Test Paper : **III**

Test Subject : **PHYSICAL SCIENCE**

Test Subject Code : **K-2514**

Test Booklet Serial No. : _____

OMR Sheet No. : _____

Roll No. | | | | | | | | |

(Figures as per admission card)

Name & Signature of Invigilator/s

Signature : _____ Signature : _____

Name : _____ Name : _____

Paper : III

Subject : PHYSICAL SCIENCE

Time : 2 Hours 30 Minutes Maximum Marks : 150

Number of Pages in this Booklet : **16** Number of Questions in this Booklet : **75**

ಅಭ್ಯರ್ಥಿಗಳಿಗೆ ಸೂಚನೆಗಳು

1. ಈ ಪುಟದ ಮೇಲ್ತುದಿಯಲ್ಲಿ ಒದಗಿಸಿದ ಸ್ಥಳದಲ್ಲಿ ನಿಮ್ಮ ರೋಲ್ ನಂಬರನ್ನು ಬರೆಯಿರಿ.
2. ಈ ಪತ್ರಿಕೆಯು ಬಹು ಆಯ್ಕೆ ವಿಧದ ಎಪ್ಪತ್ತೈದು ಪ್ರಶ್ನೆಗಳನ್ನು ಒಳಗೊಂಡಿದೆ.
3. ಪರೀಕ್ಷೆಯ ಪ್ರಾರಂಭದಲ್ಲಿ ಪ್ರಶ್ನೆಪುಸ್ತಿಕೆಯನ್ನು ನಿಮಗೆನೀಡಲಾಗುವುದು. ಮೊದಲ5 ನಿಮಿಷಗಳಲ್ಲಿ ನೀವು ಪುಸ್ತಿಕೆಯನ್ನು ತೆರೆಯಲು ಮತ್ತು ಕೆಳಗಿನಂತೆಕಡ್ಡಾಯವಾಗಿ ಪರೀಕ್ಷಿಸಲು ಕೋರಲಾಗಿದೆ.
   (i) ಪ್ರಶ್ನೆಪುಸ್ತಿಕೆಗೆ ಪ್ರವೇಶಾವಕಾಶ ಪಡೆಯಲು, ಈ ಹೊದಿಕೆ ಪುಟದ ಅಂಚಿನ ಮೇಲಿರುವ ಪೇಪರ್ ಸೀಲನ್ನು ಹರಿಯಿರಿ. ಸ್ಟಿಕ್ಕರ್ ಸೀಲ್ ಇಲ್ಲದ ಪ್ರಶ್ನೆಪುಸ್ತಿಕೆ ಸ್ವೀಕರಿಸಬೇಡಿ. ತೆರೆದ ಪುಸ್ತಿಕೆಯನ್ನು ಸ್ವೀಕರಿಸಬೇಡಿ.
   (ii) **ಪುಸ್ತಿಕೆಯಲ್ಲಿನ ಪ್ರಶ್ನೆಗಳ ಸಂಖ್ಯೆ ಮತ್ತು ಪುಟಗಳ ಸಂಖ್ಯೆಯನ್ನು ಮುಖಪುಟದ ಮೇಲೆ ಮುದ್ರಿಸಿದ ಮಾಹಿತಿಯೊಂದಿಗೆತಾಳೆ ನೋಡಿರಿ. ಪುಟಗಳು/ ಪ್ರಶ್ನೆಗಳು ಕಾಣೆಯಾದ, ಅಥವಾ ದ್ವಿಪ್ರತಿ ಅಥವಾ ಅನುಕ್ರಮವಾಗಿಲ್ಲದ ಅಥವಾ ಇತರ ಯಾವುದೇ ವ್ಯತ್ಯಾಸದ ದೋಷಪೂರಿತ ಪುಸ್ತಿಕೆಯನ್ನು ಕೂಡಲೆ5 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. ಪ್ರಶ್ನೆಗಳಿಗೆ ಉತ್ತರಗಳನ್ನು, **ಪತ್ರಿಕೆIII ಪುಸ್ತಿಕೆಯೊಳಗೆ ಕೊಟ್ಟಿರುವ** OMR **ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಮಾತ್ರವೇ ಸೂಚಿಸತಕ್ಕದ್ದು.** OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿನ ಅಂಡಾಕೃತಿ ಹೊರತುಪಡಿಸಿ ಬೇರೆ ಯಾವುದೇ ಸ್ಥಳದಲ್ಲಿ 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 ಕೊಂಡೊಯ್ಯ ಕೂಡದು.
10. ಪರೀಕ್ಷೆಯ ನಂತರ, ಪರೀಕ್ಷಾ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಮತ್ತು ನಕಲು OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗಬಹುದು.
11. **ನೀಲಿ/ಕಪ್ಪು ಬಾಲ್‌ಪಾಯಿಂಟ್ ಪೆನ್ ಮಾತ್ರವೇ ಉಪಯೋಗಿಸಿರಿ.**
12. **ಕ್ಯಾಲ್ಕುಲೇಟರ್ ಅಥವಾ ಲಾಗ್ ಟೇಬಲ್ ಇತ್ಯಾದಿಯ ಉಪಯೋಗವನ್ನು ನಿಷೇಧಿಸಲಾಗಿದೆ.**
13. **ಸರಿ ಅಲ್ಲದ ಉತ್ತರಗಳಿಗೆ ಋಣ ಅಂಕ ಇರುವುದಿಲ್ಲ.**

Instructions for the Candidates

1. Write your roll number in the space provided on the top of this page.
2. This paper consists of seventy five 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 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.**
4. 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) ● (D)
   where (C) is the correct response.
5. Your responses to the question of Paper III are to be indicated in the **OMR Sheet kept inside the Booklet**. If you mark at any place other than in the ovals in OMR Answer 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 soon after the examination.
11. **Use only Blue/Black Ball point pen.**
12. **Use of any calculator or log table etc., is prohibited.**
13. **There is no negative marks for incorrect answers.**

PHYSICAL SCIENCE

PAPER – III

Note : This paper contains **seventy-five (75)** objective type questions. **Each** question carries **two (2)** marks. **All** questions are **compulsory**.

1. Newton-Raphson formula is given by

(A) $x_{n+1} = x_n - \frac{f'(x_n)}{f(x_n)}$

(B) $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$

(C) $x_{n+1} = \frac{f'(x_n)}{f(x_n)}$

(D) $x_{n+1} = -\frac{f'(x_n)}{f(x_n)}$

2. The value of the integral $\int_{-1}^{1} e^x dx$ using Simpson's $\frac{1}{3}$ rule is

(A) 4.86305

(B) 2.36205

(C) 6.46505

(D) 5.84405

3. Error in the Trapezoidal formula of the order of

(A) h

(B) h^2

(C) h^3

(D) h^4

4. Which of the following is not a tensor ?

(A) Velocity

(B) Acceleration

(C) Mass

(D) Gradient of a scalar field

5. Let f_0, f_1, f_2, ...f_n are known values of a function f(x) at the points x_0, x_1, x_2, ... x_n. The first divided difference between x_s and x_t is

(A) $f(x_s, x_t) = \frac{f_t - f_s}{x_s - x_t}$

(B) $f(x_s, x_t) = \frac{f_s - f_t}{x_t - x_s}$

(C) $f(x_s, x_t) = \frac{f_s - f_t}{x_s - x_t}$

(D) $f(x_t, x_s) = \frac{f_s - f_t}{x_s - x_t}$

6. Which interpolation formula does not give any information regarding any error committed during approximation ?

(A) Lagrange's interpolation

(B) Newton-Gregory backward difference interpolation

(C) Newton-Gregory forward difference interpolation

(D) Gauss forward difference interpolation

7. Relation between two finite groups in many-to-one mapping then it called as

(A) Isomorphic relation

(B) Homomorphic relation

(C) Automorphic relation

(D) Monomorphic relation

8. If the Lagrangian does not depend on time explicitly

(A) The kinetic energy is a constant of motion

(B) The potential energy is a constant of motion

(C) The Hamiltonian is a constant of motion

(D) The Hamiltonian cannot be a constant of motion

9. For the given transformations. $T_1 : Q = p$, $P = -q$ and $T_2 : Q = p$, $P = q$ where p and q are canonically conjugate variables, which of the following statements is true ?

(A) Both T_1 and T_2 are canonical

(B) Only T_1 is canonical

(C) Only T_2 is canonical

(D) Neither T_1 or T_2 is canonical

10. For conservative system where the coordinate transformation is independent of time the Hamiltonian function represents

(A) Kinetic energy of the system

(B) Total energy of the system

(C) Potential energy of the system

(D) Difference of kinetic and potential energies

11. The Poisson bracket of any constant of motion with Hamiltonian H is

(A) 1

(B) – 1

(C) 0

(D) Infinity

12. The principle of least action in terms of arc length of the particle trajectory is

(A) $\Delta \int \sqrt{H+V}\ \partial s = 0$

(B) $\Delta \int \sqrt{H-T}\ \partial s = 0$

(C) $\Delta \int \sqrt{H+T}\ \partial s = 0$

(D) $\Delta \int \sqrt{H-V}\ \partial s = 0$

13. If the effective potential energy for radial motion is $V_{eff}(r)$, the condition for stability in radial motion is given by

1) The existence of a local minimum in $V_{eff}(r)$ at $r = r_0$

2) $\frac{\partial^2 V_{eff}(r)}{\partial r^2} < 0$ at $r = r_0$

Which of the following is correct ?

(A) 1 and 2 are false

(B) 1 and 2 are correct

(C) 1 is false and 2 is correct

(D) 1 is correct and 2 is false

14. Larmor formula is for

(A) Energy radiated by an accelerated charged particle

(B) Power radiated by an accelerated charge particle

(C) Power radiated by an uniformly moving particle

(D) Energy radiated by an uniformly moving particle

15. The dispersive relation for a low density plasma is $\omega^2 = \omega_0^1 + c^2k^2$, where ω_0 is the plasma frequency and 'c' is the speed of light in free space. The relation between the group velocity (v_g) and phase velocity (v_p) is

(A) $v_p = v_g c$

(B) $v_p = \sqrt{v_g}$

(C) $v_p v_g = c^2$

(D) $v_g = \sqrt{v_p}$

16. The Poynting vector S is defined as the

(A) Energy per unit time

(B) Energy per unit area

(C) Energy per unit time per unit area

(D) Energy per unit volume

17. A transmission line whose characteristic impedance a pure resistance

(A) Must be a lossless line

(B) Must be a distortion-less line

(C) May be a lossless line

(D) May not a distortion-less line

18. The velocity factor of a transmission line

(A) Depends on the dielectric constant of the material used

(B) Increases the velocity along the transmission line

(C) Is governed by skin effect

(D) Is higher for a solid dielectric than air

19. Choose the correct answer :

According to Dirac's relativistic theory, orbital angular momentum

(A) is a constant of motion in a central force-field

(B) vanishes in a central force-field

(C) is not a constant of motion in a central force-field

(D) is a parameter in a central force-field

20. The WKB approximation often referred as

(A) Classical approximation

(B) Quantum approximation

(C) Semi-classical approximation

(D) Weak approximation

21. In partial wave analysis, the expression for total cross-section of scattering is

(A) $\frac{4\pi}{k^2}\sum_l (2l+1)\sin^2\delta_l$

(B) $4\pi\sum_l k^2(2l+1)\sin^2\delta_l$

(C) $\frac{2\pi}{k^2}\sum_l (2l+1)p_l^2\cos\theta$

(D) $2\pi k^2\sum_l(2l+1)p_l^2\cos\theta$

22. Alpha emission is an example of

(A) Barrier reflection

(B) Barrier tunnelling

(C) Barrier refraction

(D) Barrier absorption

23. The ratio of Einstein's A and B coefficients is

(A) $\frac{A_{21}}{B_{21}} = \frac{\hbar\omega}{\pi c}$

(B) $\frac{A_{21}}{B_{21}} = \frac{\hbar\omega^2}{\pi^2 c}$

(C) $\frac{A_{21}}{B_{21}} = \frac{\hbar\omega^2}{\pi^2 c^3}$

(D) $\frac{A_{21}}{B_{21}} = \hbar\omega$

24. The relativistic relation for the total energy E of a free particle with rest mass m_0 is

(A) $E^2 = C^2p^2 + m_0^2C^4$

(B) $E^2 = C^2p^2 + m_0C^4$

(C) $E^2 = cp + m_0^2C^4$

(D) $E^2 = m_0^2C^4$

25. In Born's approximation the effective cross-section of scattering depends on

(A) Momentum (p) of the incident particle

(B) Angle of scattering (θ)

(C) p and θ in any combination

(D) p and θ in the combination p sin $\theta/2$

26. Identify which of the following is second order phase transition ?

1) Transition of liquid helium-I into liquid helium-II

2) Transition of water into water vapour

3) Transition of non-ferromagnetic state to ferromagnetic state

(A) 1 and 2

(B) 2 and 3

(C) 1 and 3

(D) 1, 2 and 3

27. Ising model is to understand the behaviour of a substance whose molecules possess

(A) Non-magnetic nature

(B) Random orientation

(C) Electrostatic nature

(D) Magnetic moment

28. Fractional fluctuations of number of particles in Bose-Einstein gas is given by

(A) $\left(1+\tilde{n}_i\right)$

(B) $(1+\tilde{n}_i^2)$

(C) $\left(1+1/\tilde{n}_i\right)$

(D) $\left(1-\tilde{n}_i^2\right)$

29. Magnetic susceptibility per electron of diamagnetic materials is

(A) $\chi^m = \dfrac{3\mu_0 Nr^2}{4m}$

(B) $\chi^m = \dfrac{-\mu_0 NZe^2}{6m}\left\langle r^2\right\rangle$

(C) $\chi^m = \dfrac{\mu_0 Nr^2}{4m}$

(D) $\chi^m = \dfrac{3\mu_0 NZe^2}{6m}\left\langle r^2\right\rangle$

30. According to Curie-Weiss law, which is of the following is correct ?

(A) $X = \dfrac{C}{T-\theta}$

(B) $X = \dfrac{C}{T+\theta}$

(C) $X = \dfrac{C}{\theta-T}$

(D) $X = \dfrac{C}{T\theta}$

31. All the materials have _____ property.

(A) Paramagnetic

(B) Diamagnetic

(C) Ferromagnetic

(D) Ferrimagnetic

32. The equation of fitting a straight line that gives as $a_0 + a_1 \bar{x} = \bar{y}$ indicates the given below information.

Statement (A) : $(\bar{x}, \bar{y})$ is the centroid of the given data points.

Statement (B) : The fitted straight line passes through the centroid of the data points.

(A) (A) and (B) are correct

(B) Only (A) is correct

(C) Only (B) is correct

(D) (A) and (B) are both wrong

33. Flash ADC is

(A) The slowest of all types of ADCs

(B) A converter which uses 'n' comparators for generating a n-bit digital number

(C) Fastest of all ADCs and need $(2^n - 1)$ comparators for generating a n-bit digital number

(D) Cannot be practically realized

34. An OP AMP data sheet gives a 15 V power bandwidth of 25 kHz. Its slew rate is

(A) 0.236 V/μs

(B) 2.36 V/μs

(C) 23.6 V/μs

(D) 236.0 V/μs

35. A piece of semiconducting material is introduced in a circuit. If the temperature of the material is raised the circuit current will

(A) Increase

(B) Remain the same

(C) Decrease

(D) Cease to flow

36. The Fourier transform of sin(x)/x is

(A) $\frac{x}{\cos(x)}$

(B) $\frac{1}{\sin(x)}$

(C) $\frac{1}{\sin(x)\cos(x)}$

(D) a square function

37. An amplifier has a voltage gain of 500 and an input impedance 20 $k\Omega$ without any feedback. Now a negative feedback with $\beta = 0.1$ is applied. Its gain and input impedance with feedback will respectively be

(A) 9.8 and 392 Ω

(B) 9.8 and 1020 $k\Omega$

(C) 50 and 1020 Ω

(D) 50 and 2 $k\Omega$

38. The normal Zeeman effect of cadmium red line is 6438 $\mathring{A}$. When the cadmium atoms are placed in a magnetic field of 0.009 T, the shift is

(A) 0.174 $\mathring{A}$

(B) 0.0174 $\mathring{A}$

(C) 0.00174 $\mathring{A}$

(D) 0.000174 $\mathring{A}$

39. In 4f shell of an atom, there are 6 electrons. The value of J is

(A) 0

(B) 1

(C) 2

(D) 3

40. Paschen-Back effect is due to

(A) Spin of the electron

(B) Only orbital motion of the electron

(C) Spin-orbit interaction

(D) Spin of the nucleus

41. In ESR the contribution by nuclear magnetic moment

(A) Exists but neglected

(B) Does not exist

(C) Exists and considered

(D) Has very high value

42. The Frank-Condon principle is based on the principle on the fact that nuclei are

(A) moving with velocity of light

(B) are having zero mass

(C) are at rest

(D) are neglected

43. Hyperfine structure and isotope effect are associated with

(A) only splitting of the electronic energy levels

(B) only shifting of electronic energy levels

(C) both shifting and splitting of electronic energy levels

(D) no change in the energy levels

44. A laser operates at a frequency of 3×10^4 Hz and has a slit width 10^{-2}m. The angular spread will be

(A) 10^{-2} radians

(B) 10^{-4} radians

(C) 10^{-3} radians

(D) 10^{-5} radians

45. Moseley's law relates

(A) wavelength and intensity of X-rays

(B) frequency and applied voltage

(C) frequency and atomic number

(D) wavelength and scattering

46. The possible values of total angular momentum J resulting from the addition of two angular momenta $j_1 = 1$ and $j_2 = 2$ are

(A) 1, 2

(B) 1, 3

(C) 0, 1, 2

(D) 1, 2, 3

47. Raman spectra is due to collision of

(A) Photon with electron

(B) Photon with molecule

(C) Electron with atom

(D) Electron with photon

48. The energy separation between two consecutive Stokes line in Raman scattering depends on

(A) Energy separation between vibrational levels in the excited state

(B) Wavelength of the incident light

(C) Energy separation between vibrational levels in the ground state

(D) Intensity of the incident light

49. The number of photons emitted per second from one watt Ar-ion laser operating at 488.0 nm is approximately

(A) 10.23×10^{19}

(B) 2.46×10^{18}

(C) 10.23×10^{17}

(D) 2.46×10^{15}

50. The maximum degeneracy of an energy level with principal quantum number 'n' is

(A) n

(B) n^2

(C) $2n^2$

(D) $2n^2 + 1$

51. A two-dimensional lattice has the basis vectors 2i and i + 2j. The basis vectors of the reciprocal lattice are

(A) $\pi i + \frac{\pi}{2} j$ and πj

(B) $\pi i - \frac{\pi}{2} j$ and $-\pi j$

(C) $-\pi i - \frac{\pi}{2} j$ and $-\pi j$

(D) $\pi i - \frac{\pi}{2} j$ and πj

52. Which one of the following pairs of crystal structures can have the same packing fraction of 0.74 ?

(A) BCC and BCT

(B) BCC and FCC

(C) BCC and HCP

(D) FCC and HCP

53. Ionic solids are

(A) Soft and brittle

(B) hard and brittle

(C) Malleable and ductile

(D) Malleable, hard and brittle

54. In case of instability in a cubic crystal

(A) $C_{44} < 0$

(B) $C_{44} > 0$

(C) $C_{11} > C_{12}$

(D) $C_{11} = C_{12}$

55. Match the material properties (List – I) with the units (List – II) :

List – I	List – II
1. Specific heat	A. $Wm^{-1}K^{-1}$
2. Carrier mobility	B. $J\ mol^{-1}K^{-1}$
3. Thermal conductivity	C. $V\ K^{-1}$
4. Thermoelectric power	D. $m^2\ V^{-1}s^{-1}$

(A) 1-A, 2-D, 3-B, 4-C

(B) 1-B, 2-C, 3-A, 4-D

(C) 1-B, 2-D, 3-A, 4-C

(D) 1-A, 2-D, 3-C, 4-B

56. For copper metal, the conduction electron density is $8.45 \times 10^{28}\ m^{-3}$. The Fermi wave vector is

(A) 2.5×10^{10} m

(B) $1.36 \times 10^{10}\ m^{-1}$

(C) 4.5×10^{10} m

(D) 1.36×10^{10} m

57. If E is the electric field developed in the presence of a temperature gradient ∇T maintained at the ends of a metal rod, under open circuit conditions, then the constant of proportionality in the equation $E = c \nabla T$ is

(A) Peltier coefficient

(B) Joule coefficient

(C) Seebeck coefficient

(D) Thermal coefficient

58. A Frenkel defect in an ionic crystal is a stochiometric defect of

(A) a cation vacancy

(B) an anion vacancy

(C) a pair of cation and anion vacancy

(D) a pair of cation interstitial and cation vacancy

59. When a dc voltage V is applied across a superconductor-insulator-superconductor junction ?

1) Cooper pairs cross the barrier layer
2) An oscillating current of KHz frequency is produced
3) A photon of energy 2eV is emitted/ absorbed
4) A dc current is produced
5) A very precise value of e/h can be obtained

Which of the above statements are true ?

(A) 1, 4, 5

(B) 2, 4, 5

(C) 1, 3, 5

(D) 1, 2, 5

60. The relation between resistivity of a metal at high temperature T is

(A) $\rho \alpha T$

(B) $\rho \alpha \sqrt{T}$

(C) $\rho \alpha T^2$

(D) $\rho \alpha T^{-1}$

61. In tight binding approximation, for a simple cubic lattice, the band width is

(A) 15γ

(B) 12γ

(C) 9γ

(D) 6γ

62. Liquid helium does not exhibit

(A) Fountain effect

(B) Lambda transition

(C) Thermo-mechanical effect

(D) Photo-mechanical effect

63. Most of the liquid crystal cells used in LCD display are of the type

(A) Smectic

(B) Nematic

(C) Twisted nematic

(D) Cholestric

64. Which of the following are probable to be captured by the nucleus ?

(A) K-shell electrons

(B) L-shell electrons

(C) M-shell electrons

(D) Outermost-shell electrons

65. The binding energy per nucleon is maximum for the nucleus

(A) ^{56}Fe

(B) ^{4}He

(C) ^{208}Pb

(D) ^{101}Mo

66. According to meson theory of nuclear forces a neutron

(A) Emits a π° meson and is converted into a proton

(B) Emits a π^{-} meson and is converted into a proton

(C) Emits a π^{+} meson and is converted into a proton

(D) Cannot be converted into a proton

67. Consider α, β, γ particles each having an energy of 1 MeV. Arrange these particles in the order of increasing distance they travel in air.

(A) β, γ, α

(B) γ, α, β

(C) α, γ, β

(D) α, β, γ

68. In the β^{+} decay, the particles accompanying the daughter nucleus are

(A) Electron and neutrino

(B) Electron and anti-neutrino

(C) Positron and neutrino

(D) Positron and anti-neutrino

69. The reaction $^{41}_{20}Ca \rightarrow {}^{41}_{19}K +$ _____ is an example of

(A) Alpha decay

(B) Beta decay

(C) Positron decay

(D) Electron capture

70. ^{131}I, has a half life of 8.04 days. Assuming you start with a 1.53 mg sample of ^{131}I, how many mg will remain after 13 days ?

(A) 0.835

(B) 0.499

(C) 0.422

(D) 0.268

71. Nuclei above the belt of stability can lower their neutron to proton ratio by

(A) Beta emission

(B) Gamma emission

(C) Positron emission

(D) Electron capture

72. How many neutrons are emitted when a californium-249 nucleus (Z = 98) is bombarded with a carbon 12 nucleus to produce a $^{257}_{104}Rf$ nucleus ?

(A) 1 (B) 2

(C) 3 (D) 4

73. In the case of fundamental particles ?

1) Conservation of energy is obeyed
2) Conservation of momentum is obeyed but angular momentum is not obeyed
3) Conservation of parity is not obeyed
4) Conservation of isotopic spin is obeyed

Which of the following options is correct ?

(A) 1, 2 (B) 2, 3

(C) 3, 4 (D) 1, 4

74. The decay chain of the radioactive nucleus involves eight alpha decays and six β^- decays. The final nucleus at the end of the process will have

(A) Z = 84, A = 224

(B) Z = 88, A = 206

(C) Z = 82, A = 206

(D) Z = 76, A = 200

75. CPT theorem is also known as

(A) Luders-Pauli theorem

(B) Briet-Wigner theorem

(C) Optical theorem

(D) Gellmann theorem

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