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- 1) For a laminar incompressible flow past a flat plate at zero angle of attack, the variation of skin friction drag coefficient (C_f) with Reynolds number based on the chord length (Re_c) can be expressed as
 - a) $C_f \propto \sqrt{Re_c}$
 - b) $C_f \propto Re_c$
 - c) $C_f \propto \frac{1}{\sqrt{Re_c}}$
 - d) $C_f \propto \frac{1}{Re_c}$
- 2) Which of the following is NOT TRUE across an oblique shock wave?
 - a) Static temperature increases, total temperature remains constant.
 - b) Static pressure increases, static temperature increases.
 - c) Static temperature increases, total pressure decreases.
 - d) Static pressure increases, total temperature decreases.
- 3) For a completely subsonic isentropic flow through a convergent nozzle, which of the following statement is TRUE?
 - a) Pressure at the nozzle exit > back pressure.
 - b) Pressure at the nozzle exit > back pressure.
 - c) Pressure at the nozzle exit = back pressure.
 - d) Pressure at the nozzle exit = total pressure.
- 4) Which of the following aircraft engines has the highest propulsive efficiency at cruising Mach number of less than 0.5?
 - a) Turbofan engine
 - b) Turbojet engine
 - c) Turboprop engine
 - d) Ramjet engine
- 5) Air, with a Prandtl number of 0.7, flows over a flat plate at a high Reynolds number. Which of the following statement is TRUE?
 - a) Thermal boundary layer is thicker than the velocity boundary layer.
 - b) Thermal boundary layer is thinner than the velocity boundary layer.
 - c) Thermal boundary layer is as thick as the velocity boundary layer.
 - d) There is no relationship between the thickness of thermal and velocity boundary layers.
- 6) Consider an eigenvalue problem given by $\mathbf{Ax} = \lambda_i \mathbf{x}$. If λ_i represents the eigenvalues of the non-singular square matrix \mathbf{A} , then what will be the eigenvalues of the matrix \mathbf{A}^2 ?
 - a) λ_i^4
 - b) λ_i^2
 - c) $\lambda_i^{\frac{1}{2}}$
 - d) $\lambda_i^{\frac{1}{4}}$
- 7) If \mathbf{A} and \mathbf{B} are both non-singular $n \times n$ matrices, then which of the following statement is NOT TRUE. Note: \det represents the determinant of the matrix.
 - a) $\det(\mathbf{AB}) = \det(\mathbf{A}) \det(\mathbf{B})$
 - b) $\det(\mathbf{A} + \mathbf{B}) = \det(\mathbf{A}) + \det(\mathbf{B})$
 - c) $\det(\mathbf{AA}^{-1}) = 1$

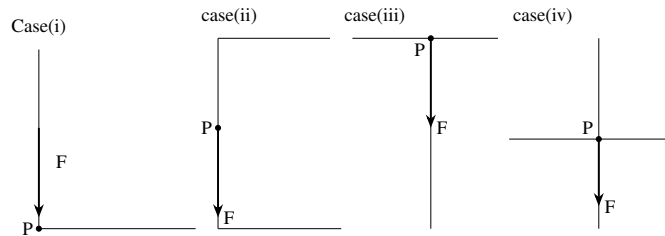
d) $\det(\mathbf{A}^T) = \det(\mathbf{A})$

- 8) The total number of material constants that are necessary and sufficient to describe the three dimensional Hooke's law for an isotropic material is _____.
 9) Determine the correctness or otherwise of the following statements [a] and [r]:

[a]: In a plane stress problem, the shear strains along the thickness direction of a body are zero but the normal strain along the thickness is not zero.

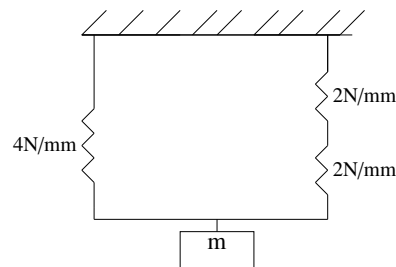
[r]: In a plane stress problem, Poisson effect induces the normal strain along the thickness direction of the body.

- a) Both [a] and [r] are true and [r] is the correct reason for [a].
 b) Both [a] and [r] are true but [r] is not the correct reason for [a].
 c) Both [a] and [r] are false.
 d) [a] is true but [r] is false
- 10) Consider four thin-walled beams of different open cross-sections, as shown in the cases (i – iv). A shear force of magnitude 'F' acts vertically downward at the location 'P' in all the beams. In which of the following case, does the shear force induce bending and twisting?



- a) (i)
 b) (ii)
 c) (iii)
 d) (iv)

- 11) The effective stiffness of the spring-mass system as shown in the figure below is _____ $\frac{N}{mm}$.



- 12) A structural member supports loads, which produce at a particular point, a state of pure shear stress of $50 \frac{N}{mm^2}$. At what angles are the principal planes oriented with respect to the plane of pure shear?
- a) $\frac{\pi}{6}$ and $\frac{2\pi}{3}$
 b) $\frac{\pi}{4}$ and $\frac{3\pi}{4}$
 c) $\frac{\pi}{4}$ and $\frac{\pi}{2}$
 d) $\frac{\pi}{2}$ and π

- 13) Let x be a positive real number. The function $f(x) = x^2 + \frac{1}{x^2}$ has its minima at $x =$ _____.