Q.1) If the α-decay of U^{238} is energetically allowed, what prevents U^{238} from decaying all at once? Why is its half life so large.

Q2) The α particle faces a columb barrier. A neutron being uncharged faces a columb barrier, why does the nucleus U^{238}_{92} not decay spontaneously emitting a neutron.

Q3) Draw the variation of P.E (V) of a pair of nucleons with seperation r between them. Using the graph, explain, why the force between nucleons must be regarded as

(i) strongly repulsive for seperation values less than r_0 $(r < r_0)$

(ii) Attractive nuclear force for seperation value greater than r_0 $(r > r_0)$.

MODERN PHYSICS

1) Define the terms : i) Work function, ii) Stopping potential iii) Threshold frequency (iv) photo electron v) threshold wave length

2) Write Einstein's photoelectric equation, state the three salient features observed in photoelectric effects, which can be explained on the basis of the above equation.

3) A proton and an α-particle are accelerated, using the same potential difference. How are the de Broglie wavelengths λ_p and λ_α related to each other.

4) Find the (a) maximum frequency
b) minimum wavelength of x-rays produced by 35 KV electrons.

5) Two metals A and B have work functions 2ev and 5ev respectively. Which metal has lower threshold wavelength?

6) An electron and a photon each have a wavelength of 2nm. Find
i) their momenta ii) the energy of the photon
iii) the KE of the electron.

7) X-rays of wavelength 'λ' fall on a photosensitive surface, emitting electrons. Assume that the work function of the surface can be neglected, prove that the de Broglie wavelength of electrons emitted will be $\sqrt{\frac{h\lambda}{2mc}}$.

8) How is the radius of a nucleus related to its mass number?

9) Write the expression of Bohr's radius in H-atom.

10) Complete it: ${}^4_2He + {}^9_4Be \longrightarrow {}^1_0n + \ldots$

11) Define the 'activity' of a radioactive element. write its units.

12) Which level of the doubly-ionized Lithium Li^{++} ion has the same energy as the ground state energy of the H-atom?

13) The half-life of a radioactive substance is 40 sec. Calculate:
   i) the decay constant,
   ii) time taken for the sample to decay $\frac{1}{4}$ th of its initial value.

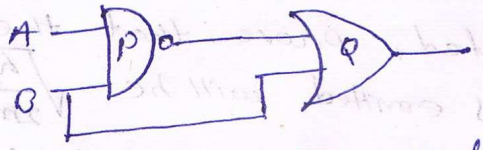
14) If 20% of a radioactive substance decay in 10 min. What percentage of original material is left after 30 min?

15) Derive i) $N = N_0 e^{-\lambda t}$ ii) $T_{av} = \frac{1}{\lambda}$ iii) $T = \frac{0.6931}{\lambda}$.

16) A radioactive sample can decay by two ~~dif~~ different process. The half-life for the first process is T_1 and that for 2nd process is T_2. Show that the effective half-life T of the nucleus is given by

$$\frac{1}{T} = \frac{1}{T_1} + \frac{1}{T_2}.$$

17) Identify the logic gates marked P and Q in the given logic circuit.



Write down the output at X for the inputs A=0, B=1 and ~~B~~ A=0, B=0.

18) In a p-n-p transistor circuit, the collector current is 20 mA. If 90% of the holes reach the collector, find the emitter and base current.