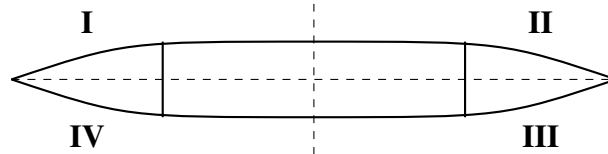


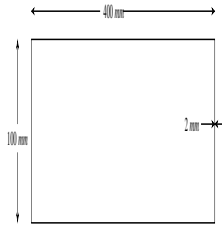
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AI24BTECH11023 - Tarun Reddy Pakala

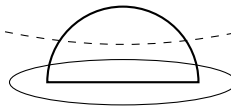
- 1) The positive high angle-of-attack condition is obtained in a steady pull-out maneuver at the largest permissible angle-of-attack of the wing. Under this condition, at which of the following regions of the wing does the maximum tension occur?



- a) I
b) II
c) III
d) IV
- 2) The natural frequency of the first mode of a rectangular cross section cantilever aluminum beam is $\omega \frac{rad}{s}$. If the material and cross-section remain the same, but the length of the beam is doubled, the first mode frequency will become
- a) $\frac{\omega}{4} \frac{rad}{s}$
b) $4\omega \frac{rad}{s}$
c) $\frac{\omega}{16} \frac{rad}{s}$
d) $16\omega \frac{rad}{s}$
- 3) Given $A = \begin{pmatrix} \sin \theta & \tan \theta \\ 0 & \cos \theta \end{pmatrix}$, the sum of squares of eigenvalues of A is
- a) $\tan^2 \theta$
b) 1
c) $\sin^2 \theta$
d) $\cos^2 \theta$
- 4) Burnout velocity of a space vehicle in a circular orbit at angle 5 degrees above the local horizon around earth is $13.5 \frac{km}{s}$. Tangential velocity of the space vehicle in the orbit is _____ $\frac{km}{s}$ (round off to two decimal places).
- 5) Velocity of an airplane in the body fixed axes is given as $[100 \ -10 \ 20] \frac{m}{s}$. The sideslip angle is _____ degrees (round off to two decimal places).
- 6) The similarity solution for the diffusion equation, $\frac{\partial u}{\partial t} = \alpha \frac{\partial^2 u}{\partial x^2}$ is $u(x, t) = u(\eta)$, where similarity variable, $\eta = \frac{x}{\sqrt{\alpha t}}$. If $u(x, 0) = e^{-x^2}$, the ratio $\frac{u(0, 1)}{u(0, 4)} =$ _____ (round off to one decimal place).
- 7) Air enters the rotor of an axial compressor stage with no pre-whirl ($C_\theta = 0$) and exits the rotor with whirl velocity, $C_\theta = 150 \frac{m}{s}$. The velocity of rotor vanes, U is $200 \frac{m}{s}$. Assume $C_P = 100 \frac{J}{kg \cdot K}$, the stagnation temperature rise across the rotor is _____ K (round off to one decimal place).
- 8) A thin walled beam of constant thickness shown in the figure is subjected to a torque of 3.2 kNm . If the shear modulus is 25 GPa , the angle of twist per unit length is _____ $\frac{rad}{m}$ (round off to three decimals).

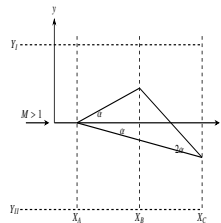


- 9) An airplane of mass 5000 kg is flying at a constant speed of $360 \frac{\text{km}}{\text{h}}$ at the bottom of a vertical circle with a radius of 400 m , as shown in the figure. Assuming that the acceleration due to gravity is $9.8 \frac{\text{m}}{\text{s}^2}$, the load factor experienced at the center of gravity of the airplane is _____ (round off to two decimal places).

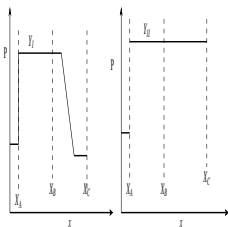


Airplane

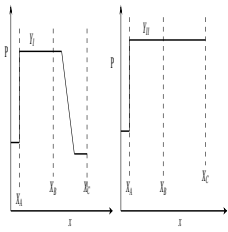
- 10) The equation $x \frac{dx}{dy} + y = c$, where c is a constant, represents a family of
- exponential curves
 - parabolas
 - circles
 - hyperbolas
- 11) A wedge shaped airfoil is placed in a supersonic flow as shown in figure (not to scale). The corners of the wedge are at $x = x_A$, $x = x_B$, $x = x_C$, respectively.



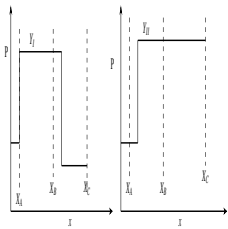
Which one of the following represents the correct static pressure along $y = Y_I$ and $y = Y_{II}$?



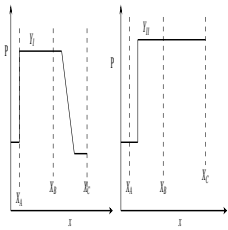
a)



b)



c)

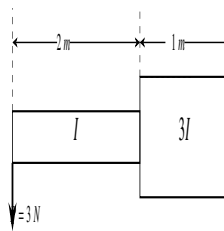


d)

12) The value of Poisson's ratio at which the shear modulus of an isotropic material is equal to the bulk modulus is

- a) $\frac{1}{2}$
- b) $\frac{1}{4}$
- c) $\frac{1}{6}$
- d) $\frac{1}{8}$

13) A load P is applied to the free end of a stepped cantilever beam as shown in the figure. The Young's modulus of the material is E , and the moments of inertia of the two sections of length 2 m and 1 m are I and $3I$, respectively. Ignoring transverse shear and stress concentration effects, the deflection at the point where the load is applied at the free end of the cantilever is



- a) $\frac{23}{243EI}$
- b) $\frac{3EI}{43}$
- c) $\frac{3EI}{23}$
- d) $\frac{23}{3EI}$