Answers with explanation:

01. For $_{92}U^{236}$, Z = 92 and A = 236.

The no. of protons = Z = *92*

The no. of neutrons = (A-Z) = 236 - 92 = *144*

Ans: - 2

02. We have the relation, $R = R_0A^{1/3}$.

$$6 = 1.2\ (A)^{1/3}$$

$$(A)^{1/3} = 6/1.2 = 5$$

Hence, A= 5^3 = 125

Ans: - 1

03. Nuclear charge= Atomic number x charge on a proton

i.e., Q = Z x e ; e = 1.6×10^{-19} C

Here 12.8×10^{-19} C = Z x 1.6×10^{-19} C

Hence Z = 12.8/1.6 = 8

Ans: - 1

04. Nuclear mass, M = Z m_p + (A-Z) m_n

As it is given that $m_p = m_n$, we get M= A m_p.

So (M) Lithium: (M) Boron = 7 m_p: 10 m_p = 7: 10

Ans: -   2

05. As per the basic properties of nuclear forces,

They are strongly attractive and exchange type forces.

Ans: -   1

06. For $_2He^4$, Z = 2 & A = 4 and hence (A-Z) = 4 - 2 = 2

According to Avogadro's concept,

The no. of atoms in 4 gm of $_2He^4$ = 6×10^{23}

No. of protons in 4 gm= Z X 6 x10^{23}= 2 x 6 x 10^{23}= 12 x 10^{23}

No. of neutrons in 4gm= (A-Z) x 6 x 10^{23}= 2 x 6 x 10^{23}= 12 x 10^{23}

No. of electrons in 4gm= Z x 6 x 10^{23}= 2 x 6 x 10^{23}= 12 x 10^{23}

Ans: -   1.

07. Binding energy of C-12= 12 x 7.68= 92.16 MeV

Binding energy of C-13= 13 x 7.47= 97.11 MeV

Therefore,

The energy required to remove a neutron from C-13
= (97.11-92.16)MeV

= 4.95MeV

Ans: -   3.

08. Binding energy of deuteron = 2 x 1.1 = 2.2 MeV

Binding energy of helium = 4 x 7 = 28 MeV

The nuclear reaction is, $2\,{}_1D^2 \rightarrow {}_2He^4 + Q$

Q = B.E of helium – 2(B.E of deuteron)

= 28 MeV - 2 x 2.2 MeV = 28 MeV - 4.4 MeV = 23.6 MeV

Hence energy 'Released' = 23.6 MeV

Ans: - 1.

09. During the neutron induced nuclear fission of ${}_{92}U^{235}$, to conserve Energy 200 MeV of energy and to conserve atomic and mass numbers, 2-3 fresh neutrons are released.

Ans: - 3.

10. Energy released per fission = 200 MeV = 200×10^6eV

$= 200 \times 10^6 \times 1.6 \times 10^{-19}$J

$\Delta E = 3.2 \times 10^{-11}$J

The no. of atoms undergoing fission per second= $(2.5\times10^{15})/10\times10^{-3}$

$N = 2.5\times10^{17}s^{-1}$

Power output = $\Delta E \times N = (3.2 \times 10^{-11}) \times (2.5\times10^{17}) = 8\times10^6\ J\ s^{-1}$= 8MW

Ans: - 1.

11. ${}_ZA^A \rightarrow {}_{(Z-2)}B^{(A-4)} + {}_2He^4$ -------------- (1)

${}_{(Z-2)}B^{(A-4)} \rightarrow {}_ZC^{(A-4)} + 2\,{}_{-1}e^0$ --------------- (2)

From (1) and (2), we see that A and C are of ' Same atomic no. and of different mass no ' .

So they are Isotopes.

Ans: - 1.

12. Initial speed of U^{238} = 0 (It is at Rest)

Mass of U^{238} = 238

Mass of α- particle = 4 ($\alpha = {}_2He^4$)

Mass of residual nucleus = 238 – 4 = 234

According to the law of conservation of linear momentum,

$238 \times 0 = 4u + 234\, v_R$; $v_R \rightarrow$ Recoil velocity

$v_R = -4u/234$

Ans: - 3.

13. Let the No. of α- particles emitted be 'm' and the No. of β- particles emitted be 'n'.

238 - 4m = 206 which gives m = 8

92 - 2m + n = 82, which gives n = 6

(Note that, when α- particle is emitted, Z↓ by 2 and A↓ by 4.

When β- particle is emitted, Z↑ by 1 and A= constant)

Ans: - 2.

14. From the law of radioactive decay, $A=A_0e^{-\lambda t}$

Hence $\log A= \log A_0 - \lambda t$. It is similar to the equation of a straight line (y=mx+c) and the slope = |λ| , Decay constant.

Ans: - 1.

15. $dN/dt = 10^{10} = |\lambda N|$

$\Rightarrow N = 10^{10}/ \lambda = 10^{10} \times T_m$

$= 10^{10} \times 10^{9} = 10^{19}$

M_{total} = N x Mass of one atom

= 10^{19} x 10^{-25} = 10^{-6}kg = 1mg

Ans: - 3

16. When 4 α- particles are emitted, the ratio of No. of neutrons and no. of protons= [(A-Z)-8] / (Z-8)-------------- (1)

When 6 β- particles are emitted, Z↑ by 6 and (A-Z) ↓ by 6.

Hence No. of neutrons/ No. of protons= {[(A-Z)-8]-6} / [(Z-8)+6]

= [(A-Z)-14] / [Z-2]

Ans: - 3.

17. R_2/R_1= $\{A_2/A_1\}^{1/3}$

= $\{128/16\}^{1/3}$

= $(8)^{1/3}$= 2

Therefore R_2 = 2 R_1= 2 x 3 x 10^{-15}m = 6 x 10^{-15}m

Ans: - 3.

18. Packing fraction of a nucleus is Mass-defect per nucleon.

i.e., f= ∆M/A ----------------- (1)

Here ∆M= [Zmp+(A-Z) mn]-M

= [1 x 1.00893 + 1 x 1.00813] - 2.01473

= 2.01706 - 2.01473 = 0.00233

From (1) f = 0.00233/2 = 0.001165 = 11.65 x 10^{-4}

Ans: - 1.

19. The overall reaction in Carbon –Nitrogen cycle of TNR,

$$4\ {}_{1}H^{1} \rightarrow {}_{2}He^{4} + 2\ {}_{+1}e^{0}$$

And ${}_{1}H^{1}$ is nothing but a proton and ${}_{+1}e^{0}$ is a positron.

Hence No. of protons fused = 4

No. of positrons released = 2

Ans: - 2.

20. Given that, Half-life = 1 month

Time at which activity is to be checked = 3 months.

Using $t = nT_{1/2}$ we get $n = 3$

$A=A_0/2^n$.Here the initial activity $A_0 = A \times 2^n$ = 2μCi x 3 = 6 μCi

Ans: - 3.

21. Given A_1= 128 and A_2= 1024

A_1/ A_2 = 128/1024 = 1/8 = $(1/2)^3$

Comparing this with $A/A_0= (1/2)^n$, we get n = 3

Hence 3 half lives = 2 min

After 6 min, equal to 9 half lives,

$A=A_1 (1/2)^9 = 1024 (1/2)^9$ =1024 x 1/512 = 2

Ans: - 4.

22. Let the no. of atoms of X and Y is N_x and N_Y, after a time t.

N_x/ N_Y = 1/7, so N_Y/ N_x = 7 and N_Y/ N_x+1 = 8 $(N_Y+ N_x)/ N_x$ = 8

$N_x/(N_Y+ N_x)$ = 1/8

$\therefore N/No= 1/8 = (1/2)^n$ and hence n = 3

T=2 hrs and hence t = nt = 3 x 2hrs = 6 hrs

Ans: - 1.

23. Activity=dN/dt = λN, which shows that

Activity doe not depend on time.

Ans: - 1.

24. $A_1 = N_1\lambda$ and $A_2 = N_2\lambda$

Mean-life,T = $1/\lambda$

$A_1 - A_2 = (N_1\lambda - N_2\lambda) = \lambda (N_1 - N_2)$

So $A_1 - A_2 = (N_1 - N_2)/T$

Hence, the no. of atoms disintegrated in

An interval $(t_1 - t_2) = (N_1 - N_2) = (A_1 - A_2)T$

Ans: - 3.

25. Copper is a Good conductor for which

$R = R_0 (1+\alpha t)$, which shows that, $R \alpha t$

Germanium is a Semiconductor for which

$R = a e^{b/T}$, which shows that, $R \alpha e^{b/T}$

As temperature decreases R of Cu decreases

& R of Ge increases

Ans: - 4.

26. Band theory of solids, considers

'Highest occupied Valence band &

Lowest Conduction band', for classification.

Ans: - 2.

27. When a p-n junction is Reverse biased,

The applied voltage adds up with the junction potential and hence the width of the junction barrier Increases.

Ans: - 2.

28. Unless a biasing voltage is applied to a p-n Junction, no current is produced.

Ans: - 3.

29. A rectifier circuit is used to convert A.C into pulsating D.C.

Ans: - 3.

30. In a transistor, Emitter is Heavily doped, Collector is Moderately doped and Base is very Lightly doped.

Ans: - 4.

31. In the operation of a transistor,

Emitter current > Collector current > Base current

Ans: - 2.

32. When the transistor is used as an Amplifier, its Emitter-Base junction is Forward Biased and Collector-Base junction is Reverse Biased.

Ans: - 3.

33. A half-wave rectifier responds only during

The half cycles of input A.C.

Ans: - 2.

34. Y = A+B is the Boolean expression for OR gate.

Ans: - 2.

35. NOR and NAND logic gates are

Considered to be the Universal gates.

Ans: - 2.

36.For a transistor, we have $I_E = I_B + I_C$

Given I_C = 90% I_E = 0.9 I_E

Hence, $I_B = I_E - 0.9\ I_E = 0.1\ I_E$ = 10% of I_E

Ans: - 1

37. Leptons are the Light particles

Which take part in Weak- interaction.

Ans: 2.

38. We know that the charge on proton is ‘e’

So the correct Quark model for proton is

uud = [+2/3e+ (-1/3e)+(-1/3e)] = e = ${}_1p^1$

Ans: - 3.

39. Milk is Water in oil type of emulsion

Ans: - 1.

40. LCD (Liquid Crystal Display)

Is done by using Twisted nematic phase

Of Liquid crystal.

Ans: - 3.

41. Recall that $R = R_0A^{1/3}$

Hence $R \propto A^{1/3}$ as R_0 is constant.

Ans: - 4.

42. $R_1/R_2 = (A_1/A_2)^{1/3}$

$= (8/64)^{1/3}$

$= 1/2.$

Ans: - 1.

43. For a nucleus $_ZX^A$, 'A' represents the total no. of protons and neutrons present, and Protons & neutrons are together called Nucleons.

Ans: - 3.

44. The density of nuclear matter is independent of Mass no. A .

$\therefore \rho \propto A^0$

Ans: - 4.

45. The nuclear charge is due to the presence of positively charged protons, and the no. of protons is represented by the Atomic no. Z.

$\therefore$ Nuclear charge $\propto$ Z

Ans: - 2.

46. The ratio of nuclear charge of hydrogen and Helium = $Z_1/Z_2 = 1/2$

Ans: - 1.

47. Nuclear mass, $M = Z\ m_p + (A-Z)\ m_n$

Ans: - 1.

48. Packing fraction of atomic nucleus, $f = (M-A) / A$

Ans: - 2.

49. The packing fraction of a nucleus is negative if it is Stable.

Ans: - 3.

50. Packing fraction of a nucleus is defined as the Nuclear mass-defect per nucleon [$\Delta M/A$]

Ans: - 1.

51. In a nuclear reaction, both Atomic no. and Mass no. are conserved.

By the given reaction, m = (7+2) - 1 = 8 and n = (14+4 -1) = 17

$\therefore$ Z = 8 and A = 17. It is an isotope of oxygen with mass no.17

Ans: - 4.

52. To start a fission reaction in U^{235} nucleus, Thermal neutrons with energy 0.025 eV, are required.

Ans: - 4.

53. In Sun, thermonuclear reaction (fusion) of hydrogen nuclei results in the release of Solar energy.

Ans: - 4.

54. Nuclear fusion is difficult to achieve, as the combining nuclei repel each other by electrostatic force.

Ans: - 2.

55. The function of Moderator in a nuclear reactor is to Slow down the neutrons, so that their energies are reduced to a smaller value.

Ans: - 1.

56. During radioactivity, there is a release of energy along with radiations. This is possible only when B.E per nucleon of the parent is greater than that of daughter nuclei. So $E_1 > E_2$

Ans: - 3.

57. The principle of an atom bomb is an uncontrolled chain reaction.

Ans: - 2.

58. Nuclear forces are due to the exchange of the particles known as Mesons.

Ans: - 3.

59. As the neutrons are electrically neutral, $F_E = 0$

As the given distance is beyond the nuclear range (10^{-15}m), $F_N = 0$

Ans: - 1.

60. After emitting one α and one β, effectively

Atomic no. Decreases by 1

Mass no. Decreases by 4.

Ans: - 3.

61. As Gamma rays are electromagnetic in nature, they do not alter either the Atomic no. or the Mass no.

Ans: - 3.

62. Given: Half-life, $T_{1/2} = 1600$ years

Let 't' be the time during which 75% of the sample disintegrates.

So after this time, the sample that remains intact = 25%

$= 25/100 = 1/4 = (1/2)^2$

But $N = N_0/2^n$. Hence we get n = 2. So $t = nT_{1/2}$

= 2 x 1600 years = 3200 years

Ans: - 1.

63. We have the relation $T_{1/2} = 0.693T_m$

So $T_{1/2}/T_m = 0.693$

Ans: - 1.

64. $T_{Av} = T_{1/2}/0.693 = 20/0.693 \approx 20/0.7 = 200/7 = 28.57$

Ans: - 1.

65. Phosphorous-39

Ans: - 1.

66. Carbon-14

Ans: - 2

67. Taking the mass of an electron to be 9.1×10^{-31}kg and using Einstein's mass-energy relation,

$E = mc^2 = 9.1 \times 10^{-31} \times (3 \times 10^8)^2 = 81.9 \times 10^{-15}$J

But 1eV= 1.602×10^{-19}J. $\therefore E = (81.9 \times 10^{-15}) / 1.602 \times 10^{-19} = 51 \times 10^4$

= 0.51MeV.

So the minimum energy of the γ-ray to produce the Electron- Positron pair = 2 x 0.51MeV = 1.02MeV.

Ans: - 1

68. In the given options, A= 235 and Z= 92 for Uranium.

Neutron-Proton ratio=(A-Z)/Z = (235-92)/92 = 143/92 = 1.5.

It is the highest.

Ans: - 4

69. Considering the given reaction, the charge and mass numbers of the fusing nuclei and that of the resulting nucleus are balanced. So the emitted particle 'x' must have <u>zero charge and zero mass</u>. Hence it is a <u>Photon</u>.

Ans: - 4

70. Given: Disintegrating fraction = 10/100

∴ Surviving fraction= 90/100 = 0.9

Also, time for 10% to disintegrate = 5 days

And time of observation = 20 days.

The ratio of these two = 20/5 = 4. Hence $N/N_o = (0.9)^4 = 0.65$

Percentage of original material left = 0.65x100 = 65%

Ans: - 2

71. The percentage of atoms that remain intact, in the radioactive sample, after one mean-life = 37

Hence the percentage that has disintegrated = 100 - 37 = 63

Ans: - 1

72. To get a p-type semiconductor from germanium (which is being Tetravalent), the impurity atoms to be added must be Trivalent.

Ans: - 1

73. According to the band theory of solids, the forbidden energy gap in a good conductor is Zero (E_g=0), as the conduction and valence bands overlap on one another.

Ans: - 1

74. According to the band theory of solids, the forbidden energy gap in

An insulator is large and will be of the order of 5eV.

Ans: - 2

75. By the study of the formation of p-n junction, we see that in an unbiased p-n junction, the depletion region is devoid of mobile charge carriers and contains only fixed ions (which are immobile).

Ans: - 4

76. In a p- n junction, depletion region is formed due to the diffusion of charge carriers.

Ans: - 3

77. In an intrinsic semiconductor, there are neither free electrons nor electric holes at absolute zero.

Ans: - 2

78. When a tetravalent element is doped with a trivalent impurity, we get a p-type semiconductor. Hence Germanium doped with indium becomes a p- type semiconductor.

Ans: - 4

79. Emulsion

Ans: - 2

80. Emulsions

Ans: - 1

81. Water is dispersed in oil

Ans: - 3

82. Hadrons

Ans: - 1

83. Photons

Ans: - 4

84. Mesons

Ans: - 1

85. During β^- - decay an electron is emitted and during β^+ - decay a positron is emitted.

Ans: - 4

86. Wolfgang Pauli

Ans: - 2

87. Charges on the quarks are,

up→+2/3e

down→ -1/3e

Strange→-1/3e

Ans: - 1

88. up-down-down (udd)

Ans: - 3

89. Both inputs are 1

Ans: - 3

90. 10

Ans: - 4

91. NAND gate

Ans: - 4

92. Carbon-dioxide

Ans: - 2

93. Mobility of an electron is greater than that of an electric hole

Ans: - 2

94. Rectifier

Ans: - 2

95. A transistor has Two junctions

And Three terminals

Ans: - 2

96. The output signal of a n-p-n transistor in CE mode is out of phase by π (rad) compared to the input signal

Ans: - 2

97. A medium input resistance and a high output resistance

Ans: - 2

98. In the normal operating conditions of a transistor,

$$I_E = I_B + I_C$$

Ans: - 1

99. According to the law of conservation of momentum,

$m_1v_1 = m_2v_2 \Rightarrow v_1/ v_2 = m_1/ m_2$

$v_1/ v_2 = (\rho_1 \times V_1)/ (\rho_2 \times V_2)$; V_1& V_2 are the volumes of the two parts.

As the densities are same, $v_1/ v_2 = V_1 / V_2$

But $V_1= (4/3)\ \pi r_1^3$ and $V_2= (4/3)\ \pi r_2^3$

$\Rightarrow V_1 / V_2 = r_1^3/ r_2^3 = 1^3/2^3 = 1/8$

Ans: - 4

100. Digital circuits are designed

By using a desired no. of NOR logic

Gates.

Ans: - 4.

←□□□→