Gate Questions

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1) The product of eigenvalues of the matrix P is
$$P = \begin{pmatrix} 2 & 0 & 1 \\ 4 & -3 & 2 \\ 0 & 2 & -1 \end{pmatrix}$$ [February 2017]
   a) -6
   b) 2
   c) 6
   d) -2

2) The value of $\lim_{x\to 0} \frac{x^3 - \sin(x)}{x}$ is [February 2017]
   a) 0
   b) 3
   c) 1
   d) -1

3) Consider the following partial differential equation for $u(x, y)$ with the constant $c > 1$.Solution of this equation is [February 2017]
$$\frac{\partial u}{\partial y} + c\frac{\partial u}{\partial x} = 0$$
   a) $u(x, y) = f(x + cy)$
   b) $u(x, y) = f(x - cy)$
   c) $u(x, y)) = f(cx + y)$
   d) $u(x, y) = f(cx - y)$

4) The differential equation $\frac{d^2y}{dx^2} + 16y = 0$ for $y(x)$ with the two boundary conditions $\frac{dy}{dx}|_{x=0} = 1$ and $\frac{dy}{dx}|_{x=\frac{\pi}{2}} = -1$has [February 2017]
   a) no solution.
   b) exactly two solutions.
   c) exactly one solution.
   d) infinitely many solutions.

5) A six-face fair dice is rolled a large number of times. The mean value of the outcomes is _____ [February 2017]

6) For steady flow of a viscous incompressible fluid through a circular pipe of constant diameter, the average velocity in the fully developed region is constant. Which one of the following statements about the average velocity in the developing region is TRUE? [February 2017]
   a) It increases until the flow is fully developed.
   b) It is constant and is equal to the average velocity in the fully developed region.
   c) It decreases until the flow is fully developed.
   d) It is constant but is always lower than the average velocity in the fully developed region.

7) Consider the two-dimensional velocity field given by

$$\mathbf{V} = (5 + a_1 x + b_1 y)\,\hat{i} + (4 + a_2 x + b_2 y)\,\hat{j},$$

where a_1, b_1, a_2 and b_2 are constants. Which one of the following conditions needs to be satisfied for the flow to be incompressible? [February 2017]

a) $a_1 + b_1 = 0$
b) $a_1 + b_2 = 0$
c) $a_2 + b_2 = 0$
d) $a_2 + b_1 = 0$

8) Water $\left(density = 1000\text{kg/m}^3\right)$ at ambient temperature flows through a horizontal pipe of uniform cross-section at the rate of $1kg/s$. If the pressure drop across the pipe is $100kPa$, the minimum power required to pump the water across the pipe, in watts, is_____ [February 2017]

9) Which one of the following is not a rotating machine? [February 2017]

a) Centrifugal pump
b) Gear pump
c) Jet pump
d) Vane pump

10) Saturated steam at 100°C condenses on the outside of a tube. Cold fluid enters the tube at 20°C and exits at 50°C. The value of the Log Mean Temperature Difference ($LMTD$) is_____ °C [February 2017]

11) The molar specific heat at constant volume of an ideal gas is equal to 2.5 times the universal gas constant ($8.314J/mol - K$). When the temperature increases by $100K$, the change in molar specific enthalpy is _____ J/mol. [February 2017]

12) A heat pump absorbs $10kW$ of heat from outside environment at $250K$ while absorbing $15kW$ of work. It delivers the heat to a room that must be kept warm at $300K$. The Coefficient of Performance (COP) of the heat pump is _____ [February 2017]

13) The Poisson's ratio for a perfectly incompressible linear elastic material is [February 2017]

a) 1
b) 0.5
c) 0
d) infinity