KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

Marks Scored:

Level : B.Sc.
Year : II

Course : PHYS 203
Semester: I

Exam Roll No.: Time: 30 mins. F.M. : 20

Registration No.: Date MAR 15 2018

SECTION "A"
[20Q. × 1 =20 marks]

Choose and tick (√) the most appropriate answer.

1. The pair of nuclides $_{92}U^{238}$ and$_{92}$ U^{234} are
[a] Isotopes [b]Isotones [c]Isobars [d] Isomers

2. A hydrogen atom is in ground state. The quantum number to which it will be excited absorbing a photon of energy 12.75eV is
[a] 3 [b] 4 [c]5 [d] 6

3. The radius of a nucleus with mass number 27 is 3.9 fm (Fermi). Then the radius of a nucleus with mass number 81 is
[a] 5.6fm [b] 7.8fm [c] 15fm [d] 6fm

4. The radioactive nuclides whose mass numbers is represented by A=4n, belongs to
[a] Thorium Series [b] Neptunium Series
[c] Uranium Series [d] Actinium Series

5. An X-rays tube operates at 13.6 kV. What is the frequency of the most energetic X- rays produced?
[a] 3.29×10^{15} Hz [b] 3.29×10^{18} Hz
[c] 3.29×10^{20} Hz [d] 3.29×10^{10} Hz

6. Rutherford is one of the units of radioactivity. Its value is
[a] 10^{9}disintegrations/sec [b] 10^{10}disintegrations/sec
[c] 3.7×10^{10}disintegrations/sec [d] 10^{6}disintegrations/sec

7. The work function of a metal is 2.3 eV. The maximum wavelength of light that is needed to eject an electron from the surface of the metal is
[a] 6.5×10^{-5} m [b] 9.4×10^{-9} m [c] 5.4×10^{-7} m [d]5.8×10^{-11} m

8. Normal Zeeman effect happens when the net spin of an atom is
[a] $-\frac{1}{2}$ [b] 1 [c] $\frac{1}{2}$ [d] 0

9. The end product of Uranium series is
[a] Pb^{205} [b] Pb^{206} [c] Pb^{207} [d] Pb^{208}

10. Which one of the following has the greatest penetrating power?
[a] beta particle [b] X-rays
[c] alpha particle [d] gamma rays

11. The closest distance of approach of an α-particle of energy 5 MeV shot at a gold nucleus is equal to
[a] 4.54×10^{-14} m [b] 4.54×10^{-10} m
[c] 4.54×10^{-17} m [d] 4.54×10^{-11} m

12. The critical potential corresponding to the excitation of mercury line λ= 5416 A° is equal to
[a] 4.5 volt [b] 3.4 volt [c] 2.29 volt [d] 2.9 volt

13. If the fission rate of U^{235} is 3.125×10^{10} fissions per second (the energy released per fission is 200 MeV) then the power produced in fission is equal to
[a] 1 watt [b] 2 watt [c] 4 watt [d] 5 watt

14. The machine in which magnetic field is kept constant and the frequency of the applied electric field is varied is known as
[a] Synchrotron [b] Synchro-cyclotron
[c] Cyclotron [d] Betatron

15. What radius is needed in proton synchrotron to attain particle energies of 10 GeV, assuming that a guide field of 1.8 Tesla is available?
[a] 10 m [b] 12 m [c] 15.52 m [d] 20.31 m

16. In Balmer series of hydrogen atom, H-α line is formed when electrons jump from
[a] 3^{rd} orbit to 2^{nd} orbit [b] 5^{th} orbit to2^{nd} orbit
[c] 4^{th} orbit to2^{nd} orbit [d] 4^{th}orbit to3^{rd} orbit

17. The splitting of lines in the spectra of atoms due to the presence of a strong electric field is known as
[a] Paschen-Back effect [b] Compton effect
[c] Zeeman effect [d] Stark effect

18. Frequency of the series limit of Balmer series of H-atom in terms of Rydberg constant R and velocity of light c is
[a] Rc [b] 4Rc [c] 4/Rc [d] Rc/4

19. The velocity of the electron in the first Bohr orbit in terms of velocity of light(c) is
[a] $\frac{1}{135}$c [b] $\frac{1}{10}$ c [c] $\frac{1}{35}$c [d] $\frac{1}{137}$c

20. Which one of the following may be the working voltage of G. M. counter?
[a] 250 volt [b] 300 volt [c] 350 volt [d] 500 volt

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F.M. : 55

SECTION "B"
[5Q. × 4 = 20 marks]

1. Describe the construction and working of linear accelerator.

OR

Describe the construction, principle and working of ionization chamber.

2. Discuss electron-proton theory of nuclear composition. Why it was thought? Give some causes for the failure of this hypothesis.

3. Derive the relation between mean life and decay constant of radioactive substances.

4. Write short notes on Bohr's correspondence principle.

5. What is Beta ray spectrum? How is it studied? Discuss the types of spectrum observed.

OR

Explain clearly the phenomenon of Paschen-Back effect and Stark effect.

SECTION "C"
[5Q.×7 = 35 marks]

6. Distinguish between normal and anomalous Zeeman effect. Describe the splitting of energy of an electron in magnetic field in anomalous Zeeman effect.

OR

Give the theory of successive disintegration of the radioactive substance and discuss the conditions for secular and transient equilibrium.

7. Describe vector model of an atom and explain the different quantum numbers associated with it. Give two important applications of this model.

8. Describe Rutherford's model of an atom and the evidence that led to it and hence obtain the expression for Rutherford's scattering formula.

OR

State different processes involved in interaction of Gamma rays with matter. Explain in detail the Compton effect for X-rays and find the expression for Compton shift.

9.(i) Calculate for hydrogen atom(a)velocity of an electron in the ground state(b)the radius of Bohr's orbit in ground state (c) time taken by the electron to traverse the Bohr's first orbit. *($h=6.62\times10^{-34}Js$, $\mathcal{E}_0 = 8.85\times10^{-12}$ F/m, $e=1.6\times10^{-19}$ C and $m=9.1\times10^{-31}$ kg)*

(ii) Calculate the ionization potential and first excitation potential of the hydrogen atom taking *$h=6.62\times10^{-34}$ Js, $\mathcal{E}_0 = 8.85\times10^{-12}$ F/m, $e=1.6\times10^{-19}$ C and $m=9.1\times10^{-31}$*

10.(i) A carbon specimen found in a cave contained 1/8 as much C^{14} as an equal amount of carbon in living matter. Calculate the approximate age of the specimen. Half-life period of C^{14} is 5568 years.

(ii) A sample of uranium emitting alpha- particles of energy 4.18 MeV is placed near an ionization chamber. Assuming that 12 particles per second enter the chamber, calculate the current produced. An ion pair requires energy of 40 eV. Charge on an electron=1.6×10^{-19} C