

Test Paper : II

Test Subject : PHYSICAL SCIENCE

Test Subject Code : K-2513

Test Booklet Serial No. : _____

OMR Sheet No. : _____

Roll No.

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(Figures as per admission card)

Name & Signature of Invigilator/s

Signature: _____

Signature: _____

Name : _____

Name : _____

Paper : II

Subject : PHYSICAL SCIENCE

Time : 1 Hour 15 Minutes

Maximum Marks : 100

Number of Pages in this Booklet : 8

Number of Questions in this Booklet : 50

ಅಭ್ಯರ್ಥಿಗಳಿಗೆ ಸೂಚನೆಗಳು

- ಈ ಪುಟದ ಮೇಲ್ಭಾಗದಲ್ಲಿ ಒದಗಿಸಿದ ಸ್ಥಳದಲ್ಲಿ ನಿಮ್ಮ ರೋಲ್ ನಂಬರನ್ನು ಬರೆಯಿರಿ.
- ಈ ಪತ್ರಿಕೆಯು ಬಹು ಆಯ್ಕೆ ವಿಧದ ಐವತ್ತು ಪ್ರಶ್ನೆಗಳನ್ನು ಒಳಗೊಂಡಿದೆ.
- ಪರೀಕ್ಷೆಯ ಪ್ರಾರಂಭದಲ್ಲಿ ಪ್ರಶ್ನೆಪುಸ್ತಕವನ್ನು ನಿಮಗನಿಡಲಾಗುವುದು. ಮೊದಲ 5 ನಿಮಿಷಗಳಲ್ಲಿ ನೀವು ಪುಸ್ತಕವನ್ನು ತೆರೆಯಲು ಮತ್ತು ಕೆಳಗಿನಂತೆ ಕಡ್ಡಾಯವಾಗಿ ಪರಿಶೀಲಿಸಲು ಕೋರಲಾಗಿದೆ.
(i) ಪ್ರಶ್ನೆಪುಸ್ತಕಕ್ಕೆ ಪ್ರವೇಶವನ್ನು ಪಡೆಯಲು, ಈ ಹೊದಿಕೆ ಪುಟದ ಅಂಚಿನ ಮೇಲಿರುವ ಪೇಪರ್ ಸೀಲನ್ನು ಹರಿಯಿರಿ. ಸ್ಕ್ರೇಪ್ ಸೀಲ್ ಇಲ್ಲದ ಪ್ರಶ್ನೆಪುಸ್ತಕ ಸ್ವೀಕರಿಸಬೇಡಿ. ತೆರೆದ ಪುಸ್ತಕವನ್ನು ಸ್ವೀಕರಿಸಬೇಡಿ.
(ii) ಪುಸ್ತಕಿಯಲ್ಲಿನ ಪ್ರಶ್ನೆಗಳ ಸಂಖ್ಯೆ ಮತ್ತು ಪುಟಗಳ ಸಂಖ್ಯೆಯನ್ನು ಮುಖಪುಟದ ಮೇಲೆ ಮುದ್ರಿಸಿದ ಮಾಹಿತಿಯೊಂದಿಗೆ ತಾಳಿ ನೋಡಿ. ಪುಟಗಳು/ಪ್ರಶ್ನೆಗಳು ಕಾಣೆಯಾದ, ಅಥವಾ ದ್ವಿಪ್ರತಿ ಅಥವಾ ಅನುಕ್ರಮವಾಗಿಲ್ಲದ ಅಥವಾ ಇತರ ಯಾವುದೇ ವ್ಯತ್ಯಾಸದ ದೋಷಪೂರಿತ ಪುಸ್ತಕವನ್ನು ಕೂಡಲೆ 5 ನಿಮಿಷದ ಅವಧಿ ಒಳಗೆ, ಸಂವಿವೇಕದಿಂದ ಸರಿ ಇರುವ ಪುಸ್ತಕಕ್ಕೆ ಬದಲಾಯಿಸಿಕೊಳ್ಳಬೇಕು. ಆ ಬಳಿಕ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಬದಲಾಯಿಸಲಾಗುವುದಿಲ್ಲ, ಯಾವುದೇ ಹೆಚ್ಚು ಸಮಯವನ್ನೂ ಕೊಡಲಾಗುವುದಿಲ್ಲ.
- ಪ್ರತಿಯೊಂದು ಪ್ರಶ್ನೆಗೂ (A), (B), (C) ಮತ್ತು (D) ಎಂದು ಗುರುತಿಸಿದ ನಾಲ್ಕು ಪರ್ಯಾಯ ಉತ್ತರಗಳಿವೆ. ನೀವು ಪ್ರಶ್ನೆಯ ಎದುರು ಸರಿಯಾದ ಉತ್ತರದ ಮೇಲೆ, ಕೆಳಗೆ ಕಾಣಿಸಿದಂತೆ ಅಂಡಾಕೃತಿಯನ್ನು ಕವಚಿಸಬೇಕು.
ಉದಾಹರಣೆ:

A	B	C	D
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(C) ಸರಿಯಾದ ಉತ್ತರವಾಗಿದ್ದಾಗ.
- ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ I ರಲ್ಲಿ ಕೊಟ್ಟಿರುವ OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ II ಮತ್ತು ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ III ರಲ್ಲಿ ಇರುವ ಪ್ರಶ್ನೆಗಳಿಗೆ ನಿಮ್ಮ ಉತ್ತರಗಳನ್ನು ಸೂಚಿಸತಕ್ಕದ್ದು. OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಅಂಡಾಕೃತಿಯಿಲ್ಲದ ಬೇರೆ ಯಾವುದೇ ಸ್ಥಳದಲ್ಲಿ ಉತ್ತರವನ್ನು ಗುರುತಿಸಿದರೆ, ಅದರ ಮಾಲ್ಯಮಾಪನ ಮಾಡಲಾಗುವುದಿಲ್ಲ.
- OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಕೊಟ್ಟ ಸೂಚನೆಗಳನ್ನು ಜಾಗರೂಕತೆಯಿಂದ ಓದಿ.
- ಎಲ್ಲಾ ಕೆಲಸವನ್ನು ಪುಸ್ತಕಿಯ ಕೊನೆಯಲ್ಲಿ ಮಾಡತಕ್ಕದ್ದು.
- ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಬಹುದಾದ ನಿಮ್ಮ ಹೆಸರು ಅಥವಾ ಯಾವುದೇ ಚಿಹ್ನೆಯನ್ನು ಸಂಗತವಾದ ಸ್ಥಳ ಹೊರತು ಪಡಿಸಿ, OMR ಉತ್ತರ ಹಾಳೆಯ ಯಾವುದೇ ಭಾಗದಲ್ಲಿ ಬರೆದರೆ, ನೀವು ಅನರ್ಹತೆಗೆ ಬಾಧ್ಯರಾಗಿರುತ್ತೀರಿ.
- ಪರೀಕ್ಷೆಯು ಮುಗಿದನಂತರ, ಕಡ್ಡಾಯವಾಗಿ OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ಸಂವಿವೇಕದಿಂದ ನೀವು ಹಿಂತಿರುಗಿಸಬೇಕು ಮತ್ತು ಪರೀಕ್ಷಾ ಕೊಠಡಿಯ ಹೊರಗೆ OMR ನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ಕೊಂಡೊಯ್ಯ ಕೂಡದು.
- ಪರೀಕ್ಷೆಯ ನಂತರ, ಪರೀಕ್ಷಾ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಮತ್ತು ನಕಲು OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗಬಹುದು.
- ನೀಲಿ/ಕಪ್ಪು ಬಾಲ್ ಪಾಯಿಂಟ್ ಪೆನ್ ಮಾತ್ರವೇ ಉಪಯೋಗಿಸಿ.
- ಕ್ಯಾಲ್ಕುಲೇಟರ್ ಅಥವಾ ಲಾಗ್ ಟೇಬಲ್ ಇತ್ಯಾದಿಯ ಉಪಯೋಗವನ್ನು ನಿಷೇಧಿಸಲಾಗಿದೆ.
- ಸರಿ ಅಲ್ಲದ ಉತ್ತರಗಳಿಗೆ ಋಣ ಅಂಕ ಇರುವುದಿಲ್ಲ.

Instructions for the Candidates

- Write your roll number in the space provided on the top of this page.
- This paper consists of fifty multiple-choice type of questions.
- At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below :
(i) To have access to the Question Booklet, tear off the paper seal on the edge of this cover page. Do not accept a booklet without sticker-seal and do not accept an open booklet.
(ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**
- Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the oval as indicated below on the correct response against each item.
Example :

A	B	C	D
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where (C) is the correct response.
- Your responses to the questions are to be indicated in the **OMR Sheet kept inside the Paper I Booklet only**. If you mark at any place other than in the ovals in the Answer Sheet, it will not be evaluated.
- Read the instructions given in OMR carefully.
- Rough Work is to be done in the end of this booklet.
- If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
- You have to return the test OMR Answer Sheet to the invigilators at the end of the examination compulsorily and must NOT carry it with you outside the Examination Hall.
- You can take away question booklet and carbon copy of OMR Answer Sheet soon after the examination.
- Use only Blue/Black Ball point pen.**
- Use of any calculator or log table etc., is prohibited.**
- There is no negative marks for incorrect answers.**



PHYSICAL SCIENCE

Paper – II

Note : This paper contains **fifty (50)** objective type questions. **Each** question carries **two (2)** marks. **All** questions are **compulsory**.

1. The matrix $\begin{pmatrix} 1 & i \\ \frac{1}{\sqrt{2}} & \frac{i}{\sqrt{2}} \\ -i & -1 \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$ is

- (A) Only Hermitian
- (B) Only Unitary
- (C) Hermitian and Unitary
- (D) Neither Hermitian nor Unitary

2. What is the product of eigen values of

$$\begin{pmatrix} \alpha & 1 & 0 \\ 0 & \beta & 1 \\ 0 & 0 & \gamma \end{pmatrix}$$

- (A) $\alpha \beta^2 / \gamma$
- (B) $\alpha \gamma^2 / \beta$
- (C) $\beta \gamma^2 / \alpha$
- (D) $\alpha \beta \gamma$

3. The equation $\frac{d^2z}{dx^2} - 2x \frac{dz}{dx} + 2\lambda z = 0$ is called

- (A) Legendre's equation
- (B) Bessel's equation
- (C) Hermite equation
- (D) Beltrami's equation

4. Fourier transform of a square pulse is

- (A) cos function
- (B) sin function
- (C) sinc function
- (D) tan function

5. Using Fourier series expansion of x^2 in the interval $(-5 < x < 5)$, the value of

$$\sum_{n=1}^{\infty} \frac{1}{n^2}$$
 is

- (A) $\frac{\pi^2}{3}$
- (B) $\frac{\pi^2}{4}$
- (C) $\frac{\pi^2}{8}$
- (D) $\frac{\pi^2}{6}$

6. The first property of the orthogonality relation for the Legendre polynomial is

$$\int_{-1}^{+1} P_m(x) P_n(x) dx = 0$$
 for

- (A) $m = n$
- (B) $m \neq n$
- (C) $m = n = 0$
- (D) $m = n = 1$

7. For the Poisson distribution, the standard deviation ' σ ' is related to the mean ' m ' as

- (A) $\sigma = \sqrt{m}$
- (B) $\sigma^2 = \sqrt{m}$
- (C) $\sigma + m = 0$
- (D) $\sigma = m$

8. The value of k for which the function $f(x) = e^{-kx}$, $0 \leq x \leq \infty$ is a probability distribution function is

- (A) 0.1
- (B) 0.5
- (C) 1.0
- (D) 0.2



9. Two bodies of mass 'm' collide with each other in a stationary frame of reference. The reduced mass of the system is
- (A) $2m$ (B) $\frac{m}{4}$
(C) m^2 (D) $\frac{m}{2}$
10. A cyclic co-ordinate does not explicitly appear in
- (A) Lagrangian only
(B) Hamiltonian only
(C) Both Lagrangian and Hamiltonian
(D) Conjugate momentum
11. The equation of motion for a bead sliding on a uniformly rotating wire in a force free space is
- (A) $\ddot{r} = r\omega^2$
(B) $\ddot{\theta} + \frac{mg}{l} = 0$
(C) $2mr\dot{\theta} + mr^2\ddot{\theta} = 0$
(D) $\ddot{\theta} + \frac{g}{l}\theta = 0$
12. The general displacement of a rigid body with one point fixed is a rotation about some axis is the statement of
- (A) Bertrand's theorem
(B) Euler's theorem
(C) Virial theorem
(D) Chasle's theorem
13. If a particle moves under a central force field located at $r = 0$ describing a spiral $r = e^{-\theta}$, then the force is proportional to
- (A) r (B) r^2
(C) r^3 (D) r^4
14. Two photons X and Y are moving in the directions opposite to each with the velocity C relative to an observer in the inertial frame. The velocity of photon X relative to the photon Y is
- (A) $2C$ (B) 0
(C) C (D) $C/2$
15. The Lagrangian for a three particle system is given by
- $$L = \frac{1}{2}(\dot{\eta}_1^2 + \dot{\eta}_2^2 + \dot{\eta}_3^2) - \alpha^2(\eta_1^2 + \eta_2^2 - \eta_3^2 - \eta_1\eta_3)$$
- where α is real, then one of the normal co-ordinates has frequency ω as
- (A) $\omega^2 = \alpha^2$ (B) $\omega^2 = 2\alpha^2$
(C) $\omega^2 = \frac{\alpha^2}{2}$ (D) $\omega^2 = \sqrt{2}\alpha^2$
16. An electron at rest is made to move with velocity $\frac{\sqrt{3}}{2}C$. Its mass then becomes
- (A) $2m_0$ (B) $3m_0$
(C) $\frac{m_0}{2}$ (D) $\frac{\sqrt{3}}{2}m_0$
17. Electric field intensity on the surface of a charged conductor is
- (A) Zero
(B) Directed normal to the surface
(C) Directed tangentially to the surface
(D) Directed along 45° to the surface



18. Existence of quadrupole moment for a charge distribution signifies that it is
(A) spherically symmetric
(B) having only +ve charges
(C) spherically asymmetric
(D) having only -ve charges
19. $\nabla \cdot \vec{B} = 0$ implies that
(A) magnetic field is solenoidal
(B) magnetic field is non-solenoidal
(C) no current is flowing
(D) magnetic field is not due to current flow
20. Because of electromagnetic potentials, the number of Maxwell's equation is
(A) reduced to 2
(B) increased to 6
(C) four
(D) reduced to 1
21. The ratio of skin depth in copper at 10 kHz to that at 100 MHz is
(A) 1 (B) 10
(C) 100 (D) 1000
22. The characteristic impedance of free space for propagation of plane, monochromatic electromagnetic wave is around
(A) 3.77Ω (B) 37.7Ω
(C) 377.0Ω (D) 3777Ω
23. An isotropic dielectric offers a refractive index of 1.5 to the propagation of a plane monochromatic electromagnetic wave through it. Its dielectric constant is
(A) 2 (B) 1
(C) 0.5 (D) 2.25
24. The reflectance in visible region at normal incidence is
(A) nk
(B) $\frac{(n-1)^2 + k^2}{(n+1)^2 + k^2}$
(C) $\frac{(n-1)^2 - k^2}{(n+1)^2 + k^2}$
(D) $n^2 k^2$
25. The path of the charged particle in a region of crossed electric and magnetic fields is
(A) helical
(B) hyperbolic
(C) parabolic
(D) circular
26. If the deBroglie wavelength of Helium atom at 300 K is 0.7 \AA , then at 600 K it will be
(A) 4.9 \AA (B) 49 \AA
(C) 0.49 \AA (D) 0.049 \AA
27. The probability current density for an unnormalized wave function $\psi = \exp(ikx)$ is
(A) $\frac{\hbar^2 k^2}{2m}$ (B) $\frac{\hbar k}{m}$
(C) $\frac{\hbar^3 k^3}{m}$ (D) 0
28. A particle of energy E incident on a potential barrier of height V_0 can tunnel through it iff
(A) $E < V_0$ (B) $E > V_0$
(C) $E = V_0$ (D) $E = 0$



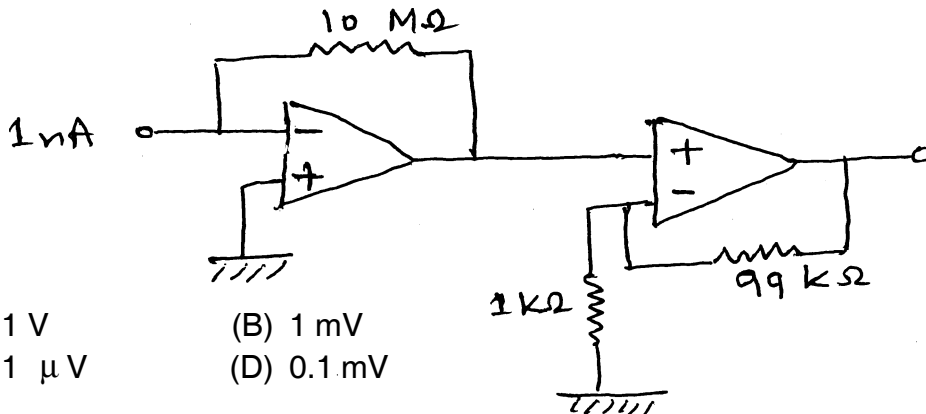
29. A nucleus has two states with energies 1 MeV and 2 MeV. If the life time of lower state is 2 ns, then the life time in higher state will be
(A) 10 ns (B) 20 ns
(C) 0.5 ns (D) 1 ns
30. The vectors of dual space are called
(A) ket vectors
(B) bra vectors
(C) Dirac vectors
(D) Poisson vector
31. If σ_x , σ_y and σ_z are the Pauli spin matrices, which of the commutation relation is correct ?
(A) $[\sigma_x, \sigma_y] = 0$
(B) $[\sigma_x, \sigma_y] = -\sigma_z$
(C) $[\sigma_x, \sigma_y] = 2i\sigma_z$
(D) $[\sigma_x, \sigma_y] = -i\hbar\sigma_z$
32. Fermi's Golden rule No. 2 is
(A) $P = \frac{2\pi}{\hbar} |\langle f | H | i \rangle|^2 \rho(E)$
(B) $P = \frac{\hbar}{2\pi} |\langle i | H | f \rangle|^2 \rho(E)$
(C) $P = \frac{\pi}{\hbar} |\langle f | H | i \rangle| |\rho(E)|^2$
(D) $P = \frac{2\pi}{\hbar} |\langle f | H | i \rangle|^2 |\rho(E)|^2$
33. The behavior of the wave function of a system of two identical Fermions under the interchange of particles is
(A) Symmetric (B) Antisymmetric
(C) Vanishing (D) Singular
34. Which of the following is not a Maxwell's thermodynamic relation ?
(A) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$
(B) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$
(C) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$
(D) $\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial T}\right)_V$
35. In a grand canonical ensemble a system A of fixed volume is in contact with a large reservoir B, then
(A) A can exchange energy only with B
(B) A can exchange only particles with B
(C) A can neither exchange particles nor energy with B
(D) A can exchange both particles and energy with B
36. If the partition function of a Harmonic oscillator with frequency ω at a temperature T is $kT/\hbar\omega$, then the free energy of N such independent oscillators is
(A) $\frac{3}{2} Nk_B T$
(B) $k_B T \ln \frac{\hbar\omega}{k_B T}$
(C) $Nk_B T \ln \frac{\hbar\omega}{k_B T}$
(D) $Nk_B T \ln \frac{\hbar\omega}{2k_B T}$



37. The quantum statistics reduces to classical statistics under the following conditions
- (A) $\rho\lambda^3 \approx 1$
 - (B) $\rho\lambda^3 \gg 1$
 - (C) $\rho\lambda^3 \ll 1$
 - (D) $\rho = 0$
38. A system has two energy levels E_1 and E_2 . In equilibrium, at temperature T , 10^6 particles occupy E_1 and another 10^5 particles occupy E_2 . The value of $E_2 - E_1$ is
- (A) $k_B T \ln 2$
 - (B) $k_B T \ln 50000$
 - (C) $2 k_B T$
 - (D) $50000 k_B T$
39. The specific heat of an ideal Fermi gas in 3-dimensions varies as
- (A) T
 - (B) $T^{3/2}$
 - (C) T^2
 - (D) T^3
40. The temperature T of a black-body enclosure is doubled. Then the total number of photons inside the enclosure increases by a factor of
- (A) 2
 - (B) 4
 - (C) 8
 - (D) 16
41. The Planck's law of radiation in terms of frequency is
- (A) $\frac{8\pi h \nu^3}{C^3} \frac{1}{e^{h\nu/kT} - 1}$
 - (B) $\frac{8\pi h \nu^3}{C^3} \frac{1}{e^{h\nu/kT} + 1}$
 - (C) $\frac{8\pi h \nu^3}{C^3} e^{h\nu/kT}$
 - (D) $\frac{8\pi h \nu^3}{C^3} e^{2h\nu/kT}$
42. The Gibb's potential is defined as
- (A) $G = U - PV + TS$
 - (B) $G = U + PV + TS$
 - (C) $G = U - PV - TS$
 - (D) $G = U + PV - TS$
43. Current I_1 and I_2 flow when large forward voltage V_1 and V_2 are applied to a semiconductor diode. If $V_1 = 3 V_2$ then the magnitude of reverse saturation current is
- (A) $\frac{I_2}{I_1}$
 - (B) $\sqrt{\frac{I_2^3}{I_1}}$
 - (C) $\frac{I_1 I_2}{I_1 + I_2}$
 - (D) $\frac{I_2^3}{I_1}$
44. A diode that has a negative resistance characteristics is the
- (A) Tunnel diode
 - (B) Schottky diode
 - (C) Laser diode
 - (D) Hot carrier cathode



45. The output voltage of the circuit below is



- (A) 1 V
- (B) 1 mV
- (C) 1 μ V
- (D) 0.1 mV

46. With a 100 kHz clock frequency, eight bits can be serially entered into a shift register in

- (A) 8 μ s
- (B) 80 μ s
- (C) 80 ms
- (D) 10 μ s

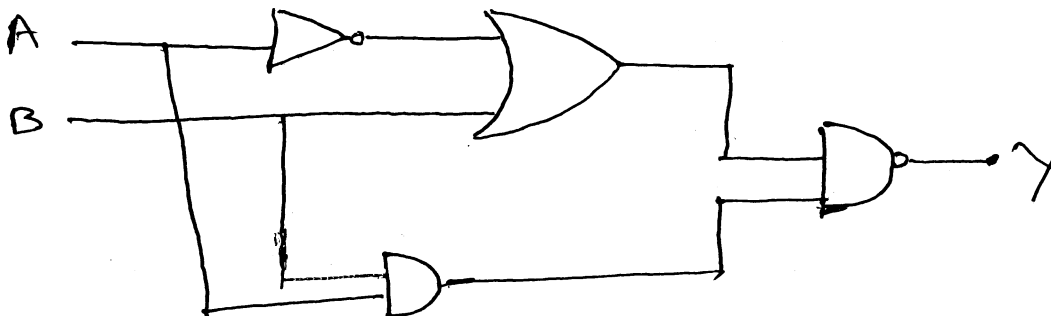
47. A 4-bit binary up/down counter is in the binary state of zero. The next state in the down mode is

- (A) 0001
- (B) 1111
- (C) 1000
- (D) 1110

48. The resolution of a 16-bit DAC with 10 V input voltage is

- (A) 15 mV
- (B) 0.3 mV
- (C) 0.15 mV
- (D) 1.5 mV

49. In the circuit given below, the relation between Y, A and B is



- (A) $\bar{A} + B$
- (B) $\bar{A} + \bar{B}$
- (C) $A + B$
- (D) $A + \bar{B}$

50. In an experiment with a GM counter, the counts are determined with a β -source. If 10,000 counts are obtained for 10 minutes, the percentage error is

- (A) 10%
- (B) 2.33%
- (C) 1%
- (D) 0.1%



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Space for Rough Work