SOLUTIONS: II PUC

NUCLEAR PHYSICS, RADIOACTIVITY, ELEMENTARY PARTICLES, SOLID STATE PHYSICS, DIGITAL ELECTRONICS AND SOFT CONDENSED MATTTER PHYSICS.

1. 1 amu=931 MeV.
2. The force which holds the nucleons together in the nucleus is called nuclear force.
3. To control the nuclear fission reaction by absorbing the neutrons released during fission reaction.
4. Atomic mass.

5.2.7x10^{17}kg/m^3

6. Helium is a stable element.

7. $R=Ro\ A^{1/3}= Ro\ (64)^{1/3}= Ro\ (4^3)^{1/3}= 4\ Ro=4x1.2=4.8$ fermi.

8. Atomic mass unit (amu) is defined as 1/12 th of the mass of the C-12 isotope.

9. The force between two nucleons is due to the exchange of pions between them. Hence nuclear forces are called exchange forces.

10. It means that a particular nucleon inside the nucleus can interact with only one nucleon at a time. It cannot interact with all the nucleons at a time.

11. A gamma ray photon with sufficiently high energy when collides with a nucleus creates an electron-positron pair. Here energy of gamma ray photon is converted into mass.(electron-positron).

12. The difference between the sum of the masses of nucleons forming the nucleus and the rest mass of the nucleus is called mass defect.

13. Materials which can easily undergo fission are called fissile materials.

14. To slow down the fast moving thermal neutrons released during fission reaction.

15 . $R^3\ \alpha\ A$ i.e $R\ \alpha\ A^{1/3}$

16.It is defined as binding energy per nucleon.

17. Specific binding energy=binding energy/A=92.17MeV/12=7.680 MeV.

18. The force between two nucleons is due to the exchange of pions between them. hence nuclear forces are called exchange forces.

19. Energy released per nucleon is more in nuclear fusion reaction.

20. Radioactivity is a process of spontaneous disintegration of a heavy unstable nucleus with the emission of α rays, β rays and γ rays.

21.No effect,because it is chargeless.

22.1 milli curie= 10^{-3}x $3.7x10^{10}$ =$3.7 x 10^7$ dis/s

23. 1curie=$3.7x10^{10}$ dis/s

24. 1curie=$3.7 x 10^{10}$ Bq

25 Atomic number changes by two units and mass number changes by four units.

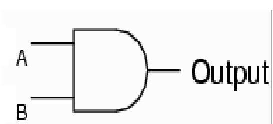
26. Gamma rays.

27. $\tau = \frac{1}{\lambda}$

28. Because the binding energy is less in case of heavy nucleus.
29. Antineutrino.
30. Its a process of converting AC into DC.
31. Holes.
32. A transistor is a three terminal two junction semi conducting diode.
33. Rectifier.
34. It is a semiconductor doped with impurities. Number of electrons and holes are different in extrinsic semiconductor.
35. It is a pure semiconductor crystal. Number of electrons and holes are same in intrinsic semiconductor.
36. Seven segment displays, indicator lamps etc

37..

.



38. Y=A+B.
39. It is a digital circuit which is used to add two binary digits.

40. Liquid crystals are a class of materials intermediate between the disordered state (liquids) and ordered state (crystals) of matter.

41. Emulsions are colloidal solutions in which both dispersed phase and dispersion medium are liquids. Thus emulsions are ‘liquid in liquid’ compositions.

42. Milk, hair cream.

43. Butter, cold cream.

44. Foams are colloidal systems in which the dispersed phase is a gas and the dispersion medium is a liquid.

45. Gel, toothpastes and lipsticks.

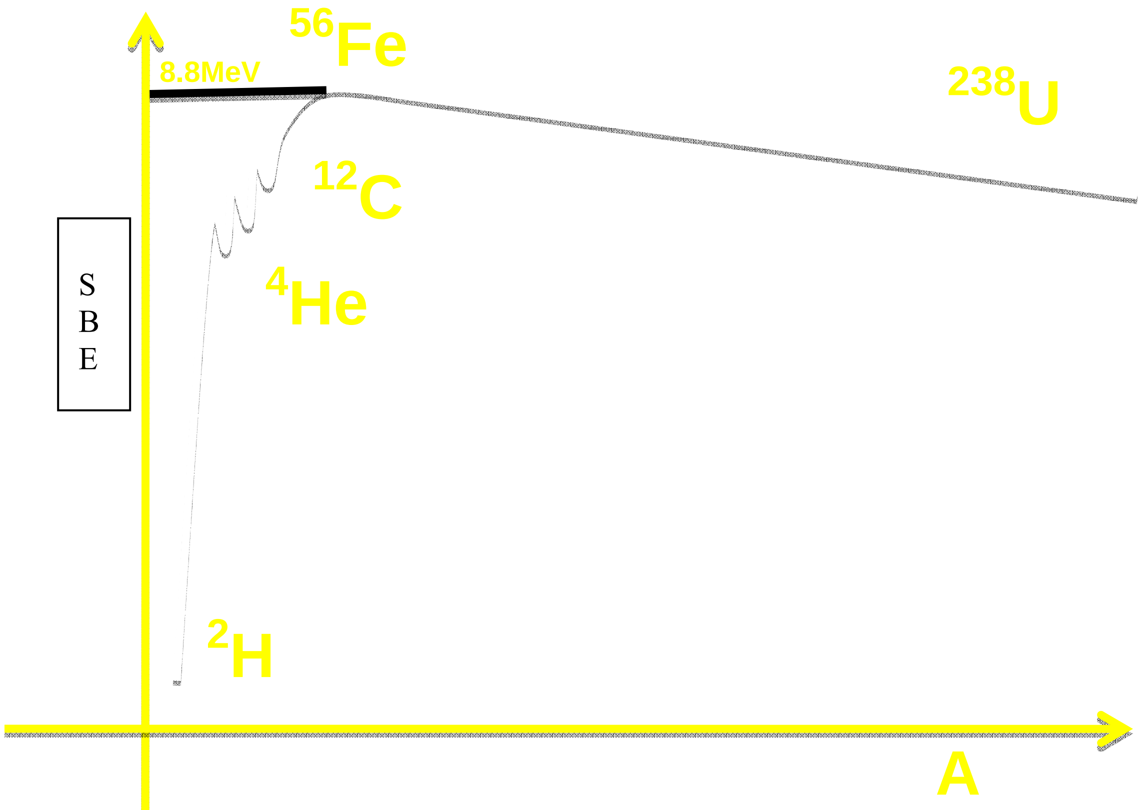
Questions carrying two marks.

46. It is a self propagating process in which the number of neutrons produced during fission goes on multiplying rapidly until entire fissile material disintegrates.

47. The energy which binds the nucleons to form a stable nucleus is called binding energy. Higher the binding energy more stable is the nucleus, thus binding energy is a measure of the stability of the nucleus.

48. It is defined as the ratio of mass error to the mass number.
If M=rest mass of the nucleus and A=mass number then,
Packing fraction$=\frac{M-A}{A}$

49. Binding energy per nucleon is called specific binding energy.



50. The difference between the sum of the masses of the nucleons forming the nucleus and rest mass of the nucleus is called mass defect.
The amount of energy required to hold the nucleons together inside the nucleus is called binding energy.

51.first law: When the nucleus of an radioactive element emits α- particle , the new element (daughter nuclei) formed has an atomic number decreased by 2 units and mass number decreased by 4 units than the parent element . The daughter nuclei falls two places to the left of the parent element in the periodic table.
2nd Law: when the nucleus of a radioactive element emits a beta particle , the new element formed has an atomic number increased by one unit but the mass number remains unchanged . The daughter element falls one place to the right of the parent element in the periodic table.

52. $N = \frac{N_0}{2^n} = \frac{N_0}{2^{t/2}}$

$1.25 = \frac{40}{2^{t/2}}$; $2^{t/2} = \frac{40}{1.25} = 32 = 2^5$

Therefore, $t/2 = 5$

$t = 10$ days

53. Exposure to radiation can cause
1. Damage to tissues permanently
2. May damage reproductive cells.
3. May lead to leukemia.

54. They participate in weak interactions have no structure and includes particles having mass less than pions.ex: electron, muon etc

55. Elementary particles having fractional electronic charges. Its spin is ½.
56. Quark model of proton is (u u d) and a neutron is (d d u).
57. These are the particles which participate in strong interactions.
Ex: proton, neutron.

58. P-type semiconductor: 1.It is a semiconductor doped with trivalent impurities.
2. Holes are majority charge carriers and Electrons minority.
3. The impurity atom is called acceptor impurity
4. Conductivity is less.
5. Energy Level of the impurity atom is close to valence band
N-type semiconductor: It is a sc doped with pentavalent impurities.
2. Electrons are majority charge carriers and Holes are minority carriers.
3. The impurity atom is called donor impurity.4. Conductivity is more.
5. Energy Level of the impurity atom is close to conduction band

59. Intrinsic semiconductors:
1. It is a pure semiconductor. 2. Number of holes equal Number of electrons.
3. Its conductivity is very low and depends on temperature.
4. Conductivity is both due to Electrons and holes.
Extrinsic semiconductors1.Its a semiconductor doped with impurities.2. Number holes and electrons are not equal.3. Conductivity depends on temperature and also on impurities.
4. Conductivity is mainly due to majority Charge carriers.

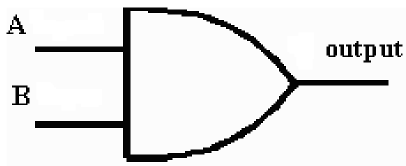
60. It's a device which converts light energy into electrical energy. Its generally is in Reverse biased condition.

61. Emitter is heavily doped than the collector and emitter is forward biased with the base whereas collector is reverse biased with base.

62.

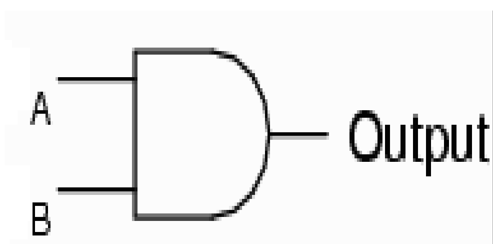
OUTPUT, Y=A+B

OR gate.



A	B	A+B
0	0	0
0	1	1
1	0	1
1	1	1

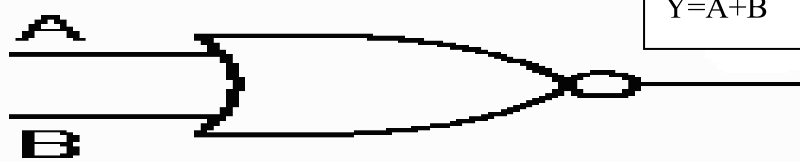
63



A	B	Y=A.B
0	0	0
0	1	0
1	0	0
1	1	1

64.

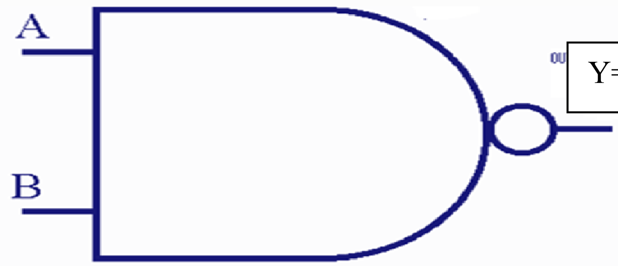
$Y=\overline{A+B}$



.

A	B	$Y=\overline{A+B}$
0	0	1
0	1	0
1	0	0
1	1	0

65..



$Y=\overline{A.B}$

A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0

66. 1.In LCD such as watch, TV, calculator, computers etc. 2. In preparations of polarizer's. 3. In medicine for the detection of tumors.

67. 1.Thermotropic liquid crystals: which are obtained by heating solids or through thermal process.

2. Lyotropic liquid crystals: which are obtained by dissolving certain crystals in suitable solutions.

68.1.Nematic liquid crystals 2. Cholesteric liquid crystals and 3. Smectic liquid crystals.

69. Emulsions are colloidal solutions in which both dispersed phase and dispersion medium are liquids. They are liquid in liquid compositions.

Ex. Milk, butter, cold cream.

Questions carrying four/five marks.

70. Characteristics of nuclear forces.

- It is the strongest of all forces
- It is the short range force.
- It is charge independent.
- It is spin dependent.
- It is a non central force.
- It is an exchange force. The particles exchanged b/w the nucleons are “pions”.

71. Atomic mass unit (amu) is defined as 1/12th of the mass of the C-12 isotope.

Electron volt is the energy gained by an electron when it is accelerated through a potential difference of one volt.

According to Einstein’s mass- energy relation, the energy equivalent of mass m is given E=mc2

The energy equivalent of mass 1 amu is given by
given bE=(1amu) c^2
$=(1.66x10-^{27})(2.9979x108\ )^2$
$=14.93x10^{-11}$ J
but $1eV=1.6x10^{-19}$ J
dividing the above eqn by 1ev, we get
1amu= 931 mev.

72. Mass defect (Δm): The mass of a nucleus M is always less than the sum of the masses of its nucleons.
The difference in mass of a nucleus and the total mass of its nucleons is called the mass defect.
$\Delta m = Z\, m_p + (A-Z)\, m_n - M$.
Binding energy
It is the energy equivalent of mass defect.
Binding energy $E=\Delta mc^2$.It is the energy which keeps the nucleons inside the nucleus together.

73. Nuclear fission
1. It's a process of splitting nucleus into two lighter nuclei.
2. Energy released per nucleon is less.
3. It takes place at low temperature.
4. Products are radioactive and harmful.
5. It forms the principle of atomic bomb.
6. Reaction rate can be controlled.

Nuclear fusion
1. Its a process of combining two lighter nuclei into a single nucleus.
2. Energy released per nucleon is more.
3. It takes place at very high temperature.
4. Products are harmless and its pure energy.
5. It forms the principle behind hydrogen bomb.
6. Reaction rate can not be controlled.

74. 1.Nuclear size: Assuming nucleus to be spherical. The volume of a nucleus is proportional to mass number ($V \alpha A$) .
or R3 α A. i.e $R=R_o A^{1/3}$. R_o=1.2 fermi.
2. Nuclear charge: It is the total charge of the protons in the nucleus q=+Ze, where z=atomic no and e= elementary charge.
3. Nuclear mass M: It is due to the mass of the protons and neutrons in the nucleus.
4. Nuclear density: It's the density of nucleus. Its of order of $2.7 x 10^{17}$kg/m3. Nuclear density is independent of mass number.
5. Nuclear spin: The vector sum of the intrinsic spin(S) and orbital angular momentum (L) of all the nucleons is the total angular momentum of the nucleus (J) which is known as nuclear spin.

75. According to the radio active decay law the rate of disintegration of a radioactive element at any instant is directly proportional to the number of atoms present at that instant.

$$ie., \ \frac{dN}{dt} \ \alpha \ N$$

$$\frac{dN}{dt} = -\lambda N \qquad \text{------------1}$$

-ve sign shows that the number of atoms decreases with time.

$$\frac{dN}{N} = -\lambda dt \qquad \text{------------2}$$

$$\int \frac{dN}{N} = -\lambda \int dt$$

$$\log_e N = -\lambda t + c$$

where 'c' is the constant of integration.

At $t=0, N = N_0$; $\log_e N_0 = 0 + c$ $:c = \log_e N_0$ ------------3 from eqn 1 and 2

$$\log_e N = -\lambda t + \log_e N_0 \quad = \log_e N - \log_e N_0 = -\lambda t$$

$$\log_e \frac{N}{N_0} = -\lambda t \frac{N}{N_0} = e^{-\lambda t}$$

$$N = N_0 e^{-\lambda t}$$

76. Decay constant is defined as the reciprocal of the time during which the number of atoms in a radioactive sample reduces to 37% of its initial number.

Half life: It is defined as the time taken for half the number of atoms to disintegrate.

We have

$$N = N_0 e^{-\lambda t} \qquad \text{-----------------------} \rightarrow 1$$

Where N_0 = number at t=0 (initial)

From definition of Half Life,

$$t = T_{1/2} \quad and \quad N = \frac{N_0}{2}$$

$$\frac{N_0}{2} = N_0 e^{-\lambda T_{1/2}}$$

$$\frac{1}{2} = e^{-\lambda T_{1/2}}$$

$$\Rightarrow \quad 2 = e^{\lambda T_{1/2}}$$

Taking log on both sides,

$$\log_e e^{\lambda T_{1/2}} = \log_e 2$$

$$\lambda T_{1/2} = \log_e 2 = 2.303\ x\ \log_{10} 2$$

$$= 2.303\ x\ 0.3010 = 0.693$$

$$T_{1/2} = \frac{0.693}{\lambda}$$

77.

Properties of alpha rays

1. Can be deflected by electric and magnetic field.

2. Its penetrating power is small.

3. It is doubly positively charged helium nucleus.

4. It has high ionizing power.

Properties of beta rays

1. Penetrating power is about 1000 times more than alpha particle.

2. They get deflected by both electric and magnetic field.

3. Ionizing power is about 1/100 times of alpha particle.

4. They consist of electrons or positrons.

5. They have a nuclear origin.

Properties of gamma rays.

1. Ionizing power is less than 1/100 times of beta particles and 1/10,000 times of alpha particles.

2. Penetrating power is 10,000 times more than alpha particles. 3. They produce photoelectric effect and Compton effect.4. They are not deflected by electric and magnetic field.

78. 1st law: When the nucleus of an radioactive element emits α- particle, the new element (daughter nuclei) formed has an atomic number decreased by 2 units and mass number decreased by 4 units than the parent element. The daughter nuclei falls two places to the left of the parent element in the periodic table.

$_ZX^A \xrightarrow{\alpha\text{ - decay}} {}_{Z-2}Y^{A-4} + {}_2He^4$ (α – particle)

$_{92}U^{238} \xrightarrow{\alpha - \text{decay}} {}_{90}Th^{234} + {}_2He^4$

- 2nd Law: when the nucleus of a radioactive element emits a beta particle, the new element formed has an atomic number increased by one unit but the mass number remains unchanged. The daughter element falls one place to the right of the parent element in the periodic table.

$_ZX^A \xrightarrow{\beta\text{ - decay}} {}_{Z+1}Y^A + {}_{-1}e^O$

$_{90}Th^{234} \xrightarrow{\beta\text{ - decay}} {}_{91}Pa^{234} + {}_{-1}e^0$

79.On the basis of band theory, solids are classified into conductors, semiconductors and insulators.

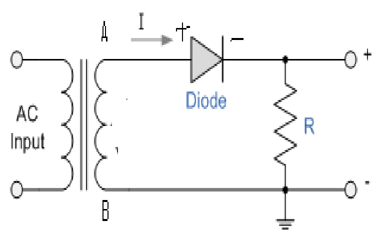
1. Conductors: Conductors are solids in which the valence band and the conduction band overlap. Therefore there is no forbidden band. Hence electrons are available in the conduction band even at low temperature. The conductivity of conductors is high.

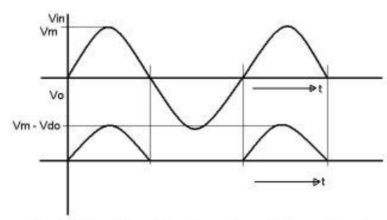
2. Semiconductors: semiconductors are solids in which the forbidden energy gap is very small. The valence band and conduction band are moderately separated. At 0k the valence band is completely filled and the conduction band is empty, hence semiconductors behave as insulators at low temperature. At room

temperature few electrons are available in the conduction band hence conduction takes place. Its conductivity lies between conductor and insulator.

3. Insulators: Insulators are solids in which the forbidden energy gap between valence band and conduction band is very large. The conduction band is completely empty and forbidden gap is very large. The electrons in valence band require a lot of energy to jump to the conduction band. hence insulators don't conduct.

80.





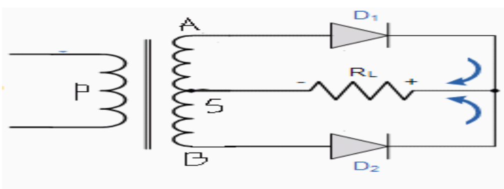
Half Wave Rectifier Circuit and Wave Front

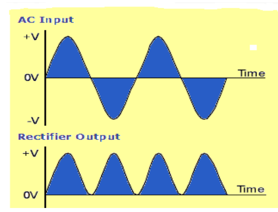
It's a device which converts only half cycles of AC into DC. An Ac voltage to be rectified is applied to primary of the transformer. A diode and a load resistor R_L is connected.

During the positive half cycle of the AC input A is positive and diode is forward biased and it conducts, the output appears across R_L.

During the negative half cycle of the AC input A is negative. The diode D is reverse biased and it does not conduct. Thus no output voltage appears across load resistor. The diode conducts only during positive half cycle of AC and hence it acts as a half wave rectifier.

81. Full wave rectifier. It's a device which converts the whole of AC into DC.





An voltage to be rectified is applied to the primary coil P. During the positive half Cycle of the AC input, A is positive and the diode D1 is forward biased and D2is reverse biased. As a result D1 conducts while D2 does not. Hence a current flows through RL .

During the negative half cycles of the AC input A is negative and the diode D1 is reverse biased and D2 is forward biased as a result D2 conducts while D1 does not. Thus during both the half cycles of AC input, current through RL flows in the same direction. Hence output voltage is unidirectional.

82. P-type semiconductor

1. It is a semiconductor doped with trivalent impurities.

2. Holes are majority charge carriers and Electrons minority.

3. The impurity atom is called acceptor impurity

4. Conductivity is less.5. Energy Level of the impurity atom is close to valence band

n-type semiconductor:

1. It is a sc doped with pentavalent impurities.

2. Electrons are majority charge carriers and Holes are minority carriers.

3. The impurity atom is called donor impurity.

4. Conductivity is more.

5. Energy Level of the impurity atom is close to conduction band.

83.A transistor is a three terminal two junction semi conducting device. The basic action of a transistor is to amplify a weak signal into a strong signal (amplification).Two p-n junctions are present in a transistor.

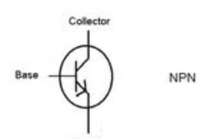
npn transistor.

1. Its obtained by sandwiching a p-type semiconductor b/w two n-type semiconductor.

2. The conventional emitter current flows from base to emitter.

3. Electrons are majority charge carriers.

4. The circuit symbol is



pnp transistor.

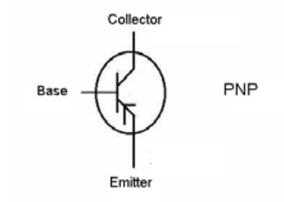
1. It is obtained by sandwiching a n type b/w two p-type sc

2. The conventional emitter current flows from emitter

to base.

3. Holes are majority charge carriers.

4. The circuit symbol is



84 .Intrinsic semiconductor: 1. It is a pure semiconductor.

2. Number of holes equal to Number of electrons.

3. Its conductivity is very low and depends on temperature.

4. Conductivity is both due to Electrons and holes.

Extrinsic semiconductor: 1. It's a semiconductor doped with impurities.

2. Number holes and electrons are not equal.

3. Conductivity depends on temperature and also on impurities.

4. Conductivity is mainly due to majority Charge carriers.

Q1. Solution:

Half Life T = 26.8 min= 26.8x60= 1608 s

$$T = \frac{0.693}{\lambda} \quad \text{or}$$

$$\lambda = \frac{0.693}{T} = \frac{0.693}{1608} = 4.31\text{x}10^{\square}\ /\text{s}$$

Activity A = 10μCi = $10\text{x}10^{-6}\text{x}3.7\text{x}10^{10}$

= $3.7\text{x}10^{5}$dis/s

Activity A is given by

$$A = \lambda N$$

$$3.7\text{x}10^{5} = 4.31\text{x}10^{-4}\text{x}N$$

Number of atoms present,

$$N = \frac{3.7\text{x}10^{5}}{4.31\text{x}10^{-4}} = 8.585\text{x}10^{8}$$

Mass of $6.023\text{x}10^{23}$ atoms of Pb^{214}

$$= \frac{214\text{x}10^{-3}\text{x}8.585\text{x}10^{8}}{6.023\ \text{x}10^{23}}$$

$$= 3.05\text{x}10^{-16}\ \text{Kg}$$

Q2. Solution:

Half Life T = $4\text{x}10^{8}$ years

Half Life of a radioactive element is $T = \frac{0.693}{\lambda}$

Decay Constant,

$$\lambda = \frac{0.693}{T} = \frac{0.693}{4\text{x}10^{8}} = 1.733\text{x}10^{-9}/\text{year}$$

$$\text{Mean Life, } T_m = \frac{1}{\lambda} = 1/1.733\text{x}10^{-9}$$

$$= 5.772\text{x}10^{8}\ \text{years}$$

Q3. Solution:

Half Life T = 1620 years

$= 1620 \times 365 \times 24 \times 60 \times 60$

$= 5.109 \times 10^{10}$ s

Decay constant, $\lambda = \frac{0.693}{T}$

$= \frac{0.693}{5.109 \times 10^{10}} = 1.356 \times 10^{-11}$/s

Number of atoms in 226 gm of $Ra^{226} = 6.023 \times 10^{23}$

Number of atoms in 1 gm,

$N = 6.023 \times 10^{23} = \frac{2.665 \times 10^{21}}{226}$

Activity $A = \lambda N$

$= 1.356 \times 10^{11} \times 2.665 \times 10^{21}$

$= 3.614 \times 10^{10}$/s

$A = \frac{3.614 \times 10^{10}}{3.7 \times 10^{10}}$

$A = 0.9768$ Ci

Q4. Solution:

Activity of radium A = 1 curie= 3.7×10^{10} dis/sec.

Half Life T = 1620 years

Decay Constant, $\lambda = \frac{0.693}{T}$

$= \frac{0.693}{1620 \times 365 \times 24 \times 3600}$

$\lambda = 1.356 \times 10^{-11}$/s

Activity $A = \lambda N$

$N = \frac{A}{\lambda} = \frac{3.7 \times 10^{10}}{1.356 \times 10^{-11}}$

$= 2.729 \times 10^{21}$ atoms

Mass of 6.023×10^{23} atoms of radium is $= 226$ grams

Mass of 2.729×10^{21} atoms of radium is $= \frac{226 \times 2.729 \times 10^{21}}{6.023 \times 10^{23}}$

$= 1.024$ gms

Q5. Solution:

$A = 3.7x10^{10}$ dis/s, m = 1gm

226gm of radium $= 6.022x10^{23}$atoms

Number of atoms in the sample.

i.e., $N = \frac{1x6.022\ x10^{23}}{226}$

$= 0.026646x10^{23}$ atoms

Activity $A=\lambda N$ or

Decay constant $\lambda = \frac{A}{N}$

$= \frac{3.7x10^{10}}{0.026646x10^{23}}$

$= 138.86x10^{-13}/s$

Half life time $T_{1/2} = \frac{0.963}{\lambda}$

$= \frac{0.693}{138.86x10^{-13}}$

$= 0.00499x10^{13}$ s

$= 5x10^{10}$ s

Q6. Solution:

m = 1gm, A = 222, $T_{1/2} = 3.825$ days

$N=6.023x10^{23}$

$\lambda = \frac{0.693}{T_{1/2}} = \frac{0.693}{3.825x24x3600}$

$= 2.097x10^{-6}/s$

222 gm of radon = $6.022x10^{23}$atoms

number of atoms in the sample.

i.e., $N = \frac{1x6.023\ x10^{23}}{222}$

$=0.02713\times10^{23}$ atoms

Activity, $A = \lambda N$

$= 2.097\times10^{-6}\times0.02713\times10^{23}$

$= 5.689\times10^{15}$ dis/sec

Or, $A = \dfrac{5.689\times10^{15}}{3.7\times10^{10}} = 0.154\times10^{6}$Ci

Q7. Solution:

Given:

Mass of U^{235} = 235.040 amu,

Mass of Ba^{141} = 140.910 amu,

Mass of Kr^{92} = 91.900 amu,

Mass of ${}_0n^1$ = 1.00867 amu.

$${}_{92}U^{235}+{}_0n^1 \longrightarrow {}_{56}Ba^{141}+{}_{36}Kr^{92}+3{}_0n^1+Q$$

Total mass of reactants

= 235.04+1.00867 =236.04867amu

Total mass of Products

= 140.910+91.900+3x1.00867

= 235.83601 amu

Mass defect,

Δm = 236.04867 - 235.83601

=0.21266 amu

Energy released = Δm x 931 MeV

= 0.21266 x 931

= 198 MeV

The energy released is 198 MeV

Q8. Solution:

Rest mass of U^{235} = 235.0439 amu,

Rest mass of Ba^{141} = 140.9178 amu,

Rest mass of Kr^{92} = 91.8854 amu,

Rest mass of neutron = 1.0087 amu.

$${}_{92}U^{235}+{}_0n^1 \longrightarrow {}_{56}Ba^{141}+{}_{36}Kr^{92}+3{}_0n^1$$

Total mass of reactants

= 235.0439+1.0087 = 236.0526 amu

Total mass of Products

= 140.9178+91.8854+(3x1.0087)

= 235.8293 amu
Mass defect,
Δm = 236.0526-235.8293
= 0.2233 amu
Energy released=0.2233x931 MeV
= 207.89 MeV
235 g of U-235 contains 6.023×10^{23} atoms
1g of U-235 contains

$$N = \frac{6.023 \times 10^{23} \text{ X } 1}{235} = 0.02563 \times 10^{23} \text{ atoms}$$

Total energy released by 1g of
U-235 = $0.02563 \times 10^{23} \times 207.89$
= 5.328×10^{23} MeV

Q9. Solution:
An α particle (He-atom) consists of 2 protons and 2 neutrons
Mass defect, $\Delta m = [Zm_p + (A-Z)\, m_n] - M$
= [2x1.007825+2x1.008665]-4.00260
= 4.03298 - 4.00260
Δm = 0.03038 amu
Binding energy = Δm x 931 MeV
1 amu = 931 MeV
= 0.03038 x 931 MeV
BE = 28.28 MeV

Binding energy of an α particle is 28.28 MeV

Q10. Solution:
Given:
Rest mass of proton, m_p =1.00729 amu
Rest mass of neutron,m_n =1.00867 amu
Rest mass of nitrogen,$_7N^{14}$ =14.003 amu
Nitrogen atom consists of 7 protons and 7 neutrons Calculated mass,
m_c= mass of 7 protons + mass of 7 neutrons
= 7 x 1.00729 + 7 x 1.00867
=7(1.00729 + 1.00867)
=14.11172 amu
Given, Actual mass m_A=14.003 amu

Mass defect, $\Delta m = m_c - m_A$
$= 14.11172 - 14.003$
$= 0.10872$ amu
Binding energy, BE = Δm x 931 MeV

Specific binding energy $= \frac{BE}{\text{Mass number}}$

$= \frac{\Delta m \times 931}{A} = \frac{0.10872 \times 931}{14}$
$= 7.23$ MeV

Mass defect of nitrogen is 0.10872 amu and its specific binding energy is 7.23 MeV

Q11. Solution: Given,
Mass of U-235, m = 0.2 kg = 200 g
Energy released per fission (atom)=200MeV
$= 200 \times 10^6 \times 1.6 \times 10^{-19}$
$= 3.2 \times 10^{-11}$ J
According to Avagadro hypothesis,
235g of U-235 contains 6.023×10^{23} atoms,
200g of U-235 contains,
$N = \frac{6.023 \times 10^{23} \times 200}{235}$
$= 5.126 \times 10^{23}$ atoms
Total energy released by 200g of U-235 = $5.126 \times 10^{23} \times 3.2 \times 10^{-11}$
$= 1.64 \times 10^{13}$ J
$= \frac{1.64 \times 10^{13}}{3.6 \times 10^6}$ 1 KWh=1000x3600J
1KWh=3.6×10^6J
$= 4.556 \times 10^6$ KWh
Energy released is 4.556×10^6 KWh

Q12. Solution:
Given,
$N = \frac{N_0}{2^n} = \frac{N_0}{2^{t/2}}$

$$1.25 = \frac{40}{2^{t/2}} \quad ; 2^{t/2} = \frac{40}{1.25} = 32 = 2^5$$

Therefore, $t/2 = 5$

$t = 10$ days

Mass of radio active sample will be reduced after 10 days.

Q13. Solution: Given,

T=1620 years

= 1620 x 365 x 24 x 60 x 60 s

Decay constant,

$$\lambda = \frac{0.693}{T} = \frac{0.693}{1620 \times 365 \times 24 \times 3600}$$

$$= 1.356 \times 10^{-11}\ s^{-1}$$

Activity, $A = \lambda N$,

$$N = \frac{A}{\lambda} = \frac{3.7 \times 10^{10}}{1.356 \times 10^{-11}}$$

$$= 2.729 \times 10^{21} \text{ atoms}$$

Mass of 6.023×10^{23} atoms of radium= 226 g

Mass of 2.729×10^{21} atoms of radium= $\frac{2.729 \times 10^{21} \times 226}{6.023 \times 10^{23}}$

= 1.024g

Mass of radium-226 is 1.024g