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- 1) The integration $\int_0^1 x^3 dx$ computed using the trapezoidal rule with $n = 4$ intervals is.
- 2) An aircraft has a steady rate of climb of $300 \frac{m}{s}$ at sea level and $150 \frac{m}{s}$ at 2500 m altitude. The time taken (*insec*) for this aircraft to climb from 500 m altitude to 3000 m altitude is.
- 3) An airfoil generates a lift of 80 N when operating in a freestream flow of $60 \frac{m}{s}$. If the ambient pressure and temperature are 100 kPa and 290 K respectively specific gas constant is 287 units , the circulation on the airfoil in m^2/s is.
- 4) A rocket motor has combustion chamber temperature of 2600 K and the products have molecular weight of $25 \frac{g}{mol}$ and ratio of specific heats 1.2. The universal gas constant is $8314 \frac{J}{kg-mole-K}$. The value of theoretical c^* (*in $\frac{m}{s}$*) is.
- 5) The mode shapes of an un-damped two degrees of freedom system are $\begin{Bmatrix} 1 \\ 0.5 \end{Bmatrix}^T$ and $\begin{Bmatrix} 1 \\ -0.675 \end{Bmatrix}^T$. The corresponding natural frequencies are 0.45 Hz and 1.2471 Hz. The maximum amplitude (*inmm*) of vibration of the first degree of freedom due to an initial displacement of $\begin{Bmatrix} 2 \\ 1 \end{Bmatrix}^T$ (*inmm*) and zero initial velocities is.
- 6) The n^{th} derivative of the function $y = \frac{1}{x+3}$ is:
 - a) $\frac{(-1)^n n!}{(x+3)^{n+1}}$
 - b) $\frac{(-1)^{n+1} n!}{(x+3)^{n+1}}$
 - c) $\frac{(-1)^n (n+1)!}{(x+3)^{n+1}}$
 - d) $\frac{(-1)^n n!}{(x+3)^n}$
- 7) The volume of a solid generated by rotating the region between semi-circle $y = 1 - \sqrt{1 - x^2}$ and straight line $y = 1$, about x -axis, is:
 - a) $\pi^2 - \frac{4}{3}\pi$
 - b) $4\pi^2 - \frac{1}{3}\pi$
 - c) $\pi^2 - \frac{3}{4}\pi$
 - d) $\frac{3}{4}\pi^2 - \pi$
- 8) One eigenvalue of the matrix $A = \begin{bmatrix} 2 & 7 & 10 \\ 5 & 2 & 25 \\ 1 & 6 & 5 \end{bmatrix}$ is -9.33 . One of the other eigenvalues is:
 - a) 18.33
 - b) -18.33
 - c) $18.33 - 9.33i$

- d) $18.33 + 9.33i$
- 9) If an aircraft takes off with 10% less fuel in comparison to its standard configuration, its range is:
- Lower by exactly 10%.
 - Lower by more than 10%.
 - Lower by less than 10%.
 - An unpredictable quantity.
- 10) An aircraft has an approach speed of 144 kmph with a descent angle of 6.6° . If the aircraft load factor is 1.2 and constant deceleration at touch down is $0.25g$ ($g = 9.81 \frac{m}{s^2}$), its total landing distance approximately over a 15 m high obstacle is:
- 1830 m
 - 1380 m
 - 830 m
 - 380 m
- 11) An oblique shock wave with a wave angle β is generated from a wedge angle of θ . The ratio of the Mach number downstream of the shock to its normal component is:
- $\sin(\beta - \theta)$
 - $\cos(\beta - \theta)$
 - $\sin(\theta - \beta)$
 - $\cos(\theta - \beta)$
- 12) In a closed-circuit supersonic wind tunnel, the convergent-divergent ($C - D$) nozzle and test section are followed by a $C - D$ diffuser to swallow the starting shock. Here, we should have the:
- Diffuser throat larger than the nozzle throat and the shock located just at the diffuser throat.
 - Diffuser throat larger than the nozzle throat and the shock located downstream of the diffuser throat.
 - Diffuser throat of the same size as the nozzle throat and the shock located just at the diffuser throat.
 - Diffuser throat of the same size as the nozzle throat and the shock located downstream of the diffuser throat.
- 13) An aircraft is trimmed straight and level at true air speed (TAS) of $100 \frac{m}{s}$ at standard sea level (SSL). Further, pull of $5N$ holds the speed at $90 \frac{m}{s}$ without re-trimming at SSL air density = $1.22 kg/m^3$. To fly at 3000 m altitude air density = $0.91 kg/m^3$ and $120 (\frac{m}{s})$ TAS without re-trimming, the aircraft needs:
- $1.95N$ upward force
 - $1.95N$ downward force
 - $1.85N$ upward force
 - $1.75N$ downward force