Nuclear Chemistry Assignment

1. ^{23}Na is the more stable isotope of Na. Find out the process by which $^{24}_{11}Na$ can undergo radioactive decay

(a) β^- – emission (b) α – emission (c) β^+ – emission (d) K – electron capture

2. What is the packing fraction of $^{56}_{26}Fe$ (Atomic, mass = 55.92066)

(a) – 14.167 (b) 173.90 (c) – 14.187 (d) – 73.90

3. Consider the following decay. $^A_ZX \longrightarrow ^A_{Z+1}Y + ^0_{-1}e + \bar{\nu}$, X is unstable because

(a) Of its large nuclide (b) Its nucleus has excess energy
(c) The nuclide has more neutrons than protons (d) The nuclide has more protons than neutrons

4. Which of the following does not occur

(a) $^{40}_{20}Ca + ^1_0n \longrightarrow ^{40}_{19}K + ^1_1H$ (b) $^{24}_{12}Mg + ^4_2He \longrightarrow ^{27}_{14}Si + ^1_0n$

(c) $^{113}_{48}Cd + ^1_0n \longrightarrow ^{112}_{48}Cd + ^0_{-1}e$ (d) $^{43}_{20}Ca + ^4_2He \longrightarrow ^{46}_{21}Sc + ^1_1H$

5. A nuclide has mass number = *A* and atomic number = *Z*. During a radioactive process, if

(a) Both *A* and *Z* decrease, the process is called α -decay
(b) A remains unchanged and *Z* decreases by one, the process is called β^+ - decay or K -electron capture
(c) Both *A* and *Z* remain unchanged, the process is called γ -decay
(d) Both *A* and *Z* increase, the process undergoes nuclear isomerism

6. The binding energy of $_8O^{16}$ is $127\ MeV$. Its binding energy per nucleon is

(a) $0.794\ MeV$ (b) $1.5875\ MeV$ (c) $7.94\ MeV$ (d) $15.875\ MeV$

7. In terms of energy 1 a.m.u. is equal to

(a) $100\ J$ (b) $931.1\ MeV$ (c) $931.1\ kcal$ (d) $10^7\ erg$

8. Radioactive disintegration differs from a chemical change in being

(a) An exothermic change (b) A spontaneous process
(c) A nuclear process (d) A unimolecular first order reaction

9. Which one of the following statements is incorrect

(a) Mass defect is related with binding energy
(b) 'Meason' was discovered by Yukawa
(c) The size of the nucleus is of the order of $10^{-12} - 10^{-13}\ cm$
(d) Magnetic quantum number is a measure of orbital angular momentum of the electron

10. 1 *a.m.u.* is equal to

(a) $\frac{1}{12}$ of $C-12$ (b) $\frac{1}{14}$ of $O-16$ (c) $1\ gm$ of H_2 (d) $1.66 \times 10^{-23}\ kg$

11. Which one of the following notations shows the product incorrectly

(a) $^{242}_{96}Cm\ (\alpha, 2n)\ ^{243}_{97}Bk$ (b) $^{10}_5B\ (\alpha, n)\ ^{13}_7N$ (c) $^{14}_7N\ (n, p)\ ^{14}_6C$ (d) $^{28}_{14}Si\ (d, n)\ ^{29}_{15}P$

12. Which of the following has the maximum penetrating power

(a) α -particle (b) Proton (c) γ -radiation (d) Positron

13. Which of the following does not characterise X -rays

(a) The radiation can ionise gases (b) It causes *ZnS* to fluorescence
(c) Deflected by electric and magnetic field (d) Have wavelength shorter than ultra-violet rays

14. The radiations from a naturally occurring radioative substances as seen after deflection by a magnetic field in one direction, are

(a) Definitely alpha rays (b) Definitely beta rays (c) Both alpha and beta rays (d) Either alpha or beta rays

15. During a negative β -decay

(a) An atomic electron is ejected
(b) An electron which is already present within the nucleus is ejected
(c) A neutron in the nucleus decays emitting an electron
(d) A part of the binding energy of the nucleus is converted into an electron

16. Emission of an alpha particle leads to a

(a) Decrease of 2 units in the charge of the atom (b) Increase of 2 units in the charge of the atom
(c) Decrease of 2 units in the mass of the atom (d) Increase of 4 units in the mass of the atom

17. Consider an α-particle just in contact with a $_{92}U^{238}$ nucleus. Calculate the coulombic repulsion energy (i.e., the height of the coulombic barrier between U_{238} and alpha particle) assuming that the distance between them is equal to the sum of their radii
(a) $23.851\times10^4\ eV$ (b) $26.147738\ \times10^4\ eV$ (c) $25.3522\times10^4\ eV$ (d) $20.2254\times10^4\ eV$

18. The decay constant of a radioactive sample is λ. The half life and mean life of the sample are respectiely
(a) $\frac{1}{\lambda},\frac{\ln 2}{\lambda}$ (b) $\frac{\ln 2}{\lambda},\frac{1}{\lambda}$ (c) $\lambda \ln 2,\frac{1}{\lambda}$ (d) $\frac{\lambda}{\ln 2},\frac{1}{\lambda}$

19. The decay constant of Ra^{226} is $1.37\times10^{-11}\ \sec^{-1}$. A sample of Ra^{226} having an activity of 1.5 millicurie will contain ….. atoms
(a) 4.1×10^{18} (b) 3.7×10^{17} (c) 2.05×10^{15} (d) 4.7×10^{10}

20. A freshly prepared radioactive source of half life 2 hours emits radiations of intensity which is 64 times the permissible safe level. The minimum time after which it would be possible to work safely with this source is
(a) 6 hours (b) 12 hours (c) 24 hours (d) 128 hours

21. What is the half-life of a radioactive substance if 87.5% of any given amount of the substance disintegrates in 40 minutes
(a) 160 *min* (b) 10 *min* (c) 20 *min* (d) 13 *min* 20 *sec*

22. If 8.0 of a radioactive isotope has a half-life of 10 *hrs*. The half life of 2.0 *g* of the same substance is
(a) 2.5 *hrs* (b) 5 *hrs* (c) 10 *hrs* (d) 40 *hrs*

23. A radioactive nucleide X decays at the rate of 1.00×10^5 disintegration $s^{-1}g^{-1}$. Radium decays at the rate of 3.70×10^{10} disintegration $s^{-1}g^{-1}$. The activity of X in millicuries $g^{-1}(m\ ci\ g^{-1})$ is
(a) 0.027 (b) 0.270×10^{-5} (c) 0.00270 (d) 0.000270

24. The half-life of a radionuclide is 69.3 minutes. What is its average life (in minutes)
(a) 100 (b) 10^{-2} (c) $(69.3)^{-1}$ (d) 0.693×69.3

25. In the case of a radio-isotope the value of $T_{1/2}$ and λ are identical in magnitude. The value is
(a) 0.693 (b) $(0.693)^{1/2}$ (c) $1/0.693$ (d) $(0.693)^2$

26. The half life of $_{92}U^{238}$ is 4.5×10^9 years. After how many years, the amount of $_{92}U^{238}$ will be reduced to half of its present amount
(a) 9.0×10^9 years (b) 13.5×10^9 years (c) 4.5×10^9 years (d) $4.5\times10^{4.5}$ years

27. 8 *gm* of the radioactive isotope, cesium-137 were collected on February 1 and kept in a sealed tube. On July 1, it was found that only 0.25 *gm* of it remained. So the half-life period of the iostope is
(a) 37.5 days (b) 30 days (c) 25 days (d) 50 days

28. The half life of the radioelement $_{83}Bi^{210}$ is 5 days. Starting with 20*g* of this isotope, the amount remaining after 15 days is
(a) 10 *g* (b) 5 *g* (c) 2.5*g* (d) 6.66 *g*

29. A certain nuclide has a half life of 25 minutes. It one starts with 100 *g* of it, how much of it will remain at the end of 100 minutes
(a) 1.0 *g* (b) 4.0 *g* (c) 6.25 *g* (d) 12.50 *g*

30. The half-life of a radioactive isotope is 3 hours. Value of its disintegration constant is
(a) 0.231 *per hr* (b) 2.31 *per hr* (c) 0.2079 *per hr* (d) 2.079 *per hr*

31. The half-life of an isotope is 10 *hrs*. How much will be left behind after 4 *hrs* in 1 *gm* sample
(a) 45.6×10^{23} atoms (b) 4.56×10^{23} atoms (c) 4.56×10^{21} atoms (d) 45.6×10^{21} atoms

32. The radioisotope, tritium (^3_1H) has a half-life of 12.3 *years*. If the initial amount of tritium is 32 *mg*. How many milligrams of it would remain after 49.2 *years*
(a) 8 *mg* (b) 1 *mg* (c) 2 *mg* (d) 4 *mg*

33. If 1 microgram of radium has disintegrated for 500 years. How many alpha particles will be emitted per second
(a) 2.92×10^4 / sec (b) 292×10^4 / sec (c) 0.292×10^4 / sec (d) 29.2×10^4 / sec

34. Radioactive lead $_{82}Pb^{201}$ has a half life of 8 hours. Starting from one milligram of this isotope, how much will remain after 24 hours
(a) 1/2 *mg* (b) 1/3 *mg* (c) 1/8 *mg* (d) 1/4 *mg*

35. The half-life of ${}_6C^{14}$, if its λ is 2.31×10^{-4} , is

(a) 2×10^2 years (b) 3×10^3 years (c) 3.5×10^4 years (d) 4×10^3 years

36. Half-life is the time in which 50% of radioactive element disintegrates. Carbon-14 disintegrates 50% in 5770 years. Find the half-life of carbon 14

(a) 5770 years (b) 11540 years (c) $\sqrt{5770}$ years (d) None of the above

37. If 2.0 *g* of a radioactive isotope has a half - life of 20 hr, the half life of 0.5 *g* of the same substance is

(a) 20 *hr* (b) 80 *hr* (c) 5 *hr* (d) 10 *hr*

38. How many alpha particles are emitted per second by 1 microgram of radium

(a) 3.62×10^4 / sec (b) 0.362×10^4 / sec (c) 362×10^4 / sec (d) 36.2×10^4 / sec

39. A radioactive element decays at such a rate that after 15 minutes only 1/10 of the original amount is left. How many more minutes will be needed when only 1/100 of the original amount will be left

(a) 1.5 minutes (b) 15.0 minutes (c) 16.5 minutes (d) 30 minutes

40. What is the half life of a radioactive substance if 75% of a given amount of the substance disintegrates in 30 minutes

(a) 7.5 minutes (b) 25 minutes (c) 20 minutes (d) 15 minutes

41. The half life period of a radioactive substance is 8 years. After 16 years, the mass of the substance will reduce from starting 16.0 *g* to

(a) 8.0 *g* (b) 6.0 *g* (c) 4.0 *g* (d) 2.0 *g*

42. The radium and uranium atoms in a sample of uranium mineral are in the ratio of $1:2.8\times10^6$. If half-life period of radium is 1620 years, the half-life period of uranium will be

(a) 45.3×10^9 years (b) 45.3×10^{10} years (c) 4.53×10^9 years (d) 4.53×10^{10} years

43. The ratio of the amount of two elements X and Y at radioactive equilibrium is $1:2\times10^{-6}$. If the half life period of element Y is 4.9×10^{-4} days, then the half life period of element X will be

(a) 4.8×10^{-3} *days* (b) 245 *days* (c) 122.5 *days* (d) None of these

44. The $t_{1/2}$ of radioactive $K-40$ is 5.27 years $(\lambda=2.5\times10^{-7}\ \text{min}^{-1})$. The decay activity of $2.0g$ of the sample is about

(a) $5\times10^5 dpm$ (b) $5\times10^{10} dpm$ (c) $7.5\times10^{15} dpm$ (d) $7.5\times10^{20} dpm$

45. The half-life of a radioactive sample is $2n$ years. What fraction of a sample will remain undecayed after n years

(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\frac{1}{\sqrt{3}}$ (d) 2

46. One gram of ${}^{226}Ra$ has an activity of nearly $1\ Ci$. The $t_{1/2}$ of ${}^{226}Ra$ is

(a) 1620 *years* (b) 12.5 *years* (c) 140 *days* (d) 4.5×10^9 *years*

47. A sample of a radioisotope $(t_{1/2}=3$ *days*) was taken. After 12 days, $3g$ of the sample was left. What was the initial mass of the samle

(a) 112 g (b) 136 g (c) 12 g (d) 48 g

48. The rate of decay of a radioactive sample is given by R_1 at time t_1 and R_2 at a later time t_2. The mean life of this radioactive sample is

(a) $R_1=R_2\,t_2/t_1$ (b) $R_2=R_1\,e^{(t_1-t_2)/T}$ (c) $R_1=R_2\,e^{(t_2-t_1)T}$ (d) $R_1t_1=R_2\,e^{(t_1-t_2)}.\,t_2$

49. A certain nuclide has a half life period of 30 minutes. If a sample containing 600 atoms is allowed to decy for 90 minutes. How many atoms will remain

(a) 200 atoms (b) 450 atoms (c) 75 atoms (d) 500 atoms

50. A radioactive sample decays to half of its initial concentration in 6.93 minutes. It further decays half in next 6.93 minutes. The rate constant for the reaction is

(a) $0.10\ \text{min}^{-1}$ (b) $0.01\ \text{min}^{-1}$ (c) $1.0\ \text{min}^{-1}$ (d) $0.001\ \text{min}^{-1}$