1. Total Duration: The examination is of 3 hours duration.
2. Question Paper Format:

- The question paper consists of three sections: Physics, Chemistry, and Mathematics.
- Each section has a maximum of [Number] questions.
- The maximum marks for each section are [Number].

3. Answering Instructions:

- Answers must be marked/written in the provided answer sheet/space.
- Use a blue/black ballpoint pen for writing.
- Use HB pencils for drawing and sketching if required.

4. Marking Scheme:

- Multiple Choice Questions (MCQs):
    - Single Correct Option: [+3] for correct answer, [-1] for incorrect answer, [0] if not attempted.
    - Multiple Correct Options: [+4] for all correct options, [+1] for each correct option if all four are not correct, [-2] for incorrect option, [0] if not attempted.
- Numerical Answer Type (NAT):
    - [+3] for correct numerical answer, [0] in all other cases.
- Match the Following:
    - [+3 or +4] for each correct match, [-1 or -2] for each incorrect match, [0] if not attempted.
- Paragraph Based Questions:
    - Each question associated with the paragraph will have its marking scheme, as indicated within the question.

5. Calculators and Electronic Devices:

- Calculators and electronic devices are strictly prohibited in the examination hall.

6. Rough Work:

- Rough work can be done in the space provided in the question paper itself.

7. Symbols and Notation:

- Standard symbols and notations are used unless otherwise specified.
- Values of physical constants (if needed) will be provided in the question paper.

8. Language:

- The question paper is printed in English.

9. General Advice:

- Read all instructions carefully before attempting the questions.
- Answer all parts of a question in one place.
- Check your answers carefully before submitting the answer sheet.

10. Question Paper Codes:

- The question paper will have a unique code, and candidates must fill in this code on the answer sheet.

Physics:

1. Multiple Correct Options:

- A particle is executing a simple harmonic motion (SHM). Which of the following statements are/is correct?
  - (A) The kinetic energy of the particle is maximum at the mean position.
  - (B) The potential energy of the particle is maximum at the extreme positions.
  - (C) The total energy of the particle remains constant throughout the motion.
  - (D) The acceleration of the particle is always directed towards the mean position.

2. Numerical Answer Type (NAT):

   - A parallel plate capacitor with air between the plates has a capacitance of 8 pF (8×10−12 F). What will be the capacitance (in pF) if the distance between the plates is halved and a dielectric medium of dielectric constant 6 is introduced between the plates?

3. Match the Following:

   - Match List I (Physical Phenomena) with List II (Associated Principles/Laws).
     - List I:
       - (P) Electromagnetic Induction
       - (Q) Photoelectric Effect
       - (R) Nuclear Fusion
       - (S) Black Body Radiation
     - List II:
       - (1) Planck's Quantum Theory
       - (2) Faraday's Law
       - (3) Einstein's Equation
       - (4) Nuclear Binding Energy.
     - Answer by matching P, Q, R, and S with 1,2,3,4.

Chemistry:

1. Multiple Correct Options:

   - Which of the following statements are/is correct regarding the properties of transition metal compounds?
     - (A) They often exhibit variable oxidation states.
     - (B) They form colored complexes.
     - (C) They generally have low melting points.
     - (D) Many of their compounds are paramagnetic.

2. Numerical Answer Type (NAT):

   - The pH of a buffer solution containing 0.1 M CH3COOH and 0.1 M CH3COONa is 4.74. What is the pH of the solution after adding 0.01 moles of HCl to 1 L of the buffer solution? (Round off the answer to 2 decimal places).

3. Paragraph type question:

    - A reaction involving gasses is done within a closed container. The reaction is as follows:
    - $N_2(g)+3H_2(g) \leftrightarrows 2NH_3(g)$
    - The reaction is exothermic.
    - What will happen to the equilibrium constant if the temperature of the container is increased?
    - What will happen to the partial pressure of NH_3 if more N_2 is added to the container?

Mathematics:

1. Multiple Correct Options:

    - Let $f(x)=x3-6x2+9x+3$. Which of the following statements are/is correct?
        - (A) f(x) has a local maximum at x=1.
        - (B) f(x) has a local minimum at x=3.
        - (C) f(x) is increasing in the interval $(-\infty,1)$.
        - (D) f(x) is decreasing in the interval (1,3).
2. Numerical Answer Type (NAT):

    - If the area enclosed by the curves $y2=4x$ and $x2=4y$ is 3A square units, then find the value of A.
3. Match the Following:

    - Match List I (Mathematical Objects) with List II (Properties/Values).
        - List I:
            - (P) Determinant of a 3x3 matrix with rows (1, 0, 0), (0, 1, 0), and (0, 0, 1)
            - (Q) Integral of $\int 0\pi \sin(x)dx$
            - (R) The number of solutions to sin(x)=1 in the interval [0, 2π]
            - (S) The derivative of ex
        - List II:
            - (1) 1
            - (2) 2
            - (3) ex
            - (4) 0
        - Answer by matching P, Q, R, and S with 1,2,3,4.

Physics:

4. Paragraph Based Question:

    - A particle of mass 'm' is moving in a circular path of radius 'r' with a constant speed 'v'. A uniform magnetic field 'B' is applied perpendicular to the plane of the circle.
    - (a) What is the expression for the magnetic force acting on the particle?

- (b) How does the radius of the circular path change if the speed of the particle is doubled?
- (c) If the particle is a proton and the magnetic field is 0.5 T, what is the frequency of revolution?

5. Multiple Correct Options:

   - Consider a monochromatic light incident on a double-slit apparatus. Which of the following statements are/is correct?
     - (A) The fringe width is directly proportional to the wavelength of light.
     - (B) The fringe width is inversely proportional to the distance between the slits.
     - (C) The central fringe is always bright.
     - (D) The path difference between the waves from the two slits at the central fringe is zero.

6. Numerical Answer Type (NAT):

   - A radioactive sample has a half-life of 10 days. If the initial number of nuclei is 1020, how many nuclei will remain after 30 days? (Express your answer in the form of x×10y, and provide the value of y).

Chemistry:

4. Paragraph Based Question:

   - An organic compound 'A' with molecular formula C4H8O gives a positive Tollens' test. 'A' reacts with NaBH4 to form compound 'B'. 'B' on dehydration with concentrated H2SO4 gives compound 'C'. 'C' on ozonolysis gives acetaldehyde as the only product.
   - (a) Identify compound 'A'.
   - (b) Write the structural formula of compound 'B'.
   - (c) Write the IUPAC name of compound 'C'.

5. Multiple Correct Options:

   - Which of the following statements are/is correct regarding the properties of solutions?
     - (A) The vapor pressure of a solution is always lower than that of the pure solvent.
     - (B) The boiling point of a solution is always higher than that of the pure solvent.
     - (C) The freezing point of a solution is always higher than that of the pure solvent.
     - (D) Osmotic pressure is a colligative property.

6. Numerical Answer Type (NAT):

- The standard electrode potential (Eo) for the Zn2+/Zn couple is -0.76 V. Calculate the cell potential (in V) for the cell Zn|Zn2+(0.1M)||Cu2+(0.01M)|Cu at 298 K, given that Eo for Cu2+/Cu is +0.34 V. (Round off to two decimal places).

Mathematics:

4. Paragraph Based Question:

    - Consider the ellipse a2x2+b2y2=1, where a>b. Let F1 and F2 be the foci of the ellipse, and let P be any point on the ellipse.
    - (a) What is the sum of the distances PF1+PF2?
    - (b) If the eccentricity of the ellipse is 21, what is the ratio of a to b?
    - (c) if a=2, and b=1, find the equation of the tangent at the point (sqrt(2), 1/sqrt(2))
5. Multiple Correct Options:

    - Let A=[1324]. Which of the following statements are/is correct?
        - (A) A−1 exists.
        - (B) The eigenvalues of A are real and distinct.
        - (C) A is a symmetric matrix.
        - (D) det(A)=−2.
6. Numerical Answer Type (NAT):

    - If ∫01x2+2x+2dx=Aπ, then find the value of A.