

10th Science Lesson 6 Questions in English

6] Nuclear Physics

1. Which Greek philosopher in 400 BC(BCE) believed that matter is made up of tiny indestructible units called atoms?

- a) Parmenides
- b) Pythagoras
- c) **Democritus**
- d) Plato

Explanation

Humans are very much interested in knowing about atoms. Things around us are made up of atoms. A Greek Philosopher 'Democritus' in 400 BC (BCE) believed that matter is made up of tiny indestructible units called atoms.

2. In 1803, who considered that elements consist of atoms, which are identical in nature?

- a) **John Dalton**
- b) J J Thomson
- c) James Chadwick
- d) Henri Becquerel

Explanation

In 1803, John Dalton considered that elements consist of atoms, which are identical in nature.

3. In 1896, which French physicist finished his research for the week and stored a certain amount of uranium compound away in a drawer for the week end?

- a) Rutherford
- b) **Henri Becquerel**
- c) J J Thomson
- d) James Chadwick

Explanation

In 1896, French physicist Henri Becquerel finished his research for the week and stored a certain amount of uranium compound away in a drawer for the week end. By chance, an unexposed photographic plate was also stored in the same drawer. After a week he returned and noticed that the film had been exposed to some radiation. He discovered that he could reproduce the effect whenever he placed uranium near a photographic film.

4. The uranium radiated something that could affect a photographic plate. This phenomenon was called as _____

- a) Optimist
- b) **Radioactivity**
- c) Conductivity
- d) Relativity

Explanation

The uranium radiated something that could affect a photographic plate. This phenomenon was called as Radioactivity. Uranium was identified to be a radioactive element.

5. Which polish physicist detected radioactivity in 'Pitchblende', a tiny black substance?

- a) Gerty Theresa and Carl Ferdinand Cori
- b) Antoine and Marie-Anne Lavoisier
- c) Fredric Joliot and Irene Joliot Curie
- d) **Marie Curie and Pierre Curie**

Explanation

The Polish physicist Marie Curie and her husband Pierre Curie detected radioactivity in 'Pitchblende', a tiny black substance. They were not surprised at the radioactivity of pitchblende, which is known as an ore of uranium. Later, they discovered that the radiation was more intense from pure uranium. Also, it was found that the pitchblende had less concentration of uranium.

6. Marie Curie and her husband Pierre Curie concluded that some other substance was present in pitchblende. After separating this new substance, they discovered that it emitted radiations spontaneously like uranium. They named this new substance as -----

- a) Thorium
- b) Plutonium
- c) **Radium**
- d) Francium

Explanation

Marie Curie and her husband Pierre Curie concluded that some other substance was present in pitchblende. After separating this new substance, they discovered that it had unknown chemical properties and it also emitted radiations spontaneously like uranium. They named this new substance as 'Radium'. The radioactive elements emit harmful radioactive radiations like alpha rays or beta rays or gamma rays.

7. Which among the following statement is correct

- 1) The nucleus of some elements is unstable. Such nuclei undergo nuclear decay and get converted into more stable nuclei. During this nuclear reaction, these nuclei emit certain harmful radiations and elementary particles.
- 2) The phenomenon of nuclear decay of certain elements with the emission of radiations like alpha, beta, and gamma rays is called 'radioactivity' and the elements, which undergo this phenomenon are called 'radioactive elements'.
 - a) Only 1
 - b) Only 2
 - c) **Both 1 and 2**
 - d) None

8. The elements whose atomic number is more than what undergo spontaneous radioactivity?

- a) 70
- b) 74

- c) 78
- d) 82

Explanation

The elements such as uranium and radium undergo radioactivity and emit the radiations on their own without any human intervention. This phenomenon of spontaneous emission of radiation from certain elements on their own is called 'natural radioactivity'. The elements whose atomic number is more than 82 undergo spontaneous radioactivity.

9. Which among the following is not the radioactive element?

- a) **Gallium**
- b) Technetium
- c) Nobelium
- d) Astatine

Explanation

Gallium is not the radioactive element.

10. Which among the following radioactive element have been identified as radioactive substances with atomic number less than 82?

- a) Curium
- b) Thorium
- c) **Technetium**
- d) Astatine

Explanation

There are only two elements, which have been identified as radioactive substances with atomic number less than 82. They are technetium (Tc) with atomic number 43 and promethium (Pm) with atomic number 61.

11. Who among the following first discovered 'artificial radioactivity' or 'man-made radioactivity'?

- a) Gerty Theresa and Carl Ferdinand Cori
- b) Antoine and Marie-Anne Lavoisier
- c) **Fredric Joliot and Irene Curie**
- d) Marie Curie and Pierre Curie

Explanation

The phenomenon by which even light elements are made radioactive, by artificial or induced methods, is called 'artificial radioactivity' or 'man-made radioactivity'. This kind of radioactivity was discovered by Irene Curie and Fredric Joliot in 1934.

12. Which among the following statement is correct

- 1) Artificial radioactivity is induced in certain lighter elements like boron, aluminium etc., by bombarding them with radiations such as 'alpha particles' emitted during the natural radioactivity of uranium. This also results in the emission of invisible radiations and elementary particles.

- 2) During such a disintegration, the nucleus which undergoes disintegration is called 'daughter nucleus' and that which is produced after the disintegration is called a 'parent nucleus'. When the projectile hits the parent nucleus, it is converted into an unstable nucleus, which in turn decays spontaneously emitting the daughter nucleus along with an ejected particle.
- 3) If you denote the parent and daughter nuclei as X and Y respectively, then the nuclear disintegration is represented as follows: $X \xrightarrow{(P, E)} Y$. Here, P and E represent the projectile particle and ejected particle respectively.
- a) Both 1 and 2
 - b) Both 1 and 3**
 - c) Both 2 and 3
 - d) All 1, 2 and 3

Explanation

During such a disintegration, the nucleus which undergoes disintegration is called 'parent nucleus' and that which is produced after the disintegration is called a 'daughter nucleus'. When the projectile hits the parent nucleus, it is converted into an unstable nucleus, which in turn decays spontaneously emitting the daughter nucleus along with an ejected particle.

13. How many radioactive substances discovered so far?

- a) 24
- b) 27
- c) 29**
- d) 32

Explanation

There have been 29 radioactive substances discovered so far. Most of them are rare earth metals and transition metals.

14. The particle, which is used to induce the artificial disintegration is termed as ____

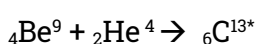
- a) Projectile**
- b) Ejectile
- c) Conserve
- d) Cone

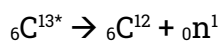
Explanation

The particle, which is used to induce the artificial disintegration is termed as projectile and the particle which is produced after the disintegration is termed as ejected particle.

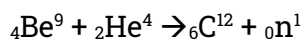
15. Complete the following equation: ${}_4\text{Be}^9 + {}_2\text{He}^4 \rightarrow$ ____

- a) ${}_6\text{C}^{11} + {}_0\text{n}^2$
- b) ${}_6\text{C}^{12} + {}_0\text{n}^1$**
- c) ${}_6\text{C}^9 + {}_0\text{n}^4$
- d) ${}_6\text{C}^{10} + {}_0\text{n}^3$

Explanation



In the above nuclear reaction, ${}_6\text{C}^{13*}$ is unstable and is radioactive. This reaction can be represented as ${}_4\text{Be}^9 (\alpha, \text{n}) {}_6\text{C}^{12}$.



16. Which among the following is not the property of Natural radioactivity?

- a) Emission of radiation due to self-disintegration of a nucleus.
- b) Alpha, beta and gamma radiations are emitted
- c) It is a spontaneous process.
- d) **This can be controlled.**

Explanation

Natural radioactivity properties are 1. Emission of radiation due to self-disintegration of a nucleus, 2. Alpha, beta and gamma radiations are emitted, 3. It is a spontaneous process, 4. Exhibited by elements with atomic number more than 83 and 5. This cannot be controlled.

17. Which among the following is not the units of Radioactivity?

- a) **Lavoisier**
- b) Curie
- c) Rutherford
- d) Becquerel

Explanation

The units of Radioactivity are 1. Curie, 2. Rutherford, 3. Becquerel and 4. Roentgen.

18. Which among the following is the SI unit of Radioactivity?

- a) Curie
- b) Rutherford
- c) **Becquerel**
- d) Roentgen

Explanation

The SI unit of radioactivity is becquerel. It is defined as the quantity of one disintegration per second.

19. Which is defined as the quantity of radioactive substance which produces a charge of 2.58×10^{-4} coulomb in 1 kg of air under standard conditions of pressure, temperature and humidity?

- a) One curie
- b) One Rutherford
- c) One Becquerel
- d) **One Roentgen**

Explanation

The radiation exposure of γ and x-rays is measured by another unit called roentgen. One roentgen is defined as the quantity of radioactive substance which produces a charge of 2.58×10^{-4} coulomb in 1 kg of air under standard conditions of pressure, temperature and humidity.

20. Which is defined as the quantity of a radioactive substance, which produces 10^6 disintegrations in one second?

- a) Curie
- b) Rutherford**
- c) Becquerel
- d) Roentgen

Explanation

Rutherford (Rd) is another unit of radioactivity. It is defined as the quantity of a radioactive substance, which produces 10^6 disintegrations in one second.

21. Which among the following is not the property of Artificial radioactivity?

- a) Emission of radiation due to disintegration of a nucleus through induced process.
- b) Mostly elementary particles such as neutron, positron, etc. are emitted.
- c) It is a spontaneous process.**
- d) This can be controlled.

Explanation

The property of Artificial radioactivity is 1. Emission of radiation due to disintegration of a nucleus through induced process, 2. Mostly elementary particles such as neutron, positron, etc. are emitted, 3. It is an induced process, 4. Exhibited by elements with atomic number less than 83 and 5. This can be controlled.

22. Which is the traditional unit of radioactivity?

- a) Curie**
- b) Rutherford
- c) Becquerel
- d) Roentgen

Explanation

Curie is the traditional unit of radioactivity. It is defined as the quantity of a radioactive substance which undergoes 3.7×10^{10} disintegrations in one second. This is actually close to the activity of 1 g of radium 226. $1 \text{ curie} = 3.7 \times 10^{10}$ disintegrations per second.

23. Which among the following particles is not comprised in radiations emitted by radioactive nucleus?

- a) Alpha
- b) Beta
- c) Gamma
- d) Delta**

Explanation

When a radioactive nucleus undergoes radioactivity, it emits harmful radiations. These radiations are usually comprised of any of the three types of particles. They are alpha(α), beta (β) and gamma(γ) rays.

24. Who among the following German chemist discovered Uranium in a mineral called pitchblende?

- a) William Gregor
- b) Carl Mosander
- c) **Martin Klaproth**
- d) Hamphry Davy

Explanation

Uranium, named after the planet Uranus, was discovered by Martin Klaproth, a German chemist in a mineral called pitchblende.

25. Which among the following is not the property of α rays?

- a) Helium nucleus (${}_2\text{He}^4$) consisting of two protons and two neutrons.
- b) Positively charged particles. Charge of each alpha particle = $+2e$
- c) **Penetrating power is greater than that of β rays. They can penetrate through a thin metal foil.**
- d) Deflected by both the fields. (in accordance with Fleming's left hand rule)

Explanation

Low penetrating power (even stopped by a thick paper). Ionising power is 100 time greater than β rays and 10,000 times greater than γ rays.

26. Which among the following is not the property of γ rays?

- a) They are electromagnetic waves consisting of photons.
- b) **Negatively charged particles. Charge of each beta particle = $-e$**
- c) They have a very high penetrating power greater than that of β rays. They can penetrate through thick metal blocks.
- d) They are not deflected by both the fields

Explanation

Neutral particles. Charge of each gamma particle = zero. Very less ionization power

27. Which among the following is not the property of β rays?

- a) They are electrons (${}_{-1}\text{e}^0$), basic elementary particle in all atoms.
- b) Negatively charged particles. Charge of each beta particle = $-e$
- c) **Deflected by only one field; but the direction of deflection is same as that of alpha rays. (in accordance with Fleming's left hand rule)**
- d) They travel with the speed of light.

Explanation

Deflected by both the fields; but the direction of deflection is opposite to that for alpha rays. (in accordance with Fleming's left hand rule). Penetrating power is greater than that of α rays. They can penetrate through a thin metal foil.

28. Which among the following statement is incorrect

- 1) α rays speed ranges from $1/10$ to $1/20$ times the speed of light
- 2) γ rays speed can go up to $9/10$ times the speed of light.
- 3) β rays travel with the speed of light.
 - a) Both 1 and 2
 - b) Both 1 and 3
 - c) **Both 2 and 3**
 - d) All 1, 2 and 3

Explanation

β rays speed can go up to $9/10$ times the speed of light. γ rays travel with the speed of light.

29 Complete the following equation: ${}_{92}\text{U}^{238} \rightarrow \text{-----}$

- a) ${}_{90}\text{Th}^{234} + {}_2\text{He}^4$
- b) ${}_{90}\text{Pm}^{234} + {}_2\text{He}^4$
- c) ${}_{90}\text{Np}^{234} + {}_2\text{He}^4$
- d) ${}_{90}\text{Rf}^{234} + {}_2\text{He}^4$

Explanation



30. Which among the following statement is correct regarding Gamma decay

- a) In the radioactive nucleus the atomic number is greater than the mass number
- b) In the radioactive nucleus the mass number is greater than the atomic number
- c) **The atomic number and mass number of the radioactive nucleus remain the same**
- d) None of the above

Explanation

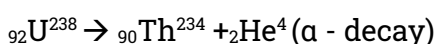
In a γ - decay, only the energy level of the nucleus changes. The atomic number and mass number of the radioactive nucleus remain the same.

31. When Uranium (U^{238}) decays to thorium (Th^{234}) it emits which particle?

- a) Gamma particle
- b) Beta particle
- c) **Alpha particle**
- d) All the above

Explanation

A nuclear reaction in which an unstable parent nucleus emits an alpha particle and forms a stable daughter nucleus, is called 'alpha decay'. E.g.: Decay of uranium (U^{238}) to thorium (Th^{234}) with the emission of an alpha particle.



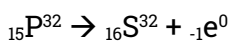
In α - decay, the parent nucleus emits an α particle and so it is clear that for the daughter nucleus, the mass number decreases by four and the atomic number decreases by two.

32. Complete the following equation: ${}_{15}\text{P}^{32} \rightarrow \text{-----}$

- a) ${}_{16}\text{Cl}^{32} + {}_{-1}\text{e}^0$
- b) ${}_{16}\text{S}^{32} + {}_{-1}\text{e}^0$
- c) ${}_{16}\text{F}^{32} + {}_{-1}\text{e}^0$
- d) ${}_{16}\text{B}^{32} + {}_{-1}\text{e}^0$

Explanation

A nuclear reaction, in which an unstable parent nucleus emits a beta particle and forms a stable daughter nucleus, is called 'beta decay'. E.g.: Beta decay of phosphorous.



In β - decay there is no change in the mass number of the daughter nucleus but the atomic number increases by one.

33. Which German scientists discovered that when a uranium nucleus is bombarded with a neutron, it breaks up into two smaller nuclei of comparable mass along with the emission of a few neutrons and energy?

- a) **Otto Hahn and F. Strassman**
- b) Irene Curie and F. Joliot
- c) Antoine and Marie-Anne Lavoisier
- d) Adair Crawford and Humphry Davy

Explanation

In 1939, German Scientist Otto Hahn and F. Strassman discovered that when a uranium nucleus is bombarded with a neutron, it breaks up into two smaller nuclei of comparable mass along with the emission of a few neutrons and energy.

34. The process of breaking (splitting) up of a heavier nucleus into two smaller nuclei with the release of a large amount of energy and a few neutrons is called ____

- a) **Nuclear fission**
- b) Nuclear fusion
- c) Nuclear Spike
- d) All the above

Explanation

The process of breaking (splitting) up of a heavier nucleus into two smaller nuclei with the release of a large amount of energy and a few neutrons is called 'nuclear fission'.

35. Complete the following Equation: ${}_{92}\text{U}^{235} + {}_0\text{n}^1 \rightarrow \text{-----}$

- a) ${}_{92}\text{U}^{235} + {}_0\text{n}^1 \rightarrow {}_{56}\text{Ba}^{141} + {}_{36}\text{Kr}^{92} + 3{}_0\text{n}^1 + \text{Q}$
- b) ${}_{92}\text{U}^{235} + {}_0\text{n}^1 \rightarrow {}_{56}\text{Pm}^{141} + {}_{36}\text{Np}^{92} + 3{}_0\text{n}^1 + \text{Q}$
- c) ${}_{92}\text{U}^{235} + {}_0\text{n}^1 \rightarrow {}_{56}\text{Ba}^{141} + {}_{36}\text{Kr}^{92} + 3{}_0\text{n}^1 + \text{Q}$
- d) ${}_{92}\text{U}^{235} + {}_0\text{n}^1 \rightarrow {}_{56}\text{Po}^{141} + {}_{36}\text{Tc}^{92} + 3{}_0\text{n}^1 + \text{Q}$

Explanation

Nuclear fission of a uranium nucleus (U^{235}): ${}_{92}U^{235} + {}_0n^1 \rightarrow {}_{56}Ba^{141} + {}_{36}Kr^{92} + 3{}_0n^1 + Q$.

The average energy released in each fission process is about 3.2×10^{-11} J. Nuclear fission is pictorially represented.

36. Which among the following statement is correct

- 1) A fissionable material is a radioactive element, which undergoes fission in a sustained manner when it absorbs a neutron. It is also termed as 'fissile material'. E.g.: U^{235} , plutonium (Pu^{239} and Pu^{241})
- 2) All isotopes of uranium undergo nuclear fission when they absorb a neutron. For example, natural uranium consists of 99.28 % of ${}_{92}U^{238}$ and 0.72 % of ${}_{92}U^{235}$. Of these two, U^{238} and U^{235} undergoes fission at different rate.
 - a) Only 1
 - b) Only 2
 - c) Both 1 and 2
 - d) None

Explanation

All isotopes of uranium do not undergo nuclear fission when they absorb a neutron. For example, natural uranium consists of 99.28 % of ${}_{92}U^{238}$ and 0.72 % of ${}_{92}U^{235}$. Of these two, U^{238} does not undergo fission whereas U^{235} undergoes fission. Hence, U^{235} is a fissionable material and U^{238} is non fissionable.

37. There are some radioactive elements, which can be converted into fissionable material. They are called as _____

- a) Coil material
- b) Morse material
- c) Reserve material
- d) **Fertile material**

Explanation

There are some radioactive elements, which can be converted into fissionable material. They are called as fertile materials. E.g.: Uranium-238, Thorium-232, Plutonium-240.

38. A uranium nucleus (U^{235}) when bombarded with a neutron undergoes fission producing three neutrons. These three neutrons in turn can cause fission in three other uranium nuclei present in the sample, thus producing nine neutrons. This is known as _____

- a) Critical reaction
- b) Mass reaction
- c) Liquid reaction
- d) **Chain reaction**

Explanation

A uranium nucleus (U^{235}) when bombarded with a neutron undergoes fission producing three neutrons. These three neutrons in turn can cause fission in three other uranium nuclei present in the sample, thus producing nine neutrons. These nine neutrons in turn may produce twenty-seven

neutrons and so on. This is known as 'chain reaction'. A chain reaction is a self-propagating process in which the number of neutrons goes on multiplying rapidly almost in a geometrical progression.

39. How many kinds of chain reactions are possible in Nuclear fission?

- a) One
- b) Two**
- c) Three
- d) Six

Explanation

Two kinds of chain reactions are possible. They are: (i) controlled chain reaction and (ii) uncontrolled chain reaction.

40. Which among the following statement is incorrect

- 1) In the controlled chain reaction, the number of neutrons released is maintained to be one. This is achieved by absorbing the extra neutrons with a neutron absorber leaving only one neutron to produce further fission. Thus, the reaction is sustained in a controlled manner.
- 2) The energy released due to a controlled chain reaction can be utilized for constructive purposes. Controlled chain reaction is used in the atom bomb to produce an explosion energy in a sustained manner.
 - a) Only 1
 - b) Only 2**
 - c) Both 1 and 2
 - d) None

Explanation

The energy released due to a controlled chain reaction can be utilized for constructive purposes. Controlled chain reaction is used in a nuclear reactor to produce energy in a sustained and controlled manner.

41. Which kind of chain reaction is used in Atom bomb?

- a) Controlled chain reaction
- b) Uncontrolled chain reaction**
- c) Both Controlled and Uncontrolled
- d) Semi Controlled chain reaction

Explanation

In the uncontrolled chain reaction, the number of neutrons multiplies indefinitely and causes fission in a large amount of the fissile material. This results in the release of a huge amount of energy within a fraction of a second. This kind of chain reaction is used in the atom bomb to produce an explosion.

42. Which among the following statement is correct?

- 1) During a nuclear fission process, about 2 to 3 neutrons are released. But all these neutrons may not be available to produce further fission. Some of them may escape from the system, which is termed as 'leakage of neutrons' and some may be absorbed by the non-fissionable materials present in the system.

- 2) These two factors lead to the loss of neutrons. To sustain the chain reaction, the rate of production of neutrons due to nuclear fission must be more than the rate of its loss. This can be achieved only when the size (i.e., mass) of the fissionable material is equal to a certain optimum value. This is known as 'critical mass'.
- 3) The minimum mass of a fissile material necessary to sustain the chain reaction is called 'critical mass (m_c)'. It depends on the nature, density and the size of the fissile material.
 - a) Both 1 and 2
 - b) Both 1 and 3
 - c) Both 3 and 3
 - d) **All 1, 2 and 3**

43. If the mass of the fissile material is less than the critical mass, it is termed as _____

- a) Micro critical
- b) **Subcritical**
- c) Super critical
- d) Sonic critical

Explanation

If the mass of the fissile material is less than the critical mass, it is termed as 'subcritical'.

44. If the mass of the fissile material is more than the critical mass, it is termed as _____

- a) Sonic critical
- b) Scope critical
- c) **Super critical**
- d) All the above

Explanation

If the mass of the fissile material is more than the critical mass, it is termed as 'supercritical'.

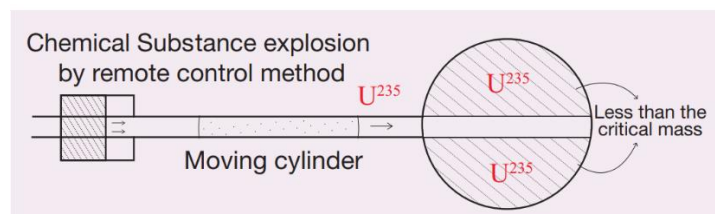
45. Which among the following statement is correct

- 1) The atom bomb is based on the principle of uncontrolled chain reaction. In an uncontrolled chain reaction, the number of neutrons and the number of fission reactions multiply almost in a geometrical progression. This releases a huge amount of energy in a very small time interval and leads to an explosion.
- 2) An atom bomb consists of a piece of fissile material whose mass is subcritical. This piece has a cylindrical void. It has a cylindrical fissile material which can fit into this void and its mass is also subcritical. When the bomb has to be exploded, this cylinder is injected into the void using a conventional explosive. Now, the two pieces of fissile material join to form the supercritical mass, which leads to an explosion.
- 3) During this explosion tremendous amount of energy in the form of heat, light and radiation is released. A region of very high temperature and pressure is formed in a fraction of a second along with the emission of hazardous radiation like γ rays, which adversely affect the living creatures. This type of atom bombs was exploded in 1947 at Hiroshima and Nagasaki in Japan during the World War II.
 - a) **Both 1 and 2**
 - b) Both 1 and 3
 - c) Both 2 and 3

d) All 1, 2 and 3

Explanation

During this explosion tremendous amount of energy in the form of heat, light and radiation is released. A region of very high temperature and pressure is formed in a fraction of a second along with the emission of hazardous radiation like γ rays, which adversely affect the living creatures. This type of atom bombs was exploded in 1945 at Hiroshima and Nagasaki in Japan during the World War II.



46. Which is the unit used in nuclear physics to measure the energy of small particles?

- a) Mass Valent
- b) Critical Joule
- c) **Electron Volte**
- d) Ohm Electron

Explanation

Electron Volt (eV) is the unit used in nuclear physics to measure the energy of small particles. It is nothing but the energy of one electron when it is accelerated using an electric potential of one volt. $1\text{eV} = 1.602 \times 10^{-19}$ joule. 1 million electron volt = 1 MeV = 10^6 eV (mega electron volt). The energy released in a nuclear fission process is about 200 MeV.

47. The energy can be produced when two lighter nuclei combine to form a heavier nucleus. This phenomenon is known as _____

- a) Nuclear fission
- b) **Nuclear fusion**
- c) Nuclear Spike
- d) All the above

Explanation

The energy can be produced when two lighter nuclei combine to form a heavier nucleus. This phenomenon is known as nuclear fusion.

48. Nuclear fusion reaction. ${}_1\text{H}^2 + {}_1\text{H}^2 \rightarrow {}_2\text{He}^4 + Q$ (Energy). Here, ${}_1\text{H}^2$ represents an isotope of hydrogen known as _____

- a) Neuterium
- b) **Deuterium**
- c) Poterium
- d) Santerium

Explanation

Here, ${}_1\text{H}^2$ represents an isotope of hydrogen known as 'deuterium'. The average energy released in each fusion reaction is about 3.84×10^{-12} J.

49. The mass of the daughter nucleus formed during a nuclear reaction (fission and fusion) is lesser than the sum of the masses of the two parent nuclei. This difference in mass is called ____

- a) Mass effect
- b) Mass corrupt
- c) Mass retreat
- d) **Mass defect**

Explanation

The mass of the daughter nucleus formed during a nuclear reaction (fission and fusion) is lesser than the sum of the masses of the two parent nuclei. This difference in mass is called mass defect. This mass is converted into energy, according to the mass-energy equivalence.

50. Who discovered cathode rays, known as electrons, experimentally?

- a) John Dalton
- b) **J J Thomson**
- c) Goldstein
- d) Rutherford

Explanation

J J Thomson discovered cathode rays, known as electrons, experimentally.

51. Who discovered positive rays, which were named as protons by Rutherford?

- a) John Dalton
- b) James Chadwick
- c) **Goldstein**
- d) Rutherford

Explanation

Goldstein discovered positive rays, which were named as protons by Rutherford.

52. Who proposed the relation between mass and energy i.e., $E = mc^2$?

- a) Newton
- b) **Einstein**
- c) Pascal
- d) Marie Curie

Explanation

The concept of mass-energy equivalence was proposed by Einstein in 1905. It stated that mass can be converted into energy and vice versa. The relation between mass and energy proposed by Einstein is $E = mc^2$ where c is the velocity of light in vacuum and is equal to $3 \times 10^8 \text{ m s}^{-1}$.

53. The nuclear bomb that was dropped in Hiroshima during World War II was called as ____

- a) Fat man
- b) Small man
- c) **Little boy**
- d) Old boy

Explanation

The nuclear bomb that was dropped in Hiroshima during World War II was called as 'Little boy'. It was a gun-type bomb which used a uranium core.

54. Nuclear fusion is possible only at an extremely high temperature of the order of 10^7 to 10^9 K and a high pressure to push the hydrogen nuclei closer to fuse with each other. Hence, it is named as ___

- a) **Thermonuclear reaction**
- b) Subatomic reaction
- c) Nerve reaction
- d) Nano nuclear reaction

Explanation

Nuclear fusion is possible only at an extremely high temperature of the order of 10^7 to 10^9 K and a high pressure to push the hydrogen nuclei closer to fuse with each other. Hence, it is named as 'Thermonuclear reaction'.

55. Which among the following statement is correct

- 1) Nuclear fusion is the combination of two lighter nuclei. The charge of both nuclei is negative. According to electrostatic theory, when they come closer, they tend to repel each other.
 - 2) This repulsive force will be overcome by the kinetic energy of the nuclei at higher temperature of the order of 10^7 to 10^9 K.
- a) **Only 1**
 - b) Only 2
 - c) Both 1 and 2
 - d) None

Explanation

Nuclear fusion is the combination of two lighter nuclei. The charge of both nuclei is positive. According to electrostatic theory, when they come closer, they tend to repel each other.

56. The stars like our Sun emit a large amount of energy in the form of light and heat. This energy is termed as ____

- a) Constellation energy
- b) **Stellar energy**
- c) Basal energy
- d) All the above

Explanation

The stars like our Sun emit a large amount of energy in the form of light and heat. This energy is termed as the stellar energy. All stars contain a large amount of hydrogen. The surface temperature of the stars is very high which is sufficient to induce fusion of the hydrogen nuclei. Fusion reaction

that takes place in the cores of the Sun and other stars results in an enormous amount of energy, which is called as 'stellar energy'. Thus, nuclear fusion or thermonuclear reaction is the source of light and heat energy in the Sun and other stars.

57. The bomb, which was subsequently dropped over Nagasaki was called as ___

- a) **Fat man**
- b) Small man
- c) Little boy
- d) Old boy

Explanation

The bomb, which was subsequently dropped over Nagasaki was called as 'Fat man'. It was an explosion type bomb, which used a plutonium core.

58. Which among the following statement is correct

- 1) Hydrogen bomb is based on the principle of nuclear fusion. A hydrogen bomb is always designed to have an inbuilt atom bomb which creates the high temperature and pressure required for fusion when it explodes.
 - 2) Then, fusion takes place in the hydrogen core and leads to the release of a very large amount of energy in an uncontrolled manner. The energy released in a hydrogen bomb (or fusion bomb) is much higher than that released in an atom bomb (or fission bomb).
- a) Only 1
 - b) Only 2
 - c) **Both 1 and 2**
 - d) None

59. Which among the following is not the property of Nuclear Fission?

- a) The process of breaking up (splitting) of a heavy nucleus into two smaller nuclei is called 'nuclear fission'.
- b) **Extremely high temperature and pressure is needed.**
- c) Alpha, beta and gamma radiations are emitted.
- d) Fission leads to emission of gamma radiation. This triggers the mutation in the human gene and causes genetic transform diseases.

Explanation

Nuclear Fission Can be performed at room temperature.

60. In 1932, who discovered the chargeless particles called neutrons?

- a) Goldstein
- b) Rutherford
- c) John Dalton
- d) **James Chadwick**

Explanation

In 1932, James Chadwick discovered the chargeless particles called neutrons. Presently, a large number of elementary particles like photon, meson, positron and neutrino have been discovered.

61. In 1911, which British scientist explained that the mass of an atom is concentrated in its central part called Nucleus?

- a) John Dalton
- b) J J Thomson
- c) **Rutherford**
- d) Goldstein

Explanation

In 1911, the British scientist, Ernest Rutherford explained that the mass of an atom is concentrated in its central part called Nucleus.

62. Which among the following is not the property of Nuclear Fusion?

- a) Nuclear fusion is the combination of two lighter nuclei to form a heavier nucleus.
- b) Extremely high temperature and pressure is needed.
- c) Alpha rays, positrons, and neutrinos are emitted.
- d) **Only heat energy is emitted. Light energy is restricted in this.**

Explanation

In Nuclear Fusion Only light and heat energy is emitted.

63. Which among the following statement is incorrect

- 1) Sun fuses about 620 million metric tons of hydrogen each second and radiates about 3.8×10^{26} joule of energy per second.
 - 2) When this energy is radiated towards the Earth, it decreases in its intensity. When it reaches the Earth, its value is about 1.4 kilo joule per unit area in unit time.
- a) Only 1
 - b) Only 2
 - c) Both 1 and 2
 - d) **None**

64. Which among the following radio isotope helps to increase the productivity of crops?

- a) Iodine
- b) **Phosphorous**
- c) Sodium
- d) Iron

Explanation

The radio isotope of phosphorous (P-32) helps to increase the productivity of crops. The radiations from the radio isotopes can be used to kill the insects and parasites and prevent the wastage of agricultural products. Certain perishable cereals exposed to radiations remain fresh beyond their normal life, enhancing the storage time. Very small doses of radiation prevent sprouting and spoilage of onions, potatoes and gram.

65. Which radio isotope is used for the effective functioning of heart?

- a) Radio iron
- b) Radio Iodine

- c) Radio Phosphorous
- d) **Radio Sodium**

Explanation

Radio sodium (Na^{24}) is used for the effective functioning of heart.

66. Medical applications of radio isotopes can be divided into how many parts?

- a) **Two**
- b) Three
- c) Four
- d) Five

Explanation

Medical applications of radio isotopes can be divided into two parts: i) Diagnosis ii) Therapy. Radio isotopes are used as tracers to diagnose the nature of circulatory disorders of blood, defects of bone metabolism, to locate tumours, etc. Some of the radio isotopes which are used as tracers are: hydrogen, carbon, nitrogen, sulphur, etc.

67. Match the following radio isotopes with its respective medical purpose

- | | |
|-------------------------|--|
| i. Radio - Iodine | – 1. used in the treatment of skin diseases. |
| ii. Radio-iron | – 2. used to cure goitre. |
| iii. Radio phosphorous | – 3. are used in the treatment of skin cancer. |
| iv. Radio cobalt | – 4. used to diagnose anaemia. |
| a) 4 – 2 – 3 – 1 | |
| b) 2 – 4 – 1 – 3 | |
| c) 3 – 1 – 2 – 4 | |
| d) 4 – 1 – 2 – 3 | |

Explanation

Radio - Iodine (I^{131}) is used to cure goitre. Radio-iron (Fe^{59}) is used to diagnose anaemia and also to provide treatment for the same. Radio phosphorous (P^{32}) is used in the treatment of skin diseases. Radio cobalt (Co^{60}) and radio-gold (Au^{198}) are used in the treatment of skin cancer. Radiations are used to sterilize the surgical devices as they can kill the germs and microbes.

68. Which isotope is used in the airlines to detect the explosives in the luggage?

- a) **Californium**
- b) Americium
- c) Nobelium
- d) Dubnium

Explanation

An isotope of californium (Cf^{252}) is used in the airlines to detect the explosives in the luggage.

69. Which among the following statement is correct

- 1) In industries, radioactive isotopes are used as tracers to detect any manufacturing defects such as cracks and leaks. Packaging faults can also be identified through radio activity. Gauges,

which have radioactive sources are used in many industries to check the level of gases, liquids and solids

- 2) Using the technique of radio carbon dating, the age of the Earth, fossils, old paintings and monuments can be determined. In radio carbon dating, the existing amount of radio carbon is determined and this gives an estimate about the age of these things.
 - a) Only 1
 - b) Only 2
 - c) Both 1 and 2
 - d) None

70. Which isotope is used in many industries as a smoke detector?

- a) Americium
- b) Fermium
- c) Nihonium
- d) Curium

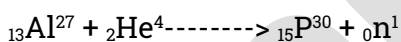
Explanation

An isotope of Americium (Am^{241}) is used in many industries as a smoke detector.

71. Identify A, B, C, and D from the following nuclear reactions.

- 1) ${}_{13}\text{Al}^{27} + \text{A} \longrightarrow {}_{15}\text{P}^{30} + \text{B}$
- 2) ${}_{12}\text{Mg}^{24} + \text{B} \longrightarrow {}_{11}\text{Na}^{24} + \text{C}$
- 3) ${}_{92}\text{U}^{238} + \text{B} \longrightarrow {}_{93}\text{Np}^{239} + \text{D}$
 - a) $\text{A} = {}_0\text{n}^1$; $\text{B} = {}_2\text{He}^4$; $\text{C} = {}_{-1}\text{e}^0$; $\text{D} = {}_1\text{H}^1$
 - b) $\text{A} = {}_2\text{He}^4$; $\text{B} = {}_0\text{n}^1$; $\text{C} = {}_{-1}\text{e}^0$; $\text{D} = {}_1\text{H}^1$
 - c) $\text{A} = {}_2\text{He}^4$; $\text{B} = {}_0\text{n}^1$; $\text{C} = {}_1\text{H}^1$; $\text{D} = {}_{-1}\text{e}^0$
 - d) $\text{A} = {}_0\text{n}^1$; $\text{B} = {}_2\text{He}^4$; $\text{C} = {}_1\text{H}^1$; $\text{D} = {}_{-1}\text{e}^0$

Explanation



72. Which among the following statement is correct

- 1) In day-to-day life, you do receive some natural radiation from the Sun. The radioactive elements present in the soil and rocks, the house hold appliances like television, microwave ovens, cell phones and the X-rays used in hospitals. These radiations do not produce any severe effects as they are very low in intensity.
- 2) The second source of radiation exposure is man-made. These are due to nuclear reactors and during the testing of the nuclear devices in the atmosphere or in the ground. Improper and careless handling of radioactive materials release harmful radiations in our environment.
- 3) These radiations are very harmful to the human body. A person who is exposed to radiations very closely or for a longer duration, is at a greater health risk and can be affected genetically.
 - a) Both 1 and 2
 - b) Both 1 and 3
 - c) Both 2 and 3

d) All 1, 2 and 3

73. Which among the following organisation has recommended certain maximum permissible exposure limits to radiation that is believed to be safe without producing any appreciable injury to a person?

- a) **ICRP**
- b) IMF
- c) WANO
- d) IPSC

Explanation

The International Commission on Radiological Protection (ICRP) has recommended certain maximum permissible exposure limits to radiation that is believed to be safe without producing any appreciable injury to a person.

74. The Safe limit of overall exposure to radiation is given as ____

- a) **20 milli sievert per year**
- b) 30 milli sievert per year
- c) 40 milli sievert per year
- d) 60 milli sievert per year

Explanation

According to International Commission on Radiological Protection (ICRP) the Safe limit of overall exposure to radiation is given as 20 milli sievert per year. In terms of roentgen, the safe limit of receiving the radiation is about 100 m R per week.

75. Which is a device used to detect the levels of exposure to an ionizing radiation?

- a) Anemometer
- b) Refractometer
- c) **Dosimeter**
- d) Seismograph

Explanation

Dosimeter is a device used to detect the levels of exposure to an ionizing radiation. It is frequently used in the environments where exposure to radiation may occur such as nuclear power plants and medical imaging facilities. Pocket dosimeter is used to provide the wearer with an immediate reading of his/her exposure to X-rays and γ rays.

76. Which among the following is not the preventive measure for nuclear radiation?

- a) Radioactive materials should be kept in a thick walled lead container
- b) **Iron coated aprons and Iron gloves should be used while working with hazardous radioactive materials.**
- c) The radioactive materials should be handled only by tongs or by a remote-control device.
- d) Dosimeters should be worn by the users to check the level of radiation.

Explanation

Lead coated aprons and lead gloves should be used while working with hazardous radioactive materials. You should avoid eating while handling radioactive materials.

77. In which country the first nuclear reactor was built in 1942?

- a) Russia
- b) German
- c) **USA**
- d) Japan

Explanation

A Nuclear reactor is a device in which the nuclear fission reaction takes place in a self-sustained and controlled manner to produce electricity. The first nuclear reactor was built in 1942 at Chicago, USA.

78. A radon specimen emits radiation of 3.7×10^3 G Bq per second. Convert this disintegration in terms of curie. (one curie = 3.7×10^{10} disintegration per second)?

- a) 50 Curie
- b) **100 Curie**
- c) 200 Curie
- d) 300 Curie

Explanation

1 Bq = one disintegration per second

one curie = 3.7×10^{10} Bq

$$1 \text{ Bq} = \frac{1}{3.7 \times 10^{10}} \text{ Curie}$$

$$\therefore 3.7 \times 10^3 \text{ G Bq} = 3.7 \times 10^3 \times 10^9 \times \frac{1}{3.7 \times 10^{10}}$$

= 100 Curie.

79. Which among the following is the type of Nuclear reactor?

- a) Breeder reactor
- b) Thermal reactor
- c) Gas-cooled reactor
- d) **All the above**

Explanation

Breeder reactor, fast breeder reactor, pressurized water reactor, pressurized heavy water reactor, boiling water reactor, water cooled reactor, gas-cooled reactor, fusion reactor and thermal reactor are some types of nuclear reactors, which are used in different places world-wide.

80. Which among the following is not the essential components of nuclear reactor?

- a) Moderator
- b) Control rod
- c) Coolant
- d) **Cam shaft**

Explanation

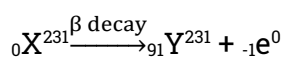
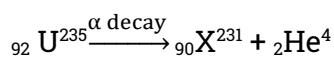
The essential components of a nuclear reactor are (i) fuel, (ii) moderator, (iii) control rod, (iv) coolant and (v) protection wall.

81. ${}_{92}\text{U}^{235}$ experiences one α - decay and one β - decay. Find number of neutrons in the final daughter nucleus that is formed?

- a) Number of neutrons = 100
- b) Number of neutrons = 120
- c) **Number of neutrons = 140**
- d) Number of neutrons = 160

Explanation

Let X and Y be the resulting nucleus after the emission of the alpha and beta particles respectively.



Number of neutrons = Mass number – Atomic number

$$= 231 - 91 = 140.$$

82. Which is used to slow down the high energy neutrons to provide slow neutrons?

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

Explanation

A moderator is used to slow down the high energy neutrons to provide slow neutrons.

83. Which is commonly used fuel material in Nuclear reactor?

- a) **Uranium**
- b) Thorium
- c) Plutonium
- d) Curium

Explanation

A fissile material is used as the fuel. The commonly used fuel material is uranium.

84. Which among the following is the commonly used moderators?

- a) Lead
- b) Cesium
- c) **Graphite**
- d) Cadmium

Explanation

Graphite and heavy water are the commonly used moderators.

85. Which among the following statement is correct

- 1) Control rods are used to control the number of neutrons in order to have sustained chain reaction. Mostly Xenon or Arsenic rods are used as control rods. They absorb the neutrons.
 - 2) A coolant is used to remove the heat produced in the reactor core, to produce steam. This steam is used to run a turbine in order to produce electricity.
 - 3) A thick concrete lead wall is built around the nuclear reactor in order to prevent the harmful radiations from escaping into the environment.
- a) Both 1 and 2
 - b) Both 1 and 3
 - c) **Both 2 and 3**
 - d) All 1, 2 and 3

Explanation

Control rods are used to control the number of neutrons in order to have sustained chain reaction. Mostly boron or cadmium rods are used as control rods. They absorb the neutrons.

86. Which among the following is not the coolant?

- a) Water
- b) Air
- c) Helium
- d) **None of the above**

Explanation

Water, air and helium are some of the coolants. Nuclear reactors are widely used in power generation. They are also used to produce radio isotopes, which are used in a variety of applications. Some reactors help us to do research in the field of nuclear physics.

87. Which are used to convert non-fissionable materials into fissionable materials?

- a) Gas-cooled reactor
- b) **Breeder Reactor**
- c) Thermal reactor
- d) Water cooled reactor

Explanation

Breeder reactors are used to convert non-fissionable materials into fissionable materials.

88. Calculate the amount of energy released when a radioactive substance undergoes fusion and results in a mass defect of 2 kg?

- a) **$1.8 \times 10^{17} \text{ J}$**
- b) $2.3 \times 10^{21} \text{ J}$
- c) $1.8 \times 10^{21} \text{ J}$
- d) $2.3 \times 10^{17} \text{ J}$

Explanation

Mass defect in the reaction (m) = 2 kg

Velocity of light (c) = $3 \times 10^8 \text{ m s}^{-1}$

By Einstein's equation, Energy released $E = mc^2$

So, $E = 2 \times (3 \times 10^8)^2 = 1.8 \times 10^{17} \text{ J}$.

89. When Indian Atomic Energy Commission (AEC) was established?

- a) 1935
- b) 1945
- c) **1948**
- d) 1952

Explanation

Indian Atomic Energy Commission (AEC) was established in August 1948 by the Department of Indian Scientific Research committee.

90. Who was the first chairman of Indian Atomic Energy Commission?

- a) Raja Raman
- b) **Homi Jahangir Bhabha**
- c) Vikram Sarabhai
- d) Satyendra Nath Bose

Explanation

Dr. Homi Jahangir Bhabha was the first chairman of Indian Atomic Energy Commission. Now, it is known as Bhabha Atomic Research Centre (BARC).

91. Which is India's first nuclear power station?

- a) Kaiga Atomic Power Station
- b) Kalpakkam Atomic Power Station
- c) Narora Atomic Power Station
- d) **Tarapur Atomic Power Station**

Explanation

Nuclear power is the fifth largest source of power in India. Tarapur Atomic Power Station is India's first nuclear power station.

92. Which among the following state has two atomic power station?

- a) Maharashtra
- b) **Tamil Nadu**
- c) Rajasthan
- d) Gujarat

Explanation

Tamil Nadu is the only state with two atomic power station in Kalpakkam and Kudankulam

93. How many power stations are there now in India?

- a) Three
- b) Four
- c) **Seven**
- d) Eight

Explanation

Now, there are a total of seven power stations, one each in Maharashtra, Rajasthan, Gujarat, Uttar Pradesh and two in Tamil Nadu. In Tamil Nadu, we have nuclear power stations in Kalpakkam and Kudankulam.

94. Which was the first nuclear reactor built in India and Asia?

- a) **Apsara**
- b) Cirus
- c) Purnima
- d) Dhuruva

Explanation

Apsara was the first nuclear reactor built in India and Asia.

95. How many nuclear reactors are now operating in India?

- a) 12
- b) 18
- c) **22**
- d) 28

Explanation

Now, there are 22 nuclear reactors which are operating in India.

96. Which among the following is operating reactors in India?

- a) Cirus
- b) Dhuruva
- c) Purnima
- d) **All the above**

Explanation

Some operating reactors in India are 1. Cirus, 2. Dhuruva and 3. Purnima.

97. Where Indian Atomic Energy Commission (AEC) was established in August 1948?

- a) **Maharashtra**
- b) Gujarat
- c) West Bengal
- d) Tamil Nadu

Explanation

Indian Atomic Energy Commission (AEC) was established in August 1948 at Bombay (now Mumbai) in Maharashtra. It is the nodal agency for all the research done in the field of atomic energy.

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