2010-XE-14-26

EE24BTECH11006 - Arnav Mahishi

1) The residue of the function $f(z) = \frac{\sin^4 z}{\left(z+\frac{\pi}{4}\right)^3}$ at $z = \frac{-\pi}{4}$

   a) 2
   b) 1
   c) -1
   d) -2

2) The variance of the number of heads resulting from independent tosses of a fair coin is

   a) $\frac{5}{4}$
   b) $\frac{5}{2}$
   c) $\frac{3}{4}$
   d) $\frac{3}{2}$

3) If the quadrature rule $\int_0^3 f(x)\,dx = \alpha f(1) + \beta f(3)$ is exact for all polynomials of degree 2 or less, then

   a) $\alpha = \frac{3}{4}, \beta = \frac{3}{4}$
   b) $\alpha = \frac{3}{4}, \beta = \frac{9}{4}$
   c) $\alpha = \frac{9}{4}, \beta = \frac{3}{4}$
   d) $\alpha = \frac{9}{4}, \beta = \frac{9}{4}$

4) Given that $\frac{dy}{dx} = 1 + y^2, y(0) = 0$, which one of the following is nearest to $y(0.4)$ computed by Euler's method with step size of 0.2?

   a) 0.408
   b) 0.404
   c) 0.208
   d) 0.204

5) $f(x) = \begin{cases} \frac{\sin x}{x} \text{ if } x \neq 0 \\ 1 \text{ if } x = 0 \end{cases}$ Then

   a) f is not continuous at $x = 0$
   b) f is continuous at $x = 0$ but not differentiable at $x = 0$
   c) f is differentiable at $x = 0$ and $f'(0) = 0$
   d) f is differentiable at $x = 0$ and $f'(0) = 1$

6) Let $u(x, y) = \tan\{xy(x + y)\}$. Then

   a) $x\frac{\delta u}{\delta x} + y\frac{\delta u}{\delta x} = \frac{1}{3}xy(x + y)\sec^2\{xy(x + y)\}$
   b) $x\frac{\delta u}{\delta x} - y\frac{\delta u}{\delta x} = \frac{1}{3}xy(x + y)\sec^2\{xy(x + y)\}$
   c) $x\frac{\delta u}{\delta x} + y\frac{\delta u}{\delta x} = 3xy(x + y)\sec^2\{xy(x + y)\}$
   d) $x\frac{\delta u}{\delta x} - y\frac{\delta u}{\delta x} = 3xy(x + y)\sec^2\{xy(x + y)\}$

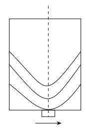
7) Which one of the following is a particular solution of ordinary differntial equation $x\frac{d^2y}{dx^2} - \frac{dy}{dx} = 2x^2 f(x)$?

   a) $x^2 \int xf(x)\,dx + \int x^3 f(x)\,dx$
   b) $x^2 \int f(x)\,dx + \int x^2 f(x)\,dx$
   c) $x^2 \int xf(x)\,dx - \int x^3 f(x)\,dx$
   d) $x^2 \int f(x)\,dx - \int x^2 f(x)\,dx$

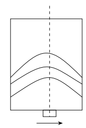
8) Which one of the following is a possible solution to the partial differential equation $\frac{\delta^2 u}{\delta t^2} - \frac{\delta^2 u}{\delta x^2} = 0$ with boundary conditions $u(0,t) = 0$, $\frac{\delta u(\pi,t)}{\delta x} = 0$ for $t \geq 0$, $u(x,0) = 0$, $\frac{\delta u(x,0)}{\delta t} = \pi$, for $0 \leq x \leq \pi$?

a) $u(x,t) = \sum_{n=0}^{\infty} a_n \sin\left(\left(n + \frac{1}{2}\right)t\right) \sin\left(\left(n + \frac{1}{2}\right)x\right)$
b) $u(x,t) = \sum_{n=0}^{\infty} a_n \cos\left(\left(n + \frac{1}{2}\right)t\right) \sin\left(\left(n + \frac{1}{2}\right)x\right)$
c) $u(x,t) = \sum_{n=0}^{\infty} a_n \sin\left(\left(n + \frac{1}{2}\right)t\right) \cos\left(\left(n + \frac{1}{2}\right)x\right)$
d) $u(x,t) = \sum_{n=0}^{\infty} a_n \cos\left(\left(n + \frac{1}{2}\right)t\right) \cos\left(\left(n + \frac{1}{2}\right)x\right)$

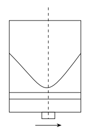
9) A cylindrical container is filled with a liquid up to half of its height. The container is mounted on the center of a turn-table and is held fixed using a spindle. The turn-table is now rotated about its central axis with a certain angular velocity. After some time interval, the fluid attains rigid body rotation. Which of the following profiles best represents the constant pressure surfaces in the container?



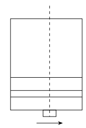
a)



c)



b)



d)

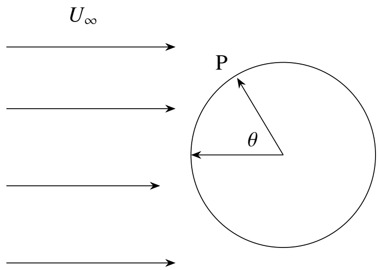
10) Match the items given in the following two columns using appropriate combinations:

a) $P-1; R-2; Q-3; S-4$
b) $P-1; Q-2; R-3; S-4$
c) $P-1; R-2; S-3; Q-4$
d) $P-1; S-2; Q-3; R-4$

11) In the context of boundry layers, which of the following statements is FALSE?

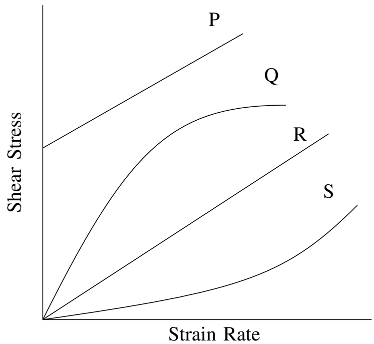
a) It is a frictional layer, close to the body
b) It is a region where fluid flow is irrotational
c) It is a region across which the pressure gradient is negligible
d) It is diffusion layer of vorticity

12) Consider an ideal fluid flow past a circular cylinder shown in the figure below. The peripheral velocity at a point P on the surface of the cylinder is



a) 0 b) U_∞ c) $U_\infty \sin\theta$ d) $2U_\infty \sin\theta$

13) The Rheological diagram depicting the relation between shear stress and strain rate for different types of fluids is shown in the figure below.



The most suitable relation for flow of tooth paste being squeezed out of the tube is given by the curve

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