Enrollment No......................................

Faculty of Engineering / Science

End Sem Examination Dec-2023

EN3ES30 / BC3ES12

Basic Civil Engineering & Mechanics

Programme: B.Tech./B.Sc. Branch/Specialisation: All/ Computer Science

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The cement sand and aggregate ratio for M-15 grade of concrete is- **1**

(a) 1:4:8 (b) 1:3:6 (c) 1:5:10 (d) 1:2:4

ii. Which of the following is not a load carrying structural component? **1**

(a) Beam (b) Foundation (c) Wall (d) Slab

iii. Engineers chain is ______ feet long. **1**

(a) 100 (b) 200 (c) 110 (d) 90

iv. Least count of Leveling staff is- **1**

(a) 50 mm (b) 5 mm (c) 500 mm (d) 5000 mm

v. The vertical distance between any two contour lines is known as- **1**

(a) Contour gradient (b) Contour interval

(c) Horizontal equivalent (d) None of these

vi. Contours drawn at large intervals depicts- **1**

(a) Steep Slope (b) Gentle Slope

(c) Uniform Slope (d) None of these

vii. What is the purpose of a truss in engineering and construction? **1**

(a) To provide electrical insulation

(b) To resist axial forces and distribute loads

(c) To enhance architectural aesthetics

(d) To facilitate transportation of materials

viii. 1 Newton is equal to ______ dynes. **1**

(a) 100 (b) 100000 (c) 1000 (d) 10000

ix. Total number of reactions at the fixed end is- **1**

(a) 1 (b) 2 (c) 3 (d) 4

x. Diving stand of swimming pool is an example of ______ beam. **1**
(a) Overhanging
(b) Cantilever
(c) Simply Supported
(d) Fixed

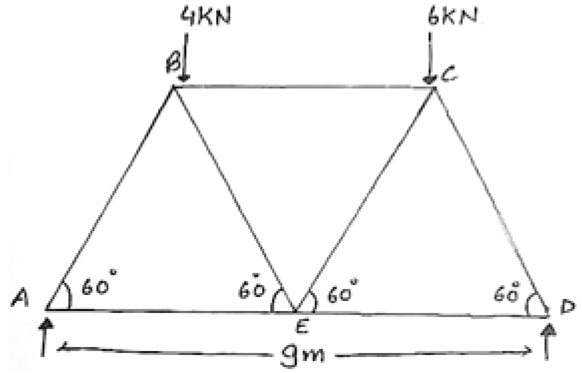
Q.2 i. Define workability of concrete. **2**
ii. Write about the two major components of building with suitable examples. **3**
iii. Draw the cross section of timber and explain seasoning of timber. **5**
OR iv. Define foundation and explain shallow foundation in detail with diagrams. **5**

Q.3 i. Define triangulation and traversing. **2**
ii. Write three points of differences between whole circle bearing & reduced bearing system. **3**
iii. The following staff readings were taken during a Leveling practice: **5**
1.234, 1.368, 1.399, 1.003. 2.860, 2.020, 1.530
Calculate the reduced level of all the stations by rise and fall method if the instrument was shifted after 4th staff reading and the reduced level of the benchmark if 500 m. Apply the check.
OR iv. Define Leveling and explain its all types with diagram. **5**

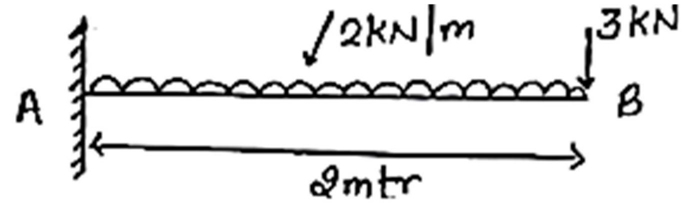
Q.4 i. Define contour and write any two characteristics. **3**
ii. The following offsets were taken to a curved boundary from a survey line: 0.245, 3.78, 3.25, 4.40, 3.27, 4.24, 5.20 m. **7**
Compute the area between curved boundary if the offsets were taken at an interval of 10 m using Simpsons and trapezoidal rule.
OR iii. Explain how volume can be computed with the help of contours and also write about trapezoidal and prismoidal formulae for volume computation. **7**

Q.5 i. State Lami's theorem with diagram. **3**
ii. Derive a relation to calculate the resultant of two forces by parallelogram law of forces. Write the cases when the forces are perpendicular and linear to each other. **7**

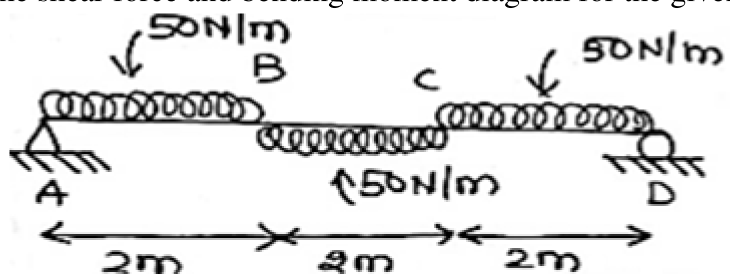
OR iii. Analyse the Truss by the joint method or section method. **7**



Q.6 Attempt any two:
i. Write the relationship between load, shear force and bending moment. **3**
ii. Draw the shear force and bending moment diagram for the given beam- **7**



OR iii. Draw the shear force and bending moment diagram for the given beam- **7**



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Scheme of Marking

MEDI-CAPS UNIVERSITY Knowledge is Power	Faculty of Engineering End Sem Examination Dec-2023 EN3ES30 Basic Civil Engineering and Mechanics
Programme: B.Tech.	Branch/Specialisation:

Note: The Paper Setter should provide the answer wise splitting of the marks in the scheme below.

Q.1	i)	d) 1:2:4	1
	ii)	c) Wall	1
	iii)	a) 100	1
	iv)	b) 5 mm	1
	v)	a) b) Contour Interval	1
	vi)	b) Gentle Slope	1
	vii)	b) To resist axial forces and distribute loads	1
	viii)	b) 100000	1
	ix)	c) 3	1
	x)	b) Cantilever	1
Q.2	i.	2 marks for correct definition	2
	ii.	2 marks for definition of sub and super structure and 1 mark for examples.	3
	iii.	2 marks for diagram of cross section of timber and 3 marks for explaining seasoning of timber.	5
OR	iv.	1 mark for definition of foundation and 4 marks for explaining minimum 4 types with diagram.	5
Q.3	i.	1 mark each for definition of triangulation and traversing.	2
	ii.	1 mark for one point of difference (total three required for 3 marks)	3
OR	iii.	2 marks for filling the table correct, 2 marks for calculation of reduced levels and one mark for the check.	5
	iv.	1 mark for definition of leveling and 4 marks for explaining any types with diagram.	5
Q.4	i.	1 mark for definition of contours and 2 marks for any two characteristics.	3
	ii.	3 marks for area by trapezoidal rule and 4 marks for are by Simpsons rule.	
OR	iii.	3 marks for area calculation by contours and 2 marks each for trapezoidal and prismoidal rule.	
Q.5	i.	2 mark for statement, 1 for diagram.	3
	ii.	2 mark for statement, 1 for diagram and 3 marks for the derivation of the parallelogram law and 1 mark for the cases.	7
OR	iii.	2 marks for calculation of reactions and 5 marks for free body diagrams and claculation of forces.	7
Q.6			
	i.	1 mark for each relation , total 3 relations required	3
	ii.	1 mark for FBD, 2 marks for calculation of reactions, 2 marks for SF values and SFD, 2 marks for BM values and BMD	7
	iii.	1 mark for FBD, 2 marks for calculation of reactions, 2 marks for SF values and SFD, 2 marks for BM values and BMD	7

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Levelling - Numerical :- (Q3 → iii)

B.M. = 500m C.P. - 4th staff Reading

1.234,	1.368,	1.399,	1.003,	2.860,	2.020,	1.530
BS	IS	IS	FS	BS	IS	FS

Station	BS	IS	FS	Rise	Fall	R.L.	Remarks
A	1.234					500	BM
B		1.368			0.134	499.866	
C		1.399			0.031	499.835	
D	2.860		1.003	0.396		500.231	C.P.1.
E		2.020		0.840		501.071	
F			1.530	0.49		501.561	TP.

$\Sigma BS - FS = \Sigma Rise - \Sigma Fall = Last\ RL - First\ RL$

$4.094 - 2.533 = 1.726 - 0.165 = 501.561 - 500$

$1.561 = 1.561 = 1.561$

Q4 → ii

$$\begin{array}{ccccccc} 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ 0.245, & 3.78, & 3.25, & 4.40, & 3.27, & 4.24, & 5.20 \end{array}$$

Trapezoidal Formula

$$A = \left(\left(\frac{0.245+5.2}{2}\right) + 3.78 + 3.25 + 4.4 + 3.27 + 4.24\right) 10$$

$$= 216.62\ m^2$$

Simpson's Formula

$$3.78+4.4+4.24$$

$$A = \frac{10}{3}\left[(0.245+5.2) + 4\left(\cancel{3.25+3.27+5.2}\right) + 2\left(\cancel{3.78+4.40+4.24}\right)\right]$$

$$3.25+3.27$$

$$A = \cancel{5.445 + 4(6.52) + 2(12.42)}$$

$$\downarrow \qquad \downarrow$$

$$\frac{10}{3}\left[\cancel{5.445 + 26.08 + 24.84}\right]$$

$$\boxed{227.216\ m^2}$$

$$\cancel{187.884\ m^2}$$

1. Parallelogram law of forces. It states as under :

"If two forces, acting simultaneously on a particle, be represented in magnitude and direction by the two adjacent sides of a parallelogram then their resultant may be represented in magnitude and direction by the diagonal of the parallelogram which passes through their point of intersection."

Refer Fig. 2.14. Let two forces P and Q acting simultaneously on a particle be represented in magnitude and direction by the adjacent sides oa and ob of a parallelogram $oacb$ drawn from a point o, their resultant R will be represented in magnitude and direction by the diagonal oc of the parallelogram.

The value of R can be determined either graphically or analytically as explained below :

(Q5 → ii)

Graphical method. Draw vectors oa and ob to represent to some convenient scale the forces P and Q in magnitude and direction. Complete the parallelogram $oacb$ by drawing ac parallel to ob and bc parallel to oa. The *vector* oc measured to the same scale will represent the resultant force R.

Analytical method. As shown in Fig. 2.14, in the parallelogram $oacb$, from c drop a perpendicular cd to oa at d when produced. Now from the geometry of the figure.

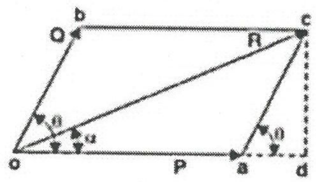


Fig. 2.14

$$\angle cad = \theta,\ ac = Q$$

$$\therefore \quad cd = Q \sin \theta$$

and
$$ad = Q \cos \theta$$

From right-angled triangle, odc

$$oc = \sqrt{(od)^2 + (cd)^2}$$

$$= \sqrt{(oa + ad)^2 + (cd)^2}$$

or
$$R = \sqrt{(P + Q\cos\theta)^2 + (Q\sin\theta)^2}$$

$$= \sqrt{P^2 + Q^2\cos^2\theta + 2PQ\cos\theta + Q^2\sin^2\theta}$$

$$= \sqrt{P^2 + Q^2(\sin^2\theta + \cos^2\theta) + 2PQ\cos\theta}$$

$$= \sqrt{P^2 + Q^2 + 2PQ\cos\theta} \qquad (\because \sin^2\theta + \cos^2\theta = 1)$$

$$\therefore \quad R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta} \qquad ...(2.3)$$

Let the resultant makes an angle α with P as shown in figure.

Then
$$\tan\alpha = \frac{cd}{od} = \frac{cd}{oa + ad}$$

$$= \frac{Q\sin\theta}{P + Q\cos\theta} \qquad ...(2.4)$$

Case 1. If $\theta = 0°$, *i.e.*, when the forces P and Q act along the same straight line then equation (2.3) reduces to

$$R = P + Q \qquad (\because \cos 0° = 1)$$

Case 2. If $\theta = 90°$, *i.e.*, when the forces P and Q act at right angles to each other, then

$$R = \sqrt{P^2 + Q^2} \qquad (\because \cos 90° = 0)$$

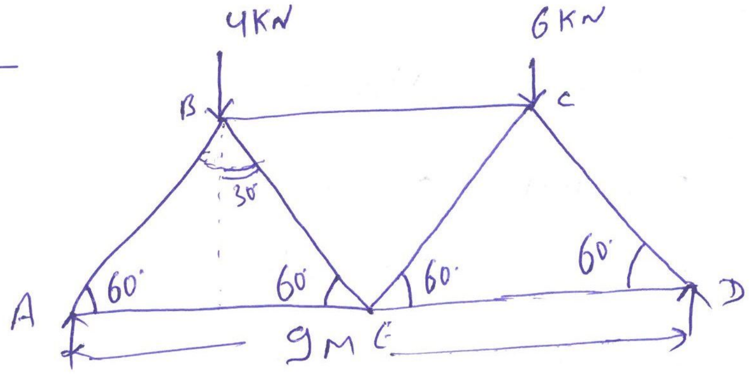
Case 3. If $\theta = 180°$, *i.e.*, the forces P and Q act along the same straight line but in opposite directions, then

$$R = P - Q \qquad (\because \cos 180° = -1)$$

The resultant will act in the direction of the greater force.

Q. 5

(iii)



Sol^n $R_x = ?$ $R_A + R_D = 10\ KN$

taking moment about $D = 0$

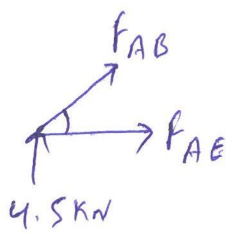
$R_A \times 9 - 4 \times 6.75 - 6 \times 2.25 = 0$

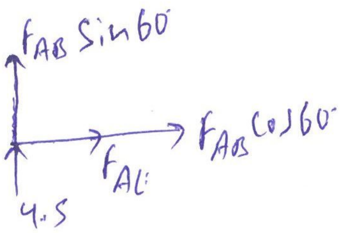
$9R_A = 40.5 \Rightarrow \boxed{R_A = 4.5\ KN}$

$\boxed{R_D = 5.5\ KN}$

— 2

At Joint A





$\Sigma V = 0$

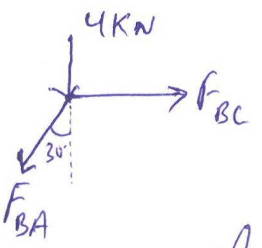
$F_{AB}\sin 60° + 4.5 = 0$

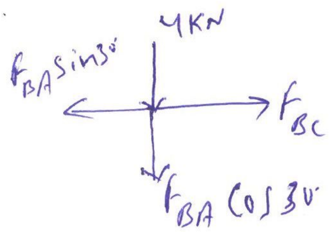
$\boxed{F_{AB} = -5.17\ KN}$

$\Sigma H = 0$

$F_{AE} + (-2.59) = 0 \Rightarrow \boxed{F_{AE} = +2.59\ KN}$

At Joint B





~~$\Sigma V = 0$~~

~~4 — 4.47~~ $F_{BA} = 5.17\ KN$

$\Sigma H = 0$

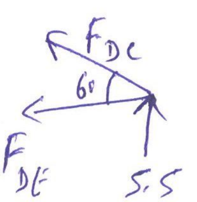
$-F_{BA}\sin 30° + F_{BC} = 0$

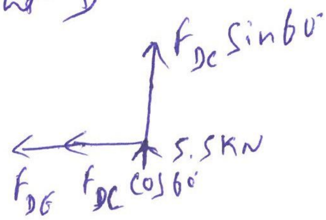
$-2.59 + F_{BC} = 0$

$\boxed{F_{BC} = +2.59}$

5

At Joint D





$\Sigma V = 0$

$F_{DC}\sin 60° + 5.5 = 0 \Rightarrow F_{DC} = -6.35\ KN$

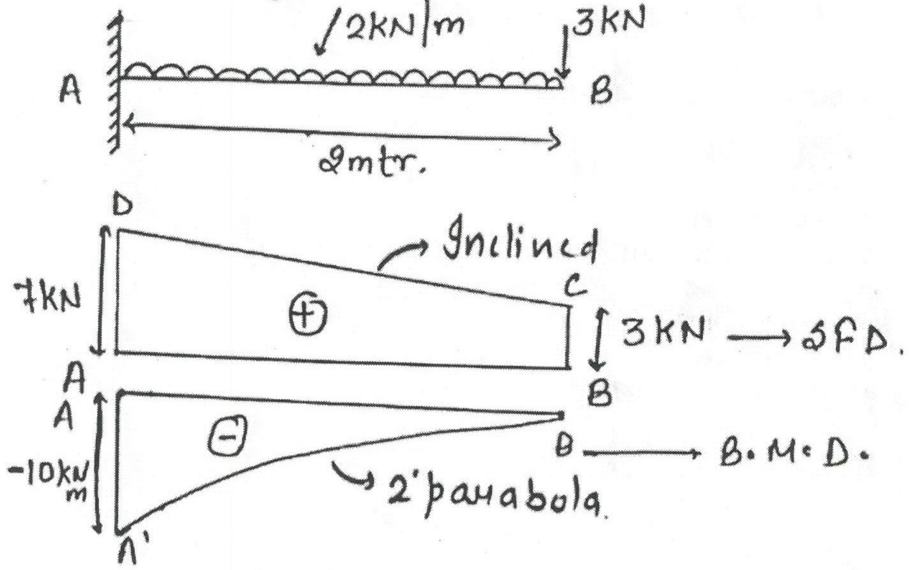
$\Sigma H = 0$

$-F_{DE} - F_{DC}\cos 60° = 0 \Rightarrow \boxed{F_{DE} = +3.17\ KN}$

S.No.	Member	Force	Nature
1.	f_{AB}, f_{BA}	5.17 KN	Comp.
2.	F_{AE}, f_{EA}	2.59	Tensile
3.	f_{BC}, f_{CB}	2.59	Tensile
4.	f_{DE} f_{ED}	3.17	Tensile
5.	f_{DC}, f_{CD}	6.35	Comp.

4) A cantilever of length 2.0 m carries a uniformly distributed load of 2KN/m over whole length and a point load of 3KN at free end. Draw shear force and bending moment diagram for the cantilever.

(Q6 - ii)



→ Given :- $L = 2.0$ mtr, $w = 2$ KN/m, Point load at free end = 3KN.

→ Shear Force :- Shear force at end B = 3KN

• Consider any section at a distance x from free end B. Eq^n for shear force is given by :- $F_x = 3.0 + wx$

$F_x = 3 + 2x$ [+ve sign due to downward force on right portion of section].

At A, $x = 2$ m ; $F_A = 7$ KN.

At B, $x = 0$ m ; $F_B = 3$ KN.

→ Bending Moment :- Consider a section at a distance of x mtr from B, Eq^n for Bending moment is given by

$$B.M._x = -\left[3x + wx \cdot \frac{x}{2}\right] = -\left[3x + x^2\right]$$

At A, $x = 2$ m, $M_A = -10$ KN-m

At B, $x = 0$ m, $M_B = 0$ KN-m.

Now,

$BM_A = 0$ (Hinged support).

$BM_B = R_A(2) - 50\times2\times1$

$= 50(2) - 50\times2$

$\boxed{M_B = 0 \text{ N-m.}}$

$BM_C = R_A(4) - 50\times2\times3 + 50\times2\times1$

$= 50(4) - 300 + 100$

$\boxed{M_C = 0 \text{ N-m.}}$

$BM_D = 0$ (Roller support).

~~Max~~ BM. B/w AB, @ dist. x from A,

$BM_x = 50(x) - (50 x \cdot \frac{x}{2})$.

$= 50x - 25x^2$.

@ x = 1m., BM will be max. for sectn AB,

$\boxed{BM_{max_{AB}} = 50 - 25 = 25 \text{ N-m.}}$

Similarly,

BM B/w BC, @ dist. y from B,

$BM_y = 50(2+y) - [50\times2\times(1+y)] + 50y \cdot y/2$

@ y = 1m., BM will be max. for sectn ~~A~~ BC,

$BM_{max_{BC}} = 50(2+1) - [50\times2\times(1+1)] + 50(1)(1/2)$

$= 100 - 200 + \cancel{50}\ 25$

$\boxed{BM_{max_{BC}} = \cancel{-75} \text{ N-m.}}$ -25N-m

Similarly,

BM B/w CD, @ dist. z from C,

$BM_z = 50(4+z) - [50\times2\times(z+3)] + [50\times2\times(z+1)] - \frac{50z^2}{2}$

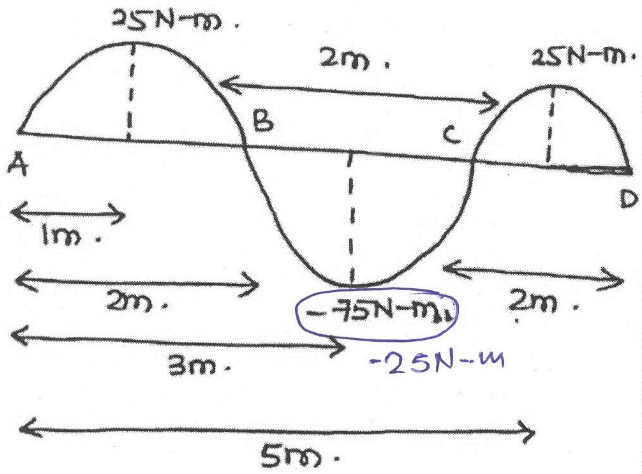
@ z = 1m., BM will be maxm for sectn CD,

$BM_{max_{CD}} = 50(5) - 100(4) + 100(2) - 25$.

$\boxed{BM_{max_{CD}} = 25 \text{ N-m.}}$

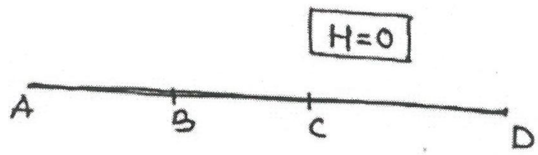
Now,

Bending moment diagram,



Now,

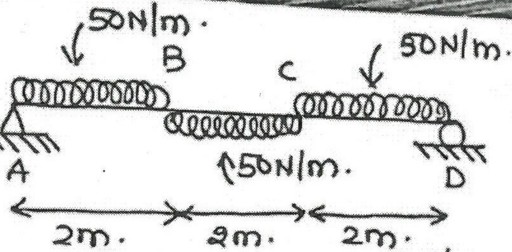
Thrust diagram,



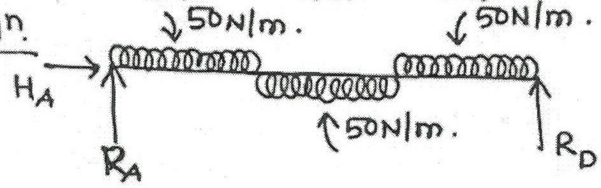
Note: Thrust diagram will be a constant line coinciding will base line as horizontal forces along span of beam is zero.

Ques. 6

(iii)



Soln.



By Equilibrium conditions,

$$\Sigma H = 0$$

$$\therefore \boxed{H_A = 0} \longrightarrow (1)$$

$$\Sigma V = 0$$

$$R_A - (50\times2) + (50\times2) - (50\times2) + R_D = 0$$

$$\boxed{R_A + R_D = 100N} \longrightarrow (2)$$

$$\Sigma M = 0$$

Taking moment about D,

$$R_A(6) - (50\times2\times5) + (50\times2\times3) - (50\times2\times1) = 0$$

$$\boxed{R_A = 50N} \text{ Also, } \boxed{R_B = 50N}$$

Now,

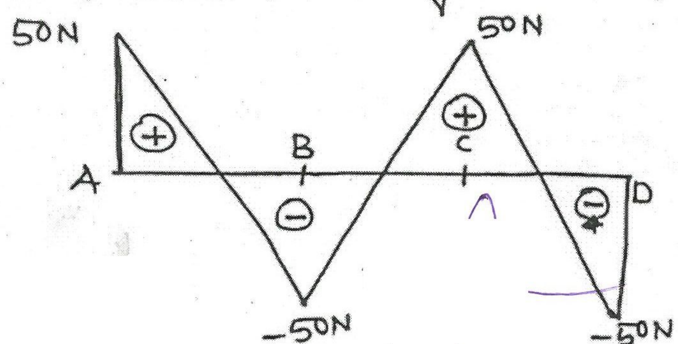
$$SF_A = 50N$$

$$SF_B = 50 - (50\times2) = -50N.$$

$$SF_C = 50 - (50\times2) + (50\times2) = 50N$$

$$SF_D = 50 - (50\times2) + (50\times2) - (50\times2) + 50 = 0.$$

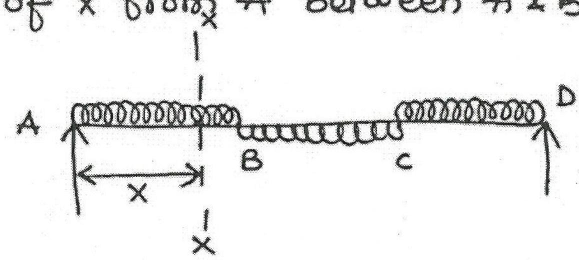
Now, Shear force diagram will be,



$\because$ SF is zero at three point i.e. b/w A & B, B & C And, C & D resp.

Now,

Taking sectn X–X at a distance of x from A between A & B,

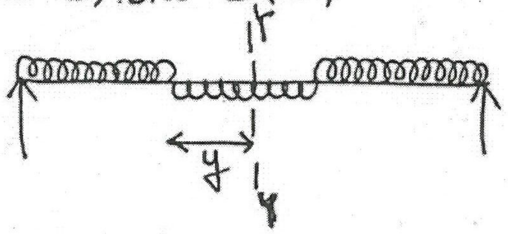


$$SF_x = 50 - 50x$$

Putting $SF_x = 0$,

$$\boxed{x = 1m.}$$

Now, taking sectn Y–Y @ dist y from B, b/w B & C,

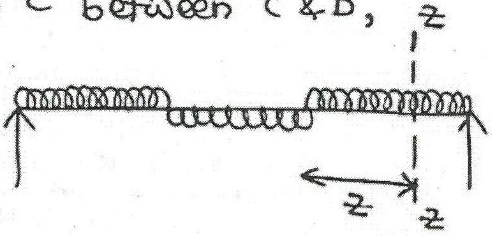


$$SF_y = 50 - 50(2) + 50y$$

Putting $SF_y = 0$,

$$\boxed{y = 1m.}$$

Again, Taking a sectn Z–Z @ dist. z from C between C & D,



$$SF_z = 50 - (50\times2) + (50\times2) - 50z$$

Putting $SF_z = 0$,

$$\boxed{z = 1m.}$$

$\therefore$ SF is zero @ dist. 1m. each from A, B & C resp. between AB, BC & CD.

$\therefore$ BM of UDL @ sectn AB, BC & CD will be max^m @ dist 1m. from A, B & C resp.