2020 Engineering Sciences

AI24BTECH11003 - Badde Vijaya Sreyas

1) Let z be a complex number. Then the series $\sum_{n=0}^{\infty} \frac{z^{2n}}{(2n)!}$ (2020)
   a) converges for all z.
   b) converges for all $|z| \leq 1$ and diverges for $|z| > 1$.
   c) converges for $z = 0$ and diverges for any $z \neq 0$.
   d) converges for $|z| < 1$ and diverges for $|z| \geq 1$
2) Let $\vec{V}(x, y, z) = ax\vec{i} - bz\vec{j} + cy\vec{k}$ be a vector whose curl is zero. Then necessarily (2020)

   a) $a = b = c$ b) $a = -b = c$ c) $b = c$ d) $b = -c$

3) Let $f(x)$be a continuous function on the real line such that for any x, $\int_0^{x^2} f(t)\,dt = x^2\left(1 + x^2\right)$. Then $f(2)$ is _____. (2020)
4) The number of points at which the function $f(x, y) = \frac{x^2}{2} + \frac{y^4}{4} - \frac{y^2}{2}$ has local minima is _____. (2020)
5) Let $f(t)$ be a real-valued differential function on $(-1, 1)$ such that $f(0) = 0$ and $\left|\frac{df}{dt}\right| < 1$ for $0 < t < 1$. Then the series $\sum_{n=0}^{\infty} f(0.5)^n$ (2020)
   a) converges but not absolutely.
   b) is unbounded.
   c) converges absolutely.
   d) is bounded but does not converge.
6) Let X be a random variable with probability density function

$$f(t) = \begin{cases} \exp(-t) & \text{for } t \geq 0 \\ 0 & \text{for } t < 0 \end{cases}$$

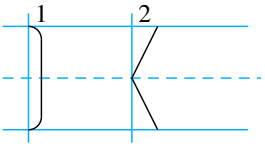
   Let $0 < a < b$. Then the probability $\mathbf{P}(X \leq b | X \geq a)$ depends only on (2020)

   a) $b - a$. b) b. c) a. d) $a + b$.

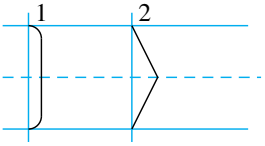
7) Let A be a 3×3 matrix such that $A^2 = A$. Then it is necessary that (2020)
   a) A is the identity matrix or the zero matrix.
   b) the determinant of A^4 is either 0 or 1.
   c) the rank of A is 3.
   d) A has one imaginary eigenvalue.
8) Players A and B take turns to throw a fair dice with six sides. If A is the first player to throw, then the probability of B being the first one to get a six is _____ (round off to two decimal places). (2020)

9) Figures below show the velocity and the shear stress profiles for the flow in a duct. In each option, '1' represents velocity profile, and '2' represents shear stress profile. Choose the correct option that closely represents the turbulent flow condition. (2020)

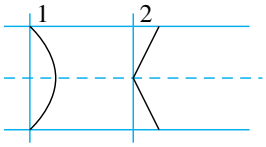
a)



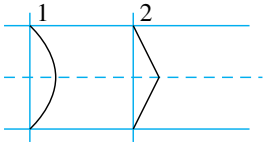
b)



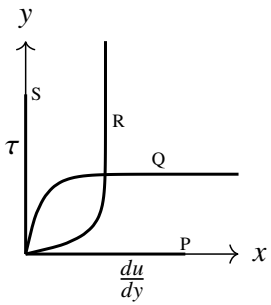
c)



d)



10) The variation of shear stress (τ) against strain rate $\left(\frac{du}{dy}\right)$ is given in the Figure. Identify the line/curve among P, Q, R and S, that represents an ideal fluid. (2020)



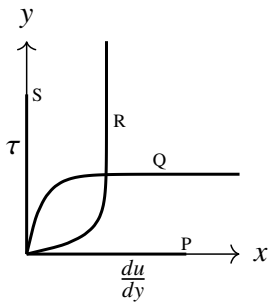
a) S b) P c) Q d) R

11) A body is under stable equilibrium in a homogeneous fluid , where CG and CB are center of gravity and center of buoyancy, respectively. Two statements, '**P**' and '**Q**', are given below:
P: For a fully submerged condition, CG should always be below CB
Q: For a floating body, CG need not be below CB
Choose the option that is valid for the present situation. (2020)

a) **P** is False, **Q** is True, when metacentre is below CG
b) **P** is False, **Q** is True, when metacentre is above CG
c) **P** is True, **Q** is False, when metacentre is below CG
d) **P** is True, **Q** is False, when metacentre is above CG

12) A laminar hydrodynamic boundary layer over a smooth flat plate is shown in the Figure. The shear stress at the wall is denoted by τ_W. Which one of the following conditions is correct? (2020)

a) pressure is varying along 'x' and $(\tau_w)_{x1} > (\tau_w)_{x2}$



b) pressure is constant along 'x' and $(\tau_w)_{x2} > (\tau_w)_{x1}$
c) pressure is constant along 'x' and $(\tau_w)_{x1} > (\tau_w)_{x2}$
d) pressure is varying along 'x' and $(\tau_w)_{x2} > (\tau_w)_{x1}$

13) A non-dimensional number known as **Weber** number is used to characterize which one of the following flows, (2020)

a) motion of fluid in open channel
b) motion of fluid droplets
c) motion of fluid at high velocity
d) motion of fluid through a pipe