

**POSTGRADUATE ASSISTANT EXAMINATION**

**PGTRB PHYSICS**

**PREVIOUS YEAR EXAM QUESTION PAPER WITH ANSWER**

**UNITWISE**

**2001**

**2002-03**

**2003-04**

**2003-04**

**2004-05**

**2005-06**

**2006-07**

**2011-12**

**2012-13**

**2014-15**

**2017**

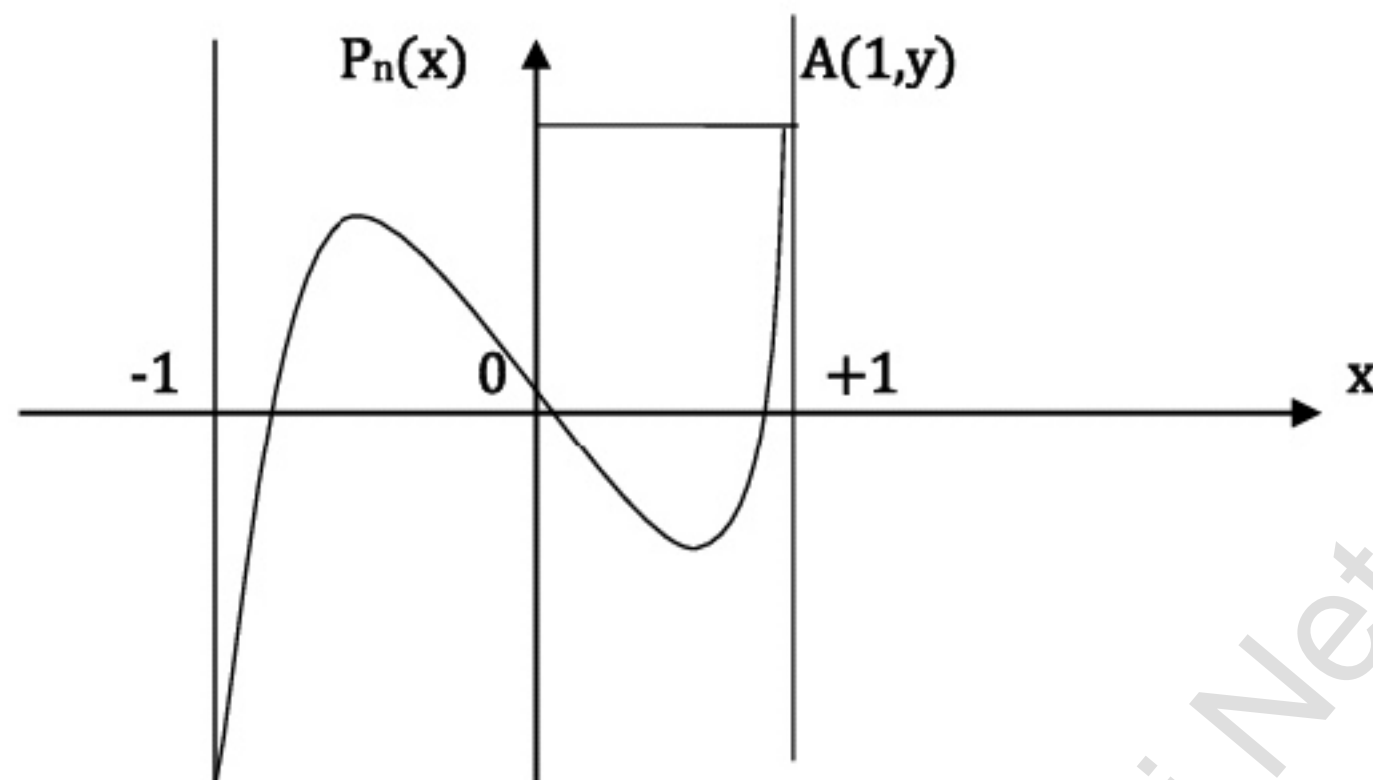
**2019**

PGTRB-PHYSICS  
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2001

1. If a vector function  $\vec{V}$  is said to be solenoidal, then
  - a.  $\nabla \cdot \vec{V} = 0$
  - b.  $\nabla \times \vec{V} = 0$
  - c. both (a) and (b)
  - d. either (a) and (b)
2. The condition for a vector function  $\vec{F}$  to be irrotational is
  - a.  $\nabla \cdot \vec{F} = 0$
  - b.  $\nabla \times \vec{F} = 0$
  - c. both (a) and (b)
  - d. either (a) and (b)
3. Stoke's theorem relates
  - a. line integral with surface integral
  - b. surface integral with volume integral
  - c. line integral with volume integral
  - d. none of these
4. The characteristic roots of a Hermitian matrix are all
  - a. imaginary
  - b. real
  - c. either real or imaginary
  - d. zero
5. The rank of the matrix  $\begin{pmatrix} 1 & 2 & 3 \\ 2 & 4 & 7 \\ 3 & 6 & 7 \end{pmatrix}$  is
  - a. 1
  - b. 2
  - c. 3
  - d. 4
6. For  $j=0$ , the components of  $\vec{j}$  are all represented by null matrices of rank
  - a. 1
  - b. 2
  - c. 3
  - d. 4
7. The matrix which satisfies its own characteristic equation is
  - a. Row matrix
  - b. Column matrix
  - c. Null matrix
  - d. Square matrix

8. Identify the Legendre polynomial and its  $y$ -coordinate at the point  $a$  respectively from its plot given below



- a.  $P_1(x), 5$   
 b.  $P_2(x), 0.75$   
 c.  $P_3(x), 1$   
 d.  $P_4(x), 1.5$
9. The value of the  $\iiint (x^3 dy dz + y^3 dz dx + z^3 dx dy)$  over the surfaces of the sphere

$$x^2 + y^2 + z^2 = a^2 \text{ is}$$

- a.  $\frac{4}{3}\pi a^5$   
 b.  $4\pi a^5$   
 c.  $2\pi a^5$   
 d.  $\frac{2}{3\pi a^5}$
10. Evaluate the gamma function  $\Gamma\left(-\frac{1}{2}\right)$  if  $\Gamma\left(-\frac{1}{2}\right) = \sqrt{\pi}$
- a.  $\pi$   
 b.  $-\pi$   
 c.  $2\sqrt{\pi}$   
 d.  $-2\sqrt{\pi}$

11. If  $x > 0$  and  $y > 0$ , then  $\frac{\beta(x+1, y)}{\beta(x, y)}$

- a.  $\frac{x+1}{x+y}$   
 b.  $\frac{x-1}{x+y}$   
 c.  $\frac{x}{x+y}$   
 d.  $\frac{x}{y}$

ANSWER

**2015**

1. The binomial distribution is skewed to the right if 'P' the probability of success is of value
  - a.  $P = 0.5$
  - b.  $P > 0.5$
  - c.  $P < 0.5$
  - d.  $P = 0.005$
2. Which one of the following are the characteristics of a normal curve?
  - a. Only mean and median coincide
  - b. Only mean and mode coincide
  - c. Only median and mode coincide
  - d. Mean, median and mode coincide
3. If  $x_i$  is the error in the measurement and  $n$  is the number of measurements, then the principle of least squares gives
  - a.  $x_1^2 \cdot x_2^2 \cdot x_3^2 \dots x_n^2 = \text{minimum}$
  - b.  $\sum_{i=1}^n x_i^2 = \text{minimum}$
  - c.  $\frac{1}{\sum_{i=1}^n x_i^2} = \text{minimum}$
  - d.  $\frac{x_1 x_2 \dots x_n}{\sum_{i=1}^n x_i^2} = \text{minimum}$
4. In a group which one the following is true?
  - a. Every element is conjugate with itself
  - b. if A is conjugate with B then B is conjugate with A
  - c. if two elements A and B are conjugate to a third element C then A and B are also conjugate one another
  - d. all the above
5. In a toss of a balanced dice, the occurrence of 8 is
  - a. sure event
  - b. exclusive event
  - c. impossible event
  - d. random event
6. One card is drawn from a standard pack of 52. The probability that it is either a king Or a queen is
  - a.  $52/8$
  - b.  $2/52$
  - c.  $8/52$
  - d.  $4/52$

2012

1. The mathematical expression of D'Alemberts principle:
  - a.  $\sum_i (\dot{P}_i - F_i^{(a)}) \cdot \delta r_i = 0$
  - b.  $\sum_i (F_i^{(a)} - \dot{P}_i) \cdot \delta r_i = 0$
  - c.  $\sum_i (F_i^{(a)} + \dot{P}_i) \cdot \delta r_i = 0$
  - d.  $\sum_i (\dot{P}_i + F_i^{(a)}) \cdot \delta r_i = 0$
2. The Lagranges equation of conservative system ;
  - a.  $\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{q}_j} \right) - \left( \frac{\partial L}{\partial q_j} \right) = 0$
  - b.  $\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{q}_j} \right) - \left( \frac{\partial L}{\partial q_j} \right) = 0$
  - c.  $\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{q}_j} \right) - \left( \frac{\partial L}{\partial q_j} \right) = 0$
  - d.  $\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{q}_j} \right) - \left( \frac{\partial L}{\partial q_j} \right) = 0$
3. The Eulers equation for the motion of rigid body
  - a.  $N_x = I_1 \omega_x - (I_2 - I_3) \omega_y \omega_z ; N_y = I_2 \omega_y - (I_3 - I_1) \omega_z \omega_x ; N_z = I_3 \omega_z - (I_1 - I_2) \omega_x \omega_y$
  - b.  $N_x = I_1 \dot{\omega}_x - (I_2 - I_3) \omega_y \omega_z ; N_y = I_2 \dot{\omega}_y - (I_3 - I_1) \omega_z \omega_x ; N_z = I_3 \dot{\omega}_z - (I_1 - I_2) \omega_x \omega_y$
  - c.  $N_x = I_1 \omega_x - (I_2 + I_3) \omega_y \omega_z ; N_y = I_2 \omega_y - (I_2 + I_3) \omega_y \omega_z ; N_z = I_3 \omega_z - (I_1 + I_2) \omega_x \omega_y$
  - d.  $N_x = I_1 \omega_x + (I_1 - I_3) \omega_y \omega_z ; N_y = I_2 \omega_y + (I_3 - I_1) \omega_z \omega_x ; N_z = I_3 \omega_z + (I_1 - I_2) \omega_x \omega_y$
4.  $L = I \vec{\omega}$  implies that L is the angular momentum,  $\vec{\omega}$  the angular velocity vector and I represents
  - a. Tensor of rank 3
  - b. A vector
  - c. The momentum of inertia tensor
  - d. None of these
5. The angular velocity components expressed in terms of Euler's angle :
  - a.  $\omega_x = \dot{\phi} \sin \theta \sin \psi + \dot{\theta} \cos \psi ; \omega_y = \dot{\phi} \sin \theta \cos \psi + \dot{\theta} \sin \psi ; \omega_z = \dot{\phi} \cos \theta + \dot{\psi}$
  - b.  $\omega_x = \dot{\phi} \sin \theta \sin \psi + \dot{\theta} \cos \psi ; \omega_y = \dot{\phi} \sin \theta \cos \psi - \dot{\theta} \sin \psi ; \omega_z = \dot{\phi} \cos \theta + \dot{\psi}$
  - c.  $\omega_x = \theta \sin \phi \sin \psi + \phi \cos \psi ; \omega_y = \theta \sin \phi \cos \psi + \phi \sin \psi ; \omega_z = \phi \cos \theta + \psi$
  - d.  $\omega_x = \theta \sin \phi \sin \psi - \phi \cos \psi ; \omega_y = \theta \sin \phi \cos \psi - \phi \sin \psi ; \omega_z = \phi \cos \theta - \psi$
6. Lagrangian function for the simple pendulum
  - a.  $\ddot{\theta} + \frac{g}{l} \sin \theta = 0$
  - b.  $\ddot{\theta} + \frac{l}{g} \sin \theta = 0$
  - c.  $\ddot{\theta} - \frac{g}{l} \sin \theta = 0$
  - d.  $\ddot{\theta} + \frac{g}{l} \sin \theta = 0$

8. Which of the following is correct?

- $\bar{V} < V_{rms} < V_p$
- $V_{rms} < V_p < \bar{V}$
- $V_p < \bar{V} < V_{rms}$
- $V_{rms} < \bar{V} < V_p$

Where  $\bar{V}$  - mean velocity

$V_{rms}$  - root means square velocity

$V_p$  - most probable velocity of the molecules of a gas

9. Richardson - Dushman equation for thermionic emission is

- $J = T^4 e^{-\Phi/KT}$
- $J = AT^2 e^{-\Phi/KT}$
- $J = AT^3 e^{-\Phi/KT}$
- $J = AT^4 e^{-\Phi/KT}$

10. Liouville's theorem is

- $\left(\frac{\partial \rho}{\partial t}\right) + \sum_j \left(\frac{\partial \rho}{\partial q_j} \dot{q}_j + \frac{\partial \rho}{\partial p_j} \dot{p}_j\right) = 0$
- $\left(\frac{\partial^2 \rho}{\partial t^2}\right) + \sum_j \left(\frac{\partial \rho}{\partial q_j} \dot{q}_j + \frac{\partial \rho}{\partial p_j} \dot{p}_j\right) = 0$
- $\left(\frac{\partial \rho}{\partial t}\right) + \sum_j \left(\frac{\partial \rho}{\partial q_j} \dot{p}_j + \frac{\partial \rho}{\partial p_j} \dot{q}_j\right) = 0$
- $\left(\frac{\partial^2 \rho}{\partial t^2}\right) + \sum_j \left(\frac{\partial \rho}{\partial q_j} \dot{p}_j + \frac{\partial \rho}{\partial p_j} \dot{q}_j\right) = 0$

11. The density of energy state is

- $\frac{\pi}{2} \left(\frac{8m}{h^3}\right)^{3/2} \sqrt{E} dE$
- $\frac{\pi}{2} \left(\frac{8m}{h^2}\right)^{3/2} \sqrt{E} dE$
- $\frac{\pi}{4} \left(\frac{8m}{h^2}\right)^{3/2} \sqrt{E} dE$
- $\frac{\pi}{2} \left(\frac{8\pi m}{h^2}\right)^{3/2} \sqrt{E} dE$

ANSWER

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
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2019

- According to Lorentz transformation, when an observer  $S'$  moves with constant velocity ' $v$ ' along positive  $x$  axis, his position co-ordinate is  $x' =$  \_\_\_\_\_.
  - $X$
  - $X-vt$
  - $\frac{x-vt}{\sqrt{1-\frac{v^2}{c^2}}}$
  - $\frac{x+vt}{\sqrt{1-\frac{v^2}{c^2}}}$
- If ' $\rho$ ' is the space charge per unit volume, then the variation of potential along  $x$ ,  $\frac{d^2\phi}{dx^2} = -4\pi\rho$  gives \_\_\_\_ equation
  - Coulomb
  - Gauss divergence
  - Laplace
  - Poisson .
- What is the mass ' $m$ ' of a particle, if its rest mass ' $m_0$ ' moves with a speed of  $\frac{c}{\sqrt{2}}$ 
  - $m_0$
  - $0.707 m_0$
  - $0.5 m_0$
  - $1.414 m_0$
- The total power radiated by an oscillating electric dipole is proportional to \_\_\_\_ of the exciting wavelength.
  - $\omega^2$
  - $\omega^3$
  - $\omega^4$
  - $\omega^5$
- A circular coil having 50 turns has a radius of 0.1m. what is the magnetic induction at the centre of coil when a current of 0.1 A flows in it?
  - $3.14 \times 10^{-5}$  Tesla .
  - $6.28 \times 10^{-5}$  Tesla
  - $2.81 \times 10^{-5}$  Tesla
  - 25 Tesla
- Which of the following equation explains that net magnetic induction through any closed surface is zero?
  - $\nabla \cdot B = 0$
  - $\nabla \times B = 0$
  - $\nabla^2 B = 0$
  - $\nabla B = 0$
- Coulomb's law states that the force of attraction or repulsion between two electric point charges is directly proportional to?
  - $r^2$
  - $\frac{1}{r}$
  - $\frac{1}{r^2}$
  - $\frac{1}{\sqrt{r}}$

**2017**

1. If the force constant of the bond in CO molecule is 1870 N/m and the reduced mass of molecule is  $1.14 \times 10^{-26}$  kg, then the separation between the successive vibrational level is :
  - a. 2.67 eV
  - b. 0.267 eV
  - c. 3.18 eV
  - d. 0.318 eV
2. If the spin quantum  $I = 1$  for a nucleus, how many orientation it can have when placed in an external magnetic field?
  - a. 1
  - b. 2
  - c. 3
  - d. 0
3. An NMR signal for a compound is found to be 240 Hz downward from tetra methylsilane (TMS) peak using a spectrometer operating at 80 MHz. The chemical shift in ppm is :
  - a. 1 ppm
  - b. 1 ppm
  - c. 3 ppm
  - d. 4 ppm
4. The lifetime of an atomic state is  $1 \times 10^{-9}$  seconds. The natural linewidth of the spectral line, in the emission spectrum of this state is of the order of
  - a.  $10^{-10}$  eV
  - b.  $10^{-9}$  eV
  - c.  $10^{-6}$  eV
  - d.  $10^{-4}$  eV
5. The first absorption spectrum of  $^{12}\text{C } ^{16}\text{O}$  is at  $3.842 \text{ cm}^{-1}$  while that of  $^{13}\text{C } ^{16}\text{O}$  is at  $3.673 \text{ cm}^{-1}$ . The ratio of their moments of inertia is :
  - a. 1.851
  - b. 1.046
  - c. 1.286
  - d. 1.038
6. The rotational Raman shift should be equal to \_\_\_\_ the frequency of rotation of molecule.
  - a. Thrice
  - b. Four times
  - c. Five times
  - d. Twice



1. By BCS theory, in superconductivity
  - a. Attractive electron interaction by means of phonon exchange dominates
  - b. Repulsive coulomb interaction dominates
  - c. Attractive interaction between an electron and phonon dominates
  - d. Attractive interaction between an electron and a positive ion dominates
2. In AC Josephson effect, the frequency of the oscillating current is
  - a.  $\frac{2eV}{h}$
  - b.  $\frac{h}{2eV}$
  - c.  $\frac{2h}{eV}$
  - d.  $\frac{eV}{2h}$  where V is the voltage
3. Langevin's theory applies
  - a. Only to liquids
  - b. Only to gases
  - c. Only to solids
  - d. To solids and liquids
4. The temperature above which ferromagnetic substance becomes paramagnetic is
  - a. Critical temperature
  - b. Temperature of inversion
  - c. Curie temperature
  - d. Boyle temperature
5. Which of the following is not diamagnetic?
  - a. Antimony
  - b. Bismuth
  - c. Iron
  - d. Copper
6.  $\vec{J} = \frac{ne^2}{mc} \vec{A}$  is
  - a. Maxwell's equation
  - b. London equation
  - c. Lorentz equation
  - d. Bloch equation
7. The diamagnetic behaviour of superconductor is \_\_\_
  - a. London effect
  - b. Meissner effect
  - c. AC Josephson effect
  - d. DC Josephson effect

6. The Fermi Golden rule observed using time dependent perturbation theory
- Is time dependent
  - Is time independent
  - Depends on time harmonically
  - Is partially time dependent
7. Which one of the following is wrong?
- $[L_x, L_y] = 0$
  - $[L^2, L_y] = 0$
  - $[L^2, L_x] = 0$
  - $[L^2, L_z] = 0$
8. The method of partial wave analysis is applicable to
- Long range potentials
  - Short range potentials
  - Spherically symmetric potentials
  - Any type of arbitrary potentials
9. The Klein -Gordon equation is
- $\hat{H} \psi^2 = -\hbar^2 \frac{\partial^2 \psi}{\partial t^2}$
  - $\hat{H} \psi = -\hbar^2 \frac{\partial^2 \psi}{\partial t^2}$
  - $\hat{H} \psi^2 = \hbar^2 \frac{\partial^2 \psi}{\partial t^2}$
  - $\hat{H}^2 \psi = -\hbar^2 \frac{\partial^2 \psi}{\partial t^2}$
10. According to Dirac theory, the probability density of free electron is
- $\psi + \psi$
  - $\Psi * \Psi$
  - $\alpha \Psi * \Psi$
  - $\psi^2 \psi$
11. For Hydrogen atom
- The ground state is degenerate
  - The excited state are degenerate
  - The energy spectrum is discrete and equally spaced
  - The excited state are non-degenerate
12. According to uncertainty principle, the volume of phase space is
- $\hbar$
  - $\hbar^3$
  - $\hbar^2$
  - $6\hbar$

## ANSWER

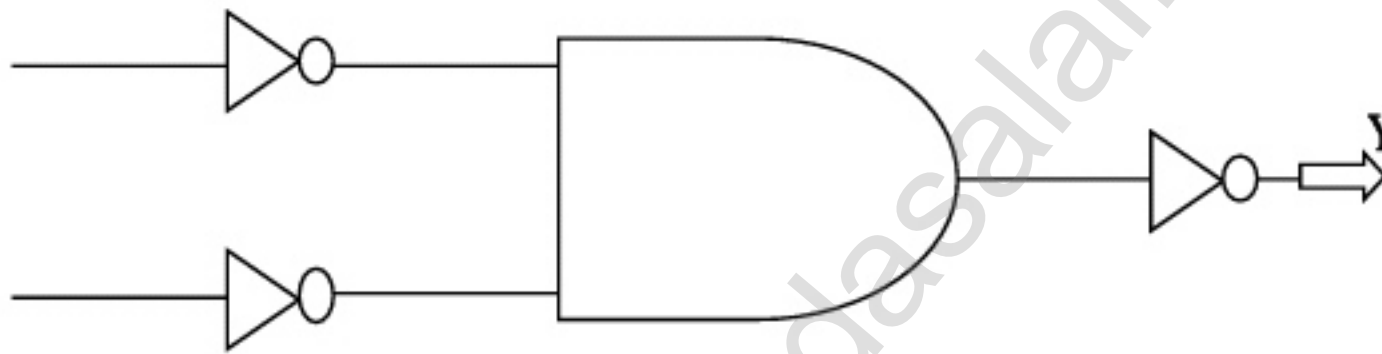
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
a	d	c	a	a	a	a	a	a	a	b	b

2014

1. The mass of proton is 1.00728 amu and that of a neutron is 1.00867 amu. The binding energy of a  ${}_{27}\text{Co}^{60}$  nucleus is ( given mass of cobalt is 59.9338 amu)
  - a.  $4.940 \times 10^{-13} \text{ J}$
  - b.  $9.117 \times 10^{-28} \text{ J}$
  - c.  $8.206 \times 10^{-11} \text{ J}$
  - d.  $2.735 \times 10^{-16} \text{ J}$
2. Synchrotron can accelerate
  - a. Electron and positron
  - b. Electron and neutron
  - c. Proton and neutron
  - d. Neutron and positron
3. In maintaining the chain reaction the ratio between escape rate and production rate is directly proportional to
  - a.  $r^2$
  - b.  $\frac{1}{r^2}$
  - c.  $\frac{1}{r^3}$
  - d.  $\frac{1}{r}$
4. Cyclotron can accelerate
  - a. Negative and positive ions
  - b. Only negative ions
  - c. Only positive ions
  - d. Only fermions
5. An ideal nuclear reactor moderators should have
  - a. High atomic weight and low absorption cross - section for neutrons
  - b. Low atomic weight and low absorption cross - section for neutrons
  - c. Low atomic weight and high absorption cross - section for neutrons
  - d. High atomic weight and high absorption cross - section for neutrons
6. According to collective model the shape and quadrupole moment of odd-odd nuclei are respectively
  - a. Spherical and finite
  - b. Non-spherical and zero
  - c. Spherical and zero
  - d. Non-spherical and finite
7. The nuclear fission was explained by
  - a. Shell model
  - b. Fermi gas model
  - c. Collective model
  - d. Liquid drop model

8. In 8085 microprocessor the \_\_\_ register pair serves as a 16 bit accumulator
- a. WZ
  - b. BC
  - c. DE
  - d. HL
9. On execution of the instruction MVIA, 00H which of the following flags will be affected?
- a. Z flag
  - b. CY flag
  - c. AC flag
  - d. No flag

10. Which of the following flip-flops has overcome the race around problem?
- a. RS
  - b. RST
  - c. JK
  - d. M/S
11. The implementation of the following logic circuit performs \_\_\_ logic.



- a. AND
- b. OR
- c. NAND
- d. NOR