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GS-299

VI Semester B.Sc. Examination, May/June 2019

PHYSICS-VII

ATOMIC, MOLECULAR AND NUCLEAR PHYSICS

(CBCS) (FRESH) (2018-19 & Onwards)

Time : 3 Hours

Max. Marks : 70

Instructions : Answer **any five** questions from all the parts.

PART - A

Answer **any five** of the following questions. Each question carries **eight** marks.

5x8=40

1. (a) State and explain Pauli's exclusion principle. **4+4**
(b) Obtain an expression for the maximum number of electrons in a shell.
2. (a) What is Zeeman effect ? **1+2+5**
(b) Distinguish between normal and anomalous Zeeman effect.
(c) Give the Quantum theory of Normal Zeeman effect.
3. (a) What is Raman effect ? Give the Quantum mechanical explanation of Raman effect. **2+4+2**
(b) Distinguish between Stoke's and Antistoke's lines.
4. (a) State the assumptions of Rutherford's theory of α -ray scattering. **2+6**
(b) Obtain an expression for Rutherford's scattering formula.
5. (a) What is α -decay ? **2+4+2**
(b) Outline Gamow's theory of α -decay.
(c) What are the factors on which the range of α -particle depends ?

P.T.O.



6. (a) What is β -decay ?
(b) Mention the types of β -decay.
(c) Give the important features of β -ray spectrum.
7. (a) Explain endoergic and exoergic types of reactions. 4+4
(b) What is threshold energy ? Derive an expression for the same.
8. (a) What are elementary particles ? 2+6
(b) What are the broad categories into which the elementary particles are classified ?

PART - B

Answer **any five** of the following questions. Each question carries **four** marks.

5x4=20

9. Find the wavelength of light emitted when the hydrogen atom undergoes transition from the 5th orbit to the 2nd orbit. Assume ionization potential for hydrogen atom to be 13.6 eV.
10. In a normal Zeeman effect, the sodium 422.6 nm line splits into three components separated by 0.025 nm in a magnetic field of 3T. Calculate the specific charge of the electron.
11. The force constant of CO bond is 187 Nm^{-1} . Find the frequency of vibration of CO molecule given mass of $\text{C}^{12} = 1.99 \times 10^{-26} \text{ kg}$, and $\text{O}^{16} = 2.66 \times 10^{-26} \text{ kg}$. Also find the spacing between vibrational levels.
12. 1 g of a radioactive substance takes 50 s to lose one centigram. Find its half life period.
13. Calculate the α -particle potential barrier in case of ${}_{86}\text{Rn}^{222}$.



14. C^{14} undergoes β -decay transition to N^{14} . If the end point energy of the transition is 0.156 MeV and the mass of the initial atom is 14.00768 amu, find the mass of the final atom.
15. Calculate the Q value of the reaction ${}_1H^2(d, n){}_2He^3$. Given ${}_1H^2=2.0141$ amu, ${}_2He^3=3.0160$ amu, ${}_0n^1=1.00866$ amu. Is it exoergic or endoergic ?
16. When target Lithium (${}_3Li^7$) of thickness 0.025 mm is bombarded with a beam of intensity 10^{15} protons per second, 10^9 neutrons are produced. Calculate the cross-section of the reaction.
- Given density of Lithium = 500 kg/m^3 .

PART - C

Answer **any five** of the following questions. Each question carries **two** marks.

5x2=10

17. (a) The Alkali metals have hydrogen - like spectra. Explain.
- (b) Why is normal Zeeman effect observed in a strong magnetic field ?
- (c) Why is red light used in danger signals ?
- (d) Electrons of target atoms are not effective in scattering alpha particles. Explain.
- (e) Electrons do not exist in the nucleus. How is it emitted during β -decay ?
- (f) Alpha ray spectrum is characteristic of the nucleus while β -ray spectrum is not. Explain.
- (g) What is the significance of positive and negative sign of Q values in nuclear reaction ?
- (h) Is kinetic energy conserved in inelastic scattering. Explain.

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GS-300

VI Semester B.Sc. Examination, May/June - 2019

PHYSICS - VIII

**Electronics Magnetic Materials, Dielectrics & Quantum
Mechanics-III**

(FRESH) (CBCS) (2018-19 & Onwards)

Time : 3 Hours

Max. Marks : 70

Instruction : Answer all Parts.

PART - A

Answer **any five** questions. Each question carries **Eight** marks. **5x8=40**

1. (a) Explain the concept of virtual ground of an operational amplifier. **3+5**
(b) Derive an expression for voltage gain of a non inverting amplifier using op-amp.
2. (a) State Barkhausen criterion for sustained oscillations. **2+6**
(b) Explain with a circuit diagram working of a phase shift oscillator. Write the expression for its frequency of oscillation.
3. (a) State De Morgan's theorems. **2+6**
(b) What is a full adder ? Draw the logic diagram of full adder using two half adders and write its truth table.
4. (a) Explain the weiss domain theory of Ferromagnetism. **4+4**
(b) Distinguish between hard and soft magnetic materials.
5. What is a Lorentz field ? Derive the expression for Lorentz field. **8**
6. (a) What is meant by Normalisation of a wavefunction ? **2+6**
(b) Solve Schrodinger time independent equation for a free particle in one dimension and show that the momentum of the particle is precisely defined.
7. Set up Schrodinger equation for a particle in one dimensional box and solve it to obtain the eigen values. Represent the first three wave functions graphically. **8**

P.T.O.



8. (a) Write Schrodinger equation for a linear harmonic oscillator. 2+3+3
 (b) What is a rigid rotator ? Write expression for energy of a rigid rotator.
 (c) What is a quantum mechanical operator ? Write quantum mechanical operators for energy and momentum.

PART - B

Solve **any five** problems. Each problem carries **four** marks.

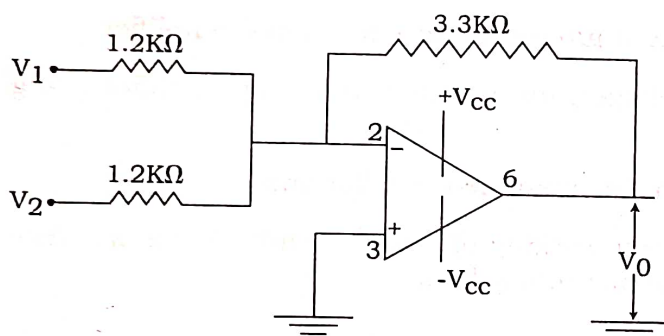
5x4=20

$$[\epsilon_0 = 8.85 \times 10^{-12} \text{ Fm}^{-1}; \mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}]$$

$$\text{mass of electron} = 9.1 \times 10^{-31} \text{ kg}; h = 6.625 \times 10^{-34} \text{ Js}$$

$$\text{mass of proton} = 1.67 \times 10^{-27} \text{ kg}]$$

9. Find the output voltage in the given circuit if $V_1 = V_2 = 0.1 \text{ V}$



10. An amplifier has a gain of 800. When the feedback is applied, the gain is reduced to 150. Find the feedback fraction.
11. (a) Convert $(376)_8$ to binary number.
 (b) Convert $(10110)_2$ to Gray code.
12. A paramagnetic material has magnetic field intensity of 10^4 Am^{-1} . If the susceptibility of the material at room temperature is 3.7×10^{-3} . Calculate the magnetisation and flux density of the material.
13. The dielectric constant of helium gas at NTP is 1.0000684. Calculate the electronic polarizability of atoms if the gas contains 2.7×10^{25} atoms per m^3 .
14. The operator $\left(x + \frac{d}{dx}\right)$ has the eigen value λ , operating on a function.
 Find the corresponding eigen function.



15. Assuming the nucleus as a cubical box with a size of 10^{-14}m , calculate the lowest energy of a proton inside it.
16. The period of a linear harmonic oscillator is 1 milli second. Find its zero point energy in e.v.

PART - C

17. Answer **any five** questions. Each question carries **two** marks. **5x2=10**
- (a) Does the input resistance of op-amp decrease with negative feedback ? Explain.
 - (b) NAND gate is an universal gate. Explain.
 - (c) Is 8 an octal number ? Explain.
 - (d) Is BCD code a weighted code ? Explain.
 - (e) Is N_2 a polar dielectric ? Explain.
 - (f) It is easy to magnetise a soft magnetic material than a hard magnetic material. Why ?
 - (g) Is the ground state of a particle in three dimensional box degenerate ? Explain.
 - (h) $\psi = ax^2$ is not an acceptable wave function in quantum mechanics. Why ?