

MODERN PHYSICS-II

EXERCISE – I

SINGLE CORRECT

1. C

$$1 \text{ a.m.u.} = \frac{1}{12} [\text{mass of one } {}_6\text{C}^{12}]$$

$$\text{For } C \Rightarrow A = 12$$

2. A

$$R = R_0 A^{1/3}$$

$$\text{Surface area} \Rightarrow \pi R^2$$

$$= \pi(R_0 A^{1/3})^2$$

$$= \pi R_0^2 A^{2/3}$$

3. B

$$- (7.4 \times 2000 - 8.2 \times 110 - 8.2 \times 90)$$

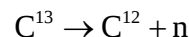
$$= 160 \text{ MeV}$$

Energy B E of Products

BE of Reactants

$$1640 - 1480 = 16 \text{ MeV}$$

4. A



$$- (7.68 \times 12 - 7.5 \times 13)$$

$$(92.16 - 7.5 \times 13)$$

$$5.34 \text{ MeV}$$

Energy Required = (BP)_R

$$97 - 50 - 92.16 (\text{BP})_p$$

5. B



$$E_2 - 2 E_1 = 0$$

6. B

$$\text{One fission} = 200 \text{ MeV}$$

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

$$= 10^3 \text{ J/s}$$

$$1.5 \times 10^{-19} \text{ J} = 1 \text{ eV.}$$

$$\text{Fission / sec} = x$$

$$x \times 3.2 \times 10^{-11} = 10^3$$

$$x = 0.3125 \times 10^{14}$$

$$x = 3.125 \times 10^{13}$$

$$\frac{1 \times 10^3}{200 \times 10^6 \times 1.6 \times 10^{-19}}$$

$$= 3.125 \times 10^{13}$$

7. C

Total energy radiated by star is 10^{16} J/s
 energy from one fission is of the order of
 $10^6 \times 1.6 \times 10^{-19} \text{ J}$

$$\text{No of reactions per sec} = 10^{16} \times 10^{13} / 1.6$$

$$= 10^{29} / 1.6$$

$$\text{No of deuterons used/sec} = 3 \times 10^{29} / 1.6$$

$$\text{Time to use } 10^{40} \text{ deuterons} = 10^{29} \text{ t}$$

$$t = 10^{40} / 10^{29} \cong 10^{11}$$

$$\text{order about } 10^{12} \text{ sec}$$

8. C



$$\downarrow \quad \downarrow$$

$$E_b \quad E_a$$

$$e = E_a - 3E_b \Rightarrow 3E_b = E_a - e$$

9. C

BE/ Nucleon $\Rightarrow$

$${}^4_2\text{He} \Rightarrow \frac{28}{4} = 7 \text{ MeV}$$

$${}^7_3\text{Li} \Rightarrow \frac{52}{7} = 7.4 \text{ MeV}$$

$${}^{12}_6\text{C} \Rightarrow \frac{90}{12} = 7.5 \text{ MeV}$$

$${}^{14}_7\text{N} \Rightarrow \frac{98}{14} = 7 \text{ MeV}$$

Elements with more BE/nucleon is more stable.

10. B

Two smaller nuclei combining to form a larger nucleus is called a Fusion reaction.

11. D

$$(939 + 940 - 1876)$$

$$= 3 \text{ MeV (Captures)}$$

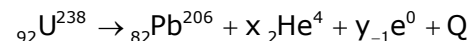
12. B

$$K.E._\alpha = \frac{A 50 \text{ MeV}}{(A + 4)} = 48 \text{ MeV}$$

$$0.96 \times 50 \text{ MeV} = 48 \text{ MeV}$$

$$A = 100$$

13. B



$$A = 206 + 4x = 238$$

$$4x = 32$$

$$x = 8$$

$$2x - y + 82 = 92$$

$$2x - y = 10$$

$$16 - y = 10$$

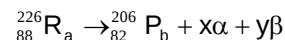
$$y = 6$$

14. D

$$M_x = e_{-1}^0 + {}_0^0\gamma + M_y$$

$$M_x = M_y$$

15. C



$$226 = 206 + 4x$$

$$x = 5$$

16. C

$$(BE)_w = 7.5 \times 120 = 900$$

$$(BE)_x = 8.0 \times 90 = 720$$

$$(BE)_y = 8.5 \times 60 = 510$$

$$(BE)_z = 3.0 \times 5.0 = 150$$

To release energy $\Rightarrow (BE)_{\text{Products}} > (BE)_{\text{Reactants}}$

17. B

$$N_1 = N_0 e^{-10\lambda_0 t}$$

$$N_2 = N_0 e^{-\lambda_0 t}$$

18. C

$$A = \lambda N$$

$$A_1 = \frac{0.693}{2} N_0 e^{-\frac{0.693}{2} t}$$

$$A_2 = \frac{0.693}{4} N_0 e^{-\frac{0.693}{4} t} \quad \frac{A_1}{A_2} = 2e^{\frac{0.693}{4} t - \frac{0.693}{2} t}$$

$$= 2e^{-\frac{0.693}{2} t}$$

19. C

$$N_1 = N_0 e^{-\lambda t}$$

$$= N_0 e^{-1} = \frac{N_0}{e}$$

20. B

$$0.9N_0 = N_0 e^{-\lambda t}$$

$$N = N_0 e^{-2\lambda t}$$

$$N = N_0 0.9 \times 0.9$$

$$N = 0.81 N_0$$

21. C

$$A_1 = A_0 e^{-\lambda t}$$

$$A_2 = 2A_0 e^{-\lambda(t-t^1)}$$

$$\frac{A_1}{A_2} = \frac{1}{2} e^{-\lambda t^1} \quad \log \frac{2A_1}{A_2} = -\lambda t^1$$

$$t^1 = \frac{T}{\log_2} \left| \log \frac{A_2}{A_1} \right|$$

22. D

$$R_1 = R_0 e^{-\lambda t_1}$$

$$R_2 = R_0 e^{-\lambda t_2}$$

$$\frac{R_2}{R_1} = e^{-\lambda(t_2-t_1)}$$

23. A

$$\lambda_1 : \lambda_2 = 1 : 2$$

$$\lambda_1 A_0 = \lambda_2 B_0$$

$$A_0 = 2B_0$$

24. B

$$\frac{A_0}{\sqrt{3}} = A_0 e^{-\lambda \cdot 1}$$

$$A' = A_0 e^{-\lambda \cdot 4}$$

$$A' = \frac{A_0}{9}$$

25. B

$$\text{Give } t_{1/2} = 1620 \text{ yr} \quad t_{1/2} = \frac{0.693}{\lambda}$$

$$\lambda = \frac{0.693}{1620 \times 365 \times 24 \times 60 \times 60}$$

$$\text{No of mols (n)} = \frac{\text{mass}}{\text{At. wt}} = \frac{5}{223}$$

$$N_0 = n \times N_A = 6.023 \times 10^{23}$$

$$\text{At } t = 5 \text{ hr} = 5 \times 3600$$

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

$$N(t) = 3.23 \times 10^{15}$$

26. C

$$A_1 = A_0 e^{-\lambda t_1}$$

$$A_2 = A_0 e^{-\lambda t_2}$$

$$A_2 = A_1 e^{(t_1-t_2)\lambda} \Rightarrow A_2 = A_1 e^{\frac{(t_1-t_2)}{T}}$$

27. A

$$f_1 = 1 - e^{-\frac{1}{\lambda}} = 0.634$$

$$f_2 = 1 - e^{-\frac{\ln 2}{\lambda}} = 1 - e^{-\ln 2^{-1}}$$

$$= \left(1 - \frac{1}{2}\right) = \frac{1}{2}$$

28. C



$$\frac{dN}{dt} = R - \lambda N \quad N = \text{be the number of at any time } t)$$

$$\int_0^N \frac{dN}{R - \lambda N} = \int_0^N dt$$

$$N = \frac{R(1 - e^{-\lambda t})}{\lambda}$$

$$2(1 - e^{-\lambda t}) = 1 \quad e^{-\lambda t} = \frac{1}{2}$$

$$\frac{t}{2} = \ln 2$$

$$t = 2 \times 0.693 = 1.386$$

29. B

$$R_1 = \lambda N_0 e^{-\lambda T_1}$$

$$R_2 = \lambda N_0 e^{-\lambda T_2}$$

Atoms decayed $N_1 - N_2$

$$= \frac{R_1 - R_2}{\lambda} = R_1 - R_2$$

30. A

Zero

31. C

$$-\frac{dN'_1}{dt} = \lambda_1 N'_1$$

$$\frac{-dN_2'}{dt} = \lambda_2 N_2'$$

$$\frac{-dN}{dt} = \frac{-dN_1'}{dt} + \left(\frac{-dN_2'}{dt} \right)$$

$$= \lambda_1 N_1' + \lambda_2 N_2'$$

$$= \lambda_1 N_1' e^{-\lambda_1 t} + \lambda_2 N_2' e^{-\lambda_2 t}$$

32. D

A given Nucleus may decay after $t = 0$ at any time

33. A

$$\lambda_1 : \lambda_2 = 1 : 2$$

$$\lambda_1 A_0 = \lambda_2 B_0$$

$$A_0 = 2B_0$$

34. C

$$\text{Probability} = \frac{\text{favourable}}{\text{Total}}$$

Surviving Nucleus after 6 half lives in $\frac{N_0}{2^6}$

$$\text{Total } \frac{N_0}{2^5}$$

$$\text{Prob} = \frac{N_0}{2^6} / \frac{N_0}{2^5} = \frac{1}{2}$$

35. B

$$\text{Initial} = N_0$$

Total decayed in 10 years

$$\frac{N_0}{2} + \frac{N_0}{2^2} = \frac{3}{4} N_0$$

$$\text{Prob} = \frac{\frac{3}{4} N_0}{N_0} \quad \text{Prob} = 75\%$$

36. B

Let sample is x' $\begin{matrix} x & \rightarrow & Y \\ 2\% & & 14\% \end{matrix}$

$$\frac{2x}{100} \quad \frac{14x}{100} \quad \lambda = \frac{\ln 2}{45}$$

$$\text{Total} = \frac{16x}{100}$$

$$\frac{2}{100} x = \frac{16x}{100} e^{-\lambda t} = 2^{-3}$$

$$\lambda t = 3 \ln 2 = 45 \times 3 = 135$$

37. A

$$\text{Prob of decay by } \lambda_1 \Rightarrow \frac{dN_1}{N_1} = \lambda_1 t$$

$$\lambda_2 \Rightarrow \frac{dN_2}{N_2} = \lambda_2 t$$

$$\text{Total Prob} = \frac{dN}{N} = \lambda dt$$

$$\lambda dt = \lambda_1 dt + \lambda_2 dt$$

$$\lambda = \lambda_1 + \lambda_2$$

38. E

$$N = N_0 (1 - e^{-\lambda t})$$

39. C

No effect of concentration on activity.

40. C

$$\xrightarrow{1000} A \xrightarrow{\lambda} B$$

$$\frac{dN}{dt} = R - \lambda N = 0 \quad R = \lambda N$$

$$1000 = \frac{1}{40 \times 60} N \quad N = 24 \times 10^5$$

41. C

At $t = 0$

$$N_0 = 20 \times 10^5 \quad N = N_0 \frac{R}{\lambda} (1 - e^{-\lambda t})$$

42. B

$$\text{time} = \frac{3200 \times 10^3}{2000}$$

$$1600 \rightarrow 1600 \text{ sec.}$$

Remaining after two half time

$$\frac{N_0}{4} = \frac{10^8}{4} = 25 \times 10^6$$

43. C

$$v = \frac{kq}{r} \quad 1 = \frac{9 \times 10^9 q}{1.6 \times 10^{-3}}$$

$$q = \frac{1.6}{9} \times 10^{-12} \quad q = ne = n \times 1.6 \times 10^{-19}$$

$$n = 6.25 \times 10^{10} t$$

44. D

$$13.6 Z^2 = 13.6 \times 4 = 54.4$$

$$\text{Second electron} = 54.4 + 24.6 = 79$$

45. A

It is difficult to overcome attractive forces

46. A

The nucleus of Atom is positively charged So striking it with +ve proton or α particle would be relatively difficult

47. C

Photon thermal energy or excess energy is always liberated in the form of gamma radiation

48. D

Half of total number of nucleus are left after one half life.