Test Paper : **II**

Test Subject : **PHYSICAL SCIENCE**

Test Subject Code : **K-2516**

Test Booklet Serial No. : _____

OMR Sheet No. : _____

Roll No.

(Figures as per admission card)

Name & Signature of Invigilator/s

Signature : _____

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

1. ಈ ಪುಟದ ಮೇಲ್ತುದಿಯಲ್ಲಿ ಒದಗಿಸಿದ ಸ್ಥಳದಲ್ಲಿ ನಿಮ್ಮ ರೋಲ್ ನಂಬರನ್ನು ಬರೆಯಿರಿ.
2. ಈ ಪತ್ರಿಕೆಯು ಬಹು ಆಯ್ಕೆ ವಿಧದ ಐವತ್ತು ಪ್ರಶ್ನೆಗಳನ್ನು ಒಳಗೊಂಡಿದೆ.
3. ಪರೀಕ್ಷೆಯ ಪ್ರಾರಂಭದಲ್ಲಿ, ಪ್ರಶ್ನೆಪುಸ್ತಿಕೆಯನ್ನು ನಿಮಗೆ ನೀಡಲಾಗುವುದು. ಮೊದಲ 5 ನಿಮಿಷಗಳಲ್ಲಿ ನೀವು ಪುಸ್ತಿಕೆಯನ್ನು ತೆರೆಯಲು ಮತ್ತು ಕೆಳಗಿನಂತೆ ಕಡ್ಡಾಯವಾಗಿ ಪರೀಕ್ಷಿಸಲು ಕೋರಲಾಗಿದೆ.
   (i) ಪ್ರಶ್ನೆ ಪುಸ್ತಿಕೆಗೆ ಪ್ರವೇಶಾವಕಾಶ ಪಡೆಯಲು, ಈ ಹೊದಿಕೆ ಪುಟದ ಅಂಚಿನ ಮೇಲಿರುವ ಪೇಪರ್ ಸೀಲನ್ನು ಹರಿಯಿರಿ. ಸ್ಟಿಕ್ಕರ್ ಸೀಲ್ ಇಲ್ಲದ ಅಥವಾ ತೆರೆದ ಪುಸ್ತಿಕೆಯನ್ನು ಸ್ವೀಕರಿಸಬೇಡಿ.
   (ii) **ಪುಸ್ತಿಕೆಯಲ್ಲಿನ ಪ್ರಶ್ನೆಗಳ ಸಂಖ್ಯೆ ಮತ್ತು ಪುಟಗಳ ಸಂಖ್ಯೆಯನ್ನು ಮುಖಪುಟದ ಮೇಲೆ ಮುದ್ರಿಸಿದ ಮಾಹಿತಿಯೊಂದಿಗೆ ತಾಳೆ ನೋಡಿರಿ. ಪುಟಗಳು/ಪ್ರಶ್ನೆಗಳು ಕಾಣೆಯಾದ, ಅಥವಾ ದ್ವಿಪ್ರತಿ ಅಥವಾ ಅನುಕ್ರಮವಾಗಿಲ್ಲದ ಅಥವಾ ಇತರ ಯಾವುದೇ ವ್ಯತ್ಯಾಸದ ದೋಷಪೂರಿತ ಪುಸ್ತಿಕೆಯನ್ನು ಕೂಡಲೆ 5 ನಿಮಿಷದ ಅವಧಿ ಒಳಗೆ, ಸಂವೀಕ್ಷಕರಿಂದ ಸರಿ ಇರುವ ಪುಸ್ತಿಕೆಗೆ ಬದಲಾಯಿಸಿಕೊಳ್ಳಬೇಕು. ಆ ಬಳಿಕ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಬದಲಾಯಿಸಲಾಗುವುದಿಲ್ಲ, ಯಾವುದೇ ಹೆಚ್ಚು ಸಮಯವನ್ನೂ ಕೊಡಲಾಗುವುದಿಲ್ಲ.**
4. ಪ್ರತಿಯೊಂದು ಪ್ರಶ್ನೆಗೂ (A), (B), (C) ಮತ್ತು (D) ಎಂದು ಗುರುತಿಸಿದ ನಾಲ್ಕು ಪರ್ಯಾಯ ಉತ್ತರಗಳಿವೆ. ನೀವು ಪ್ರಶ್ನೆಯ ಎದುರು ಸರಿಯಾದ ಉತ್ತರದ ಮೇಲೆ, ಕೆಳಗೆ ಕಾಣಿಸಿದಂತೆ ಅಂಡಾಕೃತಿಯನ್ನು ಕಪ್ಪಾಗಿಸಬೇಕು.
   ಉದಾಹರಣೆ: (A) (B) ● (D)
   (C) ಸರಿಯಾದ ಉತ್ತರವಾಗಿದ್ದಾಗ.
5. ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ I ರಲ್ಲಿ **ಕೊಟ್ಟಿರುವ OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ I ಮತ್ತು ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ II ರಲ್ಲಿ ಇರುವ ಪ್ರಶ್ನೆಗಳಿಗೆ ನಿಮ್ಮ ಉತ್ತರಗಳನ್ನು ಸೂಚಿಸತಕ್ಕದ್ದು.** OMR ಹಾಳೆಯಲ್ಲಿ ಅಂಡಾಕೃತಿಯಲ್ಲದೆ ಬೇರೆ ಯಾವುದೇ ಸ್ಥಳದಲ್ಲಿ ಉತ್ತರವನ್ನು ಗುರುತಿಸಿದರೆ, ಅದರ ಮೌಲ್ಯಮಾಪನ ಮಾಡಲಾಗುವುದಿಲ್ಲ.
6. OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಕೊಟ್ಟ ಸೂಚನೆಗಳನ್ನು ಜಾಗರೂಕತೆಯಿಂದ ಓದಿರಿ.
7. ಎಲ್ಲಾ ಕರಡು ಕೆಲಸವನ್ನು ಪುಸ್ತಿಕೆಯ ಕೊನೆಯಲ್ಲಿ ಮಾಡತಕ್ಕದ್ದು.
8. ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಬಹುದಾದ ನಿಮ್ಮ ಹೆಸರು ಅಥವಾ ಯಾವುದೇ ಚಿಹ್ನೆಯನ್ನು, ಸಂಗತವಾದ ಸ್ಥಳ ಹೊರತು ಪಡಿಸಿ, OMR ಉತ್ತರ ಹಾಳೆಯ ಯಾವುದೇ ಭಾಗದಲ್ಲಿ ಬರೆದರೆ, ನೀವು ಅನರ್ಹತೆಗೆ ಬಾಧ್ಯರಾಗಿರುತ್ತೀರಿ.
9. ಪರೀಕ್ಷೆಯು ಮುಗಿದನಂತರ, ಕಡ್ಡಾಯವಾಗಿ OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ಸಂವೀಕ್ಷಕರಿಗೆ ನೀವು ಹಿಂತಿರುಗಿಸಬೇಕು ಮತ್ತು ಪರೀಕ್ಷಾ ಕೊಠಡಿಯ ಹೊರಗೆ OMR ನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ಕೊಂಡೊಯ್ಯಕೂಡದು.
10. ಪರೀಕ್ಷೆಯ ನಂತರ, ಪರೀಕ್ಷಾ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಮತ್ತು ನಕಲು OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗಬಹುದು.
11. **ನೀಲಿ/ಕಪ್ಪು ಬಾಲ್‌ಪಾಯಿಂಟ್ ಪೆನ್ ಮಾತ್ರವೇ ಉಪಯೋಗಿಸಿರಿ.**
12. **ಕ್ಯಾಲ್ಕುಲೇಟರ್, ವಿದ್ಯುನ್ಮಾನ ಉಪಕರಣ ಅಥವಾ ಲಾಗ್ ಟೇಬಲ್ ಇತ್ಯಾದಿಯ ಉಪಯೋಗವನ್ನು ನಿಷೇಧಿಸಲಾಗಿದೆ.**
13. **ಸರಿ ಅಲ್ಲದ ಉತ್ತರಗಳಿಗೆ ಋಣ ಅಂಕ ಇರುವುದಿಲ್ಲ.**
14. **ಕನ್ನಡ ಮತ್ತು ಇಂಗ್ಲೀಷ್ ಆವೃತ್ತಿಗಳ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳಲ್ಲಿ ಯಾವುದೇ ರೀತಿಯ ವ್ಯತ್ಯಾಸಗಳು ಕಂಡುಬಂದಲ್ಲಿ, ಇಂಗ್ಲೀಷ್ ಆವೃತ್ತಿಗಳಲ್ಲಿರುವುದೇ ಅಂತಿಮವೆಂದು ಪರಿಗಣಿಸಬೇಕು.**

Instructions for the Candidates

1. Write your roll number in the space provided on the top of this page.
2. This paper consists of fifty multiple-choice type of questions.
3. 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 the cover page. Do not accept a booklet without sticker seal or 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.**
4. Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the circle as indicated below on the correct response against each item.
   Example : (A) (B) ● (D)
   where (C) is the correct response.
5. 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 circles in the OMR Sheet, it will not be evaluated.
6. Read the instructions given in OMR carefully.
7. Rough Work is to be done in the end of this booklet.
8. 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.
9. 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.
10. You can take away question booklet and carbon copy of OMR Answer Sheet after the examination.
11. **Use only Blue/Black Ball point pen.**
12. **Use of any calculator, Electronic gadgets or log table etc., is prohibited.**
13. **There is no negative marks for incorrect answers.**
14. **In case of any discrepancy found in the Kannada translation of a question booklet the question in English version shall be taken as final.**

PHYSICAL SCIENCE
Paper – II

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

1. If $\vec{a} = 2\hat{i} + 2\hat{j} + \hat{k}$, $\vec{a}.\vec{b} = 14$ and $\vec{a} \times \vec{b} = 3\hat{i} + \hat{j} - 8\hat{k}$, then $\vec{b}$ is equal to

(A) $5\hat{i} - \hat{j} + 2\hat{k}$

(B) $5\hat{i} + \hat{j} - 2\hat{k}$

(C) $5\hat{i} + \hat{j} + 2\hat{k}$

(D) $5\hat{i} - \hat{j} - 2\hat{k}$

2. The vector that is perpendicular to the surface $x^2 + 2y^2 + 3z^2 = 4$ at (0, 1, 1) is

(A) $4\hat{j} + 6\hat{k}$ (B) $2\hat{i} + 4\hat{j} + 6\hat{k}$

(C) $2\hat{j} + 3\hat{k}$ (D) $4\hat{j} - 6\hat{k}$

3. A body is executing circular motion about the point O (1, 3, 4) with a radius of 5 units. The direction of the acceleration of the body, when it is located at (1, 0, 0) is given by the vector

(A) $3\hat{j} + 4\hat{k}$ (B) $2\hat{i} + 3\hat{j} + 4\hat{k}$

(C) $\hat{i} + \frac{3}{2}\hat{j} + 2\hat{k}$ (D) $-\hat{i} - 3\hat{j} - 4\hat{k}$

4. The eigen values of the matrix $\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$ are

(A) 0 (B) 0 and 1

(C) –1 and 0 (D) 1 and –1

5. The eigen values of the matrix $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{pmatrix}$ are

(A) 1, 1, 2 (B) 0, 1, 2

(C) 2, 2, 0 (D) 2, 2, 1

6. The general solution of $\frac{d^2y}{dx^2} + \omega^2 y = 0$ is

(A) $C \cos \omega x$

(B) $C \sin \omega x$

(C) $C \cos \omega x + D \sin \omega x$

(D) $C\ e^{-\omega^2 x}$

7. If $f_1 = 2x + 2iy$ and $f_2 = (x^2 - y^2) + 2ixy$, then choose the correct answer

(A) f_1 is not analytic, f_2 is analytic

(B) f_1 is analytic, f_2 is not analytic

(C) f_1 and f_2 are both analytic

(D) Both f_1 and f_2 are not analytic

8. The value of the integral $I = \int_0^{2\pi} \frac{d\theta}{(5 + 4\cos\theta)^2}$ is

(A) $\frac{10\pi}{49}$ (B) $\frac{10\pi}{27}$

(C) $\frac{8\pi}{25}$ (D) $\frac{10\pi}{9}$

9. A bag contains 6 red balls and 4 blue balls. The probability of drawing two red balls in succession is

(A) $\frac{1}{3}$ (B) $\frac{9}{25}$

(C) $\frac{3}{10}$ (D) $\frac{4}{15}$

10. An object dropped from sky follows the motion $x = \frac{1}{2}gt^2$. Then the acceleration of the body

(A) Varies with time

(B) Remains constant

(C) Varies according to velocity

(D) Varies as square of the distance

11. The Lagrangian for a particle of mass m in an electromagnetic field is given by

$$L=\frac{1}{2}m\left(\dot{x}^2+\dot{y}^2+\dot{z}^2\right)-q\phi(x,y,z,t)+q\vec{A}(x,y,z,t).\vec{v}$$

the momentum conjugate to x is

(A) $m\dot{x}$ (B) $m\dot{x}-q\phi+qA_x$

(C) $m\dot{x}+qA_x$ (D) $m\dot{x}-q\frac{\partial A_x}{\partial x}$

12. The Lagrangian equation of motion for a simple pendulum is

(A) $\ddot{\theta}=-\frac{g}{e}\sin\theta$ (B) $\ddot{\theta}=\frac{g}{e}\sin\theta$

(C) $\ddot{\theta}=\frac{g}{e}\cos\theta$ (D) $\ddot{\theta}=-\frac{g}{e}\cos\theta$

13. Let E and $\vec{p}$ be the energy and momentum of a relativistic particle with rest mass m, then

(A) $E^2=p^2c^2+m^2c^4$

(B) $E^2=p^2c^2-m^2c^4$

(C) $E^2=m^2c^4-p^2c^2$

(D) $E^2=\frac{1}{2}p^2c^2+m^2c^4$

14. Rotation of a vector in XY plane about the Z axis is represented by a 2 × 2 rotation matrix. What is the trace of that matrix ?

(A) Zero (B) Cos θ

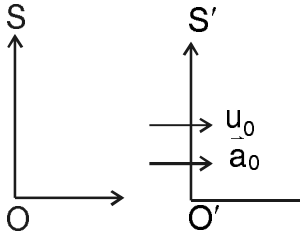
(C) 2 Sin θ (D) 2 Cos θ

15. If the orbit of a body is given in polar coordinates as : $r\theta$ = constant, it is under the influence of a force that varies as

(A) $\frac{1}{r}$ (B) $\frac{1}{r^2}$

(C) $\frac{1}{r^3}$ (D) $\frac{1}{r^4}$

16.



The origin O' of the inertial frame S' is moving with respect to O, the origin of the inertial frame S with a velocity $\vec{u}_0$ and acceleration $\vec{a}_0$ (see figure), then the velocity $\vec{v}'$ and acceleration $\vec{a}'$ of a body in S' will be related to the velocity $\vec{V}$ and acceleration $\vec{a}$ in frame S as follows :

(A) $\vec{v}'=\vec{v}+\vec{u}_0+\vec{a}_0t,\ \vec{a}'=\vec{a}+\vec{a}_0$

(B) $\vec{v}'=\vec{v}-\vec{u}_0-\vec{a}_0t,\ \vec{a}'=\vec{a}-\vec{a}_0$

(C) $\vec{v}'=\vec{v}-\vec{u}_0-\vec{a}_0t,\ \vec{a}'=\vec{a}+\vec{a}_0$

(D) $\vec{v}'=\vec{v}+\vec{u}_0+\vec{a}_0t,\ \vec{a}'=\vec{a}-\vec{a}_0$

17. The Lagrangian for a relativistic particle of rest mass m_0 can be expressed as

(A) $L=\frac{m_0c^2}{\sqrt{1-v^2/c^2}}$

(B) $L=-m_0c^2\sqrt{1-v^2/c^2}$

(C) $L=-m_0c^2\left(1-v^2/c^2\right)^{3/2}$

(D) $L=-m_0\frac{v^2}{2}\sqrt{1-v^2/c^2}$

18. The electric field of an electromagnetic wave in vacuum is given by $E_x = 0$, $E_y = 40\cos\left(2\pi\times10^{10}t-\frac{5\pi}{3}x\right)$, $E_z = 0$

The direction of magnetic field is

(A) Z-direction

(B) X-direction

(C) Y-direction

(D) Azimuthal direction

19. The potential energy U of an electric dipole with dipole moment $\vec{p}$ placed in an electric field $\vec{E}$ is given by

(A) $U = -\vec{p}.\vec{E}$ (B) $U = \vec{p}.\vec{E}$

(C) $U = (\vec{p}.\vec{E})(\vec{E}.\vec{p})$ (D) $U = \frac{(\vec{p}.\vec{E})^2}{2}$

20. The Poisson's equation for electrostatic potential ϕ is given as

(A) $\nabla^2\phi = \rho/\varepsilon_0$ (B) $\nabla^2\phi = \int_v \rho/\varepsilon_0 \, dv$

(C) $\vec{\nabla} \times \phi = \rho/\varepsilon_0$ (D) $\nabla^2\phi = -\rho/\varepsilon_0$

21. For a uniformly charged cylinder with charge per unit length λ, of diameter 2a and of infinite length, the electric field at a point P at a distance d > a from the axis of the cylinder is given by

(A) $E = \frac{\lambda a}{2\pi d \varepsilon_0}$ (B) $E = \frac{\lambda}{2\pi\varepsilon_0 d}$

(C) $E = \frac{\lambda 2a}{\pi \varepsilon_0 d^2}$ (D) $E = \frac{\lambda d}{2\pi\varepsilon_0 a}$

22. For an arbitrary volume V enclosed in a surface S with volume charge distribution ρ the following is true.

(A) $\vec{\nabla}.\vec{E} - \rho/\varepsilon_0 = 0$

(B) $\vec{\nabla}.\vec{E} = \int_v \rho \, dv$

(C) $\vec{\nabla} \times \vec{E} = \int_v \left(\rho/\varepsilon_0\right).\hat{n} \, dv$

(D) $\vec{\nabla} \times \vec{E} = \int_s \frac{\varepsilon_0}{\rho}.\hat{n} \, ds$

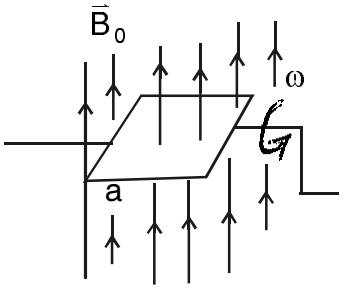
Where $\hat{n}$ is unit vector normal to the surface S.

23. The electrostatic field at a distance r from the center of a uniformly charged sphere of radius R varies as (for $r \le R$)

(A) $\frac{1}{r^2}$ (B) $\frac{1}{r}$

(C) r (D) r^2

24.



A square loop of side a is rotated with angular velocity ω about an axis that is perpendicular to the direction of a uniform magnetic field $\vec{B}_0$ (see figure). The emf generated in the loop is

(A) Zero (B) $B_0 a^2 \omega \cos\omega t$

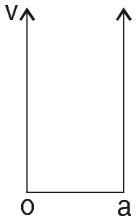
(C) $2 B_0 a \omega \cos\omega t$ (D) $B_0 a^2 \omega \sin\omega t$

25. For a uniform magnetic field $\vec{B}$, the vector potential $\vec{A}$ is given by

(A) $\frac{1}{2}\vec{r}(\vec{r}.\vec{B})$ (B) $\frac{1}{2}(\vec{B} \times \vec{r})$

(C) $\frac{1}{2}\vec{B}(\vec{r}.\vec{B})$ (D) $\frac{1}{2}\frac{\vec{B} \times \vec{r}}{r}$

26.



For a particle confined in a one-dimensional box of length a, the energy levels for a particle of mass m are given by

(A) $\frac{\pi^2\hbar^2 n^2}{2ma^2}$ (B) $\frac{\hbar^2\pi^2 a^2}{2mn^2}$

(C) $\frac{\hbar\pi n}{2ma}$ (D) $-\frac{\hbar^2\pi^2}{2ma^2n^2}$

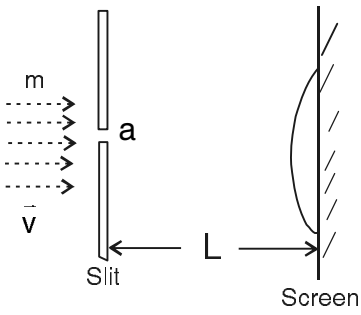
27. Let L_x, L_y and L_z denote the Cartesian components of angular momentum. Study the following statements :

1) L_x, L_y and L_z do not commute with each other
2) L_x, L_y and L_z commute with L^2
3) The commutator of L_x and L_y depends linearly on L_x and L_y
4) $\left[\left[L_x, L_y\right], L_z\right] = 0$

Choose the correct statement :

(A) 1) and 2) are correct but 3) and 4) are false
(B) 1), 2) and 3) are true but 4) is false
(C) 1), 2) and 4) are true but 3) is false
(D) 1), 3) and 4) are true but 2) is false

28.



A beam of particles having mass m and velocity v is incident on a slit of width a (see figure), then the approximate spread of the particles on a screen kept at a distance L is

(A) 2a (B) $\frac{\hbar L}{amv}$

(C) $\frac{\hbar v}{maL}$ (D) $\sqrt{\frac{\hbar L}{mav}}$

29. Four fold degeneracy in the excited state (n = 2) in hydrogen atom can be partially removed by

(A) Application of weak electric field
(B) By supplying heat energy to the atom
(C) By accelerating the atom in a particle acceleration
(D) By applying gravitational field

30. Two successive applications of an operator $\hat{p}$ on the function leaves the function unchanged, the eigen values of the operator are

(A) +1, 0 (B) –1, –2
(C) +1 and –1 (D) 0, 2

31. A system has an unperturbed Hamiltonian, in energy units given by

$$\begin{bmatrix} 15 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 3 \end{bmatrix}.$$

The unperturbed energy eigen values of the system are

(A) (15, 3, 3, 3) (B) $(-3, -15, -3, -3)$
(C) (6, 3, 15, 9) (D) $(-3, -3, 15, -12)$

32. The Hamiltonian of the system is given by

$$H = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 8 & 0 & 0 \\ 0 & 0 & 3 & -2\lambda \\ 0 & 0 & -2\lambda & 7 \end{bmatrix}$$

where λ is a small parameter. By decomposing the same as $H = H_0 + H_p$ the eigen values of unperturbed Hamiltonian H_0 can be obtained. The eigen values of H_0 are

(A) $(1+\lambda, 8, 3, 7)$

(B) $(1, 8-\lambda, 3-\lambda, 7-\lambda)$

(C) $(1, 8, 3, 7)$

(D) $(1, 8\lambda, 3\lambda, 7\lambda)$

33. The ground state energy for a particle in a box is 1.25 eV. If 3 particles, each having spin $\frac{1}{2}$ are introduced in the box then the total ground state energy of the system will be

(A) 3.75 eV (B) 4 eV
(C) 6 eV (D) 7.5 eV

34. Uncertainty in velocity for an electron in a 1A° radius orbital in which the positional uncertainty is 1% of the radius, the uncertainty in the velocity is greater than (use $h = 6.626 \times 10^{-34}$ J.s.) (mass of electron 9.11×10^{-30} Kg)

(A) 5.7×10^5 m/s (B) 9.9×10^4 m/s

(C) 5.7×10^6 m/s (D) 5.7×10^{-2} m/s

35. A system of 3 indistinguishable particles has the total energy of $4\in$. There are four single particle energy states with energy 0, $\in$, $2\in$ and $3\in$. The number of microstates accessible to the system will be

(A) 1 (B) 2

(C) 3 (D) 4

36. In thermal equilibrium at very low temperatures, the occupancy of a phonon mode of frequency ω is given by

(A) $\dfrac{1}{e^{\hbar\omega/K_BT}-1}$ (B) $\dfrac{1}{e^{\frac{\hbar\omega}{K_BT}}+1}$

(C) $\hbar\omega / K_BT$ (D) $e^{-\hbar\omega/K_BT}$

37. Change in entropy of irreversible process is

(A) Zero

(B) Positive

(C) Negative

(D) Proportional to $\ln\left[\dfrac{K_BT}{E_0}\right]$ where E_0 is its internal energy

38. In a canonical ensemble, a system A of fixed volume is in contact with a large reservoir B then

(A) A can exchange neither energy nor particles with B

(B) A can exchange only energy with B

(C) A can exchange only particles with B

(D) A can exchange both energy and particles with B

39. Which of the following quantity refers to Gibb's free energy ?

(A) U – TS (B) U + pV

(C) U – TS + pV (D) U

40. Specific heat of a photon gas in black body is proportional to

(A) T^2 (B) T

(C) T^4 (D) T^3

41. The criterion for the application of quantum statistics is

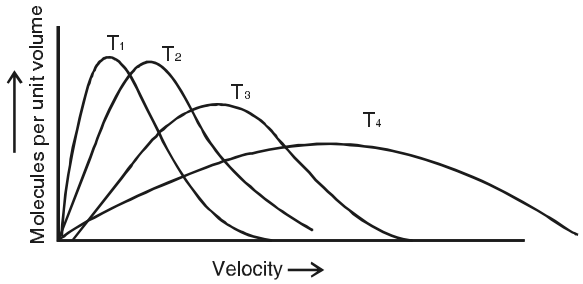
(A) A material should be at high temperature

(B) A material should be condensed

(C) The de-Broglie wavelength of the particles constituting the particle is greater than the mean free path

(D) Chemical potential is high

42. The Maxwell's distribution of velocities at four different temperatures T_1, T_2, T_3 and T_4 is shown below.



Which of the following is true for the above diagram ?

(A) $T_1 > T_2 > T_3 > T_4$

(B) $T_4 > T_3 > T_2 > T_1$

(C) $T_1 = T_2 = T_3 = T_4$

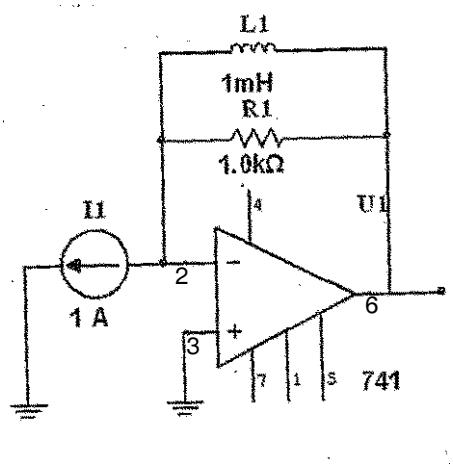
(D) $T_1 \simeq T_2 \simeq T_3 \simeq T_4$

43. A 50 Hz signal of 1 mV peak value is at the input of an Op-Amp based integrator (RC = 1s). The output will be

(A) 3.2 nV (B) 3.2 μV

(C) 3.2 mV (D) 3.2 V

44. Following circuit for an ideal Op-Amp will work as

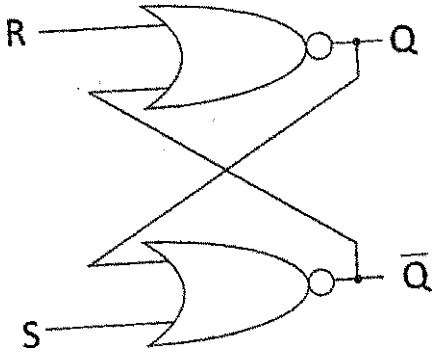


(A) Low pass filter
(B) Band pass filter
(C) Band stop filter
(D) High pass filter

45. In a nuclear counting experiment the count rate is about 5 counts/hr. To establish the uncertainty in the count to better than 1%, you will have to count for

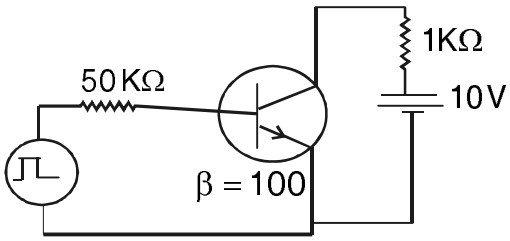
(A) 2 hrs (B) 20 hrs
(C) 200 hrs (D) 2000 hrs

46. In the following figure, the outputs are cross-coupled back to the inputs of NOR gates. Which of the following condition will lead to unpredictable operation ?



(A) R = 0, S = 0 (B) R = 0, S = 1
(C) R = 1, S = 0 (D) R = 1, S = 1

47. In the following circuit the transistor is working as

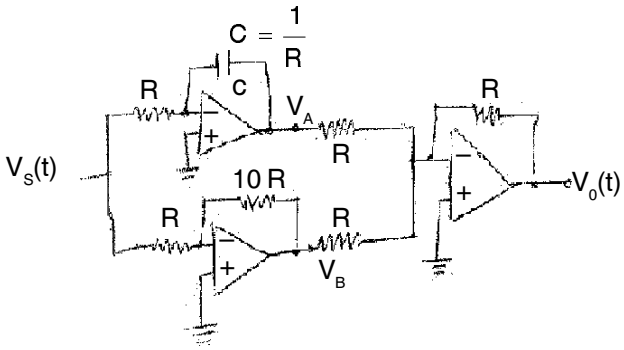


(A) Switch (B) Amplifier
(C) Regulator (D) Filter

48. The number of flip-flops required to build a MOD-31 counter is

(A) 15 flip-flops (B) 31 flip-flops
(C) 5 flip-flops (D) 8 flip-flops

49. In the Op-Amp circuit given below, the final output $V_0(t)$ is given by



(A) $V_0(t) = 10\ V_s(t) + \int_0^t V_s(t)\,dt$

(B) $V_0(t) = 10 V_s(t) - \int_0^t V_s(t)\,dt$

(C) $V_0(t) = V_s(t) + \frac{d}{dt}(10\ V_s(t))$

(D) $V_0(t) = V_s(t) - \frac{d}{dt}(V_s(t))$

50. The critically damped series LCR circuit (where L is inductor, C is capacitor and R is resister) which of the following is true ?

(A) $R^2 = 4L/C$ (B) $R^2 = 2L/C$

(C) $R = \sqrt{L/C}$ (D) $R^2 = 4L^2C^2$

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Space for Rough Work