

Sample Screening Test

The test consists of 20 problems to be attempted in 100 minutes.

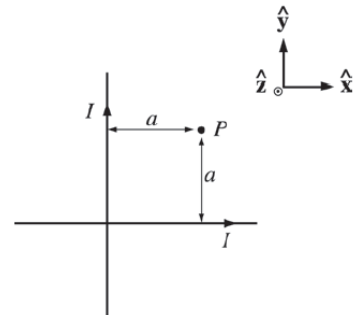
1. Classical Mechanics (4 problems)

- i. A massless spring with force constant k launches a ball of mass m . In order for the ball to reach a speed v , by what displacement s should the spring be compressed?

{Problem is to be solved in the provided space}

2. Electrodynamics (4 problems)

- ii. Consider two very long, straight, insulated wires oriented at right angles. The wires carry currents of equal magnitude I in the directions shown in the figure. What is the net magnetic field at point P ?



{Problem is to be solved in the provided space}

3. Quantum Mechanics (3 problems)

- iii. The normalized ground state wave function of hydrogen is

$$\psi_{100} = \frac{2}{(4\pi)^{1/2} a_0^{3/2}} e^{-r/a_0}$$

a_0 is the Bohr radius. What is the most likely distance that the electron is from the nucleus?

{Problem is to be solved in the provided space}

4. Solid-State Physics (3 problems)

- iv. X-rays of wavelength $\lambda = 0.250$ nm are incident on the face of a crystal at angle θ , measured from the crystal surface. The smallest angle that yields an intense reflected beam is $\theta = 14.5^\circ$. The value of the interplanar spacing d comes out to be?

{Problem is to be solved in the provided space}

5. Mathematical Methods of Physics (3 problems)

- v. A spin $\frac{1}{2}$ particle is in the state described by the spinor $\chi = A \begin{pmatrix} 1 + i \\ 2 \end{pmatrix}$ where A is a normalization constant. The probability of finding the particle with spin projection $S_z = -\hbar/2$ is.

{Problem is to be solved in the provided space}

6. Thermal and Statistical Mechanics (3 problems)

- vi. A thermodynamic system, initially at absolute temperature T_1 , contains a mass m of water with specific heat capacity c . Heat is added until the temperature rises to T_2 . The change in entropy of the water is.

{Problem is to be solved in the provided space}