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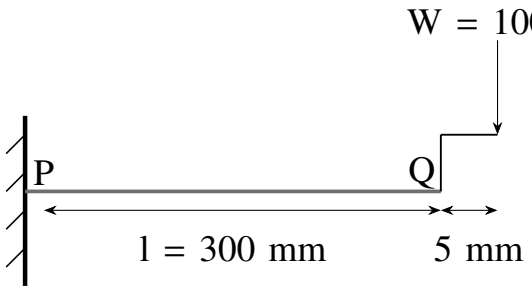
1) A cube made of linear elastic isotropic material is subjected to a uniform hydrostatic pressure of 100 N/mm^2. Under this load, the volume of the cube shrinks by 0.05%. The Young's modulus of the material, E = 300 GPa. The Poisson's ratio of the material is _____.
2) A massless cantilever beam PQ has a solid square cross section (10 mm x 10 mm). This beam is subjected to a load W through a rigid massless link at the point Q, as shown below (figure not to scale). If the Young's modulus of the material E = 200 GPa, the deflection (in mm) at point Q is _____.



3) An aircraft, with a wing loading $\frac{W}{S}$ = 500 N/m^2, is gliding at $\left(\frac{L}{D}\right)_{max}$ = 10 and C_L = 0.69. Considering the free stream density ρ_∞ = 0.9 kg/m^3, the equilibrium glide speed (in m/s) is _____.
4) For a thin flat plate at 2 degress angle of attack, the pitching moment coefficient about the training edge is _____.
5) A satellite is to be transferred from its geostationary orbit to a circular polar orbit of the same radius through a single impulse out-of-plane maneuver. The magnitude of the change in velocity required is _____ times the magnitude of the escape velocity.
6) A planetary probe is launched at a speed of 200 km/s and at a distance of 71,400 km from the mass center of its nearest planet of mass 1.9 x 10^{28} kg. The universal gravitational constant G = 6.67 x $10^{-11}\frac{m^3}{kgs^2}$. The ensuing path of the probe would be
   a) ellipse
   b) hyperbolic
   c) parabolic
   d) circular
7) The velocity of an incompressible laminar boundary layer over a flat plate developing under constant pressure is given by $\frac{u(y)}{U_\infty} = \frac{3y}{2\delta} - \frac{1}{2}\left(\frac{y}{\delta}\right)^3$. The freestream velocity U_∞ = 10 m/s and the dynamic viscosity of the fluid μ = 1.8 x $10^{-5}\frac{kg}{ms}$. At a streamwise station where the boundary layer thickness δ = 5 mm, the wall shear stress is _____ x 10^{-3} Pa.
8) the Pitot tube of an aircraft registers a pressure $p_0 = 54051 N/m^2$. The static pressure, density and the ratio of specific heats of the freestream are $p_\infty = 45565 N/m^2$, $\rho_\infty = 0.6417 kb/m^3$ and γ = 1.4, respectively. The indicated airspeed (in m/s) is
   a) 157.6
   b) 162.6
   c) 172.0
   d) 182.3
9) Consider a NACA 0012 aerfoil of chord c in a freestream with velocity V_∞ at a non-zero positive angle of attack α. The average time-of-flight for a particle to move from the leading edge to the trailing edge on the suction and pressure sides are t_1 and t_2, respectively. Thin aerfoil theory yields

the velocity perturbation to the freestream as $V_\infty \frac{(1+\cos\theta)\alpha}{\sin\theta}$ on the suction side and as $-V_\infty \frac{(1+\cos\theta)\alpha}{\sin\theta}$ on the pressure side, where θ corresponds to the chordwise position $x = \frac{c}{2}(1-\cos\theta)$. Then $t_2 - t_1$ is

a) $-\frac{8\pi\alpha c}{V_\infty\left(4-\pi^2\alpha^2\right)}$
b) 0
c) $\frac{4\pi\alpha c}{V_\infty\left(4-\pi^2\alpha^2\right)}$
d) $\frac{8\pi\alpha c}{V_\infty\left(4-\pi^2\alpha^2\right)}$

10) Air enters an aircraft engine at a velocity of 180 m/s with a flow rate of 94 kg/s. The engine combustor requires 9.2 kg/s of air to burn 1 kg/s of fuel. The velocity of gas exiting from the engine is 640 m/s. The momentum thrust (in N) developed by the engine is

a) 43241
b) 45594
c) 47940
d) 49779

11) A solid rocket monitor is designed with a cylindrical end-burning propellent grain of length 1 m and diameter 32 cm. The density of the propellent grain is $1750 kg/m^3$. The specific impulse of the motor is 190 s and the acceleration due to the gravity is $9.8 m/s^2$. Tf the propellent burns for a period of 150 s, then the thrust (in N) produced by the rocket motor is _____

12) A liquid propellent rocket has the following component masses:

$$\text{Mass of payload} = 180kg$$
$$\text{Mass of fuel} = 470kg$$
$$\text{Mass of oxidizer} = 1170kg$$
$$\text{Mass of structures} = 150kg$$
$$\text{Mass of guidance systems} = 20kg$$

The effective exhaust velocity is 3136 m/s. The velocity increment (in km/s) of the rocket at burnout, while operating in outer space, is _____.

13) If all the eigenvalues of a matrix are real and ewual, then

a) the matrix is diagonalizable
b) its eigenvectors are not necessarily linearly independent
c) its eigenvectors are linearly independent
d) its determinant is necessarily zero