196/23

Total Number of Questions : 24

Time : 2.00 Hours

Max. Marks : 100

1. a) Define iodine value of fats and oils. What is its significance ? **(2 Marks)**
   b) How sodium benzoate function as a food preservative ?

2. If line element is given as $ds^2 = (dx)^2 - 2(dy)^2 + 3(dz)^2 - 8dydz$. Find metric tensor g_{ij} and its contravariant form g^{ij}. Is metric tensor a symmetric tensor ? If so, prove it. **(3 Marks)**

3. A particle of mass 'm' is constrained to move on the parabola $z = \frac{x^2}{a}$ in the plane, a is a constant length and there is a constant gravitational force acting in the negative z direction.
   a) Define a suitable generalized co-ordinate for the problem.
   b) Write the Lagrangian.
   c) Where is the equilibrium position ?
   d) Write the equation of small oscillations about this equilibrium.
   e) Solve the equation of motion. **(3 Marks)**

4. A nucleus with quadrupole moment 'Q' find itself in a cylindrically symmetric electric field with a gradient $\left[\frac{\partial Ez}{\partial z}\right]_0$ along the z-axis at the position of the nucleus. Show that the energy of quadrupole interaction is $W = \frac{-e}{4} Q \left(\frac{\partial Ez}{\partial z}\right)_0$. **(3 Marks)**

5. For a quantum system, the operator corresponding to the physical quantity A does not commute with the Hamiltonian. It has eigenvalue a_1 and a_2 corresponding to eigenfunctions

   $\phi_1 = \frac{u_1 + u_2}{\sqrt{2}}, \phi_2 = \frac{u_1 - u_2}{\sqrt{2}}$

   where u_1 and u_2 are eigenfunctions of the Hamiltonian with eigenvalues E_1 and E_2. If the system is in the state $\psi = \phi_1$ at t = 0, what will be the expectation value of the physical quantity A at time t ? **(3 Marks)**

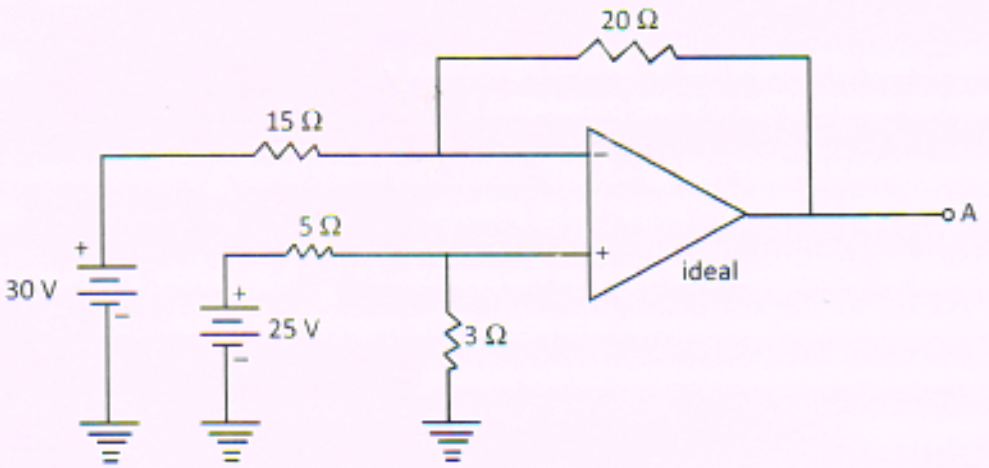
6. You are given a system of two identical particles which may occupy any of the three energy levels

   $E_n = nE$, n = 0, 1, 2,...

   The lowest energy state $E_0 = 0$ is doubly degenerate. The system is in thermal equilibrium at temperature T. Determine partition function and energy if
   1) The particles obey Fermi-Dirac statistics.
   2) The particles obey Bose-Einstein statistics.
   3) The particles obey Maxwell-Boltzmann statistics. **(3 Marks)**

P.T.O.

7. For the difference amplifier circuit shown, determine the output voltage at terminal A. **(3 Marks)**



8. Determine the number of translational, rotational and vibrational degrees of freedom in
   a) CH_3Cl
   b) OCS
   c) C_6H_6
   d) H_2CO

   Give reasons for the answer. **(3 Marks)**

9. a) What are the difference between stokes and antistokes lines ?
   b) State the selection rule for a molecule undergoing simple harmonic oscillation. **(3 Marks)**

10. Describe the significance of Bloom's Taxonomy of Educational Objectives. **(4 Marks)**

11. Why is it important for teachers to possess expertise in ICT Pedagogy ? **(4 Marks)**

12. Explain the steps involved in the process of standardisation of an achievement test. **(4 Marks)**

13. Write notes on : **(4 Marks)**
   a) Triangulation
   b) Cross validation in the context of research in science education.

14. Assume lattice points of lattice parameter 'a' in a bcc structure are occupied by spherical atoms of radius 'r'.
   a) Calculate the free volume per unit cell.
   b) Determine the radius of the largest sphere that will fit into the voids produced by the lattice point atoms not occupying the full volume of the cell. **(4 Marks)**

15. Briefly explain any five types of Intelligences belong to the Multiple Intelligence Theory. **(5 Marks)**

16. Reflective practice will help the teacher to attain professionalism. Illustrate with suitable CPD activities. **(5 Marks)**

17. a) What is a primary standard in volumetric analysis ? What are the important requisites of a primary standard ?
    b) How R_f value differs from R_t value ? **(5 Marks)**

18. a) Mention the difference between hemoglobin and myoglobin.
    b) Write notes on Van Arkel Process. **(5 Marks)**

19. a) What is resolution ? Why it is required in organic synthesis ? Explain briefly any two resolution techniques.
    b) What is Walden inversion ? **(5 Marks)**

20. a) Explain the temperature dependence of rate constant of a chemical reaction. How activation energy of a chemical reaction is determined ?
    b) Briefly explain Maxwell-Boltzmann distribution of molecular velocities. **(5 Marks)**

21. a) What are Science Process Skills ? **(6 Marks)**
    b) As a teacher, what strategies will you adopt to develop process skills among students ?

22. Elaborate the model of teaching that helps learners to attain concepts by comparing and contrasting examples. **(6 Marks)**

23. You are asked to prepare a curriculum for science education at secondary school level. Elucidate any five factors that you would consider effecting curriculum development. **(6 Marks)**

24. Suppose you are expected to conduct an experimental research in science classroom using blended mode of teaching. Briefly explain the stages of research in the form of a proposal. **(6 Marks)**