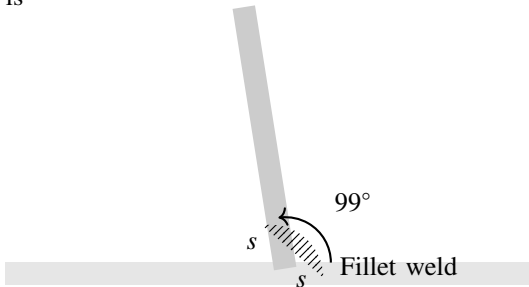
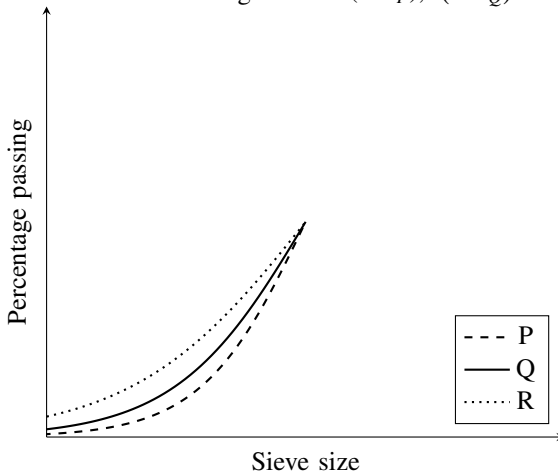


- 1) Let  $\{A\}$  be a square matrix which is neither symmetric nor skew-symmetric, and  $\{A\}^T$  is its transpose. The sum and difference of these matrices are defined as  $\{S\} = \{A\} + \{A\}^T$  and  $\{D\} = \{A\} - \{A\}^T$ , respectively. Which of the following statements is TRUE?
- Both  $\{S\}$  and  $\{D\}$  are symmetric
  - Both  $\{S\}$  and  $\{D\}$  are skew-symmetric
  - $\{S\}$  is skew-symmetric and  $\{D\}$  is symmetric
  - $\{S\}$  is symmetric and  $\{D\}$  is skew-symmetric
- 2) The square root of a number  $N$  is to be obtained by applying the Newton Raphson iterations to the equation  $x^2 - N = 0$ . If  $i$  denotes the iteration index, the correct iterative scheme will be
- $x_{i+1} = \frac{1}{2} \left( x_i + \frac{N}{x_i} \right)$
  - $x_{i+1} = \frac{1}{2} \left( x_i^2 + \frac{N}{x_i} \right)$
  - $x_{i+1} = \frac{1}{2} \left( x_i + \frac{N^2}{x_i} \right)$
  - $x_{i+1} = \frac{1}{2} \left( x_i - \frac{N}{x_i} \right)$
- 3) There are two containers, with one containing 4 Red and 3 Green balls and the other containing 3 Blue and 4 Green balls. One ball is drawn at random from each container. The probability that one of the balls is Red and the other is Blue will be
- $\frac{1}{7}$
  - $\frac{9}{49}$
  - $\frac{12}{49}$
  - $\frac{3}{7}$
- 4) For the fillet weld of size  $s$  shown in the adjoining figure, the effective throat thickness is



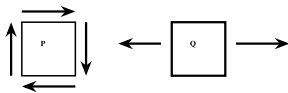
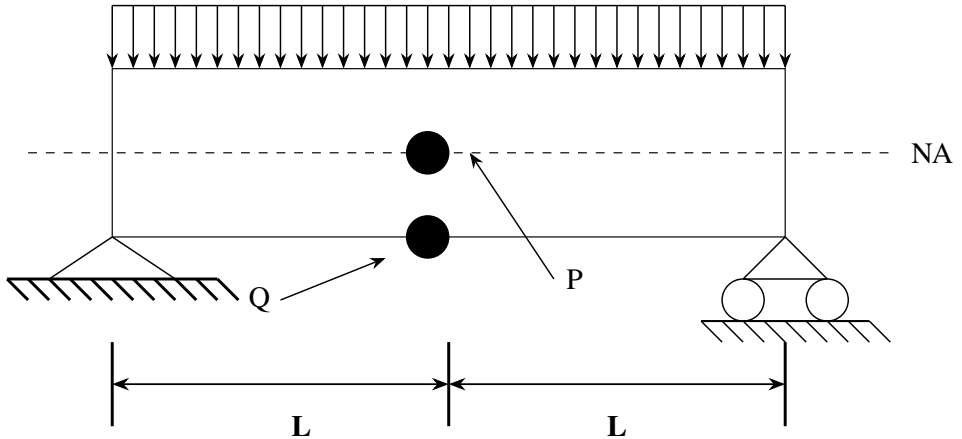
- $0.61s$
- $0.65s$
- $0.70s$
- $0.75s$

- 5) A 16 mm thick plate measuring  $650\text{mm} \times 420\text{mm}$  is used as a base plate for an ISHB 300 column subjected to a factored axial compressive load of 2000kN. As per IS 456 – 2000, the minimum grade of concrete that should be used below the base plate for safely carrying the load is
- a) M15  
b) M20  
c) M30  
d) M40
- 6) Consider a reinforcing bar embedded in concrete. In a marine environment this bar undergoes uniform corrosion, which leads to the deposition of corrosion products on its surface and an increase in the apparent volume of the bar. This subjects the surrounding concrete to expansive pressure. As a result, corrosion induced cracks appear at the surface of concrete. Which of the following statements is TRUE?
- a) Corrosion causes circumferential tensile stresses in concrete and the cracks will be parallel to the corroded reinforcing bar.  
b) Corrosion causes radial tensile stresses in concrete and the cracks will be parallel to the corroded reinforcing bar.  
c) Corrosion causes circumferential tensile stresses in concrete and the cracks will be perpendicular to the direction of the corroded reinforcing bar.  
d) Corrosion causes radial tensile stresses in concrete and the cracks will be perpendicular to the direction of the corroded reinforcing bar.
- 7) The results for sieve analysis carried out for three types of sand, (P), (Q) and (R), are given in the adjoining figure. If the fineness modulus values of the three sands are given as  $(FM_P)$ ,  $(FM_Q)$  and  $(FM_R)$ , it can be stated that

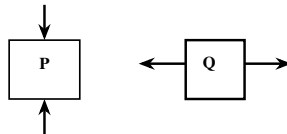


- a)  $FM_Q = \sqrt{FM_P \times FM_R}$   
b)  $FM_Q = 0.5 (FM_P + FM_R)$   
c)  $FM_P > FM_Q > FM_R$   
d)  $FM_P < FM_Q < FM_R$

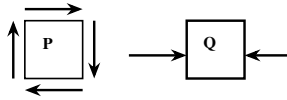
- 8) The cross-section of a thermo-mechanically treated (TMT) reinforcing bar has
- soft ferrite-pearlite throughout.
  - hard martensite throughout.
  - a soft ferrite-pearlite core with a hard martensitic rim.
  - a hard martensite core with a soft pearlite-bainitic rim.
- 9) Consider a simply supported beam with a uniformly distributed load having a neutral axis (NA) as shown. For points  $P$  (on the neutral axis) and  $Q$  (at the bottom of the beam) the state of stress is best represented by which of the following pairs?



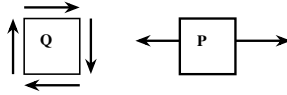
a)



b)



c)



d)

10) For a saturated sand deposit, the void ratio and specific gravity of solids are 0.70 and 2.67, respectively. The critical (*upward*) hydraulic gradient for the deposit would be

- a) 0.54  
b) 0.98

- c) 1.02  
d) 1.87

11) Likelihood of general shear failure for an isolated footing in sand decreases with

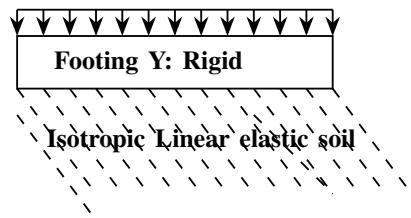
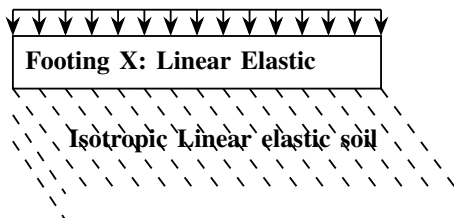
- a) decreasing footing depth  
b) decreasing inter-granular packing of the sand  
c) increasing footing depth  
d) decreasing soil grain compressibility

12) For a sample of dry, cohesionless soil with friction angle,  $\phi$ , the friction plane will be inclined to the major principal plane by an angle to

- a)  $\phi$   
b)  $45^\circ$

- c)  $45^\circ - \phi/2$   
d)  $45^\circ + \phi/2$

13) Two geometrically identical isolated footings, X (linear elastic) and Y (rigid), are loaded identically (shown alongside). The soil reactions will



- a) be uniformly for Y but not for X  
b) be uniformly for X but not for Y  
c) be uniformly distributed for both X and Y  
d) not be uniformly distributed for both X and Y