Sample Questions for IIA Entrance Exam

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The syllabus for the IIA entrance exam is the standard BSc. & M.Sc Physics syllabus covering different areas

of specialization. In particular, it presumes that the candidates have taken basic courses in Mathematical

Physics, Classical Mechanics, Electromagnetic Theory, Quantum Mechanics, and Statistical Mechanics.

There will be some questions in special subjects such as Condensed Matter Physics, Nuclear Physics etc in

addition to coverage in applied areas such as Electronics, Instrumentation and Optics.

The question paper will be multiple-choice. It will contain questions of two levels of difficulty. The first

level will have 30 "easier" questions carrying 1 mark each. The second level will have 30 "difficult" questions

carrying 3 marks each. Therefore, the test questions will have a total of 60 questions with 30 from each

level, adding to a total maximum marks of 120. It is suggested that the candidate answer as many questions

as possible in 3 hrs keeping in mind that negative marking for wrong answers is one third the value of the

question (-1 or $-1/3$) and concentrate on those questions within the candidate's grasp or specialization.

The current pattern could be subject to change in the future.

ONE MARK QUESTIONS

1. Black-body radiation, at temperature T_i fills a volume V. The system expands adiabatically and

reversibly to a volume $8V$. The final temperature $T_f = xT_i$, where the factor x is equal to

(a) 0.5 (b) 2.8 (c) 0.25 (d) 1

2. A particle of mass m, constrained to move along the x-axis. The potential energy is given by, $V(x) =$

$a + bx + cx^2$, where a, b and c are positive constants. If the particle is disturbed slightly from its

equilibrium position, then it follows that

(a) it performs simple harmonic motion with period 2π

$\sqrt{}$

$(m/2c)$

(b) it performs simple harmonic motion with period 2π

$\sqrt{}$

$(ma/2b^2)$

(c) it moves with constant velocity

(d) it moves with constant acceleration

3. Consider a square ABCD, of side a, with charges $+q, -q, +q, -q$ placed at the vertices, A, B, C, D

respectively in a clockwise manner. The electrostatic potential at some point located at a distance r

(where $r \gg a$) is proportional to

(a) a constant (b) 1/r (c) $1/r^2$

(d) $1/r^3$

4. The general solution of $dy/dx - y = 2e^x$ is (where C is an arbitrary constant)

(a)

$e^{2x} + Ce^x$

(b) $2xe^x + Ce^x$

(c) $2xe^x + C$ (d) e^{x^2}

$+ C$

5. The value of lim

$\theta \to 0$

$(\ln(1 + \sin\theta)$

$\sin\theta$

)

is

(a)

∞ (b) $-\infty$ (c) 1 (d) 0

1

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6. Two parallel infinitely long wires separated by a distance D carry steady currents I1 and I2 (I1 > I2)

flowing in the same direction. A positive point charge moves between the wires parallel to the currents

with a speed v at a distance D/2 from either wire. The magnitude of an electric field that must be

turned on to maintain the trajectory of the particle is proportional to

(a) $(I1 - I2)v/D$

(b) $(I1 + I2)v/D$

(c) $(I1 - I2)v^2/D^2$

(d) $(I1 + I2)v^2/D^2$

7. An ideal gas of non-relativistic fermions in three dimensions is at a temperature of 0 K. When both

the mass of the particles and the number density are doubled, the energy per particle is multiplied by

a factor,

(a)

$\sqrt{}$

2 (b) 1 (c) $2^{1/3}$

(d) $1/2^{1/3}$

THREE MARKS QUESTIONS

8. If p is the momentum operator, and σ are the three Pauli spin matrices, the eigenvalues of $(\sigma \cdot p)$ are

(a)

p_x and p_z

(b) $p_x \pm ip_y$

(c)

$\pm|p|$ (d) $\pm(p_x + p_y + p_z)$

9. The rotational part of the Hamiltonian of a diatomic molecule is $(1/2\mu_1)(L^2_x + L^2_y) + (1/2\mu_2)L^2_z$ where

μ_1 and μ_2 are moments of inertia. If $\mu_1 = 2\mu_2$, the three lowest energy levels (in units of $h^2/4\mu_2$) are

given by

(a) 0,2,3 (b) 0,1,2 (c) 1,2,3 (d) 0,2,4

10. A particle of mass 1 gm starts from rest and moves under the action of a force of 30 Newtons defined

in the rest frame. It will reach 99% the velocity of light in a time of

(a) 9.9×10^3 sec (b) 7×10^4 sec (c) 0.999 sec (d) 0.7 sec

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