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AE : Aerospace Engineering

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1) Which one of the following engines should be used by a subsonic passenger transport airplane for minimum specific fuel consumption?
   a) Turbojet engine with afterburner
   b) Turbofan engine
   c) Ramjet engine
   d) Scramjet engine

2) A spring-mass-damper system with a mass of $1kg$ is found to have a damping ratio of 0.2 and a natural frequency of $5rad/s$. The damping of the system is given by

   a) $2Ns/m$
   b) $2N/s$
   c) $0.2kg/s$
   d) $0.2N/s$

3) If $f(\theta) = \begin{pmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{pmatrix}$, then $f(\alpha)\,f(\beta) =$

   a) $f\left(\frac{\alpha}{\beta}\right)$
   b) $f(\alpha+\beta)$
   c) $f(\alpha-\beta)$
   d) 2×2 zero matrix

4) An artificial satellite remains in orbit and does not fall to the earth because
   a) the centrifugal force acting on it balances the gravitational attraction
   b) the on-board rocket motors provide continuous boost to keep it in orbit
   c) its transverse velocity keeps it from hitting the earth although it falls continuously
   d) due to its high speed it derives sufficient lift from the rarefied atmosphere

5) The Euler iteration formula for numerically integrating a first order nonlinear differential equation of the form $x = f(x)$, with a constant step size of Δt is
   a) $x_{k+1} = x_k - \Delta t \times f(x_k)$
   b) $x_{k+1} = x_k - \frac{\Delta t^2}{2} \times f(x_k)$
   c) $x_{k+1} = x_k - \frac{1}{\Delta t} \times f(x_k)$
   d) $x_{k+1} = x_k + \Delta t \times f(x_k)$

6) The number of natural frequencies of an elastic beam with cantilever boundary conditions is
   a) 1
   b) 3
   c) 1000
   d) Infinite

7) For maximum range of a glider, which of the following conditions is true?
   a) lift to drag ratio is maximum
   b) rate of descent is minimum
   c) descent angle is maximum
   d) lift to weight ratio is maximum

8) An airplane with a larger wing as compared to a smaller wing will necessarily have
   a) more longitudinal static stability
   b) less longitudinal static stability
   c) same longitudinal static stability
   d) more longitudinal static stability for an aft tail airplane if aerodynamic center of the larger wing is behind the center of gravity of the airplane

9) The minimum value of $f(x) = x^2 - 7x + 30$ occurs at

   a) $x = \frac{7}{2}$
   b) $x = \frac{7}{30}$
   c) $x = \frac{30}{7}$
   d) $x = 30$

10) Two airplanes are identical except for the location of the wing. The longitudinal static stability of the airplane with low wing configuration will be
   a) more than the airplane with high wing configuration
   b) less than the airplane with high wing configuration
   c) same as the airplane with high wing configuration
   d) more if elevator is deflected

11) For a fixed center of gravity location of an airplane, when the propeller is mounted on the nose of the fuselage
   a) longitudinal static stability increases
   b) longitudinal static stability decreases

c) longitudinal static stability remains same
d) longitudinal static stability is maximum

12) Let an airplane in a steady level flight be trimmed at a certain speed. A level and steady flight at a higher speed could be achieved by changing
a) engine throttle only
b) elevator only
c) throttle and elevator together
d) rudder only

13) For a plane strain problem in the $x-y$ plane, in general, the non-zero stress terms are

a) $\sigma_{zz}, \sigma_{xz}\sigma_{yz}, \sigma_{xy}$
b) $\sigma_{zz}, \sigma_{xz}\sigma_{yz}, \sigma_{xy}$
c) $\sigma_{xx}, \sigma_{xy}\sigma_{yy}, \sigma_{xz}$
d) $\sigma_{xx}, \sigma_{yy}\sigma_{xy}, \sigma_{zz}$

14) For an elastic anisotropic solid, the number of independent elastic constants in its constitutive equations is

a) 2
b) 9
c) 21
d) 36

15) Total pressure at a point is defined as the pressure when the flow is brought to rest

a) adiabatically
b) isentropically
c) isothermally
d) isobarically

16) The drag divergence Mach number of an airfoil
a) is a fixed number for a given airfoil
b) is always higher than the critical Mach number
c) is equal to the critical Mach number at zero angle of attack
d) is the Mach number at which a shock wave first appears on the airfoil

17) On which one of the following thermodynamic cycles does an ideal ramjet operate?

a) The Rankine cycle
b) The Brayton cycle
c) The Camot cycle
d) The Otto cycle