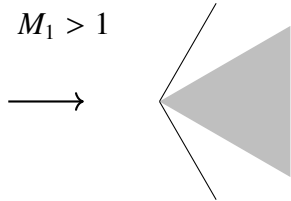


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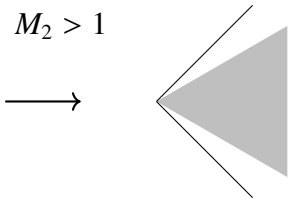
S.Sai Akshitha - EE24BTECH11054

- 1) A multistage axial compressor, with overall isentropic efficiency of 0.83, is used to compress air at a stagnation temperature of 300 K through a pressure ratio of 10:1. Each stage of the compressor is similar, and the stagnation temperature rise across each compressor stage is 20 K. Assume $C_p=1005$ J/kg K and $\gamma=1.4$ for air. How many stages are there in the compressor?
 - a) 17
 - b) 13
 - c) 19
 - d) 11
- 2) An aircraft with a turbojet engine is flying at 250 m/s. The uninstalled thrust produced by the engine is 60000 N. The heating value of the fuel is 44×10^6 J/kg. The engine has a thermal efficiency of 35
 - a) 32.5
 - b) 35.0
 - c) 11.4
 - d) 92.4
- 3) Consider a flat plate, with a sharp leading edge, placed in a uniform flow of speed U . The direction of the free-stream flow is aligned with the plate. Assume that the flow is steady, incompressible and laminar. The thickness of the boundary layer at a fixed stream-wise location L from the leading edge of the plate is δ . Which one of the following correctly describes the variation of δ with U ?
 - a) $\delta \propto U$
 - b) $\delta \propto U^{\frac{3}{2}}$
 - c) $\delta \propto U^{\frac{1}{2}}$
 - d) $\delta \propto U^{-\frac{1}{2}}$
- 4) Shock structures for flow at three different Mach numbers over a given wedge are shown in the figure below. Assuming that only the weak shock solutions are possible for the attached oblique shocks, which one of the following options is TRUE?

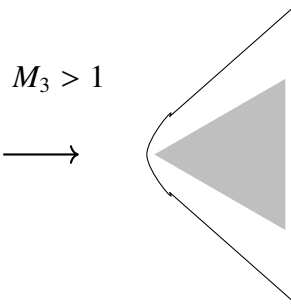
$M_1 > 1$



$M_2 > 1$



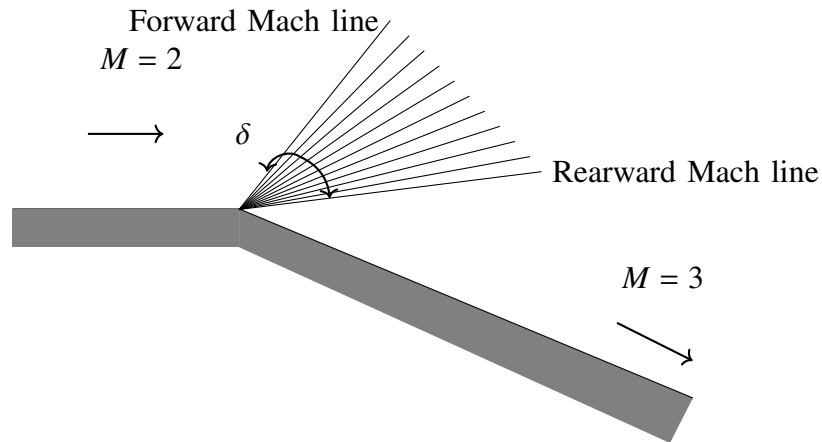
$M_3 > 1$



- a) $M_1 < M_2 < M_3$
- b) $M_1 > M_2 > M_3$
- c) $M_1 < M_3 < M_2$
- d) $M_3 < M_1 < M_2$

- 5) Air flowing at Mach number $M = 2$ from left to right accelerates to $M = 3$ across an expansion corner as shown in the figure. What is the value of δ (the angle between the Forward and Rearward Mach lines) in degrees?

The values of the Prandtl-Meyer functions are $\nu(3) = 49.76^\circ$ and $\nu(2) = 26.38^\circ$

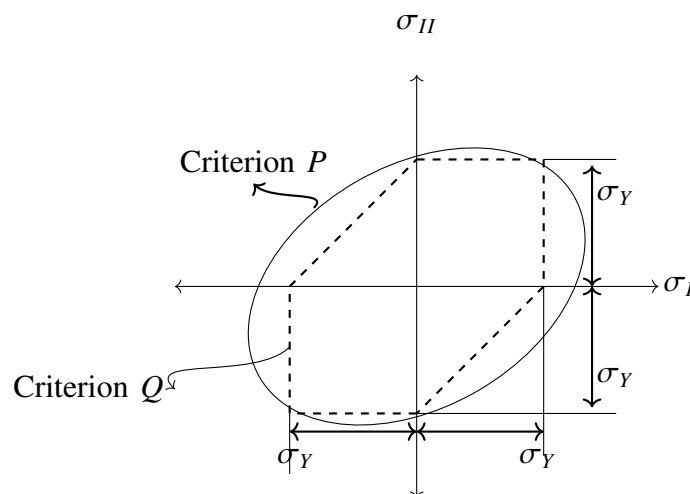


- a) 23.38
b) 19.47
c) 53.38
d) 33.91
- 6) Consider the function

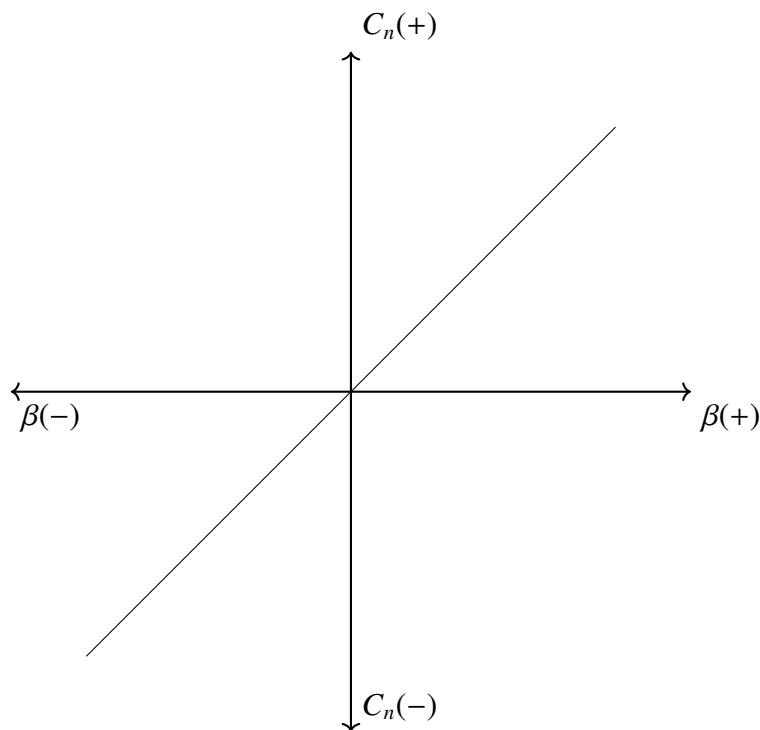
$$f(x) = \begin{cases} x^2 & x < 0 \\ x & x \geq 0 \end{cases}$$

where x is real. Which of the following statements is/are correct?

- a) The function is continuous for all x
b) The derivative of the function is discontinuous at $x = 0$
c) The derivative of the function is continuous at $x = 1$
d) The function is discontinuous at $x = 0$
- 7) The figure shows plots of two yield loci for an isotropic material, where σ_I and σ_{II} are the principal stresses and σ_Y is the yield stress in uniaxial tension. Which of the following statements is/are correct?



- a) Criterion P represents the von Mises criterion
 - b) Criterion Q represents the Tresca criterion
 - c) Criterion P represents the Tresca criterion
 - d) Criterion Q represents the von Mises criterion
- 8) Which of the following statements about absolute ceiling and service ceiling for a piston-propeller aircraft is/are correct?
- a) The altitude corresponding to absolute ceiling is higher than that for service ceiling
 - b) At the absolute ceiling, the power required for cruise equals the maximum power available
 - c) The altitude corresponding to absolute ceiling is lower than that for service ceiling
 - d) At the service ceiling, the maximum rate of climb is 50 ft/min
- 9) For an airplane having directional/weathercock static stability, which of the following options is/are correct?
- a) The airplane when disturbed in yaw, from an equilibrium state, will experience a restoring moment
 - b) The variation of yawing moment coefficient (C_n) with sideslip angle (β) for the airplane will look like:



- c) The airplane will always tend to point into the relative wind
 - d) The airplane when disturbed in yaw will return to equilibrium state in a finite amount of time after removing the disturbance
- 10) Which of the following statements is/are TRUE for an axial turbine?
- a) For a fixed rotational speed, the mass flow rate increases with increase in the flow coefficient
 - b) The absolute stagnation enthalpy of the flow decreases across the nozzle row
 - c) The relative stagnation enthalpy remains unchanged through the rotor
 - d) For a fixed rotational speed, the mass flow rate remains unchanged with a change in the flow coefficient
- 11) Which of the following statements is/are TRUE for a single stage axial compressor?
- a) Starting from design condition and keeping the mass flow rate constant, if the blade RPM is increased, the compressor rotor may experience positive incidence flow separation (actual relative

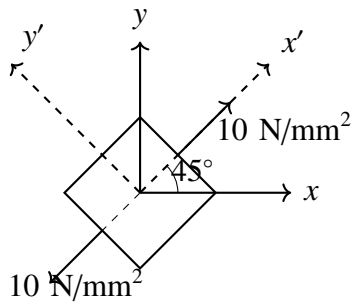
flow angle greater than the design blade angle)

- b) Starting from design condition at the same blade RPM, if the mass flow rate is increased, the compressor rotor may experience positive incidence flow separation (actual relative flow angle greater than the design blade angle)
- c) Keeping the mass flow rate constant, if the blade RPM is increased, the compressor may experience surge
- d) At the same blade RPM, if the mass flow rate is increased, the compressor may experience surge

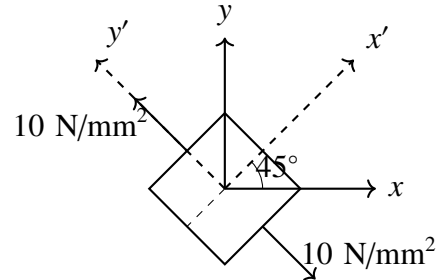
12) Consider the matrix $A = \begin{pmatrix} 5 & -4 \\ k & -1 \end{pmatrix}$

where k is a constant. If the determinant of A is 3, then the ratio of the largest eigenvalue of A to the constant k is _____ (rounded off to 1 decimal place).

- 13) The state of stress at a point is caused by two separate loading cases. One of them produces a pure uniaxial tension along the x' direction, and the other one produces a pure uniaxial compression along the y' direction, as shown in the figure. The sum of maximum and minimum principal stresses for the resultant state of stress caused by both loads acting simultaneously is _____ N/mm^2 (rounded off to 1 decimal place).



(a) State of stress in case I



(b) State of stress in case II