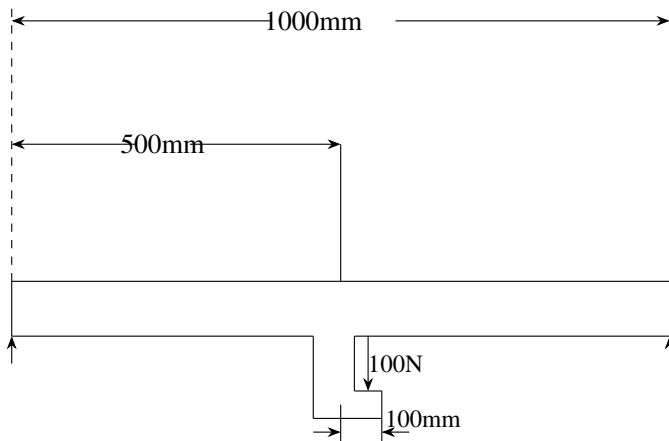


# Gate ME-2007

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- 1) The minimum value of function  $y = x^2$  in the interval  $[1, 5]$  is
  - a) 0
  - b) 1
  - c) 25
  - d) undefined
  
- 2) If a square matrix A is real and symmetric, then the eigenvalues
  - a) are always real
  - b) are always real and positive
  - c) are always real and non-negative
  - d) occurs in complex conjugate pairs
  
- 3) If  $\phi(x, y)$  and  $\psi(x, y)$  are functions with continuous second derivatives, then  $\phi(x, y) + i\psi(x, y)$  can be expressed as an analytic function of  $x + iy$  ( $i = \sqrt{-1}$ ), when
  - a)  $\frac{\partial \phi}{\partial x} = \frac{-\partial \psi}{\partial x}, \frac{\partial \phi}{\partial y} = \frac{\partial \psi}{\partial y}$
  - b)  $\frac{\partial \phi}{\partial y} = \frac{-\partial \psi}{\partial x}, \frac{\partial \phi}{\partial x} = \frac{\partial \psi}{\partial y}$
  - c)  $\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} = \frac{\partial^2 \psi}{\partial x^2} + \frac{\partial^2 \psi}{\partial y^2} = 1$
  - d)  $\frac{\partial \phi}{\partial x} + \frac{\partial \phi}{\partial y} = \frac{\partial \psi}{\partial x} + \frac{\partial \psi}{\partial y} = 0$
  
- 4) The partial differential equation
 
$$\frac{\partial^2 \phi}{\partial x^2} + \frac{\partial^2 \phi}{\partial y^2} + \left( \frac{\partial \phi}{\partial x} \right) + \left( \frac{\partial \phi}{\partial y} \right) = 0$$
 has
  - a) degree 1 and 2
  - b) degree 1 and 1
  - c) degree 2 and 1
  - d) degree 2 and 2
  
- 5) Which of the following relationships is valid only for reversible processes undergone by a closed system of simple compressible substance (neglect changes in kinetic and potential energy)?
  - a)  $\delta Q = dU + \delta W$
  - b)  $TdS = dU + pdV$
  - c)  $TdS = dU + \delta W$
  - d)  $\delta Q = dU + pdV$

- 6) Water has a critical specific volume of  $0.003155 \text{ m}^3/\text{kg}$ . A closed and rigid steel tank of volume  $0.025 \text{ m}^3$  contains a mixture of steam at  $0.1 \text{ MPa}$ . The mass of the mixture is  $10 \text{ kg}$ . The tank is now slowly heated. The liquid level inside the tank
- will rise
  - will fall
  - will remain constant
  - may rise or fall depending on the amount of heat transferred
- 7) Consider an incompressible laminar boundary layer flow over a flat plate of length  $L$  aligned with the direction of an oncoming uniform free stream. If  $F$  is the ratio of the drag force on the front half of the plate to the drag force on the rear half, then
- $F < 1/2$
  - $F = 1/2$
  - $F = 1$
  - $F > 1$
- 8) In a steady flow through a nozzle, the flow velocity on the nozzle axis is given by  $v = u_0 \left(1 + \frac{3x}{L}\right)$  where  $x$  is the distance along the axis of the nozzle from its inlet plane and  $L$  is the length of the nozzle. The time required for a fluid particle on the axis to travel from the inlet to the exit plane of the nozzle is
- $\frac{1}{u_0}$
  - $\frac{L}{3u_0} \ln 4$
  - $\frac{L}{4u_0}$
  - $\frac{L}{2.5u_0}$
- 9) Consider steady laminar incompressible axi-symmetric fully developed viscous flow through a straight circular pipe of constant cross-section area at a Reynolds number of 5. The ratio of inertia force to viscous force on a fluid particle is
- 5
  - $\frac{1}{5}$
  - 0
  - $\infty$
- 10) In a simply-supported beam loaded as shown below, the maximum bending moment in Nm is



- a) 25                      b) 30                      c) 35                      d) 60

11) A ball bearing operating at a load  $F$  has 8000 hours of life. The life of the bearing, in hours, when the load is doubled to  $2F$  is

- a) 8000                      b) 6000                      c) 4000                      d) 1000

12) During inelastic collision of two particles, which one of the following is conserved?

- a) total linear momentum only
- b) total kinetic energy only
- c) both linear momentum and kinetic energy
- d) neither linear momentum nor kinetic energy

13) A steel rod of length  $L$  and diameter  $D$ , fixed at both ends, is uniformly heated to a temperature rise of  $\Delta T$ . The Young's modulus is  $E$  and the coefficient of linear expansion is  $\alpha$ . The thermal stress in the rod is

- a) 0                      b)  $\alpha\Delta T$                       c)  $E\alpha\Delta T$                       d)  $E\alpha\Delta TL$

14) For an underdamped harmonic oscillator, resonance

- a) occurs when excitation frequency is greater than undamped natural frequency
- b) occurs when excitation frequency is equal to undamped natural frequency
- c) occurs when excitation frequency is equal to undamped natural frequency
- d) never occurs

15) If a particular Fe-C alloy contains less than 0.83% carbon, it is called

- a) high speed steel                      c) hypereutectoid steel  
b) hypoeutectoid steel                      d) cast iron

16) Which of the following engineering materials is the most suitable candidate for hot chamber die casting ?

- a) low carbon steel                      c) copper  
b) titanium                      d) tin

17) Which of the following is a solid state joining process?

- a) gas tungsten arc welding
- b) resistance spot welding
- c) friction welding
- d) submerged arc welding