International Islamic University, Islamabad

Department of Physics
Entrance Test
Session Fall 2013

Candidate's Name: ..... **Time Allowed: 2 hrs**

Father's Name: .....

Roll no.: .....

Signature: .....

Instructions

1. Attempt all the questions
2. All questions carry equal marks
3. Lead pencil is not allowed to answer the questions
4. Any attempt to copy answer from another candidate will result in permanent disbarment from the University for all purposes.
5. Use your own calculator. No permission for borrowing from others.

Q. 1. A system has four degenerate (g_i) energy levels. The levels are $E_0 = 0$ J with $g_0 = 2$, $E_1 = 1.4 \times 10^{-23}$ J with $g_1 = 3$, $E_2 = 4.2 \times 10^{-23}$ J with $g_2 = 2$ and $E_3 = 8.4 \times 10^{-23}$ J with $g_3 = 4$. Write partition function.

Q. 2. Calculate the binding energy, binding energy per nucleon, and radius of spherical alpha particle.
Given, mass of a proton = 1.0072u, mass of a neutron = 1.0086u, mass of an alpha particle = 4.0028u, mass of proton = 1.67×10^{-27}kg, Charge on electron = 1.6×10^{-19}C.

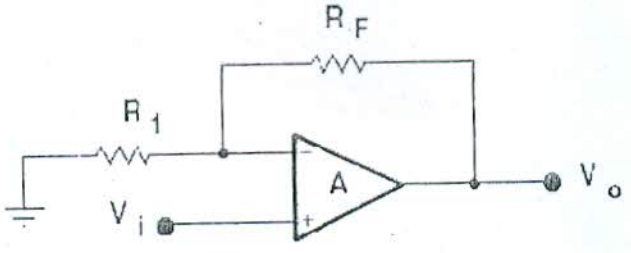
Q. 3. Find the term symbol for carbon ($1s^2$, $2s^2$, $2p^2$) in the ground state.

Q. 4. The Secondary coil of a transformer is directly connected to a 5 Ω resistance through which a current of 1 A is flowing.

a. What will be the value of primary voltage if the number of turns in primary and secondary coils is 10 and 100 respectively?

b. What current is flowing through the primary coil?

Q. 5. Determine the voltage gain for the circuit shown in figure, with R_F = 100KΩ and R_1=10 KΩ.



Q. 6. Find the number of atoms per unit cell in primitive unit cell, face centered unit cell, and body centered unit cell.

Q. 7. Find the de Broglie wavelength of

(i) Electron accelerated with a potential difference of 60 V.

(ii) Neutron of energy 0.03 eV.

Given, mass of electron = 9.1×10^{-31} kg, charge on electron = 1.6×10^{-19} C, mass of neutron = 1.6×10^{-27} kg, Planck's constant (h) = 6.63×10^{-34} Js, 1 eV = 1.6×10^{-19} J.

Q. 8. The wave functions of electrons confined in a one-dimensional potential box of dimension "a" is given by,

$$\psi_n = A\sin(n\pi/a)x$$

where n = 1, 2, 3, ⋯

Evaluate A by normalizing the wave function to unity.

Q. 9. Find the general solution of the differential equation using integrating factor,

$$\frac{dy}{dx} + \frac{3y}{x} = \frac{e^x}{x^3}$$

Q. 10. A particles of mass M is constrained to move on a horizontal plane in a field of gravity g. A second particle of mass m is constrained to a vertical line. The two particles are connected by a massless string which passes through a hole in the plane. The motion is frictionless. Find the Lagrangian of the system.