Mechanical Engineering

BILINGUAL
MASTER GUIDE

CBT 2
Computer Based Test - Stage 2

मैकेनिकल इंजीनियरिंग

RRB-JE

Previous Year Questions Paper With Solutions

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DIRECTOR'S *Message*

To reach heights one must start climbing and if the journey is difficult then perseverance is the key to success. As a teacher we have realized over past years that success in any competitive exam requires hard work and proper guidance. **Engineers Academy** with its unique teaching methodologies has always proved that we meet the expectations of thousands of students and parents to make their dreams come true. With changing patterns, we have adapted ourselves to deliver the best and ensure better results.

This book has been organized and executed with a lot of care, dedication and passion for lucidity. A conscious attempt has been made to simplify the concepts to facilitate better understanding of the subject.

Engineers Academy has many successful stories of students who secured All India Rank in ESE, GATE, PSUs, SSC-JEn, RRB JEn and other competitive examination. Now we invite you to become a part of Engineers Academy to explore and achieve ultimate goal of your life. We promise to provide you quality guidance with competitive environment which is far advanced and ahead than the reach of other institution.

We would feel satisfied if the book meets the needs of the students for whom it is meant.

Lastly, we are thankful to all the engineers, authors whose work has been the source of enlightenment, inspiration and guidance in presenting this book.

It is hoped that the book in its new form will enjoy its ever increasing popularity.

Regards

Dr. Pankaj Goyal

Preface

Railway Recruitment Board-Junior Engineer has always been preferred by Engineers due to job stability. Indian Railways is one of the biggest Government employers in India. With the exam being just a few a months away, it is time for the candidates planning to appear for the exam to pull up their socks and start their RRB-JE preparation.

The RRB-JE exam is conducted in two stages as shown in table given below.

RRB Exam	Subjects	Total Ques.	Total Marks	Duration
CBT – 1	Quantitative Aptitude	30	100	90 Min.
	General Intelligence & Reasoning	25		
	General Awareness	15		
	General Science	30		
CBT – 2	General Awareness	15	150	120 Min.
	Physics and Chemistry	15		
	Basics of Computer and Applications	10		
	Basics of Environment and Pollution control	10		
	Technical Abilities	100		

We hope this book will be proved an important tool to succeed in RRB-JE and Sr. Section Engineer Exams.

It is earnestly hoped that with the extensive additions and revisions, the present edition will facilitate the students not only in preparing themselves for competitive examinations but also in preparing for their regular examinations and prove more useful to the students than the earlier editions.

Even though, enough readings were given for correcting the error and printing mistakes, due to human tendency there could be some minor typos in the book. If any such typos found, they will be highly appreciated and in corporated in the next edition. Also, please provide your valuable suggestions at :engineers.academy.india@gmail.com

All the Best!

Engineers Academy Editorial Board

SYLLABUS

1. Engineering Mechanics

Resolution of forces, Equilibrium and Equilibrant, parallelogram law of forces, triangle law of forces, polygon law of forces and Lami's theorem, couple and moment of a couple, condition for equilibrium of rigid body subjected to number of coplanar non-concurrent forces, definition of static friction, dynamic friction, derivation of limiting angle of friction and angle of repose, resolution of forces considering friction when a body moves on horizontal plane and inclined plane, calculation of moment of inertia and radius of gyration of : (a) I-Section (b) channel section (c) T-Section (d) L-Section (Equal & unequal lengths) (e) Z-Section (f) Built up sections (simple cases only), Newton's laws of motion (without derivation), motion of projectile, D'Alembert's principle, definition law of conservation of energy, law of conservation of momentum.

2. Strength of Materials

Stress, strain, stress strain diagram, factor of safety, thermal stresses, strain energy, proof resilience and modules of resilience. Shear force and bending moment diagram – cant leaver beam, simply supported beam, continuous beam, fixed beam. Torsion in shafts and springs, thin cylinder shells.

3. Production Engineering

Material Science :

Mechanical properties of engineering materials – tensile strength, compressive strength, ductility, malleability, hardness, toughness, brittleness, impact strength, fatigue, creep resistance.
Classification of steels, mild steel and alloy steels.
Importance of heat treatment. Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.

Welding :

Welding – Introduction, classification of welding processes, advantages and limitations of welding, principles of arc welding, arc welding equipment, choice of electrodes for different metals, principle of gas (oxy-acetylene) welding, equipment of gas welding, welding procedures (arc & gas), soldering and brazing techniques, types and applications of solders and fluxes, various flame cutting processes, advantages and limitations of flame cutting, defects in welding, testing and inspection modern welding methods, (submerged, CO_2, atomic – hydrogen, ultrasonic welding), brief description of MIG & TIG welding.

Machining :

Working principle of lathe. Types of lathes – Engine lathe – construction details and specifications. Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles. General and special operations – (Turning, facing, taper turning thread cutting, knurling, forming, drilling, boring, reaming, key way cutting), cutting fluids, coolants and lubricants. Introduction to shaper, slotter, plainer, broaching, milling and manufacture of gears, heat treatment process applied to gears.

Grinding & Finishing Process :

Principles of metal removal by grinding, abrasives, natural and artificial, bonds and binding processes, vitrified, silicate, shellac rubber, grinding machines, classification: cylindrical, surface, tool & cutter grinding machine, construction details, relative merits, principles of centreless grinding, advantages & limitations of centreless grinding work, holding devices, wheel maintenance, balancing of wheels,

coolants used, finishing by grinding, honing, lapping, super finishing, electroplating, basic principles – plating metals, applications, hot dipping, galvanizing tin coating, parkerising, anodizing, metal spraying, wire process, powder process and applications, organic coatings, oil base paint, lacquer base enamels, bituminous paints, rubber base coating.

Metrology :

Linear measurement – Slip gauges and dial indicators, angle measurements, bevel protractor, sine bar, angle slip gauges, comparators (a) mechanical (b) electrical (c) optical (d) pneumatic. Measurement of surface roughness; methods of measurements by comparison, tracer instruments and by interferometry, collimators, measuring microscope, interferometer, inspection of machine parts using the concepts of shadow projection and profile projection.

4. Fluid Mechanics & Hydraulic Machinery

Properties of fluid, density, specific weight, specific gravity, viscosity, surface tension, compressibility capillarity, Pascal's law, measurement of pressures, concept of buoyancy.

Concept of Reynold's number, pressure, potential and kinetic energy of liquids, total energy, laws of conservation, mass, energy and momentum, velocity of liquids and discharge, Bernoulli's equation and assumptions, venturimeters, pitot- tube, current meters.

Working principle & constructional details of centrifugal pump, efficiencies – manometric efficiency, volumetric efficiency, mechanical efficiency and overall efficiency, cavitation and its effect, working principle of jet & submersible pumps with line diagrams.

5. Industrial Management

Job analysis, motivation, different theories, satisfaction, performance reward systems, production, planning and control, relation with other departments, routing, scheduling, dispatching, PERT and CPM, simple problems.

Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, economic ordering quantity, break even analysis, stores layout, stores equipment, stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, hoist, cranes, conveyors, trucks, fork trucks.

6. Thermal Engineering

Laws of thermodynamics, conversion of heat into work vice versa , laws of perfect gases, thermodynamic processes – isochoric, isobaric, isothermal hyperbolic, isentropic, polytrophic and throttling.

Air compressors their cycles refrigeration cycles, principle of a refrigeration plant.

7. Internal Combustion Engine

Air standards cycles – Carnot cycle, Otto cycle, Diesel cycle, construction and working of internal combustion engines, comparison of diesel engine and petrol engine. Systems of internal combustion engine, performance of internal combustion engines.

8. Heat & Mass Transfer

Modes of heat transfer, thermal conductivity, convective heat transfer coefficient, Stefan Boltzman law by radiation and overall heat transfer coefficient.

CONTENTS

1 Chapter

Engineering Mechanics

RRB Previous Year Questions

RRB : JUNIOR ENGINEER

1. A man is standing on a boat in still water. If he walks in the boat towards the shore, the boat will :

(a) Move away form the shore

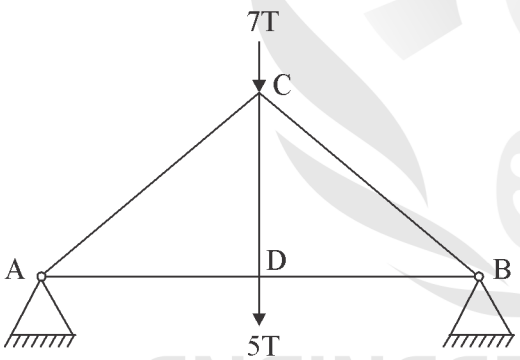
(b) Remain stationary

(c) Move towards the shore

(d) Sink

[RRB-JE : 2014]

2. What is the force in the vertical member CD of the pin - jointed frame shown below ?



(a) 12 T (Tension)

(b) 2T (Compresion)

(c) 7T (Compression)

(d) 5T (Tension)

[RRB-JE : 2014]

3. For perfectly elastic bodies, the value of coefficient of restitution is :

(a) Zero (b) 0.5

(c) 1.0 (d) 0.25

[RRB-JE : 2014]

1. एक आदमी स्थिर पानी में नाव पर खड़ा है। यदि वह नाव में किनारे की ओर चलता है, तो नाव

(a) किनारे से दूर चली जाएगी

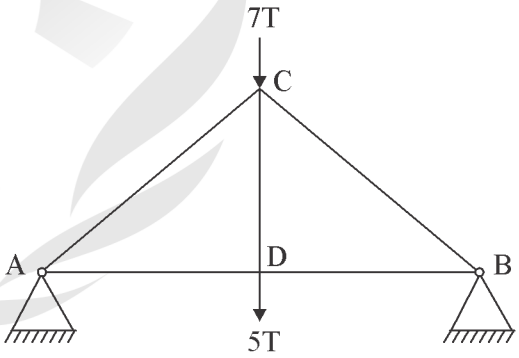
(b) स्थिर रहेगी

(c) किनारे की ओर बढ़ेगी

(d) सिंक

[RRB-JE : 2014]

2. नीचे दिखाए गए पिन-जांइट फ्रेम के लंबवत अवयव CD में बल क्या है?



(a) 12T (तनन)

(b) 2T (संपीड़न)

(c) 7T (संपीड़न)

(d) 5T (तनन)

[RRB-JE : 2014]

3. पूर्ण प्रत्यास्थ निकायों के लिए, प्रत्यवस्थान गुणांक का मान है

(a) शून्य (b) 0.5

(c) 1.0 (d) 0.25

[RRB-JE : 2014]

9. The frequency of a sound wave is 50 Hz and its wavelength is 4 m. What is the distance travelled by the sound wave in 3 s?

(a) 200 m (b) 100 m

(c) 300 m (d) 600 m

[RRB-JE : 29.08.2019]

10. The force applied on a body of mass 236 kg to produce an acceleration of 4 m/s^2 is-

(a) 944 N (b) 59 N

(c) 118 N (d) 472 N

[RRB-JE : 30.08.2019]

11. If 'α' is the angle between two forces P and Q, then the angle made by the direction of the resultant 'θ' relative to the force P is given by

(a) $\theta = \tan^{-1}\left(\frac{Q\sin\alpha}{P+Q\cos\alpha}\right)$

(b) $\theta = \sin^{-1}\left(\frac{P\sin\alpha}{P+Q\cos\alpha}\right)$

(c) $\theta = \sin^{-1}\left(\frac{Q\sin\alpha}{Q+P\cos\alpha}\right)$

(d) $\theta = \cos^{-1}\left(\frac{P\sin\alpha}{Q+P\cos\alpha}\right)$

[RRB-JE : 30.08.2019]

12. According to the principle of moments-

(a) If a system of coplanar forces is in equilibrium, then their algebraic sum is zero

(b) The algebraic sum of the moments of any two forces about any point is equal to the moment of the resultant about the same point

(c) Positive and negative couples can be balanced

(d) If a system of coplanar forces is in equilibrium, then the algebraic sum of their moments about any point in their plane is zero

[RRB-JE : 30.08.2019]

13. "If no external torque acts on a rigid body, then the product of its moment of inertia and the angular velocity about the axis of rotation must remain constant " is the statement of-

(a) Law of paralleleogram forces

(b) Law of polygon of forces

(c) Law of triangular forces

(d) Law of conservation of Angular momentum

[RRB-JE : 30.08.2019]

9. एक ध्वनि तरंग की आवृत्ति 50 Hz है और इसकी तरंगदैर्ध्य 4 मीटर है। 3 सेकंड में ध्वनि तरंग द्वारा तय की गई दूरी ज्ञात कीजिए-

(a) 200 मीटर (b) 100 मीटर

(c) 300 मीटर (d) 600 मीटर

[RRB-JE : 29.08.2019]

10. 4 m/s^2 का त्वरण उत्पन्न करने हेतु 236 kg द्रव्यमान वाले पिंड पर लगाया जाने वाला बल ज्ञात कीजिए-

(a) 944 N (b) 59 N

(c) 118 N (d) 472 N

[RRB-JE : 30.08.2019]

11. यदि 'α' दो बल P और Q के बीच का कोण है, तो बल P के सापेक्ष परिणामी 'θ' की दिशा द्वारा बना कोण _____द्वारा प्रदर्शित किया जाता है-

(a) $\theta = \tan^{-1}\left(\frac{Q\sin\alpha}{P+Q\cos\alpha}\right)$

(b) $\theta = \sin^{-1}\left(\frac{P\sin\alpha}{P+Q\cos\alpha}\right)$

(c) $\theta = \sin^{-1}\left(\frac{Q\sin\alpha}{Q+P\cos\alpha}\right)$

(d) $\theta = \cos^{-1}\left(\frac{P\sin\alpha}{Q+P\cos\alpha}\right)$

[RRB-JE : 30.08.2019]

12. आघूर्णों के सिद्धांत (principle of moments) के अनुसार-

(a) यदि समतलीय बलों का निकाय संतुलन में है, तो उनका बीजगणितीय योग शून्य होता है।

(b) किसी भी बिन्दु पर लगने वाली किसी भी दो बलों के आघूर्णों का बीजगणितीय योग, उस बिन्दु पर परिणामी आघूर्ण के बराबर होता है

(c) धनात्मक और ऋणात्मक बलयुग्म संतुलित हो सकते हैं

(d) यदि समतलीय बलों का निकाय संतुलन में है, तो उस तल में स्थित किसी बिन्दु के सापेक्ष उनके आघूर्णों का बीजगणितीय योग शून्य होता है

[RRB-JE : 30.08.2019]

13. यदि एक दृढ़ निकाय पर कोई बाह्य आघूर्ण न लगाया जाए, तो इसके जड़त्व आघूर्ण और इसकी घूर्णन अक्ष के सापेक्ष कोणीय वेग का गुणनफल नियत रहना चाहिए, यह किसका कथन है?

(a) बलों का समान्तर चतुर्भुज का नियम

(b) बलों के बहुभुज का नियम

(c) बलों का त्रिभुज का नियम

(d) कोणीय संवेग के संरक्षण का नियम

[RRB-JE : 30.08.2019]

RRB : JE ANSWERS AND EXPLANATIONS

1. ***Ans. (a)***

The boat will start moving away from the shore.

2. ***Ans. (d)***

3. ***Ans. (c)***

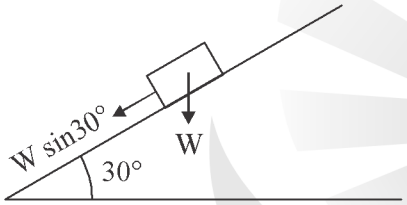
The Coefficient of Restitution (COR) is the ratio of the final to initial relative velocity between two objects after they collide. It normally ranges form 0 to 1 where 1 would be a perfectly elastic collision.

4. ***Ans. (d)***

5. ***Ans. (d)***

6. ***Ans. (d)***

7. ***Ans. (a)***



The component of gravity force parallel to inclined planes is

$= W \sin 30°$

$= 20 \times \frac{1}{2} = 10 \text{ kN}$

8. ***Ans. (a)***

9. ***Ans. (d)***

Frequency = 50 Hz

Wavelength = 4 m

The Velocity of wave

= Frequency × Wavelength

= 50 × 4 = 200 m/s

Distance travelled by the sound wave in 3 sec.

= 200 × 3 = 600 m

10. ***Ans. (a)***

F = ma

= 236 × 4

= 944 N

11. ***Ans. (a)***

12. ***Ans. (d)***

13. ***Ans. (d)***

ENGINEERS ACADEMY

2 Chapter

Strength of Material

RRB Previous Year Questions

RRB : JUNIOR ENGINEER

1. The slenderness ratio of a compression member is :

(a) $\frac{\text{Effective length}}{\text{Least radius of gyration}}$

(b) $\frac{\text{Actual length}}{\text{Moment of inertia}}$

(c) $\frac{\text{Moment of inertia}}{\text{Actual length}}$

(d) $\frac{\text{Actual length}}{\text{Radius of gyration}}$

[RRB-JE : 2014]

2. The length of a bar is L meters. It extends by 2 mm when a tensile force F is applied. Find the strain produced in the bar :

(a) $\frac{0.002}{L}$ (b) $\frac{2}{L}$

(c) $\frac{0.2}{L}$ (d) $\frac{L}{0.002}$

[RRB-JE : 2014]

3. Choose the option which correctly shows the relationship between Modulus of Elasticity (E); Modulus of Rigidly (C) and Bulk Modulus (K):

(a) $E = \frac{KC}{K+C}$ (b) $E = \frac{2KC}{2K+C}$

(c) $E = \frac{9KC}{3K+C}$ (d) $E = \frac{9KC}{K+2C}$

[RRB-JE : 2014]

1. एक संपीड़न अवयव का तनुता अनुपात है :

(a) $\frac{\text{प्रभावी लंबाई}}{\text{कम से कम घूर्णी त्रिज्या}}$

(b) $\frac{\text{वास्तविक लंबाई}}{\text{जड़त्व आघूर्ण}}$

(c) $\frac{\text{जड़त्व आघूर्ण}}{\text{वास्तविक लंबाई}}$

(d) $\frac{\text{वास्तविक लंबाई}}{\text{घूर्णी त्रिज्या}}$

[RRB-JE : 2014]

2. एक छड़ की लंबाई L मीटर है। जब एक तनन बल F लगाया जाता है तो यह 2 mm तक फैल जाता है। छड़ में उत्पन्न विकृति का पता लगाएं

(a) $\frac{0.002}{L}$ (b) $\frac{2}{L}$

(c) $\frac{0.2}{L}$ (d) $\frac{L}{0.002}$

[RRB-JE : 2014]

3. वह विकल्प चुनें जो प्रत्यास्थता मापांक (E), दृढ़ता मापांक (C) और आयतन मापांक (K) के बीच के संबंध को सही ढंग से दर्शाता है,

(a) $E = \frac{KC}{K+C}$ (b) $E = \frac{2KC}{2K+C}$

(c) $E = \frac{9KC}{3K+C}$ (d) $E = \frac{9KC}{K+2C}$

[RRB-JE : 2014]

4. The property of a material by which it can be rolled into sheets is called :

(a) Elasticity (b) Plasticity

(c) Ductility (d) Malleability

[RRB-JE : 2014]

5. A simply supported beam of length L is loaded with a uniformly distributed load of 'w' per unit length. The maximum bending moment will be :

(a) $\frac{wL^2}{4}$ (b) $\frac{wL^2}{8}$

(c) $\frac{wL^2}{2}$ (d) wL^2

[RRB-JE : 2014]

6. Which of the following property is generally NOT shown by metal ?

(a) Electrical conduction

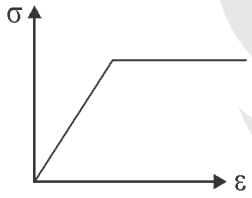
(b) Sonorous in nature

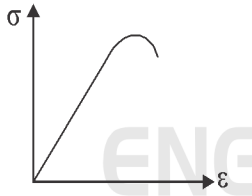
(c) Dullness

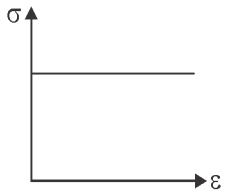
(d) Ductility

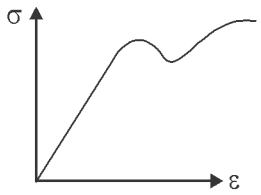
[RRB-JE : 2014]

7. The stress-strain curve for an ideally plastic material is (conventional symbols)

(a) 

(b) 

(c) 

(d) 

[RRB-JE : 2014]

4. किसी पदार्थ का वह गुणधर्म जिसके द्वारा उसे चादरों में लपेटा जा सकता है, कहलाता है :

(a) प्रत्यास्थता (b) सुघट्यता

(c) तन्यता (d) आघातवर्धनीयता

[RRB-JE : 2014]

5. लंबाई का एक शुद्धालम्बित धरन 'w' प्रति यूनिट लंबाई के समान रूप से वितरित भार के साथ भार किया जाता है। अधिकतम बंकन आघूर्ण होगा

(a) $\frac{wL^2}{4}$ (b) $\frac{wL^2}{8}$

(c) $\frac{wL^2}{2}$ (d) wL^2

[RRB-JE : 2014]

6. निम्नलिखित में से कौनसा गुणधर्म आमतौर पर धातु द्वारा नहीं दिखाया जाता है?

(a) विद्युत चालन

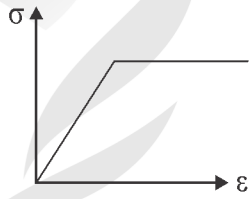
(b) ध्वानिक प्रकृति

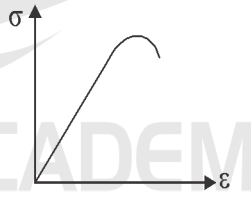
(c) मंदस्वनता

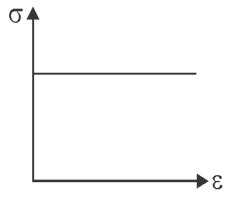
(d) तन्यता

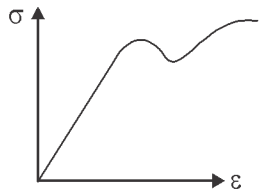
[RRB-JE : 2014]

7. एक आदर्श सुघट्य पदार्थ के लिए प्रतिबल-विकृति वक्र है (सांकेतिक प्रतीक)

(a) 

(b) 

(c) 

(d) 

[RRB-JE : 2014]

22. Which of the following is a slow rise of plastic deformation under the action of stresses?

(a) Ductile fracture

(b) Fatigue

(c) Creep

(d) Brittle fracture

[RRB-JE : 29.08.2019]

23. Which of the following materials has nearly zero coefficient of expansion?

(a) Stainless steel (b) Silver

(c) Invar (d) Selenium

[RRB-JE : 29.08.2019]

24. The Hoop stress developed in the thin cylinders is given by-

(where P = Internal pressure, d = Internal diameter and t =wall thickness)

(a) $\frac{Pd}{3t}$ (b) $\frac{Pd}{4t}$

(c) $\frac{Pd}{2t}$ (d) $\frac{Pd}{t}$

[RRB-JE : 29.08.2019]

25. The material which exhibits the same elastic properties in all directions is called-

(a) Homogeneous (b) Isotropic

(c) Isentropic (d) Inelastic

[RRB-JE : 30.08.2019]

26. The bending moment at a section of a beam will have its local maximum where the shear force is-

(a) Maximum (b) Minimum

(c) Unity (d) Zero

[RRB-JE : 30.08.2019]

27. Consider a long tube of 25 mm outside diameter (d_o) and of 20 mm inside diameter (d_i) twisted about its longitudinal axis with a torque T of 45 N-m. The polar moment of inertia of the hollow tube is-

(a) 18933 mm^4 (b) 36980 mm^4

(c) 27271 mm^4 (d) 22641 mm^4

[RRB-JE : 30.08.2019]

22. निम्नलिखित में से कौनसा प्रतिबल की क्रिया के तहत सुघट्य विरूपण की धीमी वृद्धि है?

(a) तन्य फ्रैक्चर

(b) फटीग

(c) क्रीप

(d) भंगुर भंजन

[RRB-JE : 29.08.2019]

23. इनमें से किस पदार्थ का प्रसार गुणांक लगभग शून्य होता है?

(a) स्टेनलेस स्टील (b) चांदी

(c) इन्वार (d) सेलेनियम

[RRB-JE : 29.08.2019]

24. पतले सिलेंडरों में उत्पन्न हूप प्रतिबल को_____द्वारा व्यक्त किया जाता है-

(जहाँ P = आंतरिक दबाव, d = आंतरिक व्यास और t = दीवार की मोटाई)

(a) $\frac{Pd}{3t}$ (b) $\frac{Pd}{4t}$

(c) $\frac{Pd}{2t}$ (d) $\frac{Pd}{t}$

[RRB-JE : 29.08.2019]

25. सभी दिशाओं में समान प्रत्यास्थ गुणधर्म प्रदर्शित करने वाला पदार्थ,_____होता है-

(a) समांगी (b) समदैशिक

(c) समएन्ट्रोपी (d) अप्रत्यास्थ

[RRB-JE : 30.08.2019]

26. धरन के एक खण्ड पर बंकन आघूर्ण में इसका स्थानीय अधिकतम होगा जहां कतरनी बल _____होता है-

(a) अधिकतम (b) न्यूनतम

(c) एकांक (d) शून्य

[RRB-JE : 30.08.2019]

27. 25 mm बाहरी व्यास (d_o) और 20 mm आंतरिक व्यास (d_i) की एक लम्बी ट्यूब पर विचार करें, जो 45 N-m के बलाघूर्ण T साथ अपने अनुदैर्ध्य अक्ष के सापेक्ष मुड़ी हुई है। खोखले ट्यूब का ध्रुवीय जड़त्व आघूर्ण होगा-

(a) 18933 mm^4 (b) 36980 mm^4

(c) 27271 mm^4 (d) 22641 mm^4

[RRB-JE : 30.08.2019]

❍❍❍

RRB : SENIOR SECTION ENGINEER

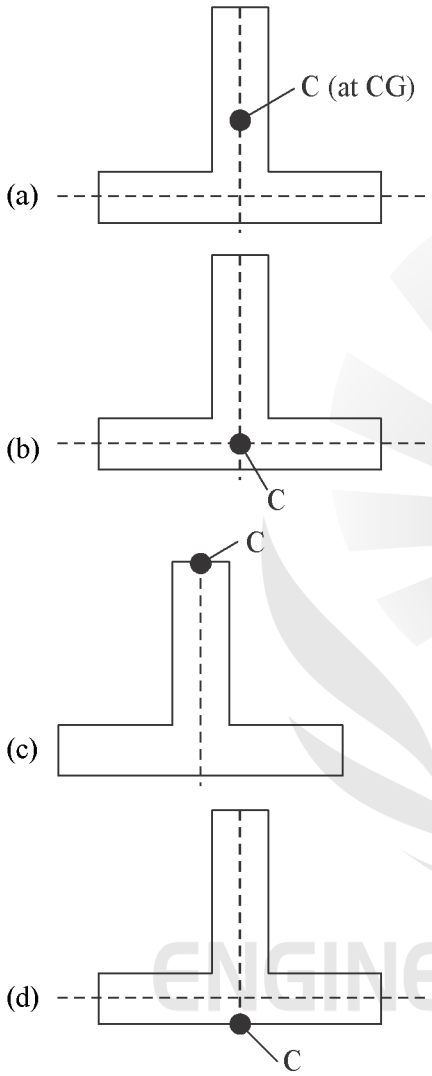
1. In S.I. System, unit of stress is :

(a) kg/cm^2 (b) N

(c) N/m^2 (d) Watt

[RRB-SSE : 2014]

2. In a thin-wall T-section, the shear centre C is located at the point Shown in



[RRB-SSE : 2014]

3. Maximum deflection of fixed beam carrying a central load is one form of maximum deflecting is equal to (other notations standard)

(a) $\frac{WL^3}{48EI}$ (b) $\frac{WL^3}{96EI}$

(c) $\frac{WL^3}{192EI}$ (d) $\frac{5}{384}\frac{WL^3}{EI}$

[RRB-SSE : 2014]

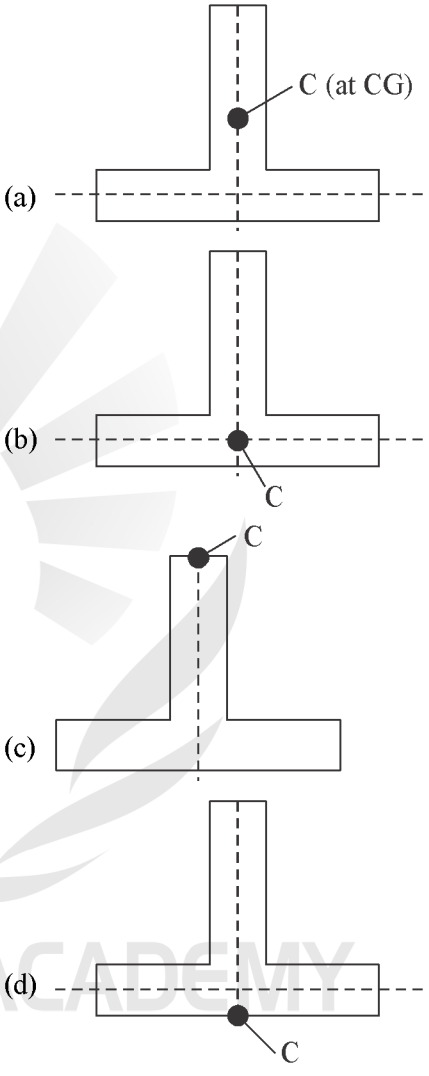
1. S.I. प्रणाली में, प्रतिबल की इकाई_____है।

(a) kg/cm^2 (b) N

(c) N/m^2 (d) Watt

[RRB-SSE : 2014]

2. एक पतली दीवार वाले T-सेक्शन में, कतरनी केंद्र C, दिखाए गए बिंदु पर स्थित है :



[RRB-SSE : 2014]

3. केंद्रीय भार वहन करने वाले बद्ध धरन का अधिकतम विक्षेपण, अधिकतम विक्षेपण का एक रूप_____के बराबर है (अन्य नोटेशन मानक है)

(a) $\frac{WL^3}{48EI}$ (b) $\frac{WL^3}{96EI}$

(c) $\frac{WL^3}{192EI}$ (d) $\frac{5}{384}\frac{WL^3}{EI}$

[RRB-SSE : 2014]

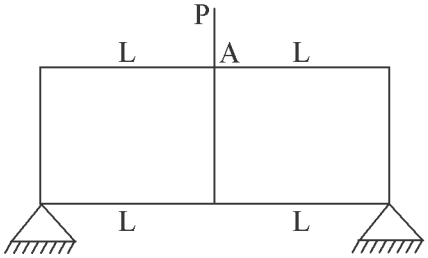
4. In C.G. S. System, the unit of strain is :

(a) cm/kg (b) m/kg

(c) No unit (d) None of these

[RRB-SSE : 2014]

5. What is the moment at A for a frame shown below:



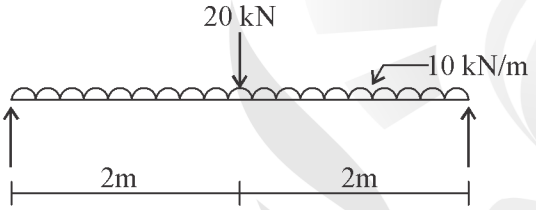
Each vertical member has very large moment of Inertia

(a) $\frac{PL}{2}$ (b) $\frac{PL}{4}$

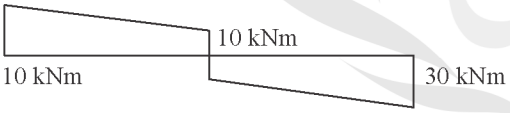
(c) $\frac{PL}{8}$ (d) $\frac{PL}{16}$

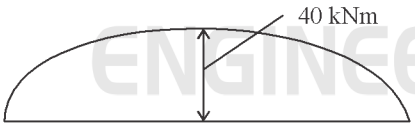
[RRB-SSE : 2014]

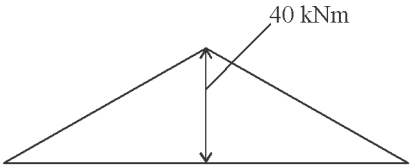
6. A simply supported beam is loaded a below

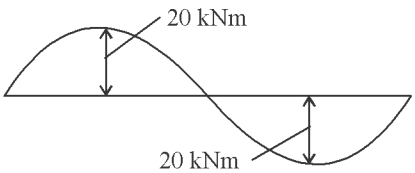


The corresponding bending moment diagram is

(a)


(b)


(c)


(d)


[RRB-SSE : 2014]

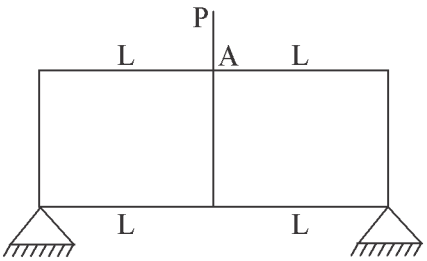
4. C.G. S. प्रणाली में, विकृति की इकाई_____है :

(a) cm/kg (b) m/kg

(c) कोई इकाई नहीं (d) इनमें से कोई नहीं

[RRB-SSE : 2014]

5. नीचे दिखाए गए फ्रेम के लिए A पर आघूर्ण क्या है :



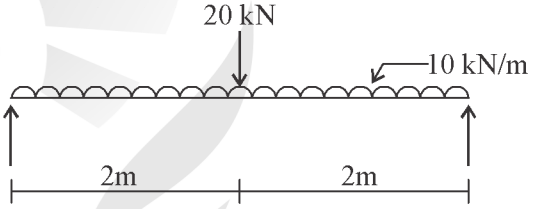
प्रत्येक उर्ध्वाधर अवयव में बहुत ज्यादा जड़ता आघूर्ण है

(a) $\frac{PL}{2}$ (b) $\frac{PL}{4}$

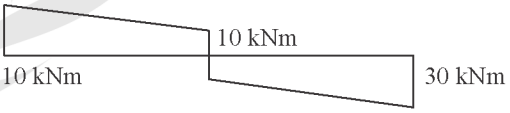
(c) $\frac{PL}{8}$ (d) $\frac{PL}{16}$

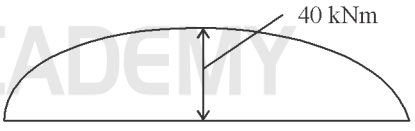
[RRB-SSE : 2014]

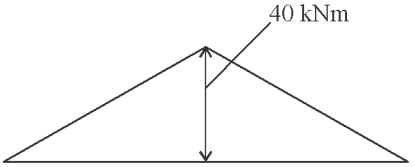
6. एक शुद्धालम्बित धरन पर को नीचे भार किया जाता है

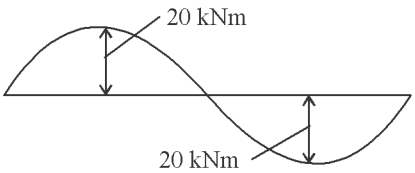


संगत बंकन आघूर्ण आरेख है

(a)


(b)


(c)


(d)


[RRB-SSE : 2014]

7. What is the radius of Mohr's circle in case of bi-axial state of stress ?

(a) Half the sum of the two principal stresses

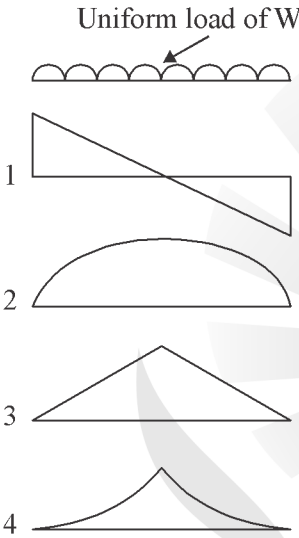
(b) Half the difference of the two principle stresses

(c) Difference of the two principal stresses

(d) Sum of the two principal stresses

[RRB-SSE : 2014]

8. In the case of a uniformly distributed load on a simply supported beam, the bending moment diagram would be –

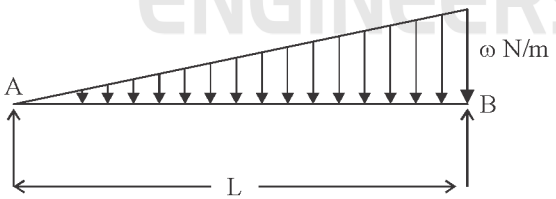


(a) 1 (b) 2

(c) 3 (d) 4

[RRB-SSE : 2014]

9. A Simply supported beam carries a varying load from zero at one end to w N/m at the other end (as under).



The length of the beam is L. The shear force will be zero at distance 'x' from A. Find 'x' :

(a) $\frac{L}{2}$ (b) $\frac{L}{4}$

(c) $\frac{L}{\sqrt{3}}$ (d) $\frac{L}{3}$

[RRB-SSE : 2014]

7. द्विअक्षीय प्रतिबल की स्थिति में मोहर वृत्त की त्रिज्या क्या है?

(a) दो मुख्य प्रतिबल के योग का आधा

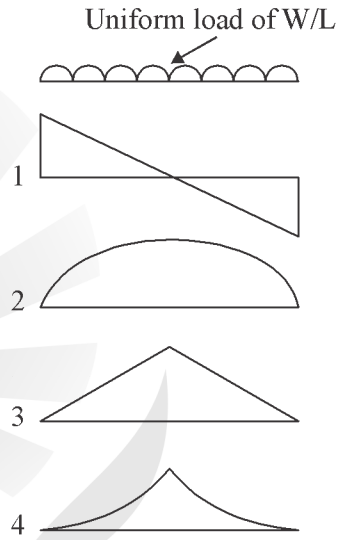
(b) दो मुख्य प्रतिबल के अंतर का आधा

(c) दो मुख्य प्रतिबल के अंतर

(d) दो मुख्य प्रतिबल के योग

[RRB-SSE : 2014]

8. शुद्धालम्बित धरन पर एकसमान वितरित भार के मामले में, बंकन आघूर्ण आरेख_____होगा

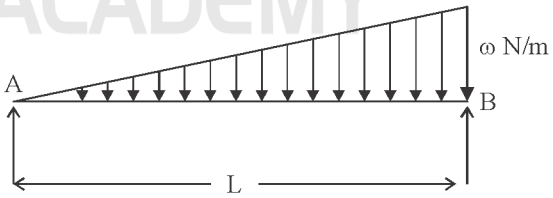


(a) 1 (b) 2

(c) 3 (d) 4

[RRB-SSE : 2014]

9. एक शुद्धालम्बित धरन, एक छोर पर शून्य से दूसरे छोर पर w N/m तक परिवर्तित भार वहन करता है (जैसा कि नीचे दिया गया है)



धरन की लंबाई L है। A से दूरी 'x' पर कतरनी प्रतिबल शून्य होगा। 'x' का मान_____होगा :

(a) $\frac{L}{2}$ (b) $\frac{L}{4}$

(c) $\frac{L}{\sqrt{3}}$ (d) $\frac{L}{3}$

[RRB-SSE : 2014]

22. The stress below which a material regains its original size and shape when the load is removed is called as :

(a) Failure stress (b) Shrinkage limit

(c) Plastic limit (d) Elastic limit

[RRB-SSE : 03.09.2015]

23. The behavior shown by some materials by virtue of which, as the shear stress reduce continuously with the development in the plastic strain is called as :

(a) Yielding

(b) Strain softening

(c) Strain hardening

(d) Plasticity

[RRB-SSE : 03.09.2015]

22. वह प्रतिबल जिसके अन्तर्गत कोई पदार्थ, भार को हटाने पर अपने मूल आकार और आकृति को पुनःप्राप्त कर लेता है_____कहलाता है :

(a) विफलता प्रतिबल (b) संकोचन सीमा

(c) सुघट्य सीमा (d) प्रत्यास्थता सीमा

[RRB-SSE : 03.09.2015]

23. कुछ पदार्थ द्वारा दिखाया गया व्यवहार जिसके आधार पर प्लास्टिक विकृति में वृद्धि के साथ कतरनी प्रतिबल लगातार कम होता जाता है, _____कहलाता है :

(a) पराभाव

(b) विकृति मृदुकरण

(c) विकृति कठोरता

(d) सुघट्यता

[RRB-SSE : 03.09.2015]

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ENGINEERS ACADEMY

RRB : JE ANSWERS AND EXPLANATIONS

1. ***Ans. (a)***

Slenderness ratio is the ratio of the length of a column and the least radius of gyration of its cross section.

2. ***Ans. (a)***

3. ***Ans. (c)***

We know that,

$$E = 2C(1 + \mu) \quad ...(i)$$

and $E = 3\ K\ (1 - 2\mu)$ ...(ii)

From (i)

$$1 + \mu = \frac{E}{2C}$$

$$\therefore \quad \mu = \left(\frac{E}{2C} - 1\right)$$

Putting this value in (i)

$$E = 3K\left[1 - 2\left(\frac{E}{2C} - 1\right)\right]$$

$$= 3K\left[\left(1 - \frac{E}{C} + 2\right)\right]$$

$$E = 3K\left[3 - \frac{E}{C}\right] = 3K\left[\frac{3C - E}{C}\right]$$

$$EC = 3K(3C - E)$$

$$= 9\ KC - 3KE$$

$$\therefore \quad EC + 3KE = 9\ KC$$

$$\therefore \quad E\ (C + 3K) = 9\ KC$$

$$\therefore \quad E = \frac{9KC}{C + 3K}$$

4. ***Ans. (d)***

Malleability is a substance's ability to deform under pressure (compressive stress). If malleable, a material may be flattened into thin sheets by hammering or rolling. Malleable materials can be flattened into metal leaf. Many metals with high malleability also have high ductility.

5. ***Ans. (b)***

6. ***Ans. (c)***

7. ***Ans. (c)***

In ideal plastic material, stress remains constant and deformation is continuous in nature.

8. ***Ans. (c)***

For simply supported beam carrying a point load 'P' at the centre

Strain Energy

$$U = 2\int_0^{\frac{L}{2}} \frac{M^2}{2EI} dx; \quad M = \frac{P}{2} x;$$

$$\therefore \quad U = 2\int_0^{\frac{L}{2}} \frac{p^2 x^2 dx}{2 \times 4EI} = \left[\frac{2P^2 x^3}{2 \times 4EI \times 3}\right]_0^{\frac{L}{2}}$$

At $P = 1,\ U = \frac{L^3}{96\ EI}$

9. ***Ans. (c)***

$$E = 2G(1 + \mu) \quad ....(1)$$

μ = Poisson's Ratio

$$E = 3K(1 - 2\mu) \quad ...(2)$$

$$2G(1 + \mu) = 3K(1 - 2\mu)$$

$$\mu = \left(\frac{3K - 2G}{6K + 2G}\right)$$

10. ***Ans. (b)***

Isotropic material means a material having identical values of a property in all direction. Glass and metals are examples of isotropic materials.

11. ***Ans. (d)***

If the modulus of elasticity is zero the material is said to be plastic.

12. ***Ans. (c)***

Bolts used in column are suitable to carry axial tension.

13. ***Ans. (a)***

The unit of Elastic modulus, stress, shear modulus and pressure is N/m^2.

14. ***Ans. (a)***

15. ***Ans. (a)***

In case of pure bending, radius of curvature will exist and it corresponds to circle.

16. ***Ans. (d)***

Prismatic beam is simply a beam in which there is a uniform cross section throughout.

17. ***Ans. (b)***

Cup and Cone Fracture. The majority of engineering metals experience moderately ductile failure. In uniaxial tension this failure mode has a characteristic appearance known as cup and cone fracture. Cup and cone fracture occurs as a stepwise process.

18. ***Ans. (d)***

Poisson's ratio is the ratio of transverse contraction strain to longitudinal extension strain in the direction of stretching force. Tensile deformation is considered positive and compressive deformation is considered negative.

19. ***Ans. (c)***

The failure of column depends on slenderness ratio. Failure can be due to buckling, compression or bending.

20. ***Ans. (d)***

21. ***Ans. (a)***

22. ***Ans. (c)***

23. ***Ans. (c)***

24. ***Ans. (c)***

25. ***Ans. (b)***

26. ***Ans. (d)***

27. ***Ans. (d)***

$d_0 = 25$ mm

$d_i = 20$ mm

Polar moment of inertia = I

$$= \frac{\pi}{32} \times d_0^4 (1 - k^4)$$

Where , $k = \left(\frac{d_i}{d_0}\right)$

$$= \frac{\pi}{32} \times (25)^4 \left[1 - \left(\frac{20}{25}\right)^4\right]$$

$$= 22641.5 \text{ mm}^4$$

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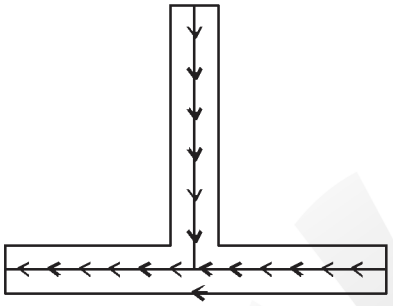
RRB : SSE ANSWERS AND EXPLANATIONS

1. *Ans. (c)*

The S.I. unit of stress is N/m^2.

2. *Ans. (b)*

The shear flow in the section is as shown in the



The shear centre is the point about whcih the moment of the shear flows in all segments should be zero. So, shear centre will lie at the intersection point of two axes.

3. *Ans. (c)*

The centre point deflection of fixed beam carrying central load is one-fourth of the centre point deflection of simply supported carrying same load

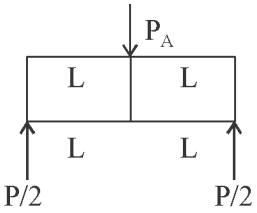
$$\therefore \quad \delta_{max} = \frac{1}{4}\left(\frac{WL^3}{48EI}\right)$$

$$= \frac{WL^3}{192EI}$$

4. *Ans. (c)*

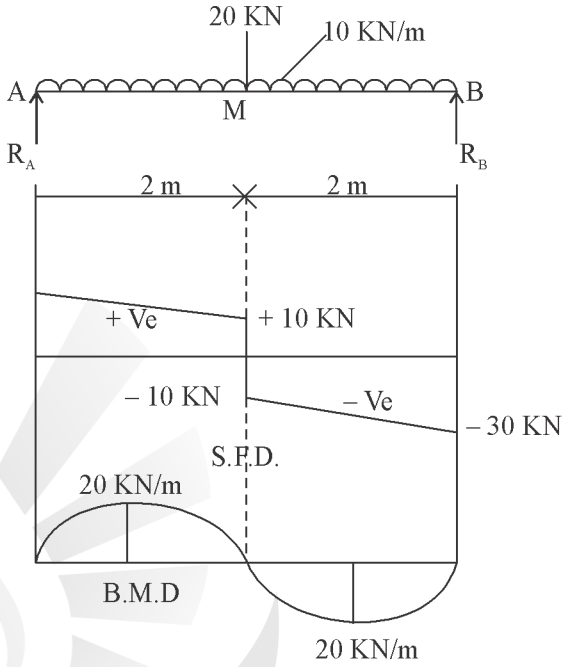
Strain is unit less quantity. It is dimensionless.

5. *Ans. (a)*



$$N_A = P/2 \times L = \frac{PL}{2}$$

6. *Ans. (d)*



7. *Ans. (b)*

Mohr Circle :

The radius of the Mohr circle is the magnitude R.

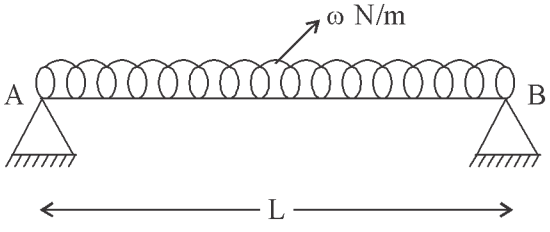
$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + (\tau_{xy})^2}$$

$$R = \frac{\sigma_1 - \sigma_2}{2}$$

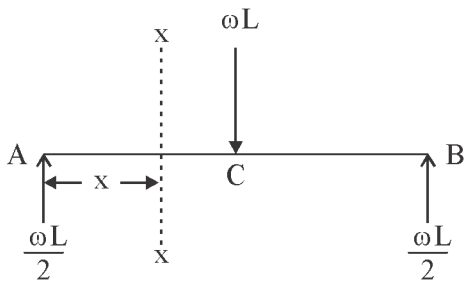
where, σ_1 and σ_2 are principal stress.

8. *Ans. (b)*

Simply supported beam with udl,



Now FBD, take sagging (+ ve) and hogging (–ve)



Now, $M_x = \frac{\omega L}{2}x - \omega x.\frac{x}{2}$

$$M_x = \frac{\omega L}{2}x - \frac{\omega x^2}{2}$$

$\Rightarrow$ $M_A = (x = 0) = 0$

$\Rightarrow$ $M_B(x = L) = \frac{\omega L^2}{2} - \frac{\omega L^2}{2} = 0$

For maximum bending.

$$\frac{dM_X}{dx} = \frac{\omega L}{2} - \omega x = 0$$

Now, $x = \frac{L}{2}$

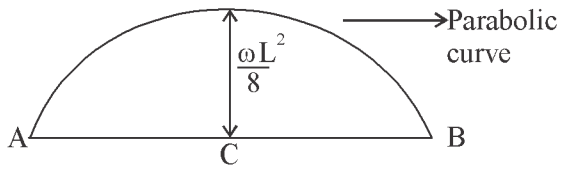
So bending moment at $x = \frac{L}{2}$ to be maximum.

Hence, $M_C = \frac{\omega L}{2}.\left(\frac{L}{2}\right) - \frac{\omega\left(\frac{L}{2}\right)^2}{2}$

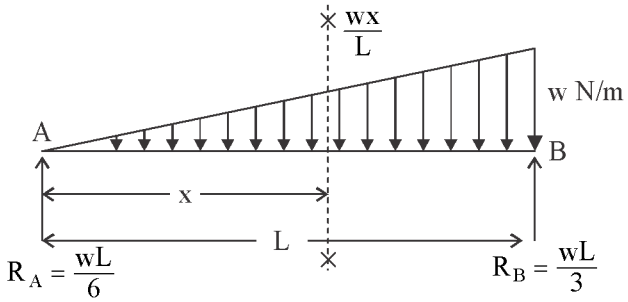
$$= \frac{\omega L^2}{4} - \frac{\omega L^2}{8} = \frac{\omega L^2}{8}$$

$$M_C = \frac{\omega L^2}{8}$$

Hence, BMD should be



9. ***Ans. (c)***



$$R_A + R_B = \frac{wL}{2} \quad ...(1)$$

$$\Sigma M_A = 0$$

$$R_A \times 0 + L \times R_B - \frac{2L}{3} \times \frac{wL}{2} = 0$$

$$R_B = \frac{wL}{3}$$

$$R_A = \frac{wL}{2} - \frac{wL}{3} = \frac{wL}{6}$$

$$(SF)_{x-x} = \frac{wL}{6} - \frac{1}{2} \times \frac{wx}{L} \times x$$

$$= \frac{wL}{6} - \frac{wx^2}{2L}$$

According to question SF = 0 at x

$$\frac{wL}{6} - \frac{wx^2}{2L} = 0$$

$$x^2 = \frac{L^2}{3}$$

$$x = \frac{L}{\sqrt{3}}$$

10. ***Ans. (c)***

Poisson's Ratio : Poisson's ratio is the ratio of transverse contraction strain to longitudinal.

11. ***Ans. (c)***

12. ***Ans. (b)***

Slenderness ratio is the ratio of the effective length of a column (Le) and the least radius of gyration (r) about the axis under consideration. it is given by the symbol "λ" (lambda).

Slenderness Ratio (λ)

$$\lambda = \frac{\text{Effective length}}{\text{least radius of gyration}}$$

$$= \frac{Le}{r}$$

13. ***Ans. (a)***

In a bending beam, a point is known as a point of contraflexure if it is a location at which no bending occurs. In a bending moment diagram, it is the point at which the bending moment curve intersects with the zero line. In other words, where the bending moment changes it's sign from negative to positive or vice versa.

14. ***Ans. (b)***

Area under stress strain represent energy per unit volume to cause failure.

15. ***Ans. (a)***

$$L_{eff} = 2\ L$$
$$= 2 \times h = 2h$$

16. ***Ans. (c)***

Anisotropy is the property of being directionally dependent, which implies different properties in different directions.

17. ***Ans. (b)***

Work hardening, also known as strain hardening, is the strengthening of a metal or polymer by plastic deformation. This strengthening occurs because of dislocation movements and dislocation generation within the crystal structure of the material.

18. ***Ans. (a)***

The deflection is zero at non-yielding supports, the slope is zero at the free end and at the point of maximum positive moment and the bending moment is zero at roller and hinge supports.

19. ***Ans. (a)***

Isotropy comes from the Greek words isos (equal) and tropos (way) and means uniform in all directions. Isotropic materials like glass exhibit the same material properties in all direction, whereas anisotropic materials like graphite exhibit different material properties depending on the direction.

20. ***Ans. (d)***

Rigid supports resist translation in all directions as well as rotation. That is why option d is not correct.

21. ***Ans. (a)***

The load at which an element, a member or a structure as a whole, either collapses in service or buckles in a load test and develops excessive lateral (out of plane) deformation or instability is called as Buckling load.

22. ***Ans. (d)***

Elastic limit, maximum stress or force per unit area within a solid material that can arise before the onset of permanent deformation. The proportional limit is the end point of what is called linearly elastic behavior.

23. ***Ans. (b)***

Strain softening is referred to as a behavior where. The shear resistance (or shear stress) reduces with continues development of plastic shear's strain.

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