BYJU'S EXAM PREP

AE/JE Foundation

Civil Engineering

Design of Steel Structures

Top 100 Most Expected Questions

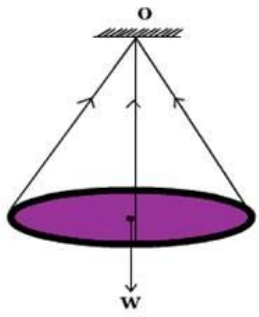
1. The forces which meet at one point and have their lines of action in different planes are called _____.

   A. coplanar non-concurrent forces
   B. non-coplanar concurrent forces
   C. non-coplanar non-concurrent forces
   D. intersecting forces

Ans. B

Sol. Non-coplanar concurrent forces: In this system, all forces do not lie in the same plane, but their line of action passes through a single point.

For example, if a disc of weight W is suspended by means of three strings, line of action of all the forces pass through point 0. The forces do not lie in a plane.



2. Two Tensile forces, each of magnitude F are acting at a point perpendicular to each other, then their resultant force will be :

   A. √2
   B. Zero
   C. √F
   D. √2F

Ans. D

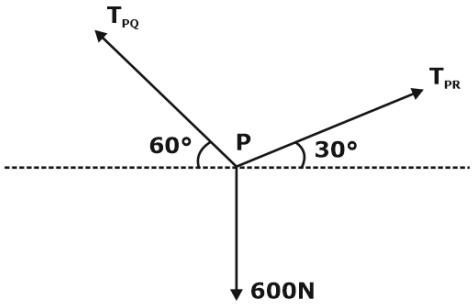
Sol. **Resultant force**is the total force acting on a body including their directions. If the object is at rest or it moves with a same velocity, the resultant force should be zero. All forces are acting on the same direction; resultant force should be the sum of all the forces. One force is acting perpendicular to other, resultant force can be calculated by using Pythagorean theorem. If the force F_1,F_2 and F_3 are acting on a body in same direction. So the formula for resultant force is,

$F_R=F_1+F_2+F_3$

If the force F_2 is perpendicular to the force F_1, then the resultant formula becomes,

$F_R= \sqrt{F_1^2 + F_2^2}$

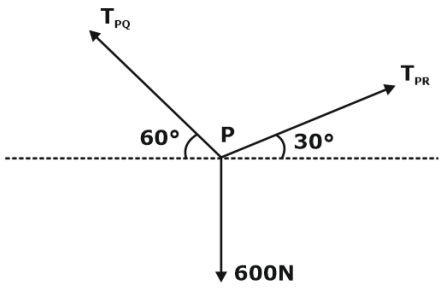
3. If point P is in equilibrium under the action of applied forces, the value of tension T_{PQ} and T_{PR} are respectively.



   A. 520, 300
   B. 300, 520
   C. 250√3, 250√3
   D. 250,250√3

Ans. A

Sol.



By lami's theorem

$$\frac{T_{PQ}}{\sin 120} = \frac{T_{PR}}{\sin(90+60)} = \frac{600}{\sin(90)}$$

T_{PQ}= 519.61

T_{PR}= 300

4. A person who weighs 600 N steps onto a scale that is on the floor of an elevator. If the elevator accelerates downwards at a rate of 6 m/s^2, the scale will read (take g=10 m/s^2)

A. 360 N B. 240 N

C. 600 N D. 120 N

Ans. B

Sol. initial reading, mg = 600N,

m = 600/10 = 60kg

If the elevator accelerates downwards at a rate of 6 m/s^2,

then net acceleration, g' = 10 - 6 = 4m/s^2

a_{net}=4 m/s^2,

therefore, the scale will read= mg' = 60 x 4=240 N

5. An object having 10 kg mass weights 9.81 kg on a spring balance. The value of 'g' at this place is _____?

A. 10 m/sec^2 B. 9.81 m/sec^2

C. 10.2 m/sec^2 D. 9.75 m/sec^2

Ans. A

Sol. in case of spring balance both side value will be same

Actual mass × gravity=mass by spring × g$'$

10 × 9.81 = 9.81 × g$'$

g$'$ = 10m/sec^2

6. An elevator weighing 1000kg attains an upward velocity of 4 m/sec in two seconds with uniform acceleration. The tension in the supporting cables will be(g=10m/s^2):-

A. 1000 N B. 800 N

C. 12000 N D. None of these

Ans. C

Sol. Acceleration is given as

$$a = \frac{4-0}{2} = 2m/s^2$$

Tension is given as

T = mg + ma = m(g+a)

T = 1000(10+2)

T = 12000 N

7. An elevator weighing 1000 kg attains at upward velocity of 2 m/s in 1 second with uniform acceleration from static. The tension in (in N) the supporting cables is

A. 7810 B. 8710

C. 11810 D. 0

Ans. C

So. given,

M = 1000kg, V =2m/s

t = 1sec

from the 1st law of motion

V =u +at

2 = 0 +a×1

a = 2m/s^2

when the elevator is moving upward ,

then

T – Mg =Ma

T – 1000×9.81 = 1000×2

T =11810N

8. The force on a particle of mass 1 kg is 2 kgf, the acceleration of the particle (in m/s^2) is

A. 2 B. 19.62

C. 9.81 D. 0.5

Ans. B

Sol. Using Newton's 2nd law of motion,

Force on a particle, F (in N) = ma

Where, m = mass of particle (kg)

a = acceleration of particle (m/s^2)

Given, F = 2 kgf = 2×9.81 = 19.62 N

(we know that 1kgf=9.81N)

a = F/m = 19.62/1 = 19.62 m/s^2

9. A 70 kg man pushes a 50 kg man by a force of 70 N. The 50 kg man has pushed the 70kg man with a force of magnitude

A. 50 N B. 70 N

C. 140 N D. 0

Ans. B

Sol. Given,

- A 70 kg man pushes a 50 kg man by a force of 70 N.

- According to Newton's 3rd law of motion, 50 kg man will push 70 kg man with same force but in opposite direction.

10. 0.1 kg block is resting on a surface with the coefficient of friction=0.35, a force of 1 N is applied on the block, the friction force will be?

A. 1 N
B. 0.5 N
C. 0.35 N
D. 1.5 N

Ans. C

Sol. When a force of 1 N is applied on the block, the friction force will be .35 N as friction force is a self-adjusting force, if its limiting value is less than the force applied, friction force becomes equal to the force applied to stop that body. Here, the friction force is μmg=0.35 which is less than 1 N. Therefore, friction force will be 0.35 N.

11. A block slips on a rough horizontal floor, moves with a deceleration of 3 m/s^2. The kinetic friction between block and floor is close to

A. 0.5
B. 0.4
C. 0.3
D. 0.1

Ans. C

Sol. Coefficient of kinetic friction is given by a/g, that is 3/9.81=0.308

12. Using lubricants on engine parts is an example of reducing :

A. Motion
B. Force
C. Acceleration
D. Friction

Ans. D

Sol. When a car screeches round a bend at high speed, the only thing that stops it skidding is the friction between its tires and the road—a force that can be several times greater than its weight. Here friction is working like a kind of glue that sticks the car to the road, but it's not always so helpful. Under the hood, friction is busily wearing out the engine parts—it's one of the main ways that a car wastes energy. That's why we need lubricants: substances that fight friction and allow moving machine parts to slide past one another more smoothly.

13. A 13 m ladder is placed against a smooth vertical wall with its lower end 5 m from the wall. What should be the coefficient of friction between the ladder and floor so that it remains in equilibrium?

A. 0.1
B. 0.15
C. 0.28
D. None of these

Ans. D

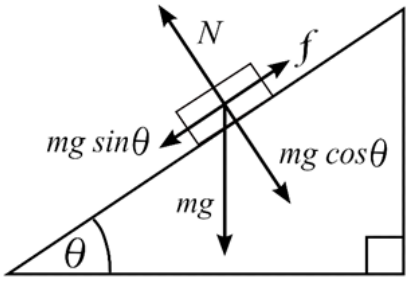
Sol. Without knowing the weight of the ladder, coefficient of friction between the ladder and floor can not be found. This question has insufficient data, although official answer given is (D)

14. When a body slides down an inclined surface, the acceleration (f) of the body is given by:-

A. $f = g$
B. $f = g \sin \theta$
C. $f = g \cos \theta$
D. $f = g \tan \theta$

Ans. B

Sol.



15. A ball is thrown up. The sum of kinetic and potential energies will be maximum at

A. ground
B. highest point
C. in the centre while going up
D. at all points

Ans. D

Sol. as the ball is thrown upwards its initial velocity is high and its height above the ground is less. As the ball continues to move upward its upward velocity reduces and at the same time its height above the ground increases. At the top most part of its trajectory its velocity is zero and its height is maximum. After this point the ball begins a free fall and its velocity increases and its height reduces.In terms of energy at the beginning the ball has high kinetic energy and no potential energy. As it moves up its kinetic energy gets converted to potential energy. At the peak its kinetic energy is nil and it has the highest potential energy. From now onwards its potential energy begins to be converted to kinetic energy as it falls to the ground.In other words the sum of kinetic energy and the potential energy remain same.

16. The rate of change of linear momentum is equals to _____.

A. Active force
B. Reactive force
C. Torque
D. Work done

Ans. A

Sol. This is Newton's Second Law of motion. According to this The rate of change of linear momentum is directly proportional applied force where proportional constant is one.

$F \propto \frac{dmV}{dt}$

F = ma

17. The rate of change of linear momentum is equals to _____.

A. Active force
B. Reactive force
C. Torque
D. Work done

Ans. A

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$F \propto \frac{dmV}{dt}$

F = ma

18. The quantity, which is equal to rate of change of momentum is known as :

A. impulse
B. displacement
C. acceleration
D. force

Ans. D

Sol. The rate of change of momentum of an object is directly proportional to the resultant force applied and is in the direction of the resultant force. The resultant force is equal to the rate of change of momentum.

$$F = \frac{\Delta(mv)}{\Delta t}$$

19. The rate of change of moment of momentum represents the :

A. Power
B. Force
C. Torque
D. Work done

Ans. C

Sol. Torque can be defined as the rate of change of momemt of momentum.
it is analogous to force.
Hence, option C. is the correct Answer .

20. During Inelastic collision of two particles, which one of the following is conserved?

A. Total K.E. only
B. Total linear momentum only
C. Both linear momentum and K.E.
D. None of these

Ans. B

Sol. An inelastic one-dimensional two-object collision. Momentum is conserved, but internal kinetic energy is not conserved.

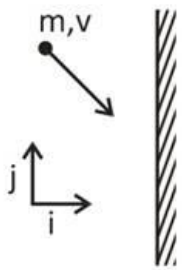
21. When the spring of a watch is wound it posses _____.

A. heat energy
B. kinetic energy
C. potential energy
D. wound energy

Ans. C

Sol. in this case,K.E. is Zero and spring of watch is wound then it store some amount of energy and that energy is called potential energy which will be maximum also.

22. A body is moving in a straight line trajectory as shown below. It hits the wall at an angle of θ with the surface of the wall. Choose from the following statements, the correct statement of the momentum change undergone by the body



A. 2mvsin θ i
B. -2mvsin θ j
C. -2mvsin θ I
D. -2mvcos θ i

Ans. C

Sol. From the diagram, we get the change of momentum in x-direction only and it is negative and 2mvsinθ in magnitude.

change of momentum in x-direction = (-mvsinθ) - (mvsinθ) = -2mvsinθ

23. A small ball of mass 1 kg moving with a velocity of 8 m/s undergoes a direct central impact with a stationary ball of mass 2 kg. the impact is perfectly elastic. The speed of 2 kg mass ball after the impact is _____.

A. 8 m/s B. 16 m/s

C. 4 m/s D. 5.34 m/s

Ans. D

Sol. Given:

mass of moving ball=1 kg

mass of stationary ball=2kg

Initial velocity balls = 8 m/s and 0 m/s.

Let V_1 and V_2 be the final velocites of the balls.

Conservation of linear Momentum:

$1 \times 8 = 1 \times V_1 + 2 \times V_2$

$V_1 + 2V_2 = 8$ ..... (1)

Since collision is perfectly elastic. Thus:

Velocity of approach = Velocity of separation

$8 - 0 = V_2 - V_1$

$V_2 - V_1 = 8$ ..... (2)

By equation (1) and (2):

$3V_2 = 16$

$V_2 = 5.33$ m/s

24. If two bodies, one light and other heavy, have equal kinetic energy, which on has a greater momentum?

A. the heavy body B. the light body

C. both have equal momentum D. unpredictable

Ans. A

Sol. Let the mass of the light body = m kg , its velocity = v m/s.

Let the mass of the heavy body = M kg, M > m , its velocity V m/s.

$KE = (mv)^2/(2m) = (MV)^2/(2M)$

$(mv)^2/(MV)^2 = m/M < 1 \Rightarrow mv < MV$

The heavier body has higher momentum

25. A bucket of water weighing 10 kg is pulled up from a 20 m deep well by a rope weighing 1 kg/m length, then the work done is _____.

A. 200 kg-m B. 400 kg-m

C. 500 kg-m D. 600 kg-m

Ans. B

Sol. Total work done will be the sum of work done to pull the bucket and work done required to pull the rope.

$$dW = (W_{bucket} + W_{rope}) \times dx$$

$$dW = (10 + x)dx$$

$$W = \int_0^{20} (10 + x)dx = 400\ Kg - m$$

Alternatively, you can also try with the concept of centre of mass.

(=10*20*20/2 + 10*20 = 400)

26. A circular disc rolls down an inclined plane, the fraction of its total energy associated with its rotation is _____.

A. 1/2 B. 1/3

C. ¼ D. 2/3

Ans. B

Sol. Kinetic energy associated with circular disc

$$V_{KE} = \frac{1}{2}MV^2$$

Rotational energy associated with circular disc

$$V_{RE} = \frac{1}{2}I\omega^2$$

For circular disc $I = \frac{1}{2}MR^2$ and $V = R\omega$

$$V_{RE} = \frac{1}{2}I\omega^2 = \frac{1}{4}MV^2$$

Hence, $\frac{\text{Rotaional kinetic energy}}{\text{Total Energy}} = \frac{0.25MV^2}{0.5MV^2 + 0.25MV^2} = 1/3$

27. The type of motion when the acceleration is proportional to displacement is called _____.

A. translation B. rotational

C. gyroscopic D. simple harmonic

Ans. D

Sol. Acceleration in SHM is given by.

$$a = \omega^2 x$$

Where x is displacement.

28. In order to double the time period of a simple pendulum _____.

A. the mass of its bob should be doubled

B. the mass of its bob should be quadrupled

C. its length should be doubled

D. its length should be quadrupled

Ans. D

Sol. Time period of simple pendulum $T = 2\pi\sqrt{\frac{L}{g}}$ where L, length of pendulum and g is local gravity acceleration

In order to double the time period it is required to quadrupled the length of pendulam.

29. The vehicle moving on a level circular path will exert pressure such that _____.

A. the reaction on the outer wheels will be more

B. the reaction on the inner wheels will be more

C. the reaction on the inner wheels as well as on the outer wheels will be equal

D. it depends on the speed

Ans. A

Sol.

- Centrifugal force pushes the car outwards. Since the center of mass of the car is above the level of the wheels, it tends to create a moment which pushes the outer wheels down and the inner wheels up.
- Since the outer wheels are being pushed downwards, the ground exerts a greater normal force on the outer wheels.

30. A satellite is kept on moving in its orbit around the earth due to _____.

A. centrifugal force

B. centripetal force

C. gravitational force

D. None of these

Ans. B

Sol. $F = \frac{MV^2}{r}$

F-Cetripital force

M-mass of orbit

r-radius of earth

V-velocity of orbit

Centripetal force is acting to its centre and it is balance all the forces to rotate the orbit. Hence (B) is correct.

31. In simple harmonic motion, acceleration of a particle is proportional to

A. rate of change of velocity

B. Displacement

C. velocity

D. direction

Ans. B

Sol. the acceleration of the object is directly proportional to its displacement from its equilibrium position.

32. A body is thrown vertically upwards with a velocity of 980 cm/sec, then the time the body will take to reach the ground will be

A. 1 second

B. 2 seconds

C. 2.5 seconds

D. 4 seconds

Ans. B

Sol. using the free fall case:

v = u –gt

v= 0 (because it is initial velocity)

u=980cm/sec (final velocity)

g=980 cm^2/sec

u=gt

t=u/g

Therefore,

t=(980/980)=1sec (time taken to go vertically upward),

same time will take to return back

Now total time taken to reach at ground is 1+1 =2 sec.

33. The apparent weight of a man in moving lift is less than his real weight when it is going down with _____.

A. uniform speed
B. an acceleration
C. some linear momentum
D. retardation

Ans. B

Sol. The weight measured can be defined as the force which the body applies in the downward direction. Or, mathematically, it can be written as

F = m.a; where a is directed towards the centre of Earth (downwards).

Now, for a body at rest, the acceleration is the gravitational acceleration 'g'. However, an accelerated body will have some relative acceleration. Considering the downward direction to be positive, we have,

Acceleration due to gravity = g

Downward acceleration inside the lift = a

Therefore, effective acceleration = (g - a)

Total Force in downward direction is given by

F = m.(Effective Acceleration) = m(g - a)

Or, F = mg – ma

Now, since m is always positive and a is positive in downward direction, for a lift moving downwards, we have

mg - ma < mg

Which means, the apparent weight in a lift moving downwards is always less than the actual weight observed at rest.

34. A fan rotates at a constant speed of 60 rpm. The total angular displacement it makes in 10 sec is:

A. Zero
B. 10 π rad
C. 40 π rad
D. 20 π rad

Ans. D

Sol. There are 60 s in a minute, so 60 rpm = 60/60 = 1 rev per second

There are 2π radians in 1 revolution so

60 rpm = 2π rad/s

2π rad/s for 10 s results in an angular displacement of (2π ×10)

Angular displacement = 20π radians

≈ 62.85 radians

35. Which one of the following laws is not applicable for a simple pendulum?

A. the time period does not depend on length

B. the time period is proportional to its length

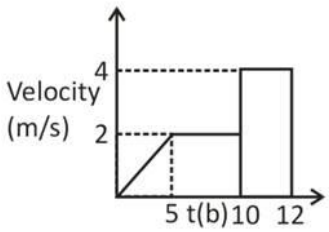
C. the time period is proportional to square root of its length

D. the time period is inversely proportional to square root of its acceleration due to gravity

Ans. B

Sol. $T = 2\pi\sqrt{\frac{L}{g}}$ where L, length of pendulum and g is local gravity acceleration

36. Given below is the velocity-time graph of a traveling body. What is the distance traveled till time t=11 seconds?



A. 23 m

B. 20 m

C. 19 m

D. 21 m

Ans. C

Sol. The area of the v-t graph gives the total distance traveled by the body

so, distance traveled by the body till 11 seconds is

$S = \frac{1}{2} \times 5 \times 2 + 2 \times (10 - 5) + 4 \times 1$

$S = 19m$

37. A right circular cone of base diameter 4 mm and height 8 mm is kept inverted. What is its CG from the top?

A. 2 mm

B. 4 mm

C. 6 mm

D. None of these

Ans. A

Sol. The distance of the centre of gravity of solid cone from the vertex is 3h/4 and from the base is h/4.

Given it's an inverted cone. Thus, the CG from top is is (8/4) =2 mm.

38. The shaft of a motor starts from rest and attains full speed of 1800 rpm in 10 seconds. The shaft has an angular acceleration of _____ rad/sec^2.

A. 3п

B. 6 п

C. 2 п

D. 18 п

Ans. B

Sol. Given

$\omega_1 = 0$.

$N_2 = 1800$ rpm

$\omega_2 = \frac{2\pi N}{60} = \frac{2\pi \times 1800}{60} = 60\pi$

Angular Acceleration ($\propto$)= $\frac{\omega_1 - \omega_2}{t} = \frac{60\pi - 0}{10}$ = 6π.

39. A body of mass 5 kg accelerates at a constant rate of 2 m/s^2 on a smooth horizontal surface due to external force acting at 30° with horizontal. The magnitude of the force is

A. 10 N
B. 13.54 N
C. 11.54 N
D. 15 N

Ans. C

Sol. Horizontal component of the force acting at 30° = Fcos θ

And we have,

$$F\cos(\theta) = m \times a \quad (in\ the\ direction\ of\ horizontal\ surface)$$

$$F\cos(30^o) = 5\ kg\ \times 2\ m/\sec^2$$

$$F\ =\ 11.54\ N$$

40. When two plates are placed end to end and are joined by two cover plates, the joint is known as _____.

A. lap joint
B. butt joint
C. chain riveted lap joint
D. double cover butt joint

Ans. D

Sol. Butt Joint: The two members to be connected are placed end to end. Additional plate/plates provided on either one or both sides, called cover plates, are placed and are connected to main plates. If the cover plate is provided on one side, it is called a single cover butt joint but if the cover plates are provided on both the sides of main plates it is called a double cover butt joint.

41. If p and d are pitch and gross diameter of rivets, the efficiency (η) of the riveted joint is given by

A. η = p/(p-d)
B. η = p/(p+d)
C. η= (p-d)/p
D. η = (p+d)/p

Ans. C

Sol. Efficiency of riveted joint,

η = (p-d)/p

42. A riveted joint may experience

A. shear failure
B. Shear failure of plates
C. bearing failure
D. All option are correct

Ans. D

Sol. A riveted joint may experience shear failure, shear failure of plates and bearing failure.

43. When plates are exposed to weather, tacking rivets are provided at a pitch in line not exceeding

A. 8t
B. 16 t
C. 24 t
D. 32 t

Ans. B

Sol. Tacking rivets should have a pitch in line not exceeding 32t or 300mm whichever is minimum. Where it is exposed to weather pitch in line should not exceed 16t or 200mm whichever is minimum.

44. The strength of a riveted lap joint is equal to its

1- shearing strength
2- bearing strength
3- tearing strength

A. Only 1
B. Only 2
C. Only 3
D. Least of 1, 2 and 3

Ans. D

Sol. All three failures possible in riveted lap joint ie. Shearing, bearing and tearing failure. Therefore least of these strengths will be strength of Lap joint. Tearing failure of plate can be avoided by providing minimum End distance.

45. If diameter of a rivet hole is 25 mm. then according to the Unwin's formula, thickness of plate will be-

A. 13.68 mm
B. 24.65 mm
C. 30.45 mm
D. 17.30 mm

Ans. D

Sol. According to Unwin's formula,
Thickness, $d = 6.01\sqrt{t}$
where d and t are in mm.
So, $25 = 6.01\sqrt{t}$
Thus,
t = 17.30 mm

46. For a 120^0 fillet weld, the ratio of throat thickness to the size of the weld is-

A. $1:\sqrt{2}$
B. $\sqrt{3}:2$
C. 1:2
D. 2:1

Ans. C

Sol. For 120^0 fillet weld, Constant K (= t/S) is given as 0.5.

47. A bolt of grade 4.6 has a nominal yield stress of:

A. 400 N/mm^2
B. 410 N/mm^2
C. 240 N/mm^2.
D. 250 N/mm^2

Ans. C

Sol. x.y is the grade of the bolt which is symbolised as,

$x = \frac{F_{ub}}{100}$, $0.y = \frac{F_{yb}}{F_{ub}}$

Where F_{yb} = yield strength of the bolt

F_{ub} = ultimate strength of the bolt

Therefore, $4 = \frac{F_{ub}}{100}$

$F_{ub} = 400$

$0.6 = \frac{F_{yb}}{F_{ub}}$

$F_{yb} = 0.6 \times 400$

$F_{yb} = 240$ MPa $= 240$ N/mm^2

48. An angle ISA 50x50x6 is connected to a gusset plate 6 mm thick, with 16 mm bolts. What is the bearing strength of the bolt when hole diameter is 16 mm and allowable bearing stress is 250 MPa?

A. 8 KN B. 20 KN

C. 22.5 KN D. 24 KN

Ans. D

Sol. Bearing strength of the bolt (P_b)

$P_b = d \times t \times f_b$

$P_b = 16 \times 6 \times 250$

$P_b = 24000$ N $= 24$ KN

49. A structural member carrying a pull of 700 KN is connected to a gusset plate using rivets. If the pulls required to shear the rivet, to crush the rivet and to tear the plate per pitch length are respectively 60 KN, 35 KN and 70 KN, then the number of rivets required will be:

A. 22 B. 20

C. 18 D. 12

Ans. B

Sol. Pull P = 700 KN

Shear strength of rivet $P_s = 60$ KN

Bearing strength of rivet $P_b = 35$ KN

Strength of rivet or rivet value (R_v) = Smaller of P_s and $P_b = 35$ KN

Number of rivets = $n = \frac{P}{R_v} = \frac{700}{35} = 20$

50. The centre to centre distance between two adjacent consecutive rivets in a line for plates of 10 mm thickness under axial compression:

A. 300 mm B. 200 mm

C. 160 mm D. 120 mm

Ans. D

Sol. Under axial compression, the centre to centre distance between two adjacent consecutive bolts is 12t or 200 mm whichever is less

= 12 x 10 or 200 mm whichever is minimum

= 120 mm or 200 mm whichever is minimum

= 120 mm

51. An equal angle of area A has been welded on one side of the Gusset plate and carries tension along the axis. What is the net effective area of the angle as per IS 800:1984?

A. 0.50 A
B. 0.75 A
C. 0.875 A
D. 1.00 A

Ans. C

Sol. $A_{net} = A_1 + kA_2$

$A_1 = A_2 = A/2$

$$K = \frac{3A_1}{3A_1+A_2}$$

$$K = \frac{3 \times 0.5\,A}{3 \times 0.5\,A+0.5\,A} = 0.75$$

$A_{net} = 0.5\,A + 0.5\,A \times 0.75 = 0.875\,A$

52. In a 10 mm fillet weld the effective length of weld is 1 cm and the permissible shear stress in the weld is 108 N/mm^2

A. 7560 N
B. 8064 N
C. 9072 N
D. 10080 N

Ans. A

Sol. Effective length of weld, l = 1 cm = 10 mm

Size of weld, S = 10 mm

Effective throat thickness, $t = 0.7S = 0.7x10 = 7\ mm$

Shear stress in the weld, $\tau = 108\ N/mm^2$

Strength of weld per unit length = τ l t =108*10*7=7560N

53. If the value of a 20 mm diameter rivet in a lap joint connecting two plates 10 mm and 15 mm thick, then bearing strength of one rivet is

(Take $\tau = 100\ N/mm^2$ and $\sigma = 200\ N/mm^2$)

A. 21.5 kN
B. 32.25 kN
C. 43 kN
D. 64.5 kN

Ans. C

Sol. Nominal diameter of rivet = 20 mm

Gross diameter of rivet, d = 20 + 1.5 = 21.5 mm

Allowable bearing stress in rivet, $\sigma = 200\ N/mm^2$

Thickness of thinner plate in lap joint, t = 10 mm

$$\text{Bearing strength of one rivet} = \sigma.d.t = 200 \times 21.5 \times 10 = 43000\ N = 43\ kN$$

54. Steel has one of the following limitation, i.e.

A. High strength per unit mass
B. High durability
C. Fire and corrosion resistance
D. Reusable

Ans. C

Sol. Steel has a high strength to weight ratio which means it has high strength per unit mass. So no matter how large the overall structure is, the steel sections will be small and lightweight, unlike other building materials.

Steel has high strength per unit mass, highly durable, and is reusable. But steel is poor in fire and corrosion resistance, it needs to be protected. Steel is an alloy of iron. This makes it susceptible to corrosion. This problem can be solved to some extent using anti-corrosion applications. It has high maintenance costs as it has to be painted to make it corrosion-resistant. There are extensive fireproofing costs involved as steel is not fireproof. In high temperatures, steel loses its properties.

55. Design of a riveted joint, is based on the assumption

A. Load is uniformly distributed among all the rivets

B. Shear stress on a rivet is uniformly distributed over its gross area

C. Bearing stress is uniform between the contact surfaces of the plate and the rivet

D. All option are correct

Ans. D

Sol. Following assumptions were made while designing a riveted joint:

i) Load is assumed to be uniformly distributed among all the rivets.

ii) Stress in the plate is assumed to be uniform.

iii) Shear stress is assumed to be uniformly distributed over the gross area of rivets.

iv) Bearing stress is assumed to be uniform between the contact surfaces of the plate and rivet.

v) Bending stress in rivet is neglected.

vi) Rivet hole is assumed to be completely filled by the rivet.

vii) Friction between plates is neglected.

56. The minimum edge and end distance from the centre of any hole to the nearest cut edge shall not be less than

A. 1.5 times hole dia

B. 1.7 times hole dia

C. 2 times hole dia

D. 1.5 times bolt/rivet dia

Ans. A

Sol. minimum edge distance shall not be

a) less than 1.7 times hole dia. In case of hand flame cut edges

b) less than 1.5 times hole dia. In case of rolled , machine flame cut, sawn & planed edges

57. The effective throat thickness in mm of a 8 mm size fillet weld with an angle of 75^0 between the fusion faces:

A. 3 mm

B. 6 mm

C. 8 mm

D. 5.6 mm

Ans. D

Sol. Effective thickness in the fillet weld = k x t_t

Where t_t = throat thickness

K = 0.707 for angle between 60^0 to 90^0

Effective thickness in the fillet weld = 0.707 x 8

= 5.6 mm

58. Design of a riveted joint assumes that _____.

A. the bending stress in rivets is accounted for

B. the riveted hole is to be filled by the rivet

C. the stress in the plate is not uniform

D. the friction between plates is considered

Ans. B

Sol. Design of a riveted joint assumes that the riveted hole is to be filled by the rivet.

59. The distance between two rivets measured perpendicular to the direction of applied force is known as

A. pitch

B. gauge

C. staggered pitch

D. edge distance

Ans. B

Sol.

- Normal Diameter: The diameter of the rivet when cold is called nominal diameter
- Gross Diameter: The diameter of the rivet when it is fully inserted in the rivet hole.
- Edge Distance: The distance between the centers of the outermost rivet and the nearest edge of the member or cover plate.
- Lap: The distance between the edges of overlapping plates or between the joints and the ends of the cover plates which are measured at right angles to the joints.
- Gauge Line: The line of rivets which are parallel to the direction of stress.
- Gauge Distance: The perpendicular distance between two adjacent gauge lines.
- Pitch: The distance between the centers of adjacent rivets in the same row.

60. Splice covers and its connection in a tension member should be designed

A. To develop net tensile strength of main member

B. To carry 50% load of main member

C. In tension member splices are not recommended

D. To carry 33(1/4)% load of main member

Ans. A

Sol. Splice covers and its connection in a tension member should be designed To develop net tensile strength of main member.

61. A single angle in tension is connected by one leg only. If the areas of connecting and outstanding legs are respectively a and b then what is the net effective area of the angle?

A. $a-\frac{b}{1+0.35\frac{b}{a}}$

B. $a+\frac{b}{1+0.35\frac{b}{a}}$

C. $a-\frac{b}{1+0.2\frac{b}{a}}$

D. $a+\frac{b}{1+0.2\frac{b}{a}}$

A. Only A

B. Only B

C. Only C

D. Only D

Ans. B

Sol. $Net\ effective\ area\ of\ the\ angle = a + kb$...(i)

Here $K = \frac{3a}{3a+b}$

By putting K in (i), we get $A_{eff} = a + \frac{b}{1+.33\frac{b}{a}}$

Option B is closest.

62. When the length of a tension member is too long

A. a wire rope is used
B. a rod is used
C. a bar is used
D. a single angle is used

Ans. C

Sol. a bar provides a better stability than the rope.

63. A structural member subjected to tensile force in a direction parallel to its longitudinal axis, is generally known as

A. a tie
B. a tie member
C. a tension member
D. All option are correct

Ans. D

Sol. Tie, tie member and tension member all are design to resist the tensile force.

64. For double angles carrying tension, placed back to back and connected to either side of the gusset plate, the sectional area of the section, is equal to the cross sectional area of

A. the section
B. the section plus area of rivet holes
C. the section minus area of rivet holes
D. the section multiplied by the area of the rivet hole

Ans. C

Sol. For double angle sections carrying tension and placed back to back,
Sectional area of the section = cross sectional area of the section – area of the rivet holes
= (b × t) – (π/4) × d_0^2
(Where one side of the angle section is connected to the either side of the gusset plate)

65. In a tension member if one or more than one rivet holes are off the line, the failure of the member depends upon

A. pitch
B. gauge
C. diameter of the rivet holes
D. All of these

Ans. D

Sol. We know that,
Net sectional area, $A_n = (b - nd_0) .t + (p_i^2 / 4g_i)$
And failure of tension member depends on the net sectional area.
So it depends on diameter of rivet holes (d_0), pitch (p) and gauge (g).

66. For a single angle section, the area of outstanding and connected legs are 450 mm^2 and 300 mm^2. What will be the net area of the section?

A. 500 mm^2
B. 550 mm^2
C. 600 mm^2
D. 650 mm^2

Ans. C

Sol. Area of outstanding leg, A_2 = 450 mm^2

Area of connected leg, $A_1 = 300\ mm^2$

$k = 3A_1 / (3A_1 + A_2) = 3 \times 300 / (3 \times 300 + 450) = 0.667$

So, net effective area, $A_{net} = A_1 + kA_2 = 300 + 0.667 \times 450 = 600\ mm^2$

67. The working stress for structural mild steel in tension is in the order of?

A. 15 N/mm^2 B. 75 N/mm^2

C. 150 N/mm^2 D. 750 N/mm^2

Ans. C

Sol. The permissible or allowable tensile stress = $\sigma_{at} = 0.6 \times f_y$

For mild steel = $f_y = 250$ MPa

$\sigma_{at} = 0.6 \times 250$

$\sigma_{at} = 150$ MPa = 150 N/mm^2

68. Steel of yield strength 400 MPa has been used in structure. What is the value of the maximum allowable tensile strength whether as per IS 800:1984 is:

A. 150 MPa B. 240 MPa

C. 250 MPa D. 400 MPa

Ans. B

Sol. Maximum allowable tensile strength as per IS 800:1984 is 0.6 f_y

Hence, 0.6 x 400 = 240 MPa

69. In steel structures, the property which does not affect the strength of tension members is

A. Length of connection B. Net area of cross section

C. Type of fabrication D. Length of plate

Ans. D

Sol. The strength of tensile members is influenced by factors such as length of connection, size and spacing of fasteners, size and spacing of fasteners, net area of cross section, type of fabrication, connection eccentricity, and shear lag at the end connection.

70. Net sectional area of a tension member is equal to its cross section area_____.

A. plus the area of the rivet holes B. divided by the area of rivet holes

C. multiplied by the area of the rivet holes D. minus the area of the rivet holes.

Ans. D

Sol. In riveting connection,

Net sectional area = gross area of member – the area of rivet holes

Or determined by this formula,

$A = (b-3d) .t$

Where b and t is width and thickness of the member.

And n and d is no. of rivets and diameter of holes.

71. A steel rod of 20 mm diameter is used as a tie member in a roof bracing system, and may be subjected to possible reversal of stress due to wind load. What is the maximum permissible length of the member?

A. 3000 mm B. 2500 mm

C. 1750 mm D. 2000 mm

Ans. C

Sol. Slenderness ratio of a tie member in the roof bracing system may be subjected to possible reversal of stress due to wind load is 350.

$\frac{L}{r_{min.}}$ = Slenderness ratio

Where $r_{min.} = \text{radius of gyration} = \frac{D}{4}$ (For circular section)

D = 20 mm

Therefore, $r_{min.}$ = 5 mm

L = 350 x 5 = 1750 mm

72. The buckling load in a steel column is _____.

A. inversely proportional to square of length

B. Directly proportional to the slenderness ratio

C. Inversely proportional to the slenderness ratio

D. Directly proportional to length

Ans. A

Sol. the buckling load,

$P = \Pi^2 EI/L^2$

P is inversely proportional to the square of the length.

P is also inversely proportional to the square of slenderness ratio.

73. The effective length of battened column is increased by _____.

A. 10% B. 7%

C. 12% D. 25%

Ans. A

Sol. The actual length L of the compression member should be taken as the length from centre-to-centre of intersection of supporting members or the cantilevered length in the case of free standing struts. & the effective length increased by 10% for battened columns.

74. Angle of inclination of the lacing bar with the longitudinal axis of the column should preferably be between _____.

A. 10 ° to 30 ° B. 30 ° to 80 °

C. 40 ° to 70 ° D. 20 ° to 70 °

Ans. C

Sol. lacing bar shall be inclined at 40^0 to 70^0 to axis of built up member or longitudinal axis of the member.

75. The slenderness ratio of lacing bars should not exceed

A. 100 B. 120

C. 180 D. 145

Ans. D

Sol. The slenderness ratio of lacing bars should not exceed to 145

76. A column splice is used to increase?

A. the rigidity of the column
B. the cross-sectional area of the column
C. the strength of the column
D. the length of the column

Ans. D

Sol. Column splice is a joint in the column. where it is used to join shorter lengths of material into longer material.Therefore it is used to increase the length of column

77. According to I.S. : 800 – 1871, lacing bars resist transverse shear equal to_____.

A. 1.0 % of the axial load
B. 2.0 % of the axial load
C. 2.5 % of the axial load
D. 3.0 % of the axial load

Ans. C

Sol. According to 1.5 : 800 — 1871, lacing bars resist transvers shear equal to 2.5 % of the axial load.

78. Maximum permissible slenderness ratio of compressive members which carry dead and superimposed load is

A. 350
B. 250
C. 180
D. 80

Ans. C

Sol. Slenderness ratio = l/r, As per IS 800:2007 A member carrying compressive loads resulting from dead and superimposed loads(live loads) the slenderness ratio should not exceed 180.

79. If the unsupported length of a stanchion is 4 meters and least radius of gyration of its cross-section is 5 cm, the slenderness ratio of the stanchion is

A. 60
B. 70
C. 80
D. 90

Ans. C

Sol. $Slenderness\ ratio = \frac{l}{r}$

$= \frac{400}{5}$

$= 80$

80. The most economical section for a column is

A. rectangular
B. solid round
C. flat strip
D. tubular section

Ans. D

Sol. The buckling load is directly proportional to Moment of inertia (I). A tubular section has higher value of MOI and it is same for both axis.

81. Effective length of a column effectively held in position at both ends and restrained in direction at one end is

A. L
B. 0.67 L
C. 0.85 L
D. 1.5 L

Ans. C

Sol. As per IS 456 & IS 800 effective length of column when one end is fixed and other is hinged = .80L

Option C is nearest.

82. If length of the column is decreased by half of the original length then its buckling load becomes-

A. 4 times
B. 2 times
C. 8 times
D. Remains same

Ans. A

Sol. As we know

$P = \pi^2 E I / L^2$

$P_1 / P_2 = (L_2 / L_1)^2 = (L / 2L)^2 = 1 / 4$

$P_2 = 4P_1$

83. AS per IS 800:2007, the effective slenderness ratio of laced column should be increased by x% than the column without lacing, then value of x is?

A. 2
B. 3
C. 4.5
D. 5

Ans. D

Sol. As per Clause 7.6.1.5 of IS 800:2007, the slenderness ratio of laced column should be 5% more than the actual maximum slenderness ratio so that the shear deformation effects are accounted for.

84. A steel column of Fe410 grade is supported by the base plate and resting on a concrete pedestal of M20 grade, the bearing strength of concrete (in N/mm^2) in limit state method of design as per IS 456-2000 is:

A. 5 N/mm^2
B. 6.75 N/mm^2
C. 9 N/mm^2
D. 20 N/mm^2

Ans. C

Sol. Bearing strength of concrete in LSM = 0.45 f_{ck}

Bearing strength of concrete in LSM = 0.45 x 20

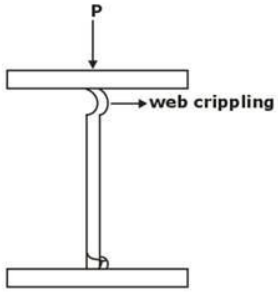
Bearing strength of concrete in LSM = 9 N/mm^2

85. - Web crippling generally occurs at the point where

A. bending moment is maximum
B. shearing force is mini mum
C. concentrated loads act
D. deflection is maximum

Ans. C

Sol. Web crippling generally occurs at the point where concentrated load acts.



86. Rolled steel T-sections are used _____.

A. as columns

B. with flat strips to connect plates in steel rectangular tanks

C. as built up sections to resist axial tension

D. None of these

Ans. B

Sol. Rolled steel T-sections are used with flat strips to connect plates in steel rectangular tanks. Flanges in T-beam increases the moment carrying capacity of tank.

87. Which of the following elements of a pitched roof industrial steel building primarily resists lateral load parallel to the ridge?

A. bracings

B. purlins

C. truss

D. columns

Ans. B

Sol. Purlins resist lateral loads. The wind / horizonal load on a building acting on a endwall panels is dispersed through endwall framing into the continuous purlin system. The purlins transmit the load into the roof bracing and then through the eave purlin to the wall diagonal bracing on the adjacent wall and finally to building.

88. The minimum spacing of vertical stiffeners in plate girder is given by

A. 0.33d

B. 0.5d

C. 0.7d

D. d

Ans. A

Sol. According to IS 800, the spacing of vertical stiffeners shall be kept between 0.33 d to 1.5 d.

89. If roof truss has span length 15 m with slope 20°, then the imposed load is

A. 0.75 kN/m^2

B. 0.95 kN/m^2

C. 0.45 kN/m^2

D. 0.55 kN/m^2

Ans. D

Sol. As per IS 875, for roofs of slope greater than 10°, the imposed load is reduced by 0.02 kN/m^2 for every degree rise in slope.

Therefore, $\text{Imposed load} = 0.75 - 0.02 \times (20° - 10°) = 0.55\ \text{kN/m}^2$

90. Purlins as per IS 800:2007 are designed as?

A. Continuous beam

B. Simply supported beam

C. Cantilever beam

D. None of these

Ans. A

Sol. Purlins can be designed simple, continuous or cantilever beams. If purlins are assumed to be simply supported, the moments will be $wl^2/8$. If they are assumed to be continuous, the moments will be slightly less and taken as $wl^2/10$. IS 800 recommends the purlins to be designed as continuous beams.

91. The load carrying mechanism in web of plate girder post buckling is analogous to?

A. A truss
B. N- truss
C. Pratt truss
D. K-truss

Ans. C

Sol. The load carrying mechanism in web of plate girder post buckling is analogous to Pratt truss. Transverse stiffeners act like the posts of a Pratt truss, with the web handling the duty of carrying the diagonal tensile stresses.

92. Allowable stresses in bending in the design of gantry girder is

A. Reduced by 10%
B. Enhanced by 10%
C. Not changed
D. Dependent on the type of gantry girder

Ans. B

Sol. Indian standard, IS: 800 – 1984 recommends that the allowable stress in axial tension, axial compression and bending stresses and allowable stresses for rivets are increased by 10 percent for the design of gantry girder for the combination of vertical and horizontal loads.

93. Assuming the values of maximum deviation ΔP and ΔE to be 25% of the computed value of P and E respectively, the minimum value of the factor of safety is _____.

A. 1
B. 0.67
C. 1.67
D. 2.67

Ans. C

Sol. P is the effect of load and will be increased by 25% as a partial safety factor.

E is the internal resistance or strength of the system and will be decreased by 25% as a partial safety factor.

Minimum Factor of safety required = $(P+\Delta P)/(E-\Delta E)=(1+25\%)/(1-25\%)=1.25/0.75=1.67$

94. The shape factor of standard rolled beam section varies from

A. 1.10 to 1.20
B. 1.20 to 1.30
C. 1.30 to 1.40
D. 1.40 to 1.50

Ans. A

Sol. Standard result

95. A propped cantilever beam of span l and constant plastic moment capacity M_p carries a concentrated load at mid-span. The load at collapse will be

A. $2\ M_p\ /l$
B. $4\ M_p\ /l$
C. $6\ M_p\ /l$
D. $8\ M_p\ /l$

Ans. C

Sol. Due to plastic mechanism,

$P\ (L/2)\ \theta = M_p\ \theta + 2\ M_p\ \theta$

$P = 6\ M_p\ /l$

96. The permissible stress, to which a structural member can be subjected to, is known as _____.

A. bearing stress
B. working stress
C. tensile stress
D. compressive stress

Ans. B

Sol. In the actual, the material is not subjected up to ultimate stress but only up to a fraction of ultimate stress. This stress is known as working stress. This stress is also known as allowable stress or permissible stress.

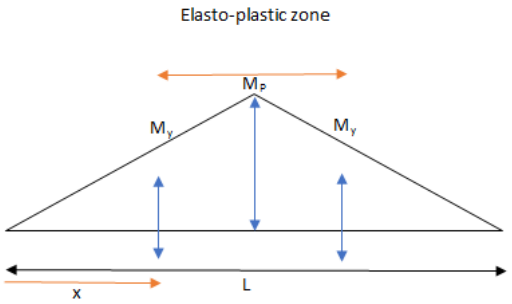
so, Working Stress = (Ultimate Stress) / (Factor of Safety).

97. In case of a simply supported rectangular beam of span L and loaded with a central load W, the length of elasto-plastic zone of the plastic hinge is

A. L/2
B. L/3
C. L/4
D. L/5

Ans. B

Sol.



$By\ similar\ trriangle, \frac{M_p}{M_y} = \frac{L/2}{x}$

$Here, \frac{M_p}{M_y} = \frac{Z_p \times f_y}{Z_y \times f_y}, \frac{Z_p}{Z_y}(shape\ factor) = \frac{3}{2}$

$Hence\ x = \frac{L}{3}, Length\ of\ plastic\ hinge = 2 \times \left(\frac{L}{2} - x\right)$

$= \frac{L}{3}$

98. In plastic analysis, the shape factor for a triangular section is

A. 1.5
B. 1.34
C. 2.34
D. 25

Ans. C

Sol. Shape factor = plastic moment/yield moment.

1. Rectangular section Shape factor 1.5
2.(a) Triangular section 1.5
(b) Triangular section (Vertex upward) 2.34
3. Solid circular section 1.7
4. Thin circular ring solid 1.27
5. (a) Diamond section (Rhombus) 2.00

(b) Thin hollow rhombus 1.50

6. Isection

(a) About strong axis 1.12

(b) about weak axis 1.55

7. Tsection 1.90 to 1.95

99. A simply supported rectangular beam, length 3m. plastic hinge is formed in beam after applying load to the beam. Length of plastic hinge will be-

A. 2m B. 3m

C. 1m D. 4m

Ans. C

Sol. Length of plastic hinge for simply supported beam,

$L' = l\ (1 - 1/k_s)$

Where, k_s = shape factor = 1.5 for rectangular beam

$L' = 3\ (1 - 1/1.5) = 3X1/3 = 1m$

100. Ratio of shape factor for solid circular section to triangular section will be-

A. 1.37 B. 0.73

C. 0.64 D. 1.56

Ans. B

Sol. Shape factor for solid circular section, $K_{s1} = 1.7$

And shape factor for triangular section, $K_{s2} = 2.34$

So, $K_{s1} / K_{s2} = 1.7 / 2.34 = 0.73$

****