generally take place in these zones for the production of liquid iron from solid iron ore. Also mention approximate analysis of blast furnace products. (20)
- (b) Why is blast furnace gas cleaned? Explain how this gas is cleaned mentioning the working principle of each components used for the gas cleaning system. (15)
6. (a) Mention the differences between acid and basic Bessemer processes of steel making. Which process should be adopted for a high phosphorus charge? Give reasons and explain the process along with its chemistry and refining curve. (23)
- (b) What does one understand by the term 'deoxidation' and 'recarburization'? Why are they performed at the end of a steel making process. (12)
7. (a) Mention different types of cast irons along with their composition and micro-structure. (15)
- (b) With the help of a heating and cooling diagram explain how ferritic malleable cast iron can be produced from white cast iron. (20)
8. (a) Discuss the operating steps of any method, which you think is suitable, in detecting surface cracks of an aluminium alloy component. (18)
- (b) Briefly discuss the advantages, disadvantages and uses of various types of plastics. (17)
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L-2/T-1/NAME

ME405
19+3
Date : 05/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **NAME 219** (Marine Engines and Fuels)

Full Marks: 210

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION - A

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

1. (a) What is knocking in diesel engine? What are the ways of minimizing knocking? (15)
(b) Describe the types of two stroke scavenging. (15)
(c) Why AFR in petrol engine is lower than in diesel engine? (5)

2. (a) What may cause failure to exhaust valves? How this can be resolved? (15)
(b) Amount of fuel needed for a 4 stroke, 12 cycle, 600 rpm diesel engine is 2400 lb/hr. Air consumption rate is 14 cft/lb. IHP of the engine is 6000 hp. Stroke length and diameter are 1.5' and 15" respectively. AFR = 22, specific gravity of fuel = 0.8, calorific value of fuel = 18000 BTU/lb. (20)
Find:
(i) Day tank capacity (15 hr)
(ii) SFC
(iii) η_{th}
(iv) air rate and
(v) volumetric efficiency.

3. (a) With a neat sketch differentiate between crosshead piston and trunk piston. (15)
(b) Define the followings: (20)
(i) Gap clearance.
(ii) Side clearance.
(iii) Back clearance.
(iv) SAE number.
(v) Ignition delay.

4. (a) What are the disadvantages of divided combustion chamber? (12)
(b) Estimate the cfm of cooling air per hp if it takes 30% of the fuel energy. Given $\eta_{th} = 35\%$, $C_p = 0.4$ BTU/hp, $\Delta T = 130^\circ F$, specific volume of air = 13.7 cft/lb. (15)
(c) Write down the basic requirements of injection system of a CI engine. (8)

Contd P/2

NAME 219/NAME

SECTION - B

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

5. (a) What is the function of a fuel booster pump? Briefly discuss the operation of gear type and vane type fuel booster pumps. (22)
- (b) Describe schematically various types of nozzles that are used in CI engines. (13)
6. (a) Describe the components of water cooling system. (17)
- (b) Name various types of lubrication system used in marine engines. Describe with figures. (18)
7. (a) Explain the effects of turbine temperature and atmospheric conditions in case of a gas turbine engine. (13)
- (b) What are the differences between internal combustion engines and thermal prime movers? (12)
- (c) What are the factors that cause low lubrication oil pressure or, discontinue lubrication oil supply? (10)
8. (a) Describe schematically the operation of turbochargers and superchargers. (12)
- (b) Write short notes on— (12)
- (i) Cylinder liners
- (ii) Compression rings
- (iii) Oil rings
- (c) Discuss about different sources of renewable energy. (11)
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L-2/T-1/NAME

Date : 10/01/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **HUM 113** (Economics)

Full Marks: 140

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION – A

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

1. (a) Define supply function. (5)
(b) What are the factors that influence the shifting of a supply curve? (10)
(c) Explain the determinants of demand, (8 1/3)

2. (a) How would you measure price elasticity of demand at any point on a straight line demand curve? Explain graphically. (13 1/3)
(b) From the following table calculate elasticity of demand if you move from point B to C and explain what you understand from the result. (10)

Point	Y	Q
A	5000	350
B	7000	550
C	9000	750

3. (a) How is price determined in an economy under competition? What will happen to the equilibrium price and quantity due to change in demand? (10)
(b) From the following demand and supply functions calculate equilibrium price and quantity and show the result in a graph. What will happen to the equilibrium price and quantity if government gives a subsidy of Tk 3 per unit. (13 1/3)

$$P = 0.20 Q + 10$$

$$P = -0.40 Q + 70$$

4. (a) Explain consumer's equilibrium with the help of budget-line and indifference curve. (13 1/3)
(b) Define budget line and budget set. (10)

Contd P/2

HUM 113/NAME

SECTION – B

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

5. (a) Distinguish Total Product, Average Product and Marginal Product of a firm. (5 1/3)
 (b) How can you measure Average Product (AP) and Marginal Product (MP) from Total Product (TP) Curve? Illustrate it with graphs. (8)
 (c) If all factors of production are paid as rewards equal to their marginal products, would the total product be just exactly exhausted? Explain. (10)
6. (a) How can you differentiate between Average Revenue and Marginal Revenue? (7)
 (b) Under what conditions will a rationale producer attain in an equilibrium level of his production in a perfect competition market? Show it with a graph. (10)
 (c) Who is a Monopolist? (2 1/3)
 (d) What are the features of a perfect competition market? (4)
7. (a) Draw a Total Cost curve, Total Variable Cost curve and Total Fixed Cost curve using the data from Table-1: (15)

Table-1

No. of Units of Output (Q)	Total Fixed Cost (TFC)	Total Variable Cost (TVC)	Total Cost (TFC+TVC)
0	50	0	50
1	50	20	70
2	50	35	85
3	50	60	110
4	50	100	150
5	50	145	195
6	50	190	240
7	50	237	287
8	50	284	334

- (b) Can you derive a Long Run Average Cost (LAC) curve from Short Run Average Cost curves? Show the different Scales of production function from this LAC curve. (8 1/3)
8. (a) What are the important features of a monopolistic market? (3 1/3)
 (b) Narrate the definition of National Income, Gross Domestic Product, Gross National Product and Net National Product of developing countries like Bangladesh. (8)
 (c) Which problems are involved in the measurement of national income in our economy? Explain in brief. (6)
 (d) Which instruments are necessary to control Inflation in our economy? Explain in short. (6)

SECTION – A

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

Symbols used have their usual meaning.

1. (a) Solve the following differential equation by the method on factorization of operator: **(16)**

$$\left[(x+1)D^2 - (3x+4)D + 3 \right] y = (3x+2)e^{3x}$$

- (b) Solve: $(x^2D^2 - xD + 4)y = \cos(\log x) + x \sin(\log x)$ **(19)**

2. Solve in series, the following differential equation by using the method of Fröbenius: **(35)**

$$(1-x^2)\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} + y = 0$$

3. (a) Derive Rodrigues's formula: **(12)**

$$P_n(x) = \frac{1}{2^n(n!)} \frac{d^n}{dx^n} (x^2 - 1)^n$$

- (b) Show that **(15)**

$$\int_{-1}^1 P_m(x)P_n(x)dx = \begin{cases} 0 & \text{if } m \neq n \\ \frac{2}{2n+1} & \text{if } m = n \end{cases}$$

- (c) Prove that **(8)**

$$nP_n(x) = xP'_n(x) - P'_{n-1}(x)$$

4. (a) Prove that $\frac{d}{dx}[J_0(x)] = -J_1(x)$ (without using recurrence relation) **(11)**

- (b) Show that when n is a positive integer $J_n(x)$ is the coefficient of t^n in the expansion of $e^{\frac{1}{2}x(t-\frac{1}{t})}$ in ascending powers of t . **(12)**

- (c) Show that $\sin(x \sin \phi) = 2 \sin \phi J_1(x) + 2 \sin 3\phi J_3(x) + \dots$ **(12)**

MATH 281/NAME**SECTION - B**

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

5. (a) Show that any vector \mathbf{r} can be represented as a linear combination of three non coplanar vectors \mathbf{a} , \mathbf{b} , \mathbf{c} . Hence find a linear relation among the vectors $(2, -3, 4)$, $(1, -1, 1)$, $(-1, 1, 1)$ and $(1, 1, 1)$. (17)
- (b) Prove that the straight line joining the middle points of the diagonals of a trapezium is parallel to parallel sides and half of their difference. (10)
- (c) Solve the vector equation for \mathbf{r} : $\mathbf{k}\mathbf{r} + \mathbf{a} \times \mathbf{r} = \mathbf{b}$, $\mathbf{k} \neq \mathbf{0}$ where \mathbf{a} , \mathbf{b} are two given vectors. (8)
6. (a) Given points $A(2, 1, 3)$, $B(1, 2, 1)$, $C(-1, -2, -2)$ and $D(1, -4, 0)$, find the shortest distance between lines AB and CD . (12)
- (b) Prove that, $\text{grad div}\mathbf{A} = \text{curl curl}\mathbf{A} + \nabla^2\mathbf{A}$ (7)
- (c) Define \mathbf{T} , \mathbf{N} , \mathbf{B} , \mathbf{k} and τ and hence derive the Frenet-Serret formulae. (16)
7. (a) Find the values of the constants a , b , c so that the directional derivative of $\phi = axy^2 + byz + cz^2x^3$ at $(1, 2, -1)$ has a maximum magnitude 64 in the direction parallel to z -axis. (10)
- (b) Prove that $\mathbf{F} = (y^2 \cos x + z^3)\mathbf{i} + (2y \sin x - 4)\mathbf{j} + (3xz^2 + 2)\mathbf{k}$ is a conservative force field. Find the work done in moving an object in this field from $(0, 1, -1)$ to $(\frac{\pi}{2}, -1, 2)$. (13)
- (c) Evaluate $\iiint_V (2x + y) dV$ where V is the closed region bounded by the cylinder $z = 4 - x^2$ and the planes $x = 0$, $y = 0$, $y = 2$, $z = 0$. (12)
8. (a) Using Green's theorem in the plane, evaluate $\oint_C (y - \sin x) dx + \cos x dy$ where C is the triangle with vertices $(0, 0)$, $(\frac{\pi}{2}, 0)$ and $(\frac{\pi}{2}, 1)$. (15)
- (b) State Stoke's theorem. Hence verify this theorem for the function $\mathbf{A} = (x^2 + y - 4)\mathbf{i} + 3xy\mathbf{j} + (2xz + z^2)\mathbf{k}$ over the surface of the hemisphere $x^2 + y^2 + z^2 = 16$ above the xy plane. (20)

L-2/T-1/NAME

Date : 07/12/2014

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-1 B. Sc. Engineering Examinations 2013-2014

Sub : **NAME 251** (Mechanics of Structure)

Full Marks: 210

Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

SECTION - A

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

1. (a) A steel bar as shown in Fig. for Q. No. 1(a), 1 m in length and $35 \times 35 \text{ mm}^2$ in cross section, is rigidly attached to a wall at its right end. Its other end is 0.5 mm from another rigid wall. If a 120 kN axial force is attached to the bar at its midpoint and the temperature is increased 60°C , what will be the unit stress in each portion of the bar? (20)
(b) The rigid rod ABC is suspended from three wires of the same material as shown in Fig. for Q. No. 1(b). The cross-sectional area of the wire at 'B' is equal to half of the cross-sectional area of the wires at A and C. Determine the tension in each wire caused by the load P. (15)
2. (a) A two-member rigid frame has pin supports at A and E, as shown in Fig. for Q. No. 2(a). It is loaded as shown in the figure and has an internal hinge at C. Determine the support reactions at A and E. (15)
(b) What is 'Buckling'? Discuss the mechanism of buckling for a tall slender column. (10)
(c) With neat sketches discuss the effect of various end conditions on tall, slender columns. (10)
3. (a) Draw the shear force and bending moment diagram for the loaded beam as shown in Fig. for Q. No. 3(a). (20)
(b) For the beam and loading as shown in Fig. for Q. No. 3(b), determine the equations of the shear and bending moment curves. (15)
4. (a) Select the most economical S beam to sustain the load on the beam as shown in Fig. for Q. No. 4(a). (Use $\sigma = 20,000 \text{ psi}$) (20)
(b) The simply supported beam as shown in Fig. for Q. No. 4(b), has a rectangular cross section 120 mm wide and 200 mm high. Determine (15)
 - (i) maximum bending (flexural) stress in the beam and
 - (ii) the bending (flexural) stress at a point on section B that is 25 mm below the top of the beam.

Contd P/2

NAME 251/NAME

SECTION – B

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

5. (a) Distinguish between the following mechanical properties of mild steel **(15)**
- (i) Modulus of Resilience and Modulus of Toughness
 - (ii) Ductility and Brittleness
 - (iii) Modulus of Elasticity and Modulus of Rigidity
 - (iv) Yield Strength and Ultimate strength
 - (v) Ductile material and Brittle material
- (b) How can you determine the yield strength of shipbuilding material by offset method? **(10)**
- (c) Derive the relationship between engineering stress and true stress. **(10)**
6. (a) Determine the midspan deflection of the simply supported beam shown in Figure for Question No. 6(a). **(18)**
- (b) Using singularity method, determine the position and magnitude of the maximum deflection in the beam shown in Figure for Question No. 6(b). **(17)**
7. (a) Determine the force in members DF, EF and GE of the truss shown in Figure for Question No. 7(a). **(18)**
- (b) Determine the moment of inertia I_x and I_y of the shaded area as shown in Figure for Question No. 7(b) with respect to the centroidal axes that is parallel to the side AB and CD. **(17)**
8. (a) The aluminum rod AB is bonded to the brass rod BD. Knowing that portion CD of the brass rod is hollow and has an inner diameter of 40 mm, determine the angle of twist at A. [Take $G_{al} = 26$ GPa and $G_{br} = 39$ GPa]. **(20)**
- (b) The state of plane stress at a point is represented by the stress element shown in Figure for Question No. 8(b). Determine the stress acting on an element oriented 30° clockwise with respect to the original element. **(15)**
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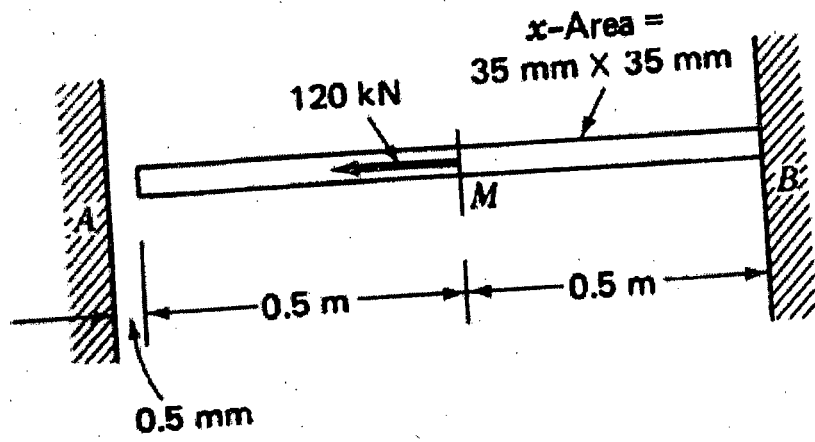


Fig. for Q. No. 1(a)

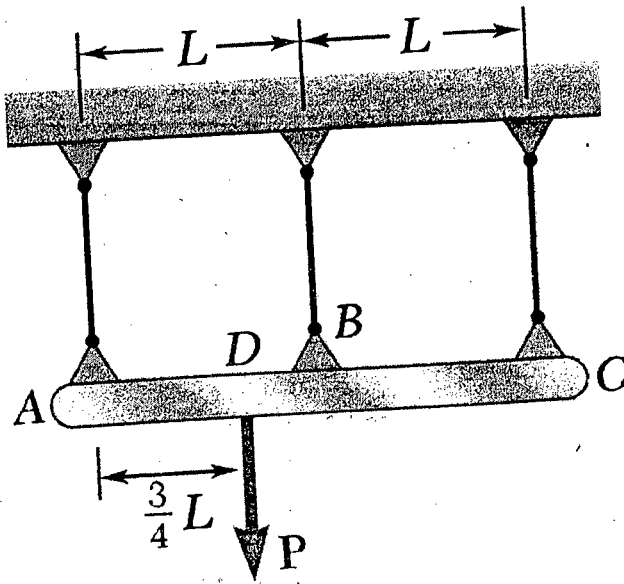


Fig. for Q. No. 1(b)

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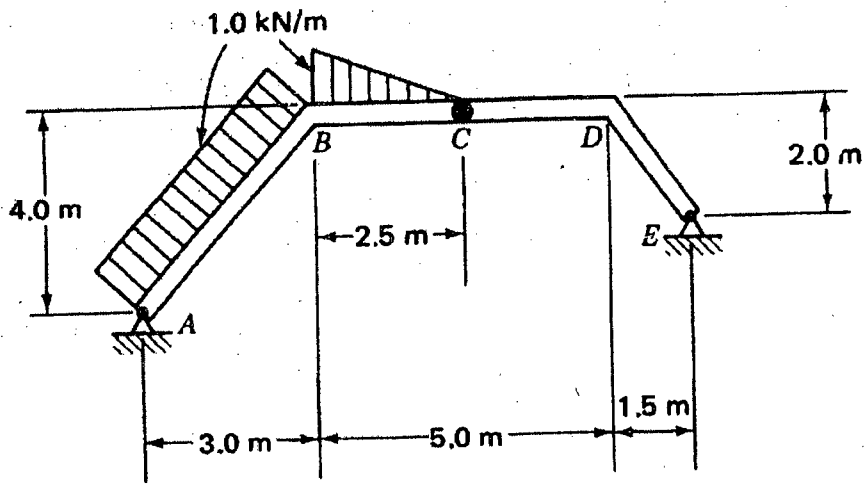


Fig. for Q. No. 2(a)

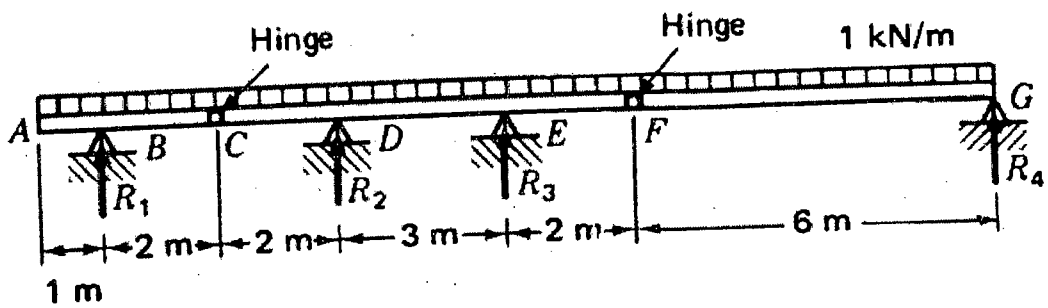


Fig. for Q. No. 3(a)

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NAME 251 (2/5)

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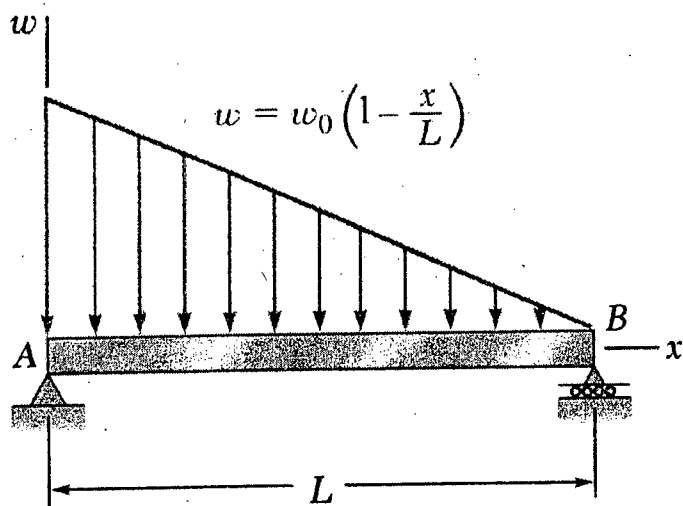
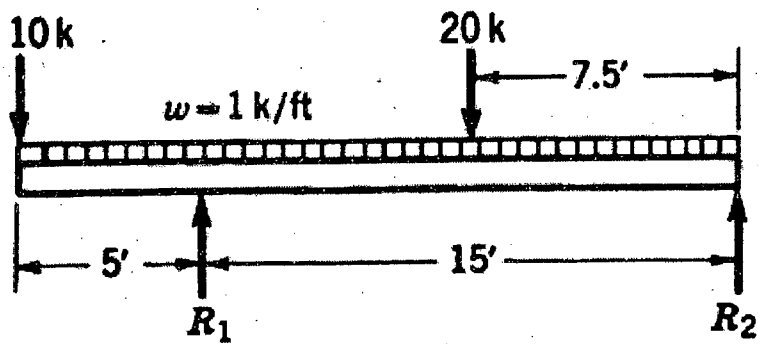


Fig. for Q. No. 3(b)



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Fig. for Q. No. 4(a)

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NAME 251 (3/5)

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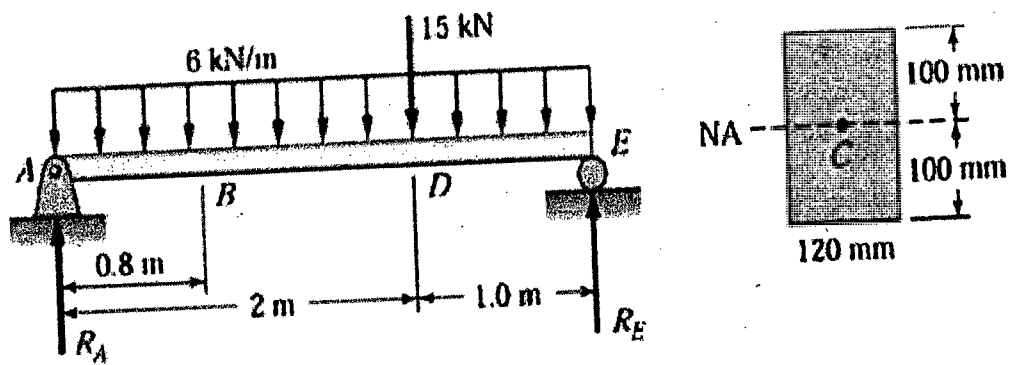


Fig. for Q. No. 4(b)

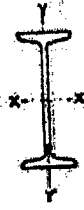
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18.11.2017

NAME 251 (4/5)

I

S SHAPES
PROPERTIES FOR DESIGNING



Designation	Area A	Depth d	Flange		Web Thick- ness t _w	Elastic Properties					
			Width b _f	Thick- ness t _f		Axis X-X			Axis Y-Y		
					I	S	r	I	S	r	
			In. ²	In.	In.	In.	In.	In. ⁴	In. ³	In.	In. ⁴
S24 x 120	35.3	24.00	8.048	1.102	0.798	3030	252	9.26	84.2	20.9	1.56
x 105.9	31.1	24.00	7.875	1.102	0.625	2830	236	9.53	78.2	19.8	1.58
S24 x 100	29.4	24.00	7.247	0.871	0.747	2390	199	9.01	47.8	13.2	1.27
x 90	26.5	24.00	7.124	0.871	0.624	2250	187	9.22	44.9	12.6	1.30
x 79.9	23.5	24.00	7.001	0.871	0.501	2110	175	9.47	42.3	12.1	1.34
S20 x 95	27.9	20.00	7.200	0.916	0.800	1610	161	7.60	49.7	13.8	1.33
x 85	25.0	20.00	7.053	0.916	0.653	1520	152	7.79	46.2	13.1	1.36
S20 x 75	22.1	20.00	6.391	0.789	0.641	1280	128	7.60	29.6	9.28	1.16
x 65.4	19.2	20.00	6.250	0.789	0.500	1180	118	7.84	27.4	8.77	1.19
S18 x 70	20.6	18.00	6.251	0.691	0.711	926	103	6.71	24.1	7.72	1.08
x 54.7	16.1	18.00	6.001	0.691	0.461	804	89.4	7.07	20.8	6.94	1.14
S15 x 50	14.7	15.00	5.640	0.622	0.550	486	64.8	5.75	15.7	5.57	1.03
x 42.9	12.6	15.00	5.501	0.622	0.411	447	59.6	5.95	14.4	5.23	1.07
S12 x 50	14.7	12.00	5.477	0.659	0.687	305	50.8	4.55	15.7	5.74	1.03
x 40.8	12.0	12.00	5.252	0.659	0.472	272	45.4	4.77	13.6	5.16	1.06
S12 x 35	10.3	12.00	5.078	0.544	0.428	229	38.2	4.72	9.87	3.89	0.980
x 31.8	9.35	12.00	5.000	0.544	0.350	218	36.4	4.83	9.36	3.74	1.00

S15 x 50	14.7	15.00	5.640	0.622	0.550	486	64.8	5.75	15.7	5.57	1.03
x 42.9	12.6	15.00	5.501	0.622	0.411	447	59.6	5.95	14.4	5.23	1.07
S12 x 50	14.7	12.00	5.477	0.659	0.687	305	50.8	4.55	15.7	5.74	1.03
x 40.8	12.0	12.00	5.252	0.659	0.472	272	45.4	4.77	13.6	5.16	1.06
S12 x 35	10.3	12.00	5.078	0.544	0.428	229	38.2	4.72	9.87	3.89	0.980
x 31.8	9.35	12.00	5.000	0.544	0.350	218	36.4	4.83	9.36	3.74	1.00
S10 x 35	10.3	10.00	4.944	0.491	0.594	147	29.4	3.78	8.36	3.38	0.901
x 25.4	7.46	10.00	4.661	0.491	0.311	124	24.7	4.07	6.79	2.91	0.934
S 8 x 23	6.77	8.00	4.171	0.425	0.441	64.9	16.2	3.10	4.31	2.07	0.798
x 18.4	5.41	8.00	4.001	0.425	0.271	57.6	14.4	3.26	3.73	1.86	0.831
S 7 x 20	5.88	7.00	3.860	0.392	0.450	42.4	12.1	2.69	3.17	1.64	0.734
x 15.3	4.50	7.00	3.662	0.392	0.252	36.7	10.5	2.86	2.64	1.44	0.766
S 6 x 17.25	5.07	6.00	3.565	0.359	0.465	26.3	8.77	2.28	2.31	1.30	0.675
x 12.5	3.67	6.00	3.332	0.359	0.232	22.1	7.37	2.45	1.82	1.09	0.705
S 5 x 14.75	4.34	5.00	3.284	0.326	0.494	15.2	6.09	1.87	1.67	1.01	0.620
x 10	2.94	5.00	3.004	0.326	0.214	12.3	4.92	2.05	1.22	0.809	0.643
S 4 x 9.5	2.79	4.00	2.796	0.293	0.326	6.79	3.39	1.56	0.903	0.646	0.569
x 7.7	2.26	4.00	2.663	0.293	0.193	6.08	3.04	1.64	0.764	0.574	0.581
S 3 x 7.5	2.21	3.00	2.509	0.260	0.349	2.93	1.95	1.15	0.586	0.468	0.516
x 5.7	1.67	3.00	2.330	0.260	0.170	2.52	1.68	1.23	0.455	0.390	0.522

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TABLE FOR QA(a)

NAME 251 (5/5)

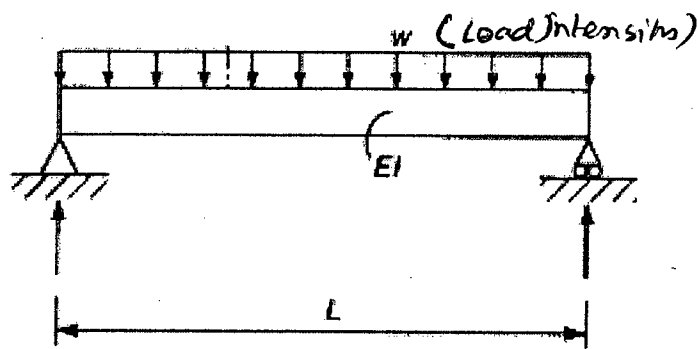


Figure for Question No. 6(a)

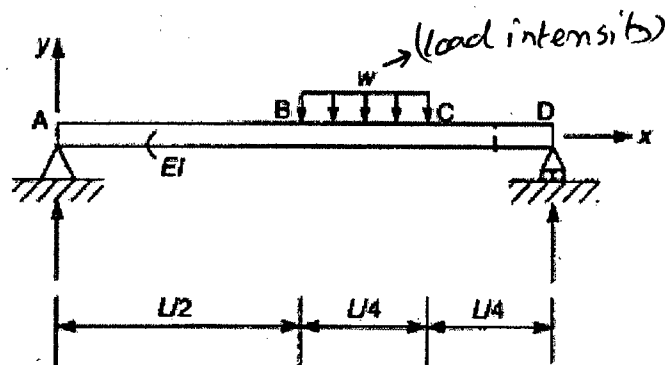


Figure for Question No. 6(b)

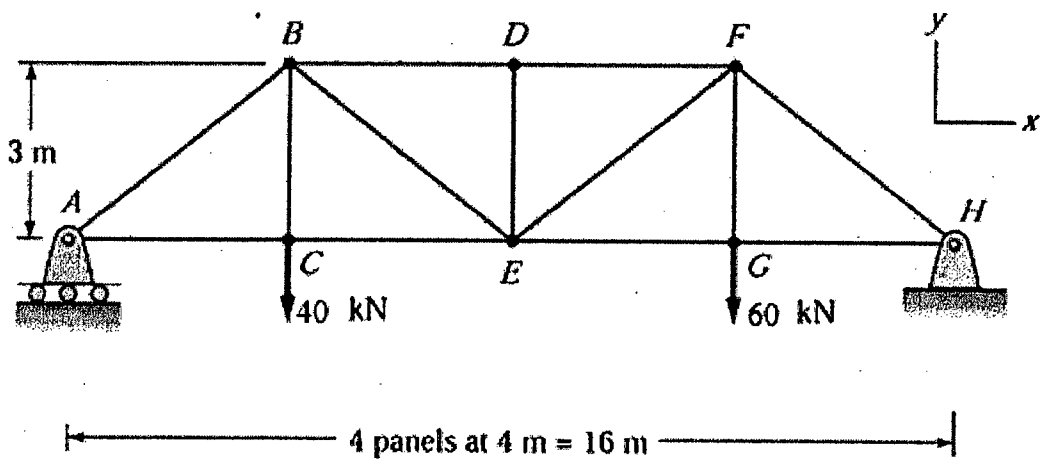


Figure for Question No. 7(a)

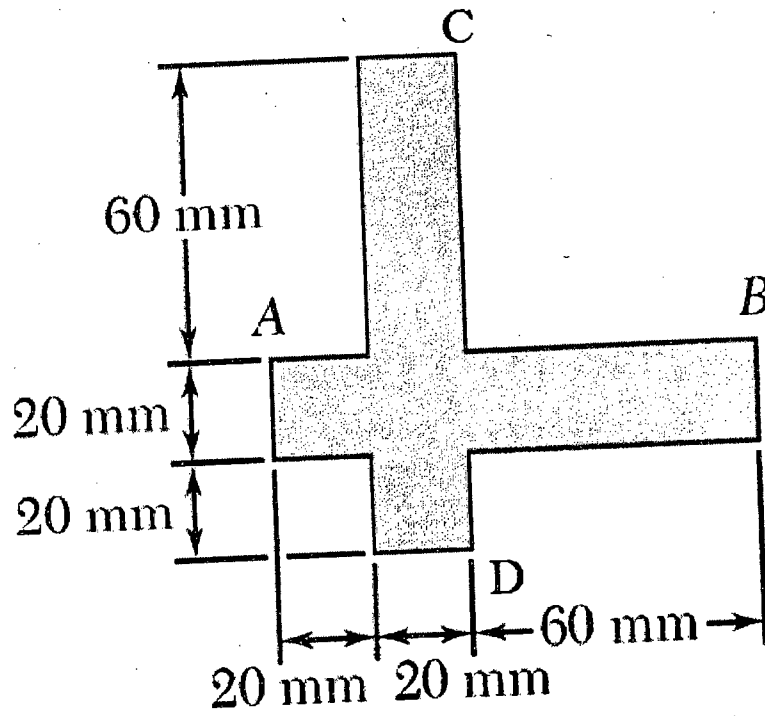


Figure for Question No. 7(b)

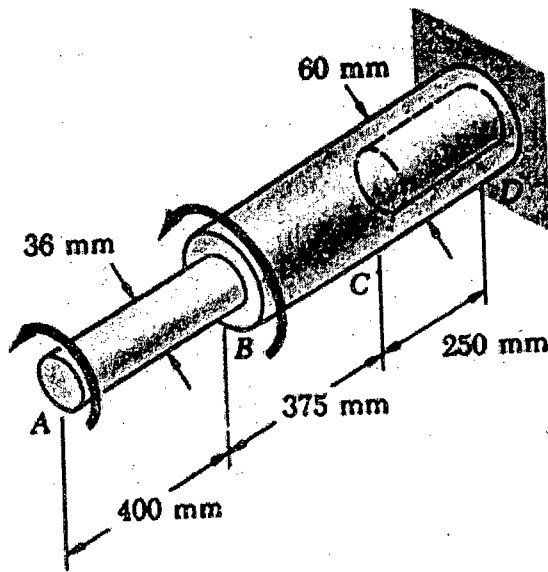


Figure for Question No. 8(a)

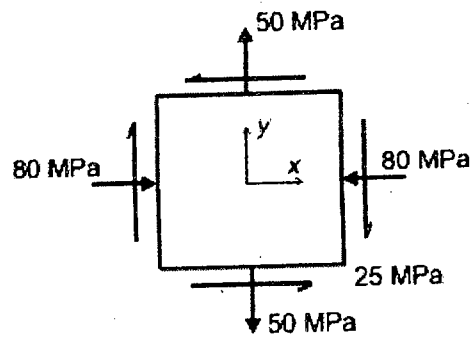


Figure For Question No. 8(b)

Part