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PG CBCS

M.Sc. Semester-III Examination, 2019

Physics

Paper Code: PHS-302

Full Marks: 40 **Time: 2 Hours**

Use Separate scripts for Group A& Group B

Group A

(Molecular Spectroscopy & Laser Physics)

1. Answer any two of the following questions: **(2 × 2 = 4)**

a) The infra-red spectrum H^1Br^{79} consists of a series of lines spaced 17 cm^{-1}apart. Find the moment of inertia of the molecule.

b) What is Fortrat parabola?

c) The intensity J=0 to J=1 is often not most intensed rotational line. Why?

d) Which of the two molecules H_2O and D_2O will have smaller separation of lines in rotational spectra?

2. Answer any two of the following questions: **(4 × 2 = 8)**

a) Obtain an expression of rotational energy of a diatomic molecule taking it as a rigid rotator. (4)

b) Explain why intensity vary in a progression series corresponding to vibrational electronic transition. (4)

c) The 2886 cm^{-1}fundamental band of HCl can be shown fit in the empirical relation

$$\nu = 2885.90 + 20.577m - 0.3034m^2$$

Calculate the value of B_e, B_0 and B_1.

Given α_c=0.3312 cm^{-1} (4)

d) Draw the energy level diagram of Ruby laser. What do you mean by Q switching in a laser. (4)

3. Answer any one of the following questions: **(8× 1 = 8)**

a) Explain the origin of P and R branch corresponding to a diatomic vibrating rotator assuming Born-Oppenheimer Approximation. Draw the energy levels corresponding to these transitions. (3 + 5)

b) Find the rotational fine structure vibrational electronic spectrum. Hence show the relation corresponding to different branches. Explain band origin and band head. (6+2)

(P.T.O)

Group B

(Nuclear Physics-I)

4. Answer any <u>two</u> of the following questions: **(2 × 2 = 4)**

a) Explain single mass parabola and double mass parabola.

b) Can a nucleus undergo $0^+ \rightarrow 0^+$ electromagnetic transition? Justify your answer.

c) Using semi-empirical mass formula, find the atomic number of most stable nucleus. Explain which is most stable ${}_2He^6$, ${}_4Be^6$, ${}_3Li^6$.

d) Explain parity violation β^-decay in Co^{60} experiment.

5. Answer any <u>two</u> of the following questions: **(4 × 2 = 8)**

a) Cl-33 decays by Positron emission with maximum energy of 4.3 MeV. Calculate radius of nucleus from this.

b)Classify the following transition

$^6He \rightarrow {}^6Li + \beta^- + \nu \ (0^+ \rightarrow 1^+)$

$^{17}Fe \rightarrow {}^{17}0 + e^+ + \nu \ (\frac{5^+}{2} \rightarrow \frac{5^+}{2})$

c) If the βdecay spectrum is represented by

$N(E)\,dE \propto \sqrt{E}(E_{max} - E)dE$

Show that most intense energy occurs at $E=E_{max}/5$.

d) A nucleus with mass number 292 undergo α emission. Calculate energy shared between the α particle and daughter nucleus.

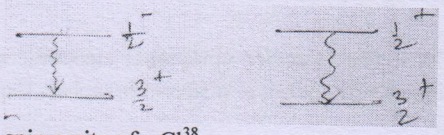
6. Answer any <u>one</u> of the following questions: **(8 × 1 = 8)**

a) Draw the potential barrier faced by α particle which is emitted from a nuclens. Assuming the rectangular barrier find the expression for decay constant. (2+6)

b) i) Find the type of gamma radiation:

$\frac{1^+}{2} \rightarrow \frac{3^+}{2}$ and $1^- \rightarrow 0^+$. (3)

ii) Find the multipole character of radiation emitted for following transitions (3)



iii) Calculate spin parity of ${}_{17}Cl^{38}$. (2)

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