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OPSC - 2020

ASSISTANT EXECUTIVE ENGINEER

PRELIMINARY EXAMINATION

QUESTIONS WITH DETAILED SOLUTIONS

CIVIL ENGINEERING

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OPSC - AEE 2020 (Preliminary)
Civil Engineering
Questions with Detailed Solutions

01. Bitumen grade 80/100 means:
(a) Its penetration value is 8 mm
(b) Its penetration value is 10 mm
(c) Its penetration value is 8 to 10 mm
(d) Its penetration value is 8 to 10 cm

01. Ans: (c)

Sol: Penetration value is $\frac{100}{80}$ grade is 80 to 100 units = 8 to 10 mm [1 unit = 1/10 mm]

02. If V is the speed of a moving vehicle, r is the radius of the curve, g is the acceleration due to gravity, W is the width of the carriage way, the super elevation is:
(a) WV/gr (b) W^2/gr
(c) WV/gr^2 (d) WV^2/gr

02. Ans: (d)

Sol: Super elevation, $e = \frac{mv^2}{R}$

$$e = \frac{WV^2}{gR}$$

03. Reinforcement in cement concrete slab of road pavements is placed:
(a) In the form of welded mesh
(b) Longitudinally
(c) Transversally
(d) Longitudinally and transversally

03. Ans: (d)

Sol: Reinforcement is provided in both perpendicular directions longitudinal & transverse directions.

04. Minimum thickness of a layer of fine sand required to cut off the capillary rise of water completely should be:
(a) 40 cm (b) 52 cm
(c) 64 cm (d) 76 cm

04. Ans: (d)

Sol: Minimum thickness of fine sand layer is 76 cm to cutoff capillary rise.

05. The suitable gradient within which an engineer must endeavour to design the road is called:
(a) Limiting gradient (b) Ruling Gradient
(c) Average gradient (d)Exceptional gradient

05. Ans: (b)

Sol: Pavement is designed for Ruling / Momentum gradient which is maximum gradient for design.

06. The ranging of the line between two stations across the raised ground is called:
(a) Direct ranging (b) Indirect ranging
(c) Random line ranging (d) None of these

06. Ans: (b)

Sol: When terminal station of the survey line are not intervisible due to an elevated ground or hill, then indirect or reciprocal levelling is adopted.

07. The correct sequencing of setting up a plane table at a working station is :
(a) Levelling, Centering, Orienting
(b) Centering, Orienting, Levelling
(c) Orienting, Levelling, Centering
(d) Levelling, Orienting, Centering

07. Ans: (a)

Sol: Temporary adjustments of Plane table are

1. Setting
2. Centering } Simultaneously
3. Levelling }
4. Orienting

08. Which of the following scale is the largest one?

(a) 1 cm = 50 m (b) 1 : 42000

(c) RF = 1/300000 (d) 1 cm = 50 km

08. Ans: (a)

Sol: Largest scale has the smallest denominator

a) 1 cm = 50 cm $\Rightarrow$1/5000

b) 1/42000

c) 1/300000

d) 1 cm = 50 km $\Rightarrow$1/5000000

09. The length of a chain is measured from:

(a) Centre of one handle to centre of other handle

(b) Outside of one handle to outside of other handle

(c) Outside of one handle to inside of other handle

(d) Inside of one handle to inside of other handle

09. Ans: (b)

Sol: The designated chain length is measured between the outer ends of the chain handle.

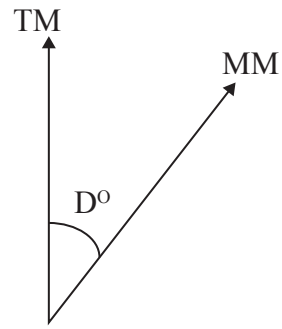
10. The horizontal angle between the true meridian and magnetic meridian is called:

(a) Azimuth (b) Declination

(c) Local attraction (d) Magnetic bearing

10. Ans: (b)

Sol:



The horizontal angle between true meridian and magnetic meridian is called declination.

11. A series of closely spaced contour lines represent a:

(a) Steep slope (b) Gentle slope

(c) Uniform slope (d) Plane surface

11. Ans: (a)

Sol: If the contours are closely spaced the horizontal equivalent is less then the steepness of ground is more.

12. If the intercept on a vertical staff is observed as 0.75 m from a tacheometer, the horizontal distance between the tacheometer and staff station is :

(a) 7.5 m (b) 25 m

(c) 50 m (d) 75 m

12. Ans: (d)

Sol: D = KS + C

Taking K = 100

C = 0

S = 0.75 m

$\therefore$ D = 100 (0.75 m)

= 75 m

#PROGRAM-1

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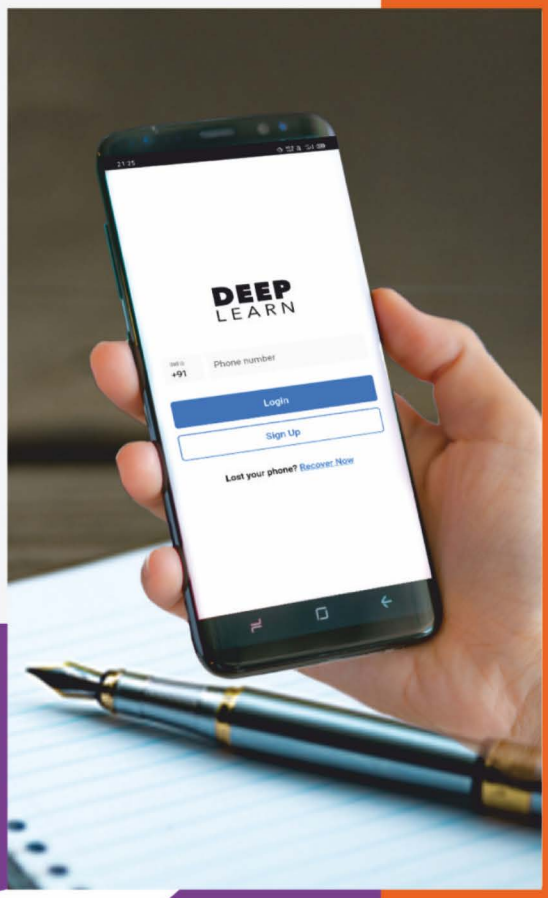

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13. If the fore bearing of a line is 36° 15′, its back bearing will be:
(a) 36° 15′ (b) 126° 15′
(c) 143° 15′ (d) 216° 15′

13. Ans: (d)

Sol: BB = FB ± 180°
+ → FB < 180°
– → FB > 180°
FB = 36°15'
∴ BB = 36°15' + 180°
= 216°15'

14. The theodolite is an instrument used for measuring very accurately:
(a) Horizontal angles only
(b) Vertical angles only
(c) Horizontal and vertical angles
(d) Linear measurement

14. Ans: (c)

Sol: Theodolite is one of the most accurate angle measuring instrument that measures horizontal & vertical angles.

15. The horizontal distance between any two consecutive contours is called:
(a) Vertical equivalent (b) Horizontal equivalent
(c) Contour interval (d) Contour gradient

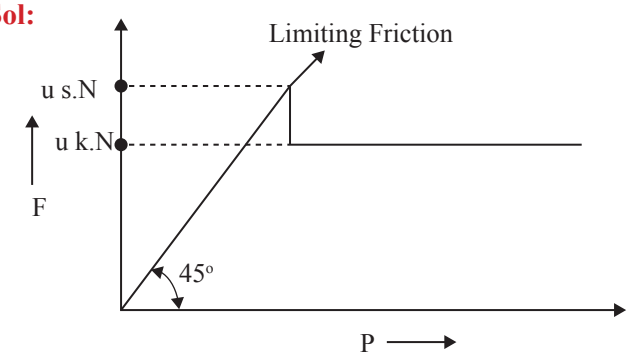
15. Ans: (b)

Sol: The horizontal distance between any 2 consecutive contour line is called horizontal equivalent.

16. The maximum frictional force which comes into play when a body just beginning to slide over the surface of another body is known as:
(a) Static friction (b) Dynamic friction
(c) Limiting friction (d) Coefficient of friction

16. Ans: (c)

Sol:



17. Two balls of equal mass and of perfectly elastic material are lying on the floor. One of the balls with velocity v is made to strike the second ball. Both the balls after impact will move with a velocity:
(a) v (b) v/2
(c) v/4 (d) v/8

17. Ans: (b)

18. The angular velocity (in radians/second) of a body rotating at NRPM is :
(a) πN/60 (b) πN/180
(c) 2πN/60 (d) 2πN/180

18. Ans: (c)

Sol:

1. NRPM means N/60 revolutions per second
2. The angle turned in one revolution is '2π' radians
3. Hence, angular velocity = $\frac{2\pi N}{60}$ rad/sec

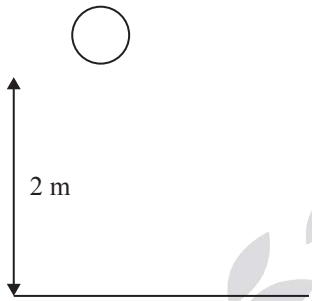
19. The velocity ratio of a differential pulley block with D and d as diameter of larger and smaller pulley is:
(a) D/(D-d) (b) 2D/(D-d)
(c) 2D/(D - d) (d) 2D/(D + d)

19. Ans: (c)

20. A rubber ball is dropped from a height of 2 meters. If there is no loss of velocity after rebounding, the ball will rise to a height of:
(a) 1 meter (b) 2 meters
(c) 3 meter (d) 4 meters

20. Ans: (b)

Sol:



Let, H = initial height from which the ball is dropped
h = height to which the ball will rise
From data H = 2 m

- The ball will strike ground with speed, $V = \sqrt{2 \times g \times H}$ (downward)
- As there is no loss of velocity, the ball will rise with same speed.
- $V1 = \sqrt{2 \times g \times h} = V$ (upward)

$$\therefore h = \frac{v1^2}{2g} = H = 2 \text{ m}$$

- As the ball is not losing the velocity, the potential energy of ball at top will remain same. Hence the ball will rise to the same height.

21. The law of motion involved in recoil of a gun is:
(a) Newton's First Law of Motion
(b) Newton's Second Law of Motion
(c) Newton's Third Law of Motion
(d) None of these

21. Ans: (b)

Sol:

- The recoil of a gun motion is based upon the conservation of momentum.
- The conservation of momentum principle is derived from Newton's Second Law.

$$F = ma = m\frac{dv}{dt}$$

$$\therefore \int F \times dt = \int m \times dv$$

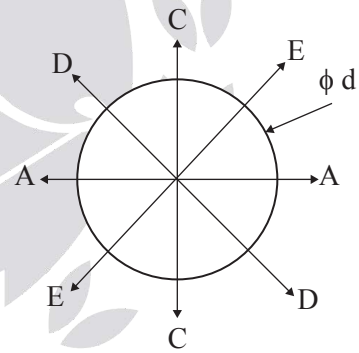
$$= m \times v - m \times u$$

$\therefore$ Impulse = change in momentum
If impulse is zero, then momentum is conserved

22. The moment of inertia of circular section about it's diameter (d) is :
(a) $\pi d^3/16$ (b) $\pi d^3/32$
(c) $\pi d^4/32$ (d) $\pi d^4/64$

22. Ans: (d)

Sol:



The moment of Inertia about axes A, B, C and D, is

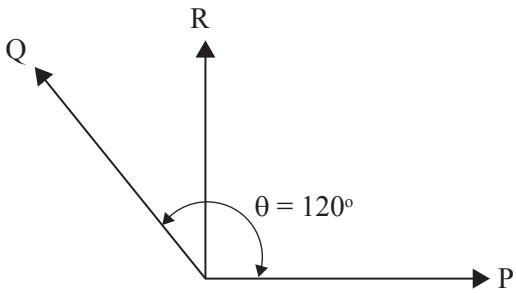
$$I_{AA} = I_{BB} = I_{CC} = I_{DD} = \frac{\pi d^4}{64}$$

- The axes A-A, B-B, C-C and D-D are along the diameter of circle.

23. Two forces are acting at angle of 120°. The bigger force is 40 Newton and the resultant is perpendicular to the smaller force. The smaller force is:
(a) 20 N (b) 40 N
(c) 80 N (d) None of these

23. Ans: (a)

Sol:



- Resultant force (R) is perpendicular to smaller force (P)

$\therefore$ Q = 40 N {Larger force)

From the diagram

$P = -Q \times \cos\theta$

$= -40 \times \cos(120)$

$= -40 \times \cos(90 + 30)$

$= -40 \times [-\sin 30]$

$= -40 \times [-1/2]$

$= 20$ N

24. The acceleration of a particle moving with simple harmonic motion, at any instant is given by:

(a) $\omega.y$ (b) $\omega^2.y$

(c) ω^2/y (d) $\omega^3.y$

Where ω is the angular velocity of the particle in rad/sec and y is the displacement of the particle from means position.

24. Ans: (b)

Sol: In simple Harmonic Motion, $\frac{d^2y}{dt^2} = -w^2 \times y$

$\frac{d^2y}{dt^2}$ = acceleration

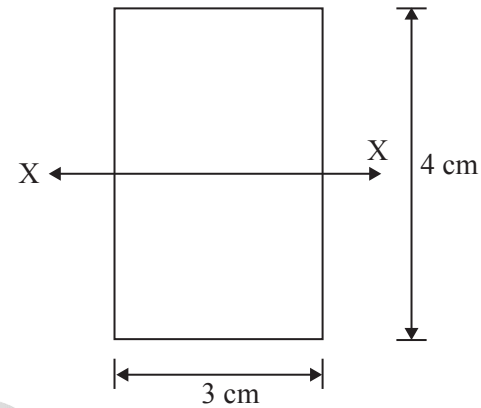
25. The moment of inertia of a rectangular section, 3 cm wide and 4 cm deep, about the X-X axis is

(a) 9 cm^4 (b) 12 cm^4

(c) 16 cm^4 (d) 20 cm^4

25. Ans: (c)

Sol:



$I_{x-x} = \frac{b \times d^3}{12}$

$= \frac{3 \times 4^3}{3 \times 4} = 4 \times 4 = 16\ cm^4$

26. The water content of soil is defined as the ratio of

(a) Volume of water to volume of given soil

(b) Volume of water to volume of voids in soil

(c) Weight of water to weight of air in voids

(d) Weight of water to weight of solids of given mass of soil

26. Ans: (d)

Sol: $w = \frac{W_w}{W_s}$

27. The minimum size of grains of silt is about:

(a) 0.0002 mm (b) 0.002 mm

(c) 0.02 mm (d) 0.2 mm

27. Ans: (b)

Sol:

$|_{2\mu m}$ Silt $|_{75\mu m}$

Minimum size = 2μm = 0.002mm

28. Gravel and sand are:

(a) Cohesive coarse grained soil

(b) Cohesive fine grained soil

(c) Non-cohesive coarse grained

(d) Non-cohesive fine grained soil

#PROGRAM-3

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28. Ans:(c)

Sol: Cohesionless and coarse grain soils

29. The ratio of settlement at any time 't' to the final settlement, is known as:
(a) Coefficient of consolidation
(b) Degree of consolidation
(c) Consolidation index
(d) Consolidation of undisturbed soil

29. Ans: (b)

Sol: Degree of consolidation

$$U(\%) = \frac{S}{S_f} \times 100$$

30. According to Terzaghi, the net ultimate bearing capacity of Clay is given by:
(a) cN_q (b) cN_γ
(c) cN_c (d) $1.3\ cN_c$

30. Ans: (c)

Sol: For clay $q_{nu} = CN_C$

31. If w is the water content and γ is the unit weight of soil mass, then the unit weight of dry soil (γ_d) is equal to :
(a) $(w/\gamma) + 1$ (b) $(\gamma/w) + 1$
(c) $\gamma/(1+w)$ (d) $(1+ w)/ \gamma$

31. Ans:(c)

Sol:

$$\gamma_d = \frac{\gamma}{1+w}$$

32. The relation between void ratio (e) and porosity ratio (n) is
(a) $n = (1+e)/(1-e)$ (b) $e = (1+n)/(1-e)$
(c) $n = e/(1-e)$ (d) $e = n(1+e)$

32. Ans:(d)

Sol:

$$n = \frac{e}{1+e}$$

$\therefore e = n(1+e)$

33. A soil has bulk density of 2.30 g/cm^3 and water content 15 percent, the dry density of the sample is:
(a) 1.0 g/cm^2 (b) 1.5 g/cm^3
(c) 2.0 g/cm^3 (d) 2.5 g/cm^3

33. Ans:(c)

Sol: $\gamma = 2.3$ g/cc

$w = 15\%$

$$\gamma_d = \frac{\gamma}{1+w} \quad \gamma_d = \frac{2.3}{1+0.15} = 2\text{g/cc}$$

34. The plasticity index is the numerical difference between:
(a) Liquid limit and plastic limit
(b) Plastic limit and shrinkage limit
(c) Liquid limit and shrinkage limit
(d) None of these

34. Ans: (a)

Sol: $I_P = w_L - w_P$

35. Mechanical stabilization of soil is done with the help of :
(a) Cement (b) Lime
(c) Bitumen (d) Proper Grading

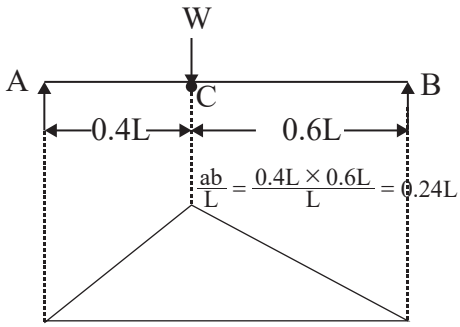
35. Ans: (d)

Sol: Mechanical stabilization is improving strength of soil by proper grading.

36. A load 'W' is moving from left to right supported on a simply supported beam of span 'L'. The maximum bending moment at 0.4 L from the left support is
(a) 0.16 WL (b) 0.20 WL
(c) 0.24 WL (d) 0.25 WL

36. Ans: (c)

Sol:



ILD for BMC

BM_C = load × ordinate of ILD under the load

= W × 0.24L

= 0.24WL kN-m

37. In Moment Distribution Method, the sum of distribution factors of all the members meeting at any joint is always

(a) Zero (b) Less than 1

(c) 1 (d) Greater than 1

37. Ans: (c)

Sol: Distribution factor at a joint equal to one.

i.e DF = 1

38. When a uniformly distributed load, longer than the span of the girder maximum bending moment a mid section occurs when the uniformly distributed load occupies:

(a) Less than the left half span

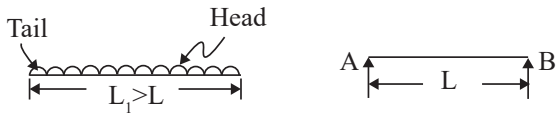
(b) Whole of the left half span

(c) More than the left half span

(d) Whole span

38. Ans: (d)

Sol:



To get the maximum bending moment at a section, place the UdL over entire span, if length of UdL is grater than span.

39. Degree of static indeterminacy of a rigid-jointed plane frame having 15 members, 3 reaction components and 14 joints is:

(a) 2 (b) 3

(c) 6 (d) 8

39. Ans: (c)

Sol: For rigid jointed plane

$D_s = (3m + r) - 3$

$= (3 \times 15 + 3) - 3 \times 14$

$= 48 - 42$

$D_s = 6$

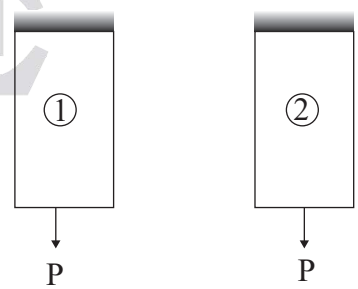
40. Two bars of different material and same size are subjected to the same tensile force. If the bars have unit elongation in the ratio of 2:5, then the ratio of the modulus of elasticity of the two materials will be:

(a) 2 : 5 (b) 5 : 2

(c) 4 : 3 (d) 3: 4

40. Ans: (b)

Sol:



$\delta_1 = \frac{PL}{AE_1}, \quad \delta_2 = \frac{PL}{AE_2}$

$\frac{\delta_1}{\delta_2} = \frac{2}{5}$

$\frac{E_1}{E_2} = ?$

$\frac{\delta_1}{\delta_2} = \frac{\frac{PL}{AE_1}}{\frac{PL}{AE_2}}$

$\frac{\delta_1}{\delta_2} = \frac{E_2}{E_1}$

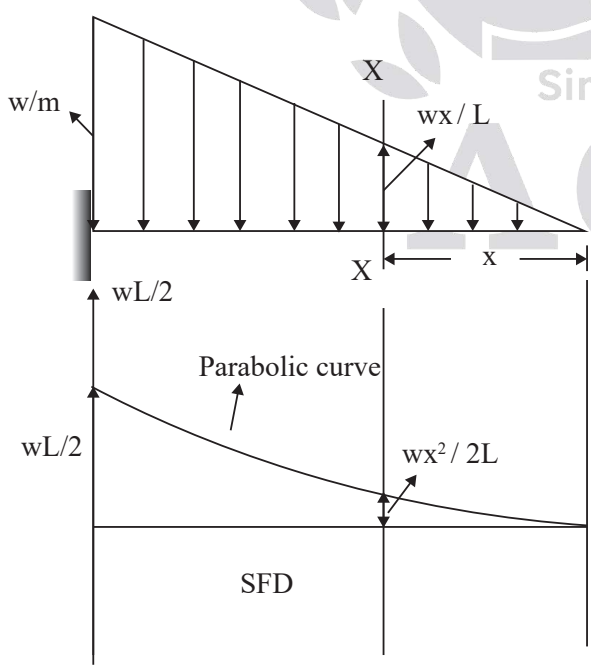
$\frac{E_2}{E_1} = \frac{2}{5}$

$\frac{E_1}{E_2} = \frac{5}{2}$

41. The shear force diagram for a cantilever beam of length *l* and carrying a gradually varying load from zero at the free end and W per unit length at the fixed end is a:
(a) Horizontal straight line
(b) Vertical straight line
(c) Inclined line
(d) Parabolic curve

41. Ans: (d)

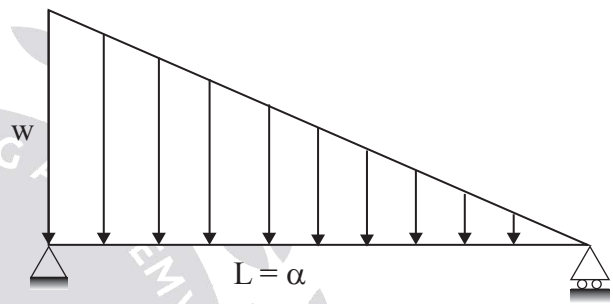
Sol:



42. A simply supported beam carries a varying load from zero at one end and ω at the other end. If the length of beam is α, the maximum bending moment is
(a) wα/27 (b) wα²/27
(c) w²α/$\sqrt{27}$ (d) wα²/9$\sqrt{3}$

42. Ans: (d)

Sol:

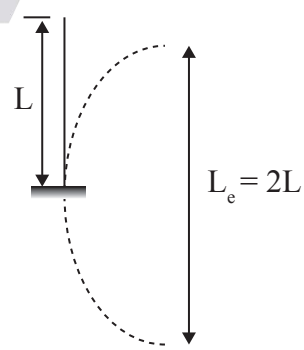


$BM_{max} = \frac{wL^2}{9\sqrt{3}} = \frac{w\alpha^2}{9\sqrt{3}}$

43. The equivalent length of a column of length L, having one end fixed and the other free, is
(a) 2L (b) L
(c) L/2 (d) L/$\sqrt{2}$

43. Ans: (a)

Sol:



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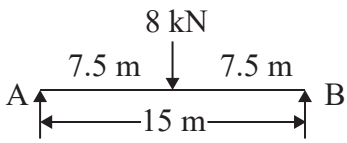
44. The single rolling load of 8 kN rolls along a girder of 15 m span. The absolute maximum bending moment will be:
(a) 8 kN.m (b) 15 kN.m
(c) 30 kN.m (d) 60 kN.m

44. Ans: (c)

Sol: W = 8 kN



To get the absolute maximum BM, place the load 'W' at the centre.

Absolute max BM = $\frac{WL}{4} = \frac{8 \times 15}{4} = 30kN - m$

45. For a single point load W moving on a symmetrical three hinged parabolic arch of span L, the maximum sagging moment occurs at a distance x from the ends. The value of x is
(a) 0.211 L (b) 0.25 L
(c) 0.234 L (d) 0.5L

45. Ans: (a)

Sol: For single point load 'W', the maximum sagging moment occurs at a distance of 0.211L from supports.

46. If the length of a wall on either side of a lintel opening is at least half of its effective span L. the load W carried by the lintel is equivalent to the weight of brickwork contained in an equilateral triangle, producing a maximum bending moment:
(a) WL/2 (b) WL/4
(c) WL/6 (d) WL/8

46. Ans: (c)

Sol: The maximum bending moment due to the weight of masonry above lintel is $\frac{WL}{6}$

47. The length of the lap in a compression member is kept greater than bar diameter x (Permissible stress in bar/ Five times the bond stress) or:
(a) 12 bar diameters (b) 18 bar diameters
(c) 24 bar diameters (d) 30 bar diameters

47. Ans: (c)

Sol: As per IS:456-2000, clause 26.2.5.1 (d). The lap length in compression is shall be equal to the development length in compression but not less than 24ϕ.

48. If H is the overall height of a retraining wall retaining a surcharge, the width of the base slab usually provided, is:
(a) 0.3 H (b) 0.4 H
(c) 0.6 H (d) 0.7 H

48. Ans: (c)

Sol: The width of base slab of retaining wall will be 0.6 H.

Where H : Height of the retaining wall.

49. Workability of concrete is inversely proportional to:
(a) The time of transit
(b) The water-cement ratio
(c) The air in the mix
(d) The size of aggregate

49. Ans: (a)

Sol: The workability of concrete is inversely proportional to the time of transit.

50. If diameter of a reinforcement bar is d, the anchorage value of the hook is:
(a) 4d (b) 8d
(c) 12d (d) 16d

50. Ans: (d)

Sol: As per IS: 456-2000, clause 26.2.2.1 (b). The anchorage value of standard U-Type hook shall be equal to 16 times the diameter of the bar.

51. According to Indian Standards, the pozzolana content in Portland Pozzolana Cement is:
(a) 10% to 25% (b) 25% to 35%
(c) 35% to 50% (d) More than 50%

51. Ans: (a)

Sol: The pozzolana content in portland pozzolana cement is 10 to 25%.

52. For longitudinal reinforcing bars in a column, the cover should not be less than:
(a) 10 mm (b) 20 mm
(c) 30 mm (d) 40 mm

52. Ans: (d)

Sol: As per IS: 456 - 2000, clause 26.4.2.1. For a longitudinal reinforcing bar in a column nominal cover shall in any case not less than 40 mm (or) less than diameter of bar.

53. For the design of retaining walls, the minimum factor of safety against overturning is taken as:
(a) 1.5 (b) 2.0
(c) 2.5 (d) 3.0

53. Ans: (b)

Sol: The factor of safety against overturning shall not be less than (or) equal to 2.

$$\text{F.O.S} = \frac{\text{Resisting moment}}{\text{Over turning moment}} \geq 2$$

54. For deflection of a simply supported beam to be within permissible limits, the ratio of span to effective depth as per IS 456-1978 should not exceed:
(a) 7 (b) 20
(c) 26 (d) 35

54. Ans: (b)

Sol: As per IS: 456-2000, clause 23.2.1 (a). The basic value of span to effective depth ratio for simply supported beam is 20.

55. The live load to be considered for an inaccessible roof, is :
(a) Nil (b) 75 kg/m^2
(c) 150 kg/m^2 (d) 200 kg/m^2

55. Ans: (b)

Sol: The live load
If slope of truss $\leq 10^o$
LL = 1500 N/m^2
If access is provided for maintaining
LL = 750^o N/m^2
(or)
If access is not provided for maintaining 75 kg/m^2

56. For rivet diameter up to 24 mm, the diameter of the rivet hole is larger than the diameter of the rivet by:
(a) 1.0 mm (b) 1.5 mm
(c) 2.0 mm (d) 2.5 mm

56. Ans: (b)

Sol: The diameter of the rivet hole (d)
$d = \phi + 1.5$ mm ($\phi \leq 24$ mm)
$d = \phi + 2.0$ mm ($\phi > 24$ mm)
Where, ϕ = Nominal / Shank diameter of rivet

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57. The effective length of a fillet weld is taken as:
(a) The actual length plus twice the size of weld
(b) The actual length minus twice the size of weld
(c) The actual length minus thrice the size of weld
(d) The actual length minus thrice the size of weld

57. Ans: (b)

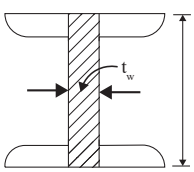
Sol: Effective length of weld (l_{eff}) :

l_{eff} = Actual length of weld - 2 × Size of weld

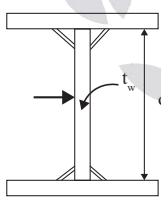
58. The average shear stress for rolled beams is calculated by dividing the shear force at the cross section by the:
(a) Gross section of the web (b) Depth of the beam
(c) Web thickness (d) Width of flange

58. Ans: (a)

Sol: For rolled steel sections, depth of web is taken as overall depth of the beam in resisting shear. If welding is done to take 'I' section, depth of web is taken as clear depth of the web excluding flange plate.



Rolled steel sections



Calculated shear stress in the web = $\frac{V}{d_w t_w}$

Where V = Shear force

Gross area of web = $d_w t_w$

59. The diameter of cold driven rivets range from:
(a) 8 to 12 mm (b) 12 to 22 mm
(c) 22 to 32 mm (d) 32 to 42 mm

59. Ans: (c)

60. The longitudinal space between the effective length of intermittent butt welds is taken not more than:
(a) Four times the thickness of the thicker part joined
(b) Four times the thickness of the thinner part joined
(c) Sixteen times the thickness of the thicker part joined
(d) Sixteen times the thickness of the thinner part joined

60. Ans: (d)

Sol:

- For welds in compression zone, maximum clear spacing between effective length of the welds = 12t or 200 mm. Which ever is less
- For welds in tension zone, maximum clear spacing between effective length of welds = 16t or 200 mm

Which ever is less

t = thickness of thinner plate

61. Maximum permissible slenderness ratio of a member carrying loads resulting from wind is:
(a) 180 (b) 250
(c) 300 (d) 350

61. Ans: (b or d)

Sol:

- A member is subjected to <u>compressive loads</u> due to wind (or) earthquake loads, maximum slenderness ratio = 250.
- <u>For a tension members</u> in a roof truss subjected to reversal of stresses due to the action of wind, maximum slenderness ratio = 350

62. Allowable working stress for rolled steel beam sections compression members may be assumed as:
(a) 60 N/mm^2 (b) 80 N/mm^2
(c) 100 N/mm^2 (d) 120 N/mm^2

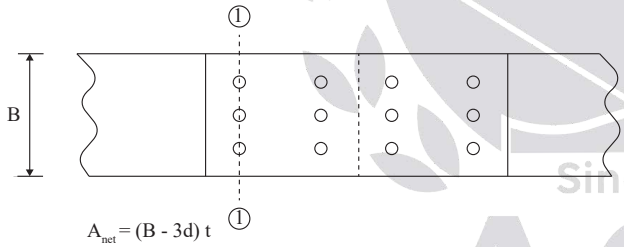
62. Ans: (c)

63. The net cross sectional area of a tension member is equal to
(a) Gross sectional area
(b) Gross sectional area minus the maximum deduction for rivet holes
(c) Gross cross sectional area plus the maximum deduction for rivet holes
(d) Two times the gross sectional area

63. Ans: (b)

Sol: The net cross sectional area of a tension member (A_{net})

A_{net} = gross sectional area-Maximum deduction for rivet holes.



64. The stress in the wall of a thin cylinder subjected to internal pressure is:
(a) Hoop tension
(b) Shear
(c) Hoop compression
(d) Torsional shear

64. Ans: (a)

Sol: σ_c = Hoop Stress

σ_L = Longitudinal stress

Nature = Tensile

65. Stiffeners area used in plate girders to:
(a) Reduce the compressive stress
(b) Reduce shear stress
(c) Take bearing stress
(d) Avoid buckling of web plate

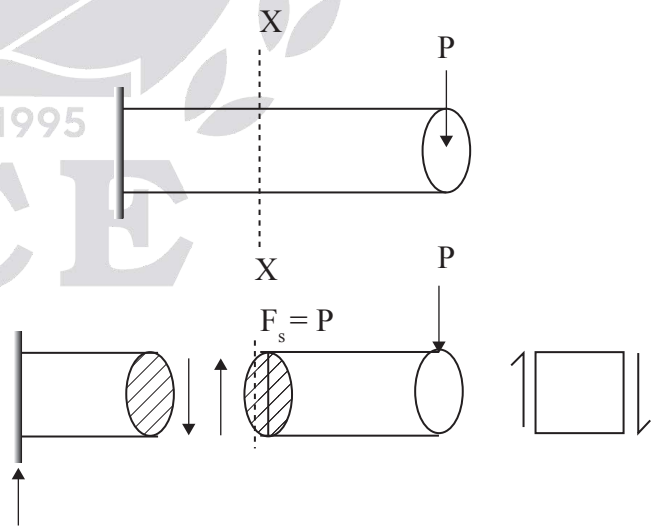
65. Ans: (d)

Sol: Stiffeners are used in a plate girder to avoid buckling of web plates.

66. When a body is subjected to two equal and opposite forces, acting tangentially across the resisting section, as a result of which, the body tends to shear off across the section, the stress and strain induced is
(a) Tensile stress, tensile strain
(b) Compressive stress, compressive strain
(c) Shear stress, tensile strain
(d) Shear stress, shear strain

66. Ans: (d)

Sol:



$$\tau = \frac{F_s}{A_s} = \frac{P}{A}$$

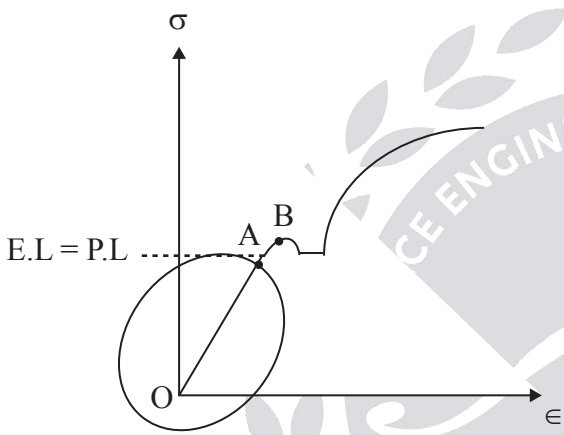
→ Here there is a tendency of sliding of molecules over each other.

Option (d) Shear stress and shear strain

67. Hook's law holds good up to:
(a) Yield point (b) Elastic limit
(c) Plastic limit (d) Breaking point

67. Ans: (b)

Sol:



68. The Poisson's ratio of steel varies from:
(a) 0.23 to 0.27 (b) 0.25 to 0.33
(c) 0.31 to 0.34 (d) 0.32 to 0.42

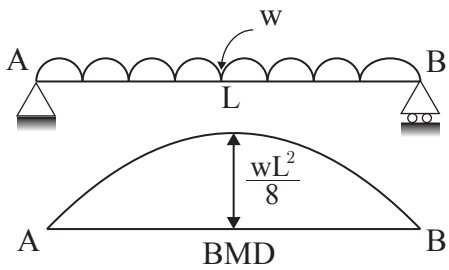
68. Ans: (b)

Sol: $0.27 \le \mu_{steel} \le 0.33$

69. In a simply supported beam, carrying a uniformly distributed load w per unit length, the point of contraflexure:
(a) Lies in the centre of the beam
(b) Lies in the end of the beam
(c) Depends on the length of the beam
(d) Does not exist

69. Ans: (d)

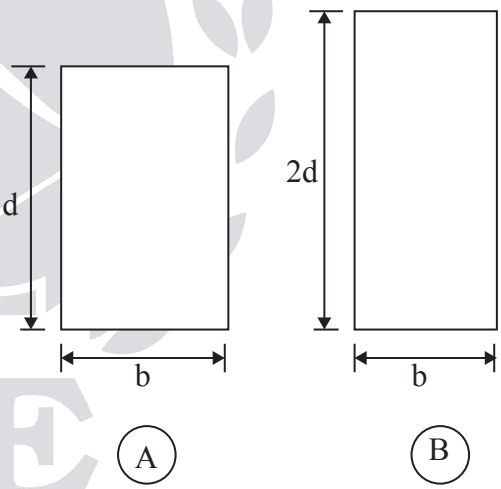
Sol:



70. A rectangular beam A has length *l*, width b and depth d. Another beam B has the same length and width but depth is 2d. The elastic strength of beam B will be:
(a) Same (b) Double
(c) Four times (d) Six times

70. Ans: (c)

Sol:



$L_A = L_B$

Beam strength $\alpha\ Z_{N.A}$

$$\frac{(Z_{N.A})_B}{(\tau_{N.A})_A} = \frac{\frac{b(2d)^2}{6}}{\left(\frac{bd^2}{6}\right)} = \frac{4\left(\frac{bd^2}{6}\right)}{\left(\frac{bd^2}{6}\right)} = 4$$

71. The radius of Mohr's circle for two equal unlike principal stresses of magnitude p is :
(a) p (b) p/2
(c) zero (d) None of these

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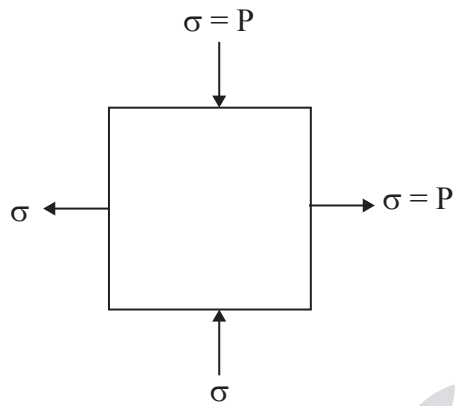
71. Ans: (a)

Sol:



$\sigma_1 = \sigma = P$

$\sigma_2 = -P = -P$

$$\text{Radius} = (\tau_{max}) = \frac{\sigma_1 - \sigma_2}{2}$$

$$= \frac{\sigma - (-\sigma)}{2} = \sigma$$

$\therefore$ Radius = P

72. Rate of change in Bending Moment is equal to
(a) Shear force (b) Deflection
(c) Slope (d) Rate of loading

72. Ans: (a)

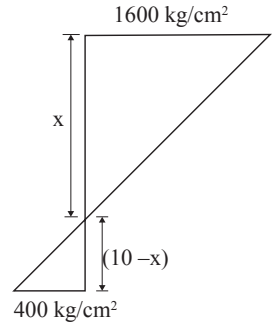
Sol: $F = \frac{dm}{dx} = \frac{kN - m}{m} = kN$

$\therefore$ Rate of change of Bending moment is equal to shear force.

73. The maximum compressive stress at the top of a beam is 1,600 kg/cm^2 and the corresponding tensile stress at the bottom of the beam is 400 kg/cm^2. If the depth of the beam is 10 cm, the neutral axis from the top is at:
(a) 2 cm (b) 4 cm
(c) 6 cm (d) 8 cm

73. Ans: (d)

Sol:



From similar triangles

$$\frac{1600}{x} = \frac{400}{10 - x}$$

$4(10 - x) = x$

$40 - 4x = x$

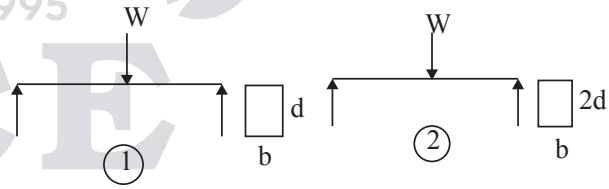
$5x = 40$

$\Rightarrow x = \frac{40}{5} = 8$ cm

74. If the depth of a simply supported beam carrying an isolated load at its centre, is double, the deflection of the beam at its centre will be changed by a factor of:
(a) 2 (b) 1/2 (c) 8 (d) 1/8

74. Ans: (d)

Sol:



$$y_1 = \frac{WL^3}{48EI_1} \qquad y_2 = \frac{WL^3}{48EI_2}$$

$$I = \frac{bd^3}{12}$$

$$y \alpha \frac{1}{I} \Rightarrow y \alpha \frac{1}{d^3}$$

$$\frac{y_2}{y_1} = \left(\frac{d_1}{d_2}\right)^3 = \left(\frac{d}{2d}\right)^3 = \frac{1}{8}$$

$$\Rightarrow y_2 = \left(\frac{1}{8}\right) y_1$$

75. For a given material Young's modulus is 200 GN/m^2 and modulus of rigidity is 80 GN/m^2. The value of Poisson's ratio is
(a) 0.15 (b) 0.20
(c) 0.25 (d) 0.40

75. Ans: (c)

Sol: $E = 200\ GN/m^2,\ G = 80\ GN/m^2$

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

$$\frac{E}{2G} - 1 = \mu$$

$$\frac{200}{2\times 80} - 1 = \mu$$

$$\mu = \frac{1}{4} = 0.25$$

76. If the dynamic viscosity of a fluid is 0.5 poise and specific gravity is 0.5, then the kinematic viscosity of that fluid in stokes is:
(a) 0.25 (b) 0.5
(c) 0.75 (d) 1.0

76. Ans: (d)

Sol: $\mu = 0.5$ Poise $= 0.05$ Pa.s

$S = 0.5 \Rightarrow \rho = 500$ kg/s

$$\upsilon = \frac{\mu}{\rho} = \frac{0.05}{500} = 10^{-4}\ m^2/s = 1\ stoke$$

77. Centre of buoyancy always:
(a) Coincide with the centre of Gravity
(b) Coincide with the centroid of the volume of liquid displaced
(c) Remains above the Centre of Gravity
(d) Remains below the Centre of Gravity

77. Ans: (b)

Sol: Coincides with the centroid of the volume of liquid displaced.

78. A rectangular block 2 meters long, 1 meter wide and 1 meter deep floats in water, the depth of immersion being 0.5 meter. If the water weighs 10 kN/m^3, then the weight of the block is:
(a) 5 kN (b) 10 kN
(c) 15 kN (d) 20 kN

78. Ans: (b)

Sol: Volume of block $= 2 \times 1 \times 1 = 2\ m^3$

Volume of block immersed $= 2 \times 1 \times 0.5 = 1\ m^3$

$$\gamma_{block} = \gamma_{water} \times \frac{V_{block\ immersed}}{V_{block}} = \frac{10\times 1}{2} = 5\ kN/m^3$$

$$W = \gamma_{block}\ V_{block} = 5 \times 2 = 10\ kN$$

79. The distance from pipe boundary, at which the "turbulent shear stress" is one-third the 'wall shear stress', is:
(a) 1/3r (b) 1/2r
(c) 2/3r (d) 3/4r
Where r is radius of the pipe

79. Ans: (c)

Sol: $$\frac{\tau}{\tau_o} = \frac{r}{R} = \frac{\frac{1}{3}\tau_o}{\tau_o} = \frac{r}{R} \Rightarrow r = \frac{1}{3}R$$

Distance from wall $= y = R - r = R$

$$= R - \frac{1}{3}R = \frac{2R}{3}$$

80. In series-pipe problems:
(a) The head loss is same through pipe
(b) The discharge is same through each pipe
(c) A trail solution is not necessary
(d) The discharge through each pipe is added to obtain discharge

80. Ans: (b)

81. The best hydraulic channel cross section is the one which has a:
(a) Minimum roughness co efficient
(b) Least cost
(c) Maximum area for a given flow
(d) Minimum wetted perimeter

81. Ans: (b & d)

82. For maximum discharge in a circular channel section, the ratio of depth of flow to that of the diameter of the channel is
(a) 0.95 (b) 0.81
(c) 0.50 (d) 0.30

82. Ans: (a)

83. If the conjugate depths before and after the jump are 0.5 m and 2.5 m respectively, then the loss of energy in the hydraulic jump will be:
(a) 0.8 m (b) 1.6 m
(c) 3.2 m (d) 6.4 m

83. Ans: (b)

84. Hydraulic pressure on a dam depends upon its
(a) Length (b) Depth
(c) Shape (d) Shape and depth

84. Ans: (b)

Sol: Pressure α h

$\therefore$ Pressure depends on depth

85. Manometers are used to measure:
(a) Pressure in water channels, pipes etc
(b) Difference in pressure at two points
(c) Atmospheric pressure
(d) Very low pressure

85. Ans: (a)

Sol: Manometers are used to measure pressure in pipes and channels.

86. The normal annual precipitation of stations A, B, C and D are 700 mm, 1000 mm, 900 mm and 800 mm respectively. If the storm precipitation at three stations B, C and D were 100 mm, 90 mm and 80 mm respectively, then the storm precipitation for station A will be:
(a) 70 mm (b) 80 mm
(c) 90 mm (d) 105 mm

86. Ans: (a)

Sol: $\frac{P_x}{N_x} = \frac{1}{n}\left(\frac{P_B}{N_B} + \frac{P_C}{N_C} + \frac{P_D}{N_D}\right)$

$$P_x = \frac{700}{3}\left(\frac{100}{1000} + \frac{90}{900} + \frac{80}{800}\right)$$

$P_A = 70$ mm

87. S-hydrograph is used to obtain hydrograph of:
(a) Shorter duration from longer duration
(b) Longer duration from shorter duration
(c) Both (A) and (B)
(d) None of these

87. Ans: (c)

88. A major resistive force in a dam is:
(a) Water pressure (b) Self weight of dam
(c) Wave pressure (d) Uplift pressure

88. Ans: (b)

89. Aqueduct or super passage type of works are used when:
(a) High flood drainage discharge is small
(b) High flood drainage discharge is large and short lived
(c) High flood drainage discharge is large and continues for a long time
(d) None of these

89. Ans: (c)

Sol: In Type - I Cross drainage works,Canal with shorter discharge runs over a drain with larger discharge.

90. Hydrograph is the graphical representation of :
(a) Rainfall and time
(b) Surface runoff and time
(c) Ground water flow and time
(d) Runoff and time

90. Ans: (c)

91. Infiltration rate is always:
(a) More than the infiltration capacity
(b) Equal to or less than the infiltration capacity
(c) Less than the infiltration capacity
(d) Equal to or more than the infiltration capacity

91. Ans: (b)

92. Seepage through embankment in an earthen dam is controlled by:
(a) Drain Trenches
(b) Drainage filters
(c) Relief wells
(d) Provision of downstream berms

92. Ans: (a)

93. Which of the following is least suited for an earthen dam?
(a) Ogee spillway
(b) Chute spillway
(c) Side channel spillway
(d) Shaft spillway

93. Ans:(a)

Sol: Ogee spillway is least suited for earth dam.

94. The main function of a divide wall is to:
(a) Control the silt entry into the canal
(b) Prevent river floods from entering into the canal
(c) Separate the under sluices from weir proper
(d) Provide smooth flow at sufficiently low velocity

94. Ans: (c)

Sol: The main function of a divide wall to separate the under sluices from weir proper.

95. A divide wall is provided:
(a) Parallel to the axis of weir and upstream of it
(b) At right to the axis of weir
(c) Parallel to the axis of weir and downstream of it
(d) At an inclination to the axis of weir

95. Ans: (b)

Sol: A divide wall is provided at right angles to the axis of weir i.e., parallel to axis of river.

96. For water bound macadam roads in localities of heavy rainfall, the recommended value of camber is
(a) 1 in 30 (b) 1 in 36
(c) 1 in 48 (d) 1 in 60

96. Ans: (a)

Sol: As per IRC minimum camber is 1 in 33, it can be rounded to 1 in 30.

97. If the stopping distance is 60 meters, then the minimum stopping sight distance for two lane, two way traffic is:
(a) 180 m (b) 120 m
(c) 30 m (d) 60 m

97. Ans: (d)

Sol: For two lane two way safe SSD = SSD = 60 m.

98. If the average centre to centre spacing of vehicles is 20 meters, than the basic capacity of traffic lane at a speed of 50 kmph is:
(a) 2,500 vehicles per day
(b) 2,000 vehicles per hour
(c) 2,500 vehicles per hour
(d) 1,000 vehicles per hour

98. Ans: (c)

Sol: Capacity, $C = \frac{1000V}{S}$

$= \frac{1000 \times 50}{20} = 2500$ veh/hr

99. The background colour of informatory sign board is
(a) Red (b) Yellow
(c) Green (d) White

99. Ans: (c)

Sol: For informatory sign Green back ground and white letters are used.

100. The ductility value of bitumen for suitability in road construction should not be less than:
(a) 50 cm (b) 60 cm
(c) 40 cm (d) 30 cm

100. Ans: (a)

Sol: Desirable ductility value as per IRC = 50 mm

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