CHEMICAL KINETICS & RADIOACTIVITY

RATE OF REACTION

1. Consider the chemical reaction :

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

The rate of this reaction can be expressed in terms of concentration of $N_2(g)$, $H_2(g)$ or $NH_3(g)$. Identify the correct relationship amongst the rate expressions.

(1) Rate $= -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

(2) Rate $= -\frac{d[N_2]}{dt} = -\frac{3d[H_2]}{dt} = \frac{2d[NH_3]}{dt}$

(3) Rate $= \frac{d[N_2]}{dt} = \frac{1}{3}\frac{d[H_2]}{dt} = \frac{1}{2}\frac{d[NH_3]}{dt}$

(4) Rate $= -\frac{d[N_2]}{dt} = -\frac{d[H_2]}{dt} = \frac{d[NH_3]}{dt}$

2. In the formation of sulphur trioxide by the contact process $2SO_2$ (g) + O_2(g) $\rightarrow$ $2SO_3$(g); the rate of reaction is expressed as

$-\frac{d[O_2]}{dt} = 2.5 \times 10^{-4}$ mol L^{-1} s^{-1}

The rate of disappearance of (SO_2) will be

(1) 5×10^{-4} mol L^{-1} s^{-1}

(2) -2.25×10^{-4} mol L^{-1} s^{-1}

(3) 3.75×10^{-4} mol L^{-1} s^{-1}

(4) 50.0×10^{-4} mol L^{-1} s^{-1}

3. Which of the following statement is correct for a reaction X + 2Y $\rightarrow$ Product

(1) The rate of disappearance of X = twice the rate of disappearance of Y.

(2) The rate of disappearance of X = ½ rate of appearance of products

(3) The rate of appearance of products = ½ the rate of disappearance of Y

(4) The rate of appearance of products = ½ the rate of disappearance of X

4. $2A_{(g)} + B_{(g)} \rightleftharpoons$ Product is an elementary reaction,

If pressure is increased three times of the initial pressure, the velocity of forward reaction will be ------ of the previous velocity:-

(1) 9 times (2) 27 times

(3) $\frac{1}{9}$ times (4) $\frac{1}{27}$ times

RATE LAW / ORDER / MOLECULARITY

5. The rate of certain hypothetical reaction A + B + C $\rightarrow$ products is given by

$r = \frac{-d[A]}{dt} = K[A]^{1/2}[B]^{1/3}[C]^{1/4}$ The order of the reaction –

(1) 1 (2) $\frac{1}{2}$ (3) 2 (4) $\frac{13}{12}$

6. Which of the following rate law has an overall order of 0.5 for reaction involving substances x,y and z ?

(1) Rate = K (C_x) (C_y) (C_z)

(2) Rate = K $(C_x)^{0.5}(C_y)^{0.5}(C_z)^{0.5}$

(3) Rate = K $(C_x)^{1.5}$ $(C_y)^{-1}(C_z)^{\circ}$

(4) Rate = $K(C_x)(C_z)^{\circ}$ / $(C_y)^2$

7. Select the rate law that corresponds to the data shown for the following reaction A + B $\rightarrow$ C

Exp.	[A]	[B]	Initial rate
1.	0.012	0.035	0.10
2.	0.024	0.070	1.6
3.	0.024	0.035	0.20
4.	0.012	0.070	0.80

(1) Rate = K $[B]^3$ (2) Rate = $K[B]^4$

(3) Rate = $K[A][B]^3$ (4) Rate = $K[A]^2[B]^2$

8. Select the law that corresponds to data shown for the following reaction 2A + B $\rightarrow$ C + D :-

Exp.	[A]	[B]	Initial rate (mol L^{-1} min^{-1})
1.	0.1	0.1	7.5×10^{-3}
2.	0.3	0.2	9.0×10^{-2}
3.	0.3	0.4	3.6×10^{-1}
4.	0.4	0.1	3.0×10^{-2}

(1) Rate = K $[A]^2[B]$ (2) Rate = $K[A][B]^2$

(3) Rate = $K[A][B]^3$ (4) Rate = K[A][B]

9. The rate law for the single step reaction 2A + B $\rightarrow$ 2C, is given by –

(1) Rate = K[A][B] (2) Rate = $K[A]^2[B]$

(3) Rate = K[2A][B] (4) Rate = $K[A]^2[B]^{\circ}$

10. For an elementary process 2X + Y $\rightarrow$ Z + W, the molecularity is –

(1) 2 (2) 1

(3) 3 (4) Unpredictable

11. For the reaction A + B $\rightarrow$ products, it is found that the order of A is 1 and the order of B is $\frac{1}{2}$. When the concentration of both A and B are increased four times, the rate will increase by a factor of :–

(1) 16 (2) 8 (3) 6 (4) 4

12. For a chemical reaction A $\rightarrow$ B, the rate of reaction doubles when the concentration of A is increased 8 times. The order of reaction w.r.t. A is :–

(1) 3 (2) $\frac{1}{2}$ (3) $\frac{1}{3}$ (4) Zero

13. The specific rate constant of a first order reaction depends on the :–

(1) Concentration of the reactant
(2) Concentration of the product
(3) Time
(4) Temperature

ZERO / FIRST / nth ORDER REACTIONS

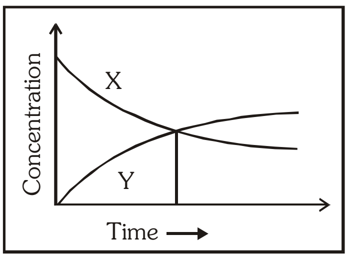
14. The rate constant is numerically the same for three reactions of first, second and third order respectively. Which one is true at a moment for rate of all three reactions if concentration of reactants is same and greater than 1 M.

(1) $r_1 = r_2 = r_3$ (2) $r_1 > r_2 > r_3$
(3) $r_1 < r_2 < r_3$ (4) All

15. The decomposition of N_2O_5 occurs as, $2N_2O_5 \rightarrow 4NO_2 + O_2$, and follows first order kinetics; hence

(1) The reaction is bimolecular
(2) The recation is unimolcular
(3) $t_{1/2}\ \alpha\ a^{\circ}$
(4) $t_{1/2}\ \alpha\ a^2$

16. The accompanying figure depicts the change in concentration of species X and Y for the reaction X $\rightarrow$ Y as a function of time the point of intersection of the two curves reperesents.



(1) $t_{1/2}$
(2) $t_{3/4}$
(3) $t_{2/3}$
(4) Data are insufficient to predict

17. The rate constant of a first order reaction is 4×10^{-3} s^{-1}. At a reactant concentration of 0.02 M, the rate of reaction would be–

(1) 8×10^{-5} M s^{-1} (2) 4×10^{-3} M s^{-1}
(3) 2×10^{-1} M s^{-1} (4) 4×10^{-1} M s^{-1}

18. In a first order reaction the a/(a – x) was found to be 8 after 10 minute. The rate constant is

(1) $\frac{(2.303 \times 3\log 2)}{10}$ (2) $\frac{(2.303 \times 2\log 3)}{10}$
(3) $10 \times 2.303 \times 2\log 3$ (4) $10 \times 2.303 \times 3\log 2$

19. 99 % of a first order reaction was completed in 32 min. when will 99.9 % of the reaction complete ?

(1) 50 min. (2) 46 min.
(3) 49 min. (4) 48 min.

20. For a given reaction of first order it takes 20 minute for the concentration to drop from 1 M to 0.6 M. The time required for the concentration to drop from 0.6 M to 0.36 M will be :

(1) More than 20 min (2) Less than 20 min
(3) Equal to 20 min (4) Infinity

21. The half life period for catalytic decomposition of AB_3 at 50 mm is found to be 4 hrs and at 100 mm it is 2 hrs. The order of reaction is –

(1) 3 (2) 1 (3) 2 (4) 0

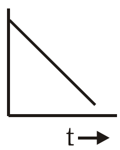
22. The reaction

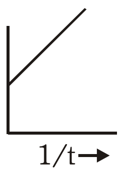
$$2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$$

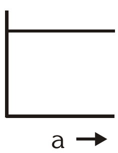
is first order with respect to N_2O_5.
Which of the following graph would yield a straight line :–

(1) $\log(P_{N_2O_5})$ v/s time with negative slope
(2) $P_{N_2O_5}{}^{-1}$ v/s time
(3) $P_{N_2O_5}$ v/s time
(4) $\log(P_{N_2O_5})$ v/s time with positive slope

23. Which of the following curves represents a Ist order reaction :–

(1) log (a-x) 

(2) log (a-x) 

(3) t ½ 

(4) 1 & 3 both

COLLISION THEORY AND FACTORS AFFECTING RATE OF REACTION

24. According to collision theory of reaction rates -

(1) Every collision between reactants leads to chemical reaction

(2) Rate of reaction is proportional to velocity of molecules

(3) All reactions which occur in gaseous phase are zero order reaction

(4) Rate of reaction is directly proportional to collision frequency.

25. Activation energy of a reaction is –

(1) The energy released during the reaction

(2) The energy evolved when activated complex is formed

(3) Minimum extra amount of energy needed to overcome the potential barrier of reaction

(4) The energy needed to form one mole of the product

26. An endothermic reaction A $\rightarrow$ B have an activation energy 15 kCal/mol and the heat of the reaction is 5 k cal/mol. The activation energy of the reaction B $\rightarrow$ A is –

(1) 20 kCal/mol (2) 15 kCal/mol

(3) 10 kCal/mol (4) Zero

27. The rate of a chemical reaction doubles for every 10^0C rise in temperature. If the temp is increased by 60^0C the rate of reaction increases by :

(1) 20 times (2) 32 times

(3) 64 times (4) 128 times

28. The rate of reaction increases to 2.3 times when the temperature is raised from 300 K to 310 K. If K is the rate constant at 300 K then the rate constant at 310 K will be equal to –

(1) 2 k (2) k (3) 2.3 k (4) 3 k^2

29. Which is used in the determination of reaction rates.

(1) Reaction Temperature

(2) Reaction Concentration

(3) Specific rate constant

(4) All of these

30. For the decomposition of $N_2O_5(g)$ it is given that $2N_2O_5(g) \rightarrow 4NO_2(g) + O_2(g)$ activation energy $= Ea$ $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$ activation energy = Ea' then

(1) Ea = 2Ea' (2) Ea > Ea'

(3) Ea < Ea' (4) Ea = Ea'

31. The energy of activation of a forward reaction is 50 kCal. The energy of activation of its backward reaction is:–

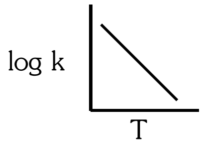
(1) Equal to 50 kCal.

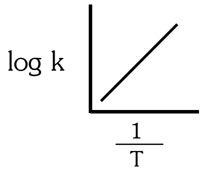
(2) Greater than 50 kCal.

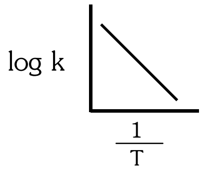
(3) Less than 50 kCal.

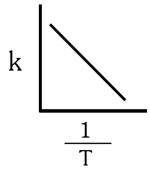
(4) Either greater or less than 50 kCal.

32. Which of the following plot is in accordance with the arrhenius equation :–

(1) 

(2) 

(3) 

(4) 

RADIOACTIVITY

33. $^{14}_{6}C$ decays by emission of

(1) β^- (2) β^+ (3) n (4) α

34. When $^{30}_{15}P$ emits a positron, the daughter nuclide formed is

(1) $_{15}P^{29}$ (2) $_{16}Si^{30}$ (3) $_{14}Si^{30}$ (4) $_{16}P^{30}$

35. $^{27}_{13}Al$ is a stable isotope. $^{29}_{13}Al$ is expected to disintegrated by

(1) α emission (2) $^{0}_{-1}\beta$ emission

(3) Positron emission (4) Proton emission

36. Loss of a β – particle is equivalent to

(1) Increase of one proton only

(2) Decrease of one neutron only

(3) Increase of one proton and decrease of one neutron

(4) None of these.

37. Which of the following nuclear reactions will generate an isotope?

(1) neutron emission (2) positron emission

(3) α-emission (4) β-emission

38. The S^{35} is neutron-rich, therefore, it is likely to undergo radioactive decay by

(1) electron capture (2) beta emission

(3) positron emission (4) alpha emission

39. The number of α and β-particles emitted, when the following nuclear transformation takes place are ______ and __________ respectively.

$$^{238}_{92}X \longrightarrow ^{206}_{82}Y$$

(1) 6, 2 (2) 5, 6

(3) 8, 4 (4) 8, 6

40. $_{35}X^{88}$ an unstable isotope, decays in two successive steps to produce stable isotope $_{32}Z^{84}$ as

$$_{35}X^{88} \xrightarrow{I} Y \xrightarrow{II} {}_{32}Z^{84}$$

The correct statement is (possible emission are α, β,positron, neutron, and K-capture)

(1) I may involve a β-emission.

(2) II may involve a neutron emission

(3) Y and Z may be isodiaphers

(4) X and Z may be isodiaphers

41. Which of the following can not be natural decay product (only α, β & γ decay) of $_{90}Th^{232}$

(1) $_{89}Ac^{228}$ (2) $_{86}Rn^{220}$

(3) $_{88}Ra^{226}$ (4) $_{84}Po^{216}$

42. The half-life of a radioactive isotope is three hours. If the initial mass of the isotope were 256 g, the mass of it remaining undecayed after 18 hours would be

(1) 16.0 g (2) 4.0 g

(3) 8.0 g (4) 12.0 g

43. The half-life of a radioisotope is four hours. If the initial rate of the isotope was 200 dpm, the rate after 24 hours is

(1) 6.25 dpm (2) 2.084 dpm

(3) 3.125 dpm (4) 4.167 dpm

44. The half life of Tc^{99} is 6.0 hr. The delivery of a sample of Tc^{99} from the reactor to the nuclear medicine lab of a certain hospital takes 3.0 hr. What is the minimum amount of Tc^{99} that must be shipped in order for the lab to receive 10.0 mg? $(\sqrt{2} = 1.41)$

(1) 20.0 mg (2) 15.0 mg

(3) 14.1 mg (4) 12.5 mg

45. Two radioactive nuclides A and B have half lives of 50 min and 10 min respectively. A fresh sample contains the nuclides of B to be eight time that of A. How much time should elapse so that the number of nuclides of A becomes double of B

(1) 30 min. (2) 40 min.

(3) 50 min. (4) 100 min.

46. A radioactive sample had an initial activity of 56 dpm (disintegration per min). After 69.3 min it was found to have an activity of 28 dpm. Find the number of atoms in a sample having an activity of 10 dpm.

(1) 693 (2) 1000

(3) 100 (4) 10,000

47. The analysis of a mineral of uranium reveals that ratio of mole of ^{206}Pb and ^{238}U in sample is 0.2. If effective decay constant of process $^{238}U \longrightarrow {}^{206}Pb$ is λ then age of rock is

(1) $\frac{1}{\lambda}\ln\left(\frac{5}{4}\right)$ (2) $\frac{1}{\lambda}\ln\left(\frac{5}{1}\right)$

(3) $\frac{1}{\lambda}\ln\left(\frac{4}{1}\right)$ (4) $\frac{1}{\lambda}\ln\left(\frac{6}{5}\right)$

48. Wooden article and freshly cut tree show activity of 7.6 and 15.2 $min^{-1}\ gm^{-1}$ of carbon ($t_{1/2}$ = 5760 years) respectively. The age of article in years, is

(1) 5760 (2) $5760 \times \left(\frac{15.2}{7.6}\right)$

(3) $5760 \times \left(\frac{7.6}{15.2}\right)$ (4) $5760 \times (15.2 - 7.6)$

49. Consider the following nuclear reactions:

$$^{238}_{92}M \rightarrow {}^{X}_{Y}N + 2\ {}^{4}_{2}He;$$

$$^{X}_{Y}N \rightarrow {}^{A}_{B}L + 2\beta^{+}$$

The number of neutrons in the element L is

(1) 142 (2) 144 (3) 140 (4) 146

50. The number of neutrons accompanying the formation of $_{54}X^{139}$ and $_{38}Sr^{94}$ from the absorption of slow neutron by $_{92}U^{235}$ followed by nuclear fission is

(1) 0 (2) 2 (3) 1 (4) 3

SOLUTION

CHEMICAL KINETICS & RADIOACTIVITY

1. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

$$\text{rate} = -\frac{d[N_2]}{dt} = -\frac{1}{3}\frac{d[H_2]}{[dt]} = \frac{1}{2}\frac{[d[NH_3]]}{dt}$$

2. $2SO_2 + O_2 \longrightarrow 2\ SO_3$

$$-\frac{1}{2}\frac{d[SO_2]}{dt} = \frac{-d[O_2]}{dt} = +\frac{1}{2}\cdot\frac{d[SO_3]}{dt}$$

$$-\frac{1}{2}\frac{d[SO_2]}{dt} = 2.5\times10^{-4}\ \frac{\text{mole}}{\text{L.Sec}}$$

$$\frac{-d[SO_2]}{dt} = 5\times10^{-4}\ \text{mole/L.Sec}$$

3. $X + 2Y \longrightarrow$ Product

$$\text{rate} = \frac{-d[X]}{dt} = -\frac{1}{2}\frac{d[Y]}{dt} = \frac{+d[\text{Product}]}{dt}$$

So rate of appearence of product

$$= \frac{\text{rate of disappearence of y}}{2}$$

4. $2A + B \rightarrow P$ (elementary)

rate = $K[A]^2[B]$

or

rate = $K\ P_A^2.P_B$

If pressure increases 3 times

rate' = $K(3P_A)^2(3P_B) = 27$ rate

velocity will be 27 times of initial.

5. rate = $K[A]^{1/2}[B]^{1/3}[C]^{1/4}$

Order of reaction $\Rightarrow$ $n = \frac{1}{2}+\frac{1}{3}+\frac{1}{4} = \frac{13}{12}$

6. Order of reaction = sum of power of concentration term in rate low expression.

ie rate = $K\ (C_x)^{1.5}\ (C_y)^{-1}\ (C_z)^0$

$n = 1.5 + (-1) + 0 = 0.5$

7. $A + B \rightarrow C$

Let rate = $K[A]^m[B]^n$

By experiment 1 & 4

Keeping concentration of A costant when B doubled rate becomes 8 times so value of n = 3

By experment 1 & 3

Keeping B constant, if concentration of A doubled rate becomes double so value of m is m =1

Now rate = $k[A][B]^3$

8. $2A + B \rightarrow C + D$

let Rate = $K[A]^m\ [B]^n$

exp.1 $7.5 \times 10^{-3} = K[.1]^m[0.1]^n$

exp.2 $9.0 \times 10^{-2} = K[.3]^m[.2]^n$

exp.3 $3.6 \times 10^{-1} = K[.3]^m[.4]^n$

exp.4 $3.0 \times 10^{-2} = K[.4]^m[.1]^n$

$$\frac{\text{Ex.1}}{\text{Ex.4}}\quad \frac{7.5}{30} = \left(\frac{1}{4}\right)^m \Rightarrow m = 1$$

$$\frac{\text{Ex.2}}{\text{Ex.3}}\quad \frac{9}{36} = \left(\frac{2}{4}\right)^n \Rightarrow n = 2 \text{ so rate} = K[A][B]^2$$

9. $2A + B \rightarrow 2C$ (single step)

rate = $k[A]^2[B]$

10. $2X + y \rightarrow z + W$ (Elementary Reaction)

Molecularity = 2 + 1 = 3

11. $A + B \rightarrow$ Product

rate = $K[A]^1[B]^{1/2}$

rate' = $K[4A][4B]^{1/2}$

= 8.rate

12. $A \rightarrow B$

rate = $K[A]^m$

rate' = $K[2A]^m$ = 8 rate

So 2^m. $K[A]^m$ = 8 rate

$2^m = 8$

$m = 3$

13. Specific rate constant depends upon temperature.

14. $\text{rate}_1 = K[A]^1$

$\text{rate}_2 = K[A]^2$

$\text{rate}_3 = K[A]^3$

given [A] > 1M so

$\text{rate}_3 > \text{rate}_2 > \text{rate}_1$

15. $2N_2O_5 \rightarrow 4\ NO_2 + O_2$ (1st order)

$$t_{1/2} = \frac{\ln 2}{2K} \propto a^0$$

16. $X \rightarrow Y$

a_0 –

a_0-a a

At intersection point

$a_0 - a = a$

$a = a_0/2$

So its represent $t_{1/2}$

17. rate $= K[A]^1$

$= 4 \times 10^{-3}\ sec^{-1}(0.02M)$

$= 8 \times 10^{-5}\ M\ sec^{-1}$

18. $t = \frac{2.303}{k}\log_{10}\left(\frac{a}{a-x}\right)$

10 minute $= \frac{2.303}{K}\log(8)$

$K = \frac{2.303 \times 3}{10}\log 2$ minute^{-1}

19. $t = \frac{2.303}{K}\log\left(\frac{a_0}{a_t}\right)$

$32 = \frac{2.303}{K}\log_{10}\left(\frac{100}{1}\right)$ .....(I)

$t = \frac{2.303}{K}\log_{10}\left(\frac{100}{0.1}\right)$ .....(II)

$\frac{(I)}{(II)} \quad \frac{32}{t} = \frac{\log 100}{\log 1000}$

t = 48 minute

20. 1M → 0.6 M 40% concentration drop

0.6 M → 0.36M 40% concentration drop

So In 1st order equal % change take equal time (20 minute)

21. $\frac{t_{1/2}1}{t_{1/2}2} = \left(\frac{P_{0_1}}{P_{0_2}}\right)^{1-n}$

$\frac{4}{2} = \left(\frac{500}{100}\right)^{1-n} \Rightarrow n = 2$

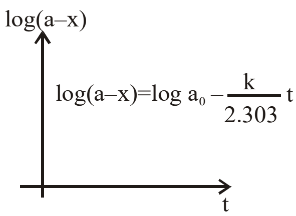
22. $2N_2O_5 \rightarrow 4\ NO_2 + O_2$ (n = 1)

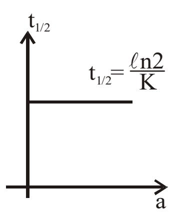
$P_{N_2O_5} = P^0_{N_2O_5} \cdot e^{-2kt}$

$\log\ P_{N_2O_5} = \log P^0_{N_2O_5} - 2kt$

y = c–mx straight line in log $P_{N_2O_5}$ vs time

23. For 1st order reaction





24. According to collision theory.

All collision between reactant does not lead to product formation

and $K = A\,e^{-\frac{Ea}{RT}}$

rate ∝ K ∝ A

25. Ea → Extra energy to overcome potential barrier for product formation.

26. A → B

$\Delta H = Ea_f - Ea_b \Rightarrow 5 = 15 - Ea_b \Rightarrow Ea_b = 10$ kcal/mole

27. No. of time when temp rise by

10°C is $= \frac{60}{10} = 6$

So rate becomes 2^6 = 64 times

28. $\frac{K_{310}}{K_{300}} = 2.3$

$K_{310} = 2.3 \times K_{300} = 2.3\ K$

29. rate = $K[A]^n$

where $K = A\,e^{-\frac{Ea}{RT}}$

So Rate depends upon concentration, specific rate, temperature.

30. Activation energy does not depends upon stoichiometric coefficient of reaction So in both reaction

Activation energy will be same Ea = Ea'

31. $\Delta H = Ea_f - Ea_b$

ΔH = 50kcal – Ea_b

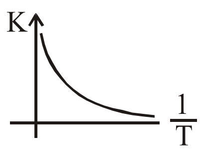
Ea_b = 50 kcal – ΔH

ΔH may be +ve or –ve

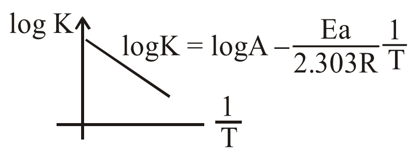
So Ea_b may be greater or less than 50 kcal

32. $K = A\ e^{-\frac{Ea}{RT}}$

$(K)\text{vs}\left(\frac{1}{T}\right)$



$(\log K)\text{vs}\left(\frac{1}{T}\right)$



33. $\frac{n}{p}$ ratio is high

34. There is a decrease in atomic number by unity

35. $\frac{n}{p}$ ratio is high

36. Loss of a β – particle will result in increase of one proton and decrease of one neutron

37. Emission of neutron do not decrease atomic number.

38. $\frac{n}{p}$ ratio is high

39. Number of α particles $= \frac{238 - 206}{4} = 8$

Number of β particles = 82 + (8 × 2) – 92 = 6

40. Factual

41. Difference in mass number should be multiple of 4.

42. There 6 half lives.

Final mass = $256 \times \left(\frac{1}{2}\right)^6 = 4.0\,gm$

43. There 6 half lives.

Final rate $= \frac{200}{64}$ dpm = 3.125 dpm

44. $\frac{x}{\sqrt{2}} = 10mg \Rightarrow x = 14.1$ mg

45. After 50 min. A becomes $\frac{1}{2}$ and B becomes $\frac{1}{32}$ times.

Final $\frac{A}{B} = \frac{1}{8} \times \frac{\frac{1}{2}}{\frac{1}{32}} = \frac{2}{1}$

46. Half life = 69.3 min.

$$\Rightarrow \lambda = \frac{0.693}{69.3} = \frac{1}{100}\,min^{-1}$$

$$\frac{dN}{dt} = 10 = \frac{1}{100}N \Rightarrow N = 1000$$

47. If at present U = x then initially U was 1.2x

$$t = \frac{1}{\lambda}\ell n\left(\frac{1.2x}{x}\right) = \frac{1}{\lambda}\ell n\left(\frac{6}{5}\right)$$

48. Activity has become half.

Hence age = 5760 years

49. ${}^{238}_{92}M \rightarrow {}^{230}_{88}N + 2\,{}^{4}_{2}He$

$${}^{230}_{88}N \rightarrow {}^{230}_{96}L + 2\,{}^{0}_{+1}e$$

Hence, number of neutrons in the element L = 230 – 86 = 144

50. ${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{139}_{54}X + {}^{94}_{38}Sr + 3\,{}^{1}_{0}n$