

12th Science Lesson 5 Questions in English

5] Atomic and Nuclear Physics

1. In which of these languages atom means as indivisible?

a) **Greek**

b) Latin

c) Rome

d) Persian

Explanation

The word atom in Greek means without division or indivisible.

2. Which of this scientist compared the sizes of atom, apple and earth?

a) J.J. Thomson

b) Albert Einstein

c) **Richard P.Feynman**

d) Neil's Bohr

Explanation

An American Physicist Richard P. Feynman said that if the atom becomes the size of an apple, then the apple becomes the size of the earth.

3. Which of the following atom models explained the unsolved issues?

a) J.J. Thomson model

b) **Bohr model**

c) Rutherford model

d) All the above

Explanation

The Bohr atom model is more successful than J. J. Thomson and Rutherford atom models. It explained many unsolved issues in those days and also gave better understanding of chemistry.

4. Choose the Incorrect statements.

i) Scientist believed that atom is the fundamental entity for all the matters.

ii) Nucleus is made of proton and neutron.

iii) Quarks are the fundamental entities for the proton and neutron.

- a) i only
- b) ii only
- c) iii only
- d) None of the above

Explanation

Later, scientists observed that even the atom is not the fundamental entity. It consists of electrons and nucleus. Around 1930, scientists discovered that nucleus is also made of proton and neutron. Further research discovered that even the proton and neutron are made up of fundamental entities known as quarks.

5. Assertion (A): Gases can conduct electricity only under special arrangements.

Reasoning(R): At normal atmospheric pressure gases don't have free electrons for conduction.

- a) Both A and R is True and R is the correct explanation of A.
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

Gases at normal atmospheric pressure are poor conductors of electricity because they do not have free electrons for conduction. But by special arrangement, one can make a gas to conduct electricity.

6. Which of the following statements are not true regarding the cathode rays?

- a) Cathode rays possess energy and momentum.
- b) Cathode ray travels in a straight line with speed 10^7 ms^{-1} .
- c) Cathode rays can be deflected by applying magnetic field only.
- d) The deflected direction of cathode rays indicates the charge of the particles.

Explanation

Cathode rays possess energy and momentum and travel in a straight line with high speed of the order of 10^7 m s^{-1} . It can be deflected by application of electric and magnetic fields. The direction of deflection indicates that they are negatively charged particles.

7. Choose the Incorrect statements.

- i) Cathode rays produce heat when they are allowed to fall on matter.
- ii) Cathode rays do not affect the photographic plates.
- iii) Cathode rays produce fluorescence on certain crystals and minerals.

- a) i only
- b) ii only**
- c) iii only
- d) None of the above

Explanation

When the cathode rays are allowed to fall on matter, they produce heat. They affect the photographic plates and also produce fluorescence when they fall on certain crystals and minerals.

8. In which of these materials cathode rays fall to produce x-rays?

- a) High atomic weight**
- b) Low density
- c) High energy value
- d) Vacuum space

Explanation

When the cathode rays fall on a material of high atomic weight, x-rays are produced.

9. What is the speed of cathode ray in terms of speed of light?

- a) $1/2$
- b) $1/3^{\text{rd}}$
- c) $2/3^{\text{rd}}$
- d) $1/10^{\text{th}}$**

Explanation

The speed of cathode rays is up to $1/10^{\text{th}}$ of the speed of light.

10. Which of these values of cathode ray is measured by varying the electric and magnetic field?

- a) Charge per unit mass
- b) Specific charge
- c) Normalized charge
- d) All the above**

Explanation

Thomson's experiment is considered as one among the landmark experiments for the birth of modern physics. In 1887, J. J. Thomson made remarkable improvement in the scope of study of gases in discharge tubes. In the presence of electric and magnetic fields, the cathode rays are

deflected. By the variation of electric and magnetic fields mass normalized charge or the specific charge (charge per unit mass) of the cathode rays is measured.

11. Which of these forces does not act on an oil droplet?

a) Gravitational force

b) Magnetic force

c) Buoyant force

d) Viscous force

Explanation

Let m be the mass of the oil drop and q be its charge. Then the forces acting on the droplet are gravitational force, electric force, buoyant force, viscous force.

12. Choose the Incorrect statements.

i) J.J.Thomson atom model was based on static distribution of electric charges.

ii) Rutherford proposed the first dynamic model of an atom.

iii) Thomson and Rutherford models explained the stability of the atom.

a) i only

b) ii only

c) iii only

d) None of the above

Explanation

J. J. Thomson proposed a theoretical atom model which is based on static distribution of electric charges. Since this model fails to explain the stability of atom, one of his students E. Rutherford proposed the first dynamic model of an atom. Rutherford gave atom model which is based on results of an experiment done by his students (Geiger and Marsden). But this model also failed to explain the stability of the atom.

13. Which of this atomic model was proposed by Neil's Bohr?

a) Hydrogen atom

b) Oxygen atom

c) Carbon atom

d) Nitrogen atom

Explanation

Neil's Bohr who is also a student of Rutherford proposed an atomic model for hydrogen atom which is more successful than other two models. Neil's Bohr atom model could explain the stability of the atom and also the origin of line spectrum.

14. Which of this explains that no stable equilibrium points in electrostatic configuration?

a) Einstein's theorem

b) J.J.Thomson Atomic model

c) Earnshaw's theorem

d) Neil's Bohr Atomic model

Explanation

The atoms are electrically neutral; this implies that the total positive charge in an atom is equal to the total negative charge. According to the Neil's model, all the charges are assumed to be at rest. But from classical electrodynamics, no stable equilibrium points exist in electrostatic configuration (this is known as Earnshaw's theorem) and hence such an atom cannot be stable. Further, it fails to explain the origin of spectral lines observed in the spectrum of hydrogen atom and other atoms.

15. Who conducted the scattering of alpha particles by gold foil experiment?

a) Geiger and Marsden

b) J.J.Thomson

c) Neil's Bohr

d) Earnshaw

Explanation

In 1911, Geiger and Marsden did a remarkable experiment based on the advice of their teacher Rutherford, which is known as scattering of alpha particles by gold foil.

16. What is the size of nucleus according to Rutherford?

a) 10^2m

b) 10^{12}m

c) 10^{-14}m

d) 10^{-6}m

Explanation

Rutherford proposed that an atom has a lot of empty space and contains a tiny matter known as nucleus whose size is of the order of 10^{-14}m .

17. Choose the correct statements about Nucleus.

- i) Most of the mass of the atom is concentrated in electrons.
- ii) Nucleus is surrounded by negatively charged electrons.
- iii) Electrons are at rest position around the nucleus.

- a) i only
- b) ii only**
- c) iii only
- d) All the above

Explanation

The nucleus is positively charged and most of the mass of the atom is concentrated in nucleus. The nucleus is surrounded by negatively charged electrons. Since static charge distribution cannot be in a stable equilibrium, he suggested that the electrons are not at rest and they revolve around the nucleus in circular orbits like planets revolving around the sun.

18. What is the minimum distance between the nucleus center and the reflected alpha particle?

- a) Contact distance**
- b) Minimum distance
- c) Saturated point
- d) Excited state

Explanation

The minimum distance between the center of the nucleus and the alpha particle just before it gets reflected back through 180° is defined as the distance of closest approach r_0 (also known as contact distance).

19. What is the range of nucleus radius calculated by Rutherford?

- a) 10^{-11} m to 10^{-15} m
- b) 10^{-14} m to 10^{-15} m**
- c) 10^{-1} m to 10^{-9} m
- d) 10^{-8} m to 10^{-15} m

Explanation

Rutherford calculated the radius of the nucleus for different nuclei and found that it ranges from 10^{-14} m to 10^{-15} m.

20. In which of these conditions the impact parameter is defined?

- a) At equilibrium

b) At a large distance

- c) Inside a vacuum space
- d) At rest

Explanation

The impact parameter is defined as the perpendicular distance between the center of the gold nucleus and the direction of velocity vector of alpha particle when it is at a large distance.

21. Which of these values is decreased with increase in the impact parameter value?

a) Scattering angle

- b) Radius of nucleus
- c) Number of electrons
- d) All the above

Explanation

When impact parameter increases the scattering angle decreases. Smaller the impact parameter, larger will be the deflection of alpha particles.

22. Which of these values were found by the Rutherford model?

a) Size of the atom

- b) Stability of atom
- c) Number of protons
- d) None of the above

Explanation

Rutherford atom model helps in the calculation of the diameter of the nucleus and also the size of the atom.

23. What are the drawbacks of the Rutherford model?

- a) Distribution of electrons around nucleus
- b) Stability of the atom
- c) Mass of the nucleus

d) Both a and b**Explanation**

The Rutherford model fails to explain the distribution of electrons around the nucleus and also the stability of the atom.

24. Choose the correct statements.

- i) According to electrodynamics theory accelerated charge emits electromagnetic radiations.
 - ii) The radius of orbit becomes smaller when the charge loses its energy.
- a) i only
 - b) ii only
 - c) Both i and ii**
 - d) Neither i nor ii

Explanation

According to classical electrodynamics any accelerated charge emits electromagnetic radiations. Due to emission of radiations, it loses its energy. Hence, it can no longer sustain the circular motion. The radius of the orbit, therefore, becomes smaller and smaller (undergoes spiral motion) and finally the electron should fall into the nucleus and the atoms should disintegrate. But this does not happen.

25. What is the pattern of radiation emission according to the electrodynamics model?

- a) Discrete**
- b) Continuous
- c) Pulse
- d) Hyperbola

Explanation

According to the electrodynamics model, emission of radiation must be continuous and must give continuous emission spectrum but experimentally we observe only line (discrete) emission spectrum for atoms.

26. Who was the first to give the theoretical model of the atom structure?

- a) Neil's Bohr**
- b) Rutherford
- c) Marsden
- d) J.J.Thomson

Explanation

In order to overcome the limitations of the Rutherford atom model in explaining the stability and also the line spectrum observed for a hydrogen atom, Neil's Bohr made modifications of Rutherford atom model. He is the first person to give better theoretical model of the structure of an atom to explain the line spectrum of hydrogen atom.

27. Which of the following is not a postulate of Bohr atom model?

- a) Electron moves around the nucleus in circular orbits in an atom.
- b) The Coulomb force gives the centripetal force for the circular motion of electron.
- c) Electrons revolve around the nucleus in all the orbits.**
- d) The discrete orbits do not radiate electromagnetic energy are stable orbits.

Explanation

Postulates of Bohr atom model: The electron in an atom moves around nucleus in circular orbits under the influence of Coulomb electrostatic force of attraction. This Coulomb force gives necessary centripetal force for the electron to undergo circular motion. Electrons in an atom revolve around the nucleus only in certain discrete orbits called stationary orbits where it does not radiate electromagnetic energy. Only those discrete orbits allowed are stable orbits.

28. Which is known as the angular momentum quantization condition?

- a) $h/2\pi$**
- b) $2\pi h$
- c) $2\hbar$
- d) $2\pi r$

Explanation

The angular momentum of the electron in these stationary orbits are quantized that is, it can be written as integer or integral multiples of $h/2\pi$ called as reduced Planck's constant that is the integer n is called as principal quantum number of the orbit. $l = n\hbar$ where $\hbar = h/2\pi$ this condition is known as angular momentum quantization condition.

29. Which is known as the de Broglie wavelength?

- a) $\hbar$
- b) v
- c) λ**
- d) σ

Explanation

The de Broglie wavelength (λ) for an electron of mass m moving with velocity v is $\lambda = h/mv$ where h is called Planck's constant.

30. What is the energy value of the photon in the quantization of energy?

- a) E
- b) ΔE**

- c) πr
- d) $E/2\pi r$

Explanation

Energy of orbits is not continuous but discrete. This is called the quantization of energy. An electron can jump from one orbit to another orbit by absorbing or emitting a photon whose energy is equal to the difference in energy (ΔE) between the two orbital levels.

31. In which of this state the velocity of electron is maximum?

a) Ground state

- b) Excited state
- c) Both a and b
- d) Neither a nor b

Explanation

The velocity of electron decreases as the principal quantum number increases. This curve is the rectangular hyperbola. This implies that the velocity of electron in ground state is maximum when compared to excited states.

32. Choose the Incorrect statements.

- i) The atomic mass of deuterium is thrice as the atomic mass of hydrogen atom.
- ii) Bohr atomic model does not explain the isotopic shift.
- iii) The Bohr atomic model considers the nuclear movement for calculating the wave length between hydrogen and deuterium.

a) i only

- b) ii only
- c) iii only
- d) None of the above

Explanation

On calculating wavelength or wave number difference between the faint and bright spectral lines, atomic mass of deuterium is measured to be twice that of atomic mass of hydrogen atom. Bohr atom model could not explain this isotopic shift. Thus by considering nuclear motion (although the movement of the nucleus is much smaller, it is observed) into account in the Bohr atom model, the wave number or wavelength difference between hydrogen atom and deuterium is theoretically calculated which perfectly agreed with the spectroscopic measured values.

33. What is the difference between the hydrogen and deuterium atom?

- a) Number of proton
- b) Number of neutron**
- c) Number of electron
- d) All the above

Explanation

The difference between hydrogen atom and deuterium is in the number of neutron. Hydrogen atom contains an electron and a proton, whereas deuterium has an electron, a proton and a neutron.

34. Assertion (A): Excitation energy is used to excite an electron from lower energy state to higher energy.

Reasoning(R): The first excitation energy excites an electron from first excited state to the ground state.

- a) Both A and R is True and R is the correct explanation of A.
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.**
- d) Both A and R is False.

Explanation

The energy required to excite an electron from lower energy state to any higher energy state is known as excitation energy. The excitation energy for an electron from ground state ($n = 1$) to first excited state ($n = 2$) is called first excitation energy.

35. What is the minimum energy required to remove an electron from an atom?

- a) Binding energy**
- b) Electrostatic energy
- c) Frictional energy
- d) Magnetic energy

Explanation

The minimum energy required to remove an electron from an atom in the ground state is known as binding energy or ionization energy.

36. What is the ionization potential for a hydrogen atom?

- a) $13.6 / n^2$ volt**
- b) $13 n$ volt
- c) 13.6 volt

d) n^2 volt

Explanation

Ionization potential is defined as ionization energy per unit charge.

$$V_{\text{ionization}} = \frac{1}{e} E_{\text{ionization}} = \frac{13.6}{n^2} Z^2 V$$

Thus, for a hydrogen atom ($Z = 1$), the ionization potential is $V = 13.6/n^2$ volt.

37. Define the spectrum of the electromagnetic radiations from any heated materials?

a) Pulse spectrum

b) Continuous spectrum

c) Discrete spectrum

d) None of the above

Explanation

Materials in the solid, liquid and gaseous states emit electromagnetic radiations when they are heated up and these emitted radiations usually belong to continuous spectrum. For example, when white light is examined through a spectrometer, electromagnetic radiations of all wavelengths are observed which is a continuous spectrum.

38. By which of these emission electrons jump back to the ground state?

a) Spontaneous emission

b) Continuous emission

c) Long-term emission

d) Discrete emission

Explanation

Electrons in excited states have very small life time, these electrons jump back to ground state through spontaneous emission in a short duration of time (approximately 10^{-8} s) by emitting the radiation with same wavelength (or frequency) corresponding to the colors it absorbed. This is called emission spectroscopy.

39. What is the value of the Rydberg constant?

a) $2.0945 \times 10^{-7} \text{ m}^{-1}$

b) $1.548 \times 10^8 \text{ m}^{-2}$

c) $1.09737 \times 10^7 \text{ m}^{-1}$

d) $10.737 \times 10^{-8} \text{ m}$

Explanation

R is known as Rydberg constant whose value is $1.09737 \times 10^7 \text{ m}^{-1}$ where m and n are positive integers such that $m > n$.

40. In which of the regions the Lyman series lies?

- a) **Ultra violet region**
- b) Infra-red region
- c) Visible region
- d) Far Infra-red region

Explanation

$$\frac{1}{\lambda} = R \left(\frac{1}{n^2} - \frac{1}{m^2} \right) = \bar{\nu}$$

Lyman series: Put $n = 1$ and $m = 2, 3, 4, \dots$ in the above equation. The wave number or wavelength of spectral lines of Lyman series which lies in ultra-violet region is $\bar{\nu} R m$.

41. Which of these series have the value of n as 2?

- a) Lyman series
- b) Paschen series
- c) **Balmer series**
- d) Brackett series

Explanation

$$\frac{1}{\lambda} = R \left(\frac{1}{n^2} - \frac{1}{m^2} \right) = \bar{\nu}$$

Balmer series: Put $n = 2$ and $m = 3, 4, 5, \dots$ in the above equation. The wave number or wavelength of spectral lines of Balmer series which lies in visible region is $\bar{\nu} R m$

42. Which of the following is not a limitation of the Bohr atomic model?

- a) **Bohr model is suitable for Hydrogen and some complex atoms.**
- b) The fine structure of hydrogen spectrum is not explained by the Bohr model.
- c) Bohr atom model fails to explain the intensity variations in the spectral lines.
- d) The electron distribution is not completely explained by Bohr atom model.

Explanation

The following are the drawbacks of Bohr atom model: Bohr atom model is valid only for hydrogen atom or hydrogen like-atoms but not for complex atoms. When the spectral lines are closely examined, individual lines of hydrogen spectrum is accompanied by a number of faint lines. These are often called fine structure. This is not explained by Bohr atom model. Bohr atom model fails to explain the intensity variations in the spectral lines. The distribution of electrons in atoms is not completely explained by Bohr atom model.

43. Choose the correct statements.

- i) Atoms have a nucleus surrounded by electrons.
- ii) The number of protons and electrons are equal.
- iii) Neutrons are electrically neutral and protons have positive charge.

- a) i only
- b) ii only
- c) iii only

d) All the above

Explanation

Atoms have a nucleus surrounded by electrons. The nucleus contains protons and neutrons. The neutrons are electrically neutral ($q = 0$) and the protons have positive charge ($q = +e$) equal in magnitude of the charge of the electron ($q = -e$).

44. What is the value of the mass number if the number of neutrons is N and atomic number is Z ?

- a) $Z + N$**
- b) $Z * N$
- c) $Z - N$
- d) Z / N

Explanation

The number of protons in the nucleus is called the atomic number and it is denoted by Z . The number of neutrons in the nucleus is called neutron number (N). The total number of neutrons and protons in the nucleus is called the mass number and it is denoted by A . Hence, $A = Z + N$.

45. Which of these are collectively called as nucleons?

- a) Electrons and Neutrons
- b) Protons and Nucleus
- c) Neutrons and Protons**

d) Protons and Electrons

Explanation

The two constituents of nucleus namely neutrons and protons, are collectively called nucleons.

46. Choose the correct statements.

- i) The mass of a proton is greater than the mass of the electron.
- ii) Mass of a neutron is slightly lesser than the mass of the proton.

a) i only

b) ii only

c) Both i and ii

d) Neither i nor ii

Explanation

The mass of a proton is $1.6726 \times 10^{-27} \text{ kg}$ which is roughly 1836 times the mass of the electron. The mass of a neutron is slightly greater than the mass of the proton and it is equal to $1.6749 \times 10^{-27} \text{ kg}$.

47. What does X represents in the notation ${}_Z^AX$?

- a) Multiply
- b) Mass number
- c) Number of protons

d) Chemical symbol of the element

Explanation

To specify the nucleus of any element, we use the following general notation ${}_Z^AX$ where X is the chemical symbol of the element, A is the mass number and Z is the atomic number.

48. Choose the incorrect statement about the atoms.

- i) Nucleus contains positively charged protons and electrically neutral neutrons.
- ii) The overall charge of the nucleus is positive.
- iii) The number of electrons in the atom is equal to the number of nucleus.

a) i only

b) ii only

c) iii only

d) All the above

Explanation

The nucleus is made up of positively charged protons and electrically neutral neutrons, the overall charge of the nucleus are positive and it has the value of $+Ze$. But the atom is electrically neutral which implies that the number of electrons in the atom is equal to the number of protons in the nucleus.

49. Define isotope.

- a) Same number of electrons and different number of protons.
- b) Equal number of neutrons and electrons.
- c) Same atomic number and different mass number.**
- d) Different number of protons and atomic number.

Explanation

In nature, there are atoms of a particular element whose nuclei have same number of protons but different number of neutrons. These kinds of atoms are called isotopes. In other words, isotopes are atoms of the same element having same atomic number Z , but different mass number A .

50. Which of these used to determine the chemical properties of any atom?

- a) Atomic number
- b) Electrons**
- c) Nucleus structure
- d) Number of protons

Explanation

The chemical properties of any atom are determined only by electrons, the isotopes of any element have same electronic structure and same chemical properties. So the isotopes of the same element are placed in the same location in the periodic table.

51. Isobars are the atoms of different elements having same ____ and different _____.

- a) Mass number, Atomic number**
- b) Number of protons, Mass number
- c) Atomic number, Number of electrons
- d) Number of neutrons, Number of protons

Explanation

Isobars are the atoms of different elements having the same mass number A , but different atomic number Z . In other words, isobars are the atoms of different chemical element which has same number of nucleon.

52. Assertion (A): Isobars are chemically different elements.

Reasoning(R): Isobars have same chemical property and different physical property.

- a) Both A and R is True and R is the correct explanation of A.
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.**
- d) Both A and R is False.

Explanation

Unlike isotopes, isobars are chemically different elements. They have different physical and chemical properties.

53. Which of the value is same for various isotone elements?

- a) Number of neutrons**
- b) Number of protons
- c) Number of Atomic number
- d) Number of electrons

Explanation

Isotones are the atoms of different elements having same number of neutrons. ${}_5^{12}\text{B}$ and ${}_6^{13}\text{C}$ are examples of isotones which 7 neutrons.

54. Assertion (A): Atomic Mass unit is used to represent the mass of nuclei.

Reasoning(R): The mass of nuclei is very small which is about 10^{-25} kg or less.

- a) Both A and R is True and R is the correct explanation of A.**
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

The mass of nuclei is very small when it expressed in SI units (about 10^{-25} kg or less). Therefore, it is more convenient to express it in terms of another unit namely, the atomic mass unit (u).

55. Which is the most abundant natural isotope of carbon?

- a) ${}_6^{12}\text{C}$**
- b) ${}_{10}^{20}\text{C}$
- c) ${}_2^8\text{C}$
- d) ${}_4^{10}\text{C}$

Explanation

One atomic mass unit (u) is defined as the 1/12th of the mass of the isotope of carbon ${}_6^{12}\text{C}$ the most abundant naturally occurring isotope of carbon.

56. Which of this instrument determines the atomic mass experimentally?

a) Bainbridge Mass Spectrometer

- b) Electron Microscope
- c) Emission spectroscopy
- d) Aneroid barometer

Explanation

Experimentally the atomic mass is determined by the instrument called Bainbridge mass spectrometer. If we determine the atomic mass of the element without considering the effect of its isotopes, we get the mass averaged over different isotopes weighted by their abundances.

57. What is the approximate shape of nuclei?

a) Spherical

- b) Parabola
- c) Hemisphere
- d) Hyperbola

Explanation

The nuclei are found to be approximately spherical in shape. It is experimentally found that radius of nuclei for $Z > 10$, satisfies the following empirical formula $R = R_0 A^{1/3}$

58. Which of this value is independent of the nuclear density?

a) Mass Number

- b) Atomic Number
- c) Atomic Mass
- d) All the above

Explanation

The empirical formula $R = R_0 A^{1/3}$ shows that the nuclear density is independent of the mass number A.

59. Choose the correct statements.

- i) Above $Z > 100$ all the nuclei have same density and it is an important characteristic.
- ii) The mass of any nuclei is always less than the sum of the mass of its individual constituents.

- a) i only
- b) ii only**
- c) Both i and ii
- d) Neither i nor ii

Explanation

In other words, all the nuclei ($Z > 10$) have the same density and it is an important characteristic of the nuclei. It is experimentally found out that the mass of any nucleus is always less than the sum of the mass of its individual constituents.

60. What is the difference between the total mass value and the individual constituents mass?

- a) Mass defect**
- b) Mass number
- c) Atomic Mass
- d) Nucleus Mass number

Explanation

The experimental mass of carbon-12 nucleus is less than the total mass of its individual constituents by $\Delta m = 0.09888 \text{ u}$. This difference in mass Δm is called mass defect. In general, if M , m_p , and m_n are mass of the nucleus (${}_A^ZX$), the mass of a proton and the mass of a neutron respectively, then the mass defect is given by

$$\Delta m = (Zm_p + Nm_n) - M$$

61. According to Einstein theory which of this value is converted to energy and vice versa?

- a) Mass**
- b) Intensity
- c) Temperature
- d) Mole

Explanation

Albert Einstein with the help of famous mass-energy relation ($E = mc^2$). According to this relation, the mass can be converted into energy and energy can be converted into mass.

62. Choose the correct statements.

- i) Binding energy is released by the mass defect when protons and neutrons combine to form the nucleus.

ii) To separate the nucleus into individual constituents we must supply energy greater than the binding energy of the nucleus.

a) i only

b) ii only

c) Both i and ii

d) Neither i nor ii

Explanation

In the case of the carbon-12 nucleus when 6 protons and 6 neutrons combine to form carbon-12 nucleus, mass equal to mass defect disappears and the corresponding energy is released. This is called the binding energy of the nucleus (BE) and is equal to $(\Delta m)c^2$. In fact, to separate the carbon-12 nucleus into individual constituents, we must supply the energy equal to binding energy of the nucleus.

63. In which of these units the atomic mass unit is expressed?

a) MeV

b) J/s

c) J

d) Both a and c

Explanation

Using Einstein's mass-energy equivalence, the energy equivalent of one atomic mass unit $1u = 1.66 \times 10^{-27} \times (3 \times 10^8)^2 = 14.94 \times 10^{-11} \text{ J} \approx 931 \text{ MeV}$

64. Which energy is required to separate single nucleon from the nucleus?

a) Average Binding energy

b) Mass defect

c) Atomic Mass

d) Average Mass value

Explanation

The average binding energy per nucleon is the energy required to separate single nucleon from the particular nucleus.

65. Assertion (A): The strong nuclear force holds the nucleus together.

Reasoning(R): A strong attractive force is needed to overcome the repulsive Coulomb's force between protons.

- a) Both A and R is True and R is the correct explanation of A.
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

There must be a strong attractive force between protons to overcome the repulsive Coulomb's force. This attractive force which holds the nucleus together is called strong nuclear force.

66. Which of these is not a property of strong nucleus force?

- a) The short range of nucleus force acts up to a few Fermi distance.
- b) Strong nuclear force acts on the electrons to alter the chemical properties of atom.
- c) Coulomb forces are weaker than the strong nuclear force.
- d) Strong nucleus forces are repulsive and acts with unequal strength between the constituents.**

Explanation

A few properties of strong nuclear force are: The strong nuclear force is of very short range, acting only up to a distance of a few Fermi. But inside the nucleus, the repulsive Coulomb force or attractive gravitational forces between two protons are much weaker than the strong nuclear force between two protons. Similarly, the gravitational force between two neutrons is also much weaker than strong nuclear force between the neutrons. So nuclear force is the strongest force in nature. The strong nuclear force is attractive and acts with an equal strength between proton-proton, proton-neutron, and neutron – neutron. Strong nuclear force does not act on the electrons. So it does not alter the chemical properties of the atom.

67. Above which of the atomic number value the elements have a unstable nuclei?

- a) 82**
- b) 42
- c) 70
- d) 25

Explanation

In the binding energy curve, the stability of the nucleus that has $Z > 82$ starts to decrease and these nuclei are called unstable nuclei. Some of the unstable nuclei decay naturally by emitting some kind of particles to form a stable nucleus.

68. Which of these particles are emitted by radioactive nuclei?

- a) α -decay

b) β -decay

c) γ -decay

d) All the above

Explanation

The elements of atomic number $Z > 82$ and isotopes of lighter nuclei belong to naturally-occurring radioactive nuclei. Each of these radioactive nuclei decays to another nucleus by the emission of ${}^2_4\text{He}$ nucleus (α -decay) or electron or positron (β -decay) or gamma rays (γ -decay).

69. Which of these are called as radio isotopes?

a) Isotopes of lighter elements

b) Isotopes of heavy elements

c) All isotopes

d) Both a and b

Explanation

Emission of highly penetrating radiations such as α , β and γ rays by an element is called radioactivity and the substances which emit these radiations are called radioactive elements. These radioactive elements can be heavy elements ($Z > 82$), isotopes of lighter and heavy elements and these isotopes are called radioisotopes.

70. Choose the correct statements.

i) After the decaying of the radioactive materials the mass of the nuclei is reduced.

ii) According to Einstein's relation the mass difference between the initial and final nuclei is greater than zero, it appears as the energy.

iii) Radioisotopes have various applications like carbon dating and cancer treatment.

a) i only

b) ii only

c) iii only

d) All the above

Explanation

Radioisotopes have a variety of applications such as carbon dating, cancer treatment, etc. When radioactive nucleus undergoes decay, the mass of the system decreases – that is, the mass of the initial nucleus before decay is always greater than the sum of the mass of the final nucleus and that of the emitted particle. When this difference in mass $\Delta m < 0$, it appears as the energy according to Einstein's relation $E = \Delta m c^2$.

71. Who discovered the radioactivity phenomenon in 1896?

- a) **Henri Becquerel**
- b) Albert Einstein
- c) Marie Curie
- d) J.J. Thomson

Explanation

The phenomenon of radioactivity was first discovered by Henri Becquerel in 1896. Later, Marie Curie and her husband Pierre Curie did a series of experiments in detail to understand the phenomenon of radioactivity.

72. In which of this place the Saha Institute of Nuclear Physics is situated?

- a) Bangalore
- b) New Delhi
- c) **Kolkata**
- d) Patna

Explanation

In India, Saha Institute of Nuclear Physics (SINP), Kolkata is the premier institute pursuing active research in nuclear physics.

73. Choose the Incorrect statements.

- i) The radioactive nucleus emits both electron and positron.
- ii) The positron is an anti-particle of an electron with same mass and opposite charge.
- iii) Positron and electron are referred as beta particles.

- a) **i only**
- b) ii only
- c) iii only
- d) None of the above

Explanation

In beta decay, a radioactive nucleus emits either electron or positron. If electron (e^-) is emitted, it is called β^- decay and if positron (e^+) is emitted, it is called β^+ decay. The positron is an anti-particle of an electron whose mass is same as that of electron and charge is opposite to that of electron – that is, $+e$. Both positron and electron are referred to as beta particles.

74. Which of this decay is used in the smoke detectors?

a) Alpha decay

- b) Gamma decay
- c) Beta decay
- d) All the above

Explanation

A very interesting application of alpha decay is in smoke detectors which prevent us from any hazardous fire.

75. What is the purpose of the third particle proposed by W.Pauli?

- a) To control the amount of decay
- b) To neutralize charge differences
- c) Carry away the missing charge and momentum**
- d) Compensate the mass difference of the nucleus.

Explanation

After a detailed theoretical and experimental study, in 1931 W.Pauli proposed a third particle which must be present in beta decay to carry away missing energy and momentum.

76. Who named the third particle as neutrino?

- a) Fermi**
- b) Bohr
- c) Einstein
- d) Pauli

Explanation

Fermi later named this particle the neutrino (little neutral one) since it has no charge, have very little mass.

77. Who was awarded Nobel Prize for the experiment discovery of neutrino?

- a) W. Pauli
- b) Henry Becquerel
- c) Fredrick Reines**
- d) Neil's Bohr

Explanation

For many years, the neutrino (symbol ν , Greek nu) was hypothetical and could not be verified experimentally. Finally, the neutrino was detected experimentally in 1956 by Fredrick Reines and Clyde Cowan. Later Reines received Nobel Prize in physics in the year 1995 for his discovery.

78. Which of the following is not a property of a neutrino?

- a) Tiny mass
- b) Negative charge**
- c) Weak interaction with matter
- d) Anti-neutrino is the antiparticle of neutrino

Explanation

The neutrino has the following properties: It has zero charge, It has an antiparticle called anti-neutrino, Recent experiments showed that the neutrino has very tiny mass, It interacts very weakly with the matter. Therefore, it is very difficult to detect. In fact, in every second, trillions of neutrinos coming from the sun are passing through our body without any interaction.

79. What is the life time of the excited state of the daughter nucleus of α and β decay?

- a) 10^{-11} s**
- b) 10^{15} s
- c) 10^{-9} s
- d) 10^5 s

Explanation

In α and β decay, the daughter nucleus is in the excited state most of the time. The typical life time of excited state is approximately 10^{-11} s. So this excited state nucleus immediately returns to the ground state or lower energy state by emitting highly energetic photons called γ rays.

80. Which of these emits a high energetic photon of energy when returning to ground state?

- a) Atom
- b) Electron
- c) Nucleus**
- d) Neutron

Explanation

When the atom is in the excited state, it returns to the ground state by emitting photons of energy in the order of few eV. But when the excited state nucleus returns to its ground state, it emits a highly energetic photon (γ rays) of energy in the order of MeV

81. The decay rate of a radioactive material is directly proportional to_____.

a) Number of Nuclei

- b) Number of protons
- c) Mass Number
- d) Atomic Number

Explanation

In a radioactive sample which contains a vast number of the radioactive nuclei and not all the radioactive nucleus in sample decay at the same time and this decay is basically a random process. It implies that we cannot predict which nucleus is going to decay or rather we can determine like probabilistic basis (like tossing a coin). We can calculate approximately how many nuclei in a sample are decayed over a period of time. At any instant t , the number of decays per unit time called rate of decay dN / dt is proportional to the number of nuclei (N) at the same instant.

$$\frac{dN}{dt} \propto N$$

82. What is the polarity of the decay constant of a radioactive material?

- a) Neutral
- b) Positive
- c) Zero
- d) Negative**

Explanation

The proportionality constant λ is called decay constant which is different for different radioactive sample and the negative sign in the equation implies that the N is decreasing with time. By rewriting the equation we get $dN = -\lambda N dt$, Here dN represents the number of nuclei decaying in the time interval dt .

83. Assertion (A): The half-life of a radioactive material is the time required for the number of atoms reduces to one half of the initial amount.

Reasoning(R): The shorter half-life sample will have a higher radio activity.

- a) Both A and R is True and R is the correct explanation of A.**
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

We can define the half-life $T_{1/2}$ as the time required for the number of atoms initially present to reduce to one half of the initial amount. The half-life is the important characteristic of every radioactive sample. Some radioactive nuclei are known to have half-life as long as 10^{14} years and some nucleus have very shorter life time. The shorter half-life sample will have higher activity and it is more 'radioactive' which is more harmful.

84. What is the range of the life time for each radio-active nucleus?

a) Zero to infinity

b) One to Hundred

c) Zero to negative value

d) None of the above

Explanation

When the radioactive nucleus undergoes the decay, the nucleus which disintegrates first has zero life time and the nucleus which decays last has an infinite lifetime. The actual life time for each nucleus varies from zero to infinity. Therefore, it is meaningful to define average life or mean life time t , that the nucleus survives before it decays.

85. Which is known as the ratio of integration of all life times to the total number of initial nuclei?

a) Average life time

b) Mean life time

c) Total life time

d) Active life time

Explanation

The mean life time of the nucleus is the ratio of sum or integration of life times of all nuclei to the total number nuclei present initially.

86. Choose the correct statements.

i) The beta decay of radioactive material is used in carbon dating applications.

ii) All living organism absorbs carbon dioxide in which very small part of $^{14}_6\text{C}$ is radioactive.

a) i only

b) ii only

c) Both i and ii

d) Neither i nor ii

Explanation

The interesting application of beta decay is radioactive dating or carbon dating. Using this technique, the age of an ancient object can be calculated. All living organisms absorb carbon dioxide (CO_2) from air to synthesize organic molecules. In this absorbed CO_2 , the major part is ${}^{12}_6\text{C}$ and very small fraction (1.3×10^{-12}) is radioactive ${}^{14}_6\text{C}$ whose half-life is 5730 years.

87. Assertion (A): The ratio of ${}^{14}_6\text{C}$ to ${}^{12}_6\text{C}$ is nearly constant in all the living organisms.

Reasoning(R): The continuous production and decay of ${}^{14}_6\text{C}$ in the atmosphere keeps the carbon ratio constant.

- a) Both A and R is True and R is the correct explanation of A.
b) Both A and R is True but R is not the correct explanation of A.
c) A is True but R is False.
d) Both A and R is False.

Explanation

Carbon-14 in the atmosphere is always decaying but at the same time, cosmic rays from outer space are continuously bombarding the atoms in the atmosphere which produces ${}^{14}_6\text{C}$. So the continuous production and decay of ${}^{14}_6\text{C}$ in the atmosphere keep the ratio of ${}^{14}_6\text{C}$ to ${}^{12}_6\text{C}$ always constant. Since our human body, tree or any living organism continuously absorbs CO_2 from the atmosphere, the ratio of ${}^{14}_6\text{C}$ to ${}^{12}_6\text{C}$ in the living organism is also nearly constant.

88. Choose the correct statements.

- i) Keezhadi is an important archeological places of Tamil Nadu located at the banks of river Vaigai.
ii) The artifacts unearthed in Keezhadi gave a substantial evidence for an ancient urban civilization.
iii) A 200g charcoal was used for the carbon dating to determine the age of the materials found in Keezhadi.
a) i only
b) ii only
c) iii only
d) All the above

Explanation

Keezhadi (கீழ்படி), a small hamlet, has become one of the very important archeological places of Tamil Nadu. It is located in Sivagangai district. A lot of artifacts (gold coins, pottery, beads, iron tools, jewelry and charcoal, etc.) have been unearthed in Keezhadi which have given substantial evidence that an ancient urban civilization had thrived on the banks of river Vaigai. To determine the age of those materials, the charcoal of 200 g sent for carbon dating.

89. Which of this material was bombarded with a particle in the experiment conducted by Bothe and Becker in the year 1930?

a) **Beryllium**

b) Gold

c) Tungsten

d) Boron

Explanation

In 1930, two German physicists Bothe and Becker found that when beryllium was bombarded with a particle highly penetrating radiation was emitted. This radiation was capable of penetrating the thick layer of lead and was unaffected by the electric and magnetic fields. Initially, it was thought as γ radiation.

90. Who discovered the neutrons in the year 1932?

a) **James Chadwick**

b) Henry Becquerel

c) Marie Curie

d) Neil's Bohr

Explanation

In the year 1932, James Chadwick discovered that those radiations found in the Bothe and Becker experiment are not EM waves but they are particles of mass little greater than the mass of the proton and had no charge. He called them as neutrons.

91. Assertion (A): Neutrons are stable only inside the nucleus and unstable outside the nucleus.

Reasoning(R): The free neutron outside the nucleus decays with the emission of proton.

a) **Both A and R is True and R is the correct explanation of A.**

b) Both A and R is True but R is not the correct explanation of A.

c) A is True but R is False.

d) Both A and R is False.

Explanation

Neutrons are stable inside the nucleus. But outside the nucleus they are unstable. If the neutron comes out of the nucleus (free neutron), it decays with emission of proton.

92. Based on which property neutrons are classified?

a) Stability

b) Chemical reactions

c) Kinetic energy

d) Mass

Explanation

Neutrons are classified according to their kinetic energy as slow neutrons (0 to 1000 eV), fast neutrons (0.5 MeV to 10 MeV).

93. Thermal neutrons are neutrons with _____ energy in _____.

a) High, Stable

b) Peak, Atmosphere

c) Low, Vacuum

d) Average, Thermal equilibrium

Explanation

The neutrons with average energy of about 0.025 eV in thermal equilibrium are called thermal neutron, because at 298K, the thermal energy kT 0.025eV. Slow and fast neutrons play a vital role in nuclear reactors.

94. Who discovered the idea of high energy release when breaking nucleus with neutron?

a) Murray Gellman and George Zweig

b) Otto Hahn and F. Strassman

c) Murray Gellman and George Zweig

d) Bothe and Becker

Explanation

In 1939, German scientists Otto Hahn and F. Strassman discovered that when uranium nucleus is bombarded with a neutron, it breaks up into two smaller nuclei of comparable masses with the release of energy.

95. Which of these constitutes for the energy release in the nuclear fission?

a) Neutrons

b) Protons

c) Electrons

d) All the above

Explanation

The process of breaking up of the nucleus of a heavier atom into two smaller nuclei with the release of a large amount of energy is called nuclear fission. The fission is accompanied by the release of neutrons.

96. Choose the correct statements.

- i) Energy released in the nuclear fission is greater than a chemical reaction.
- ii) Uranium undergoes nuclear fission in 90 different ways.

- a) i only
- b) ii only
- c) Both i and ii**
- d) Neither i nor ii

Explanation

The energy that is released in the nuclear fission is of many orders of magnitude greater than the energy released in chemical reactions. Uranium undergoes fission reaction in 90 different ways.

97. Choose the Incorrect statements.

- i) Huge amount of energy released even by one nucleus in a nuclear fission process.
- ii) Each one of a fission reaction releases more neutrons which further reacts and produces more neutrons.
- iii) The number of neutrons in a nuclear fission goes on increasing in a geometric progression.

- a) i only**
- b) ii only
- c) iii only
- d) None of the above

Explanation

When one ^{235}U nucleus undergoes fission the energy released might be small. But from each fission reaction, three neutrons are released. These three neutrons cause further fission in another three ^{235}U nuclei which in turn produce nine neutrons. These nine neutrons initiate fission in another 27 ^{235}U nuclei and so on. This is called a chain reaction and the number of neutrons goes on increasing almost in geometric progression.

98. How many types of chain reaction are possible in a nuclear fission?

- a) 2**
- b) 4

- c) 3
- d) 5

Explanation

There are two kinds of chain reactions: uncontrolled chain reaction and controlled chain reaction.

99. Assertion (A): The Atom bomb is an example of nuclear fission by an uncontrolled chain reaction.

Reasoning(R): The neutrons multiply indefinitely in an uncontrolled chain reaction and the energy releases in a fraction of a second.

- a) Both A and R is True and R is the correct explanation of A.
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

In an uncontrolled chain reaction, the number of neutrons multiplies indefinitely and the entire amount of energy released in a fraction of second. The atom bomb is an example of nuclear fission in which uncontrolled chain reaction occurs. Atom bombs produce massive destruction for mankind.

100. Choose the correct statements.

- i) In the controlled chain reaction the average numbers of neutrons are released in each stage so as to store the released energy.
 - ii) Nuclear Reactors use the controlled chain reaction to produce energy for power generation and research purposes.
- a) i only
 - b) ii only
 - c) Both i and ii
 - d) Neither i nor ii

Explanation

If the chain reaction is controllable then we can harvest an enormous amount of energy for our needs. It is achieved in a controlled chain reaction. In the controlled chain reaction, the average number of neutron released in each stage is kept as one such that it is possible to store the released energy. In nuclear reactors, the controlled chain reaction is achieved and the produced energy is used for power generation or for research purpose.

101. Assertion (A): The energy produced in a nuclear reactor is through the nuclear fission in a self-sustained controlled manner.

Reasoning(R): The Nuclear reactor produces the energy for power generation or for the research purpose.

- a) Both A and R is True and R is the correct explanation of A.
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

Nuclear reactor is a system in which the nuclear fission takes place in a self-sustained controlled manner and the energy produced is used either for research purpose or for power generation.

102. Which country built the first nuclear reactor?

- a) USA
- b) Germany
- c) Soviet Union
- d) China

Explanation

The first nuclear reactor was built in the year 1942 at Chicago, USA by physicist Enrico Fermi.

103. Which of the following is not an important part of a Nuclear reactor?

- a) Moderator
- b) Transformer
- c) Control rods
- d) Fuel

Explanation

The main parts of a nuclear reactor are fuel, moderator and control rods. In addition to this, there is a cooling system which is connected with power generation set up.

104. Choose the Incorrect statements.

- i) Uranium and plutonium are the fuels used as a fissionable material.
- ii) Additional neutron source is added to the fuel to initiate the chain reaction initially.
- iii) Fast neutrons are preferred for the sustained nuclear reactions.

- a) i only
- b) ii only
- c) iii only**
- d) None of the above

Explanation

Fuel: The fuel is fissionable material usually uranium or plutonium. In addition to this, a neutron source is required to initiate the chain reaction for the first time. A mixture of beryllium with plutonium or polonium is used as the neutron source. During fission only fast neutrons are emitted but the probability of initiating fission by it in another nucleus is very low. Therefore, slow neutrons are preferred for sustained nuclear reactions.

105. Which of the following is used to convert fast neutrons to slow neutrons?

- a) Control rod
- b) Steam
- c) Moderator**
- d) Coolant

Explanation

Moderators: The moderator is a material used to convert fast neutrons into slow neutrons.

106. Assertion (A): Moderators are chosen to be very light nucleus with comparable mass of the neutrons.

Reasoning(R): The Light nuclei collide with fast neutrons to reduce the speed of the neutrons.

- a) Both A and R is True and R is the correct explanation of A.**
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

Usually the moderators are chosen in such a way that it must be very light nucleus having mass comparable to that of neutrons. Hence, these light nuclei undergo collision with fast neutrons and the speed of the neutron is reduced.

107. Which of these is not used as a moderator?

- a) Heavy water
- b) Carbon**

- c) Graphite
- d) Normal water

Explanation

Most of the reactors use water, heavy water (D₂O) and graphite as moderators. The blocks of uranium stacked together with blocks of graphite (the moderator) to form a large pile.

108. What is the main purpose of the control rod?

a) Reaction rate control

- b) Control the energy release
- c) Temperature of the reaction
- d) All the above

Explanation

Control rods: The control rods are used to adjust the reaction rate. During each fission, on an average 2.5 neutrons are emitted and in order to have the controlled chain reactions only one neutron is allowed to cause another fission and the remaining neutrons are absorbed by the control rods.

109. Which material is used as a control rod?

a) Boron

- b) Carbon
- c) Lead
- d) Manganese

Explanation

Usually cadmium or boron acts as control rod material and these rods are inserted into the uranium blocks.

110. Choose the Incorrect statements.

- i) The average number of neutrons produced per fission depends on the insertion depth of the control rod.
- ii) If the average number of neutrons produced per fission is greater than one it is in critical state.
- iii) In the super-critical state the reactor may explode and cause massive destruction.

a) i only

b) ii only

c) iii only

d) All the above

Explanation

Depending on the insertion depth of control rod into the uranium, the average number of neutrons produced per fission is set to be equal to one or greater than one. If the average number of neutrons produced per fission is equal to one, then reactor is said to be in critical state. In fact, all the nuclear reactors are maintained in critical state by suitable adjustment of control rods. If it is greater than one, then reactor is said to be in super-critical and it may explode sooner or may cause massive destruction.

111. Which of these are used as the coolant?

- a) Heavy water
- b) Liquid sodium
- c) Normal water
- d) All the above**

Explanation

Cooling system: The cooling system removes the heat generated in the reactor core. Ordinary water, heavy water and liquid sodium are used as coolant since they have very high specific heat capacity and have large boiling point under high pressure.

112. How many nuclear reactors are operated in India?

- a) 22**
- b) 2
- c) 18
- d) 35

Explanation

India has 22 nuclear reactors in operation. Nuclear reactors are constructed in two places in Tamilnadu, Kalpakkam and Koodankulam. Even though nuclear reactors are aimed to cater to our energy need, in practice nuclear reactors now are able to provide only 2% of energy requirement of India.

113. Choose the correct statements.

- i) In Nuclear fusion two or more light nuclei combine to form a heavy nucleus.
- ii) The mass of the resultant nuclei is greater than the sum of the masses of original light nuclei.
- iii) The nuclear fusion occurs at room temperature.

- a) i only**
- b) ii only

- c) iii only
- d) All the above

Explanation

When two or more light nuclei ($A < 20$) combine to form a heavier nucleus, then it is called nuclear fusion. In the nuclear fusion, the mass of the resultant nucleus is less than the sum of the masses of original light nuclei. The mass difference appears as energy. The nuclear fusion never occurs at room temperature unlike nuclear fission. It is because when two light nuclei come closer to combine, it is strongly repelled by the coulomb repulsive force.

114. In which of this temperature value the thermonuclear fusion reaction occurs?

- a) Less than 303 K
- b) Equal to 0 K
- c) Greater than 107K**
- d) Less than 100K

Explanation

To overcome this repulsion, the two light nuclei must have enough kinetic energy to move closer to each other such that the nuclear force becomes effective. This can be achieved if the temperature is very much greater than the value 107 K. When the surrounding temperature reaches around 107K, lighter nuclei start fusing to form heavier nuclei and this resulting reaction is called thermonuclear fusion reaction.

115. Assertion (A): The cores of the stars are the natural place where nuclear fusion occurs.

Reasoning(R): Most of the stars including Sun fuse hydrogen into helium by this nuclear fusion.

- a) Both A and R is True and R is the correct explanation of A.**
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

The natural place where nuclear fusion occurs is the core of the stars, since its temperature is of the order of 107K. In fact, the energy generation in every star is only through thermonuclear fusion. Most of the stars including our Sun fuse hydrogen into helium and some stars even fuse helium into heavier elements.

116. Which of the following statements is not true regarding the nuclear fusion of stars?

- a) Stars are early in the form of cloud and dust.

- b) The Gravitational energy of stars is converted into kinetic energy and to heat.
- c) The Thermonuclear fusion is initiated in the stars when the temperature starts cooling down.**
- d) The enormous energy release of stars stabilizes the star and prevents it from further collapse.

Explanation

The early stage of a star is in the form of cloud and dust. Due to their own gravitational pull, these clouds fall inward. As a result, its gravitational potential energy is converted to kinetic energy and finally into heat. When the temperature is high enough to initiate the thermonuclear fusion, they start to release enormous energy which tends to stabilize the star and prevents it from further collapse.

117. What will happen when the Sun enters into a Red giant phase?

- a) Total hydrogen is burnt out.**
- b) The size of Sun will shrink.
- c) Helium and Hydrogen fuse to become carbon.
- d) Carbon is burnt to produce helium.

Explanation

The sun's interior temperature is around $1.5 \times 10^7 \text{K}$. The sun is converting $6 \times 10^{11} \text{kg}$ hydrogen into helium every second and it has enough hydrogen such that these fusion lasts for another 5 billion years. When the hydrogen is burnt out, the sun will enter into new phase called red giant where helium will fuse to become carbon. During this stage, sun will expand greatly in size and all its planets will be engulfed in it.

118. How many steps are involved in the fusion reaction cycle of the sun according to Hans Bethe?

- a) 10
- b) 3**
- c) 7
- d) 5

Explanation

According to Hans Bethe, the sun is powered by proton-proton cycle of fusion reaction. This cycle consists of three steps.

119. Which of this scientist theoretically proposed quark as the elementary particle?

- a) Murray Gellman and George Zweig**
- b) Hans Bethe
- c) Otto Hahn and F. Strassman

d) Bothe and Becker

Explanation

In 1964, physicist Murray Gellman and George Zweig theoretically proposed that protons and neutrons are not fundamental particles in fact they are made up of quarks. These quarks are now considered elementary particles of nature.

120. Which of these is an elementary particle?

a) Atom

b) Nucleus

c) Electrons

d) Protons

Explanation

Electrons are fundamental or elementary particles because they are not made up of anything.

121. Which of this organization discovered the quarks?

a) The University of Cambridge

b) Stanford Linear Accelerator Center

c) The French National Centre for Scientific Research

d) Helmholtz Association of German Research Centers

Explanation

In the year 1968, the quarks were discovered experimentally by Stanford Linear Accelerator Center (SLAC), USA.

122. How many quarks are classified with their antiparticles?

a) 5

b) 7

c) 4

d) 6

Explanation

There are six quarks namely, up, down, charm, strange, top and bottom and their antiparticles. All these quarks have fractional charges. For example, charge of up quark is $+ \frac{2}{3} e$ and that of down quark is $- \frac{1}{3} e$.

123. State the combinations of proton according to quark model?

a) Two up quarks and Two down quarks

- b) One up quark and Two down quarks
- c) Two up quarks and One down quark**
- d) One up quark and One down quark

Explanation

According to quark model proton is made up of two up quarks and one down quark and neutron is made up of one up quark and two down quarks.

124. Assertion (A): A gravitational force is universal in nature.

Reasoning(R): Planets are bound to the sun through the gravitational force.

- a) Both A and R is True and R is the correct explanation of A.**
- b) Both A and R is True but R is not the correct explanation of A.
- c) A is True but R is False.
- d) Both A and R is False.

Explanation

It is known that there exists gravitational force between two masses and it is universal in nature. Our planets are bound to the sun through gravitational force of the sun.

125. Which of these is not the fundamental force of nature?

- a) Gravitational forces
- b) Frictional forces**
- c) Weak forces
- d) Electromagnetic forces

Explanation

Gravitational, electromagnetic, strong and weak forces are called fundamental forces of nature. It is very interesting to realize that, even for our day-to-day life we require these four fundamental forces.