

MIZORAM PUBLIC SERVICE COMMISSION

GENERAL COMPETITIVE EXAMINATIONS FOR RECRUITMENT TO THE POST OF JR. GRADE OF MIZORAM FOREST SERVICE (ASST. CONSERVATOR OF FORESTS) UNDER ENVIRONMENT, FOREST & CLIMATE CHANGE DEPARTMENT, GOVERNMENT OF MIZORAM, 2023

PHYSICS

Time Allowed : 3 hours

Full Marks : 100

The figures in the margin indicate full marks for the questions.

*Answer any 10 (ten) questions
taking 5 (five) questions from each section.*

SECTION - A

- (a) Consider a system which is a simple pendulum with a rigid support, where 'l' is the constant length of the string connecting the bob to the fulcrum (taken to be the origin).

 - Write down the constraint equation that describe this system. (2)
 - From the classification of constraints, mention which type of constraint describe this system. (2)
 - What is the work done by the constraint force on the system? (1)

(b) For a simple pendulum oscillating in x-z plane, write the constraint equations, and derive the equation of motion. (5)
- (a) A particle travelling in the x-direction at the speed of $0.9c$ is emitting a radiation in the same direction. Using Einstein's velocity addition rule, find out the speed of the emitted radiation for an observer on the ground. (5)

(b) An astronaut who is 25 years old is travelling in a rocket for five years with $0.3c$ speed, How much difference will be the age of this astronaut and his twin brother at the end of this journey? (5)
- What are Coriolis forces? Show that the total Coriolis force acting on a body of mass m in a rotating frame is $-2m\vec{\omega} \times \vec{v}$, where $\vec{\omega}$ is the angular velocity of rotating frame and \vec{v} is the velocity of the body in rotating frame. (3+7=10)
- Explain how Newton's rings are formed. Show that the wavelength of monochromatic light can be determined from Newton's ring experiment. (4+6=10)
- Define the term Q factor and sharpness of resonance for a resonant circuit. What will happen to series resonant circuit if resistance of the circuit is doubled? What will be the effect on resonant frequency? (4+3+3=10)
- From Maxwell-Boltzmann velocity distribution law, obtain expressions for (3+3+4=10)

 - most probable velocity
 - average velocity
 - root mean square velocity
- State Ampere circuital law and explain how it was modified to include the displacement current \vec{D} . (4+6=10)

SECTION - B

8. (a) Discuss in brief the basic idea of the WKB approximation method. (4)
(b) Using WKB approximation method, find the ground state energy of an infinite well potential whose bottom of the well is raised by V_0 . (6)
9. Determine the ground state parity, the magnetic moment and Quadrupole moment for the following nuclei ${}_{14}\text{Si}^{29}$, ${}_{17}\text{Cl}^{35}$ and ${}_{29}\text{Co}^{60}$. (3+3+4=10)
10. What are de Broglie waves? Show that the de Broglie wavelength of a particle of momentum p is h/p (where h is Planck's constant). The uncertainty in the location of a particle moving with a velocity of $7.28 \times 10^7 \text{ m/s}$ is double of its de Broglie wavelength. Find out the uncertainty in measuring the velocity. (2+3+5=10)
11. Explain the fine structure of hydrogen line of the hydrogen spectra on the basis of the vector atom model. (10)
12. What is the effect of periodic potential on the energy of electrons in metal? Explain it on the basis of Kronig-Penny model and explain the formation of energy bands. (4+6=10)
13. What are the differences between a JFET and a BJT? Draw and explain the static characteristics of an n-channel JFET. What is pinch-off voltage? (3+4+3=10)
14. (a) Discuss the Stern - Gerlach experiment in detail and mention the experimental results. (5)
(b) If the wavelength of H_∞ in the Balmer series is 1401 \AA , calculate the wavelength of hydrogen atom in the same series. (5)

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