



POLLACHI INSTITUTE OF ENGINEERING AND TECHNOLOGY
POOSARIPATTI, POLLACHI 642 205
DEPARTMENT OF CHEMISTRY
ENGINEERING CHEMISTRY - I

UNIT IV

NON-CONVENTIONAL ENERGY SOURCES

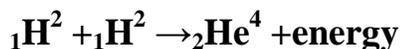
PART-A

1. Define nuclear fission? Give Example

Nuclear Fission is defined as the process of splitting of heavier nucleus into two or more smaller nuclei with simultaneous liberation of large amount of energy. Eg: Atom bomb

2. What is nuclear fusion?

Nuclear fusion is defined as the process of combination of lighter nuclei into heavier nuclei with simultaneous liberation of large amount of energy. Eg: Nuclear fusion occurs in sun

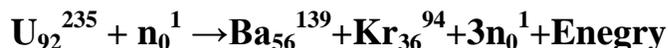


3. What is nuclear chain reaction?

A fission reaction, where the neutrons from the previous step continue to propagate and repeat the reaction is called nuclear chain reaction.

4. What is nuclear energy? Explain using a suitable example?

The energy released by the nuclear fission is called nuclear energy or nuclear fission energy. Eg: when U^{235} nucleus is hit by a thermal neutron, the following reaction occurs with the release of energy



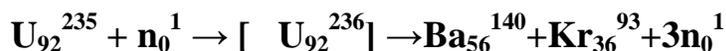
5. Mention few important characteristics of nuclear fission.

- i. A heavy nucleus (U235 (or) Pu239), when bombarded by slow moving neutrons split into two or more nuclei
- ii. Two or more neutrons are produced by fission of each nucleus.
- iii. Large quantities of energy are produced as a result of conversion of small mass of nucleus into energy.

6. Give the difference between nuclear fission and fusion?

NUCLEAR FISSION	NUCLEAR FUSION
It is the process of breaking heavier nucleus	It is the process of combination of lighter nuclei
It emits radioactive rays	It does not emit any kind of radioactive rays
It occurs at ordinary temperature	It occurs at high temperature ($>10^6$ K)

7. Give any one nuclear fission reaction, mention the factors that impede the nuclear chain reaction?



The factors that impede the nuclear chain reaction are,

- Some of the neutrons may escape from the surface to the surroundings
- Some of the neutrons may be absorbed by U^{238} present as impurity

8. What is a nuclear reactor?

The arrangement or equipment used to carry out fission reaction under controlled conditions is called a nuclear reactor.

9. What is nuclear chain reaction?

A fission reaction, where the neutrons from the previous step continue to propagate and repeat the reaction is called nuclear chain reaction.

10. What is breeder reactor?

Breeder reactor is one which converts non-fissionable material (U^{238} , Th^{232}) into fissionable material (U^{235} , Pu^{239}).

11. What is super critical mass and sub-critical mass of U^{235} ?

a) Super critical mass

If the mass of the fissionable material (U^{235}) is more than the critical mass, it is called super critical mass.

b) Sub-critical mass.

If the mass of the fissionable material is smaller than the critical mass, it is called sub- critical mass.

12. What are the types of nuclear fission reaction?

The nuclear fission reactions are of two types.

1. Uncontrolled fission reactions – Atom bomb
2. Controlled fission reactions – Nuclear reactor

13. What is light water nuclear – power plant?

Light water nuclear – power plant is the one, in which U^{235} fuel rods are submerged in water. Here the water acts as coolant and moderator.

14. What are moderators? Give some examples.

The substances used to slow down the neutrons are called moderators.

Examples: Ordinary water, Heavy water, Graphite, Beryllium.

15. What are fissile nucleides and fertile nucleides?

- i. The fissionable nucleides such as U^{235} & Pu^{239} are called fissile nucleides.
- ii. The non-fissionable nucleides such as U^{238} & Th^{232} are called fertile nucleides.

16. What are the general components of a nuclear reactor?

1. Fuel rods
2. Control rods

3. Coolents
4. Moderators
5. Pressure vessel
6. Protective shield
7. Turbine

17. What is photo galvanic cell or solar cell?

Photo galvanic cell is the one which converts the solar energy (energy obtained from the sun) directly into electrical energy.

It consists of a P-type semiconductor (Si doped with B) and N-type semiconductor (Si doped with P). They are in close contact with each other. As the solar energy is available freely and also it is pollution free in future its utility is very important.

18. What are fuel cells?

Fuel cell is the voltaic cell which converts the chemical energy of the fuels directly into electricity without combustion. In these cells, the reactants, products, and electrolytes pass through the cell.



19. What are the porous electrodes used in the fuel cells?

Compressed carbon containing a small amount of catalyst like Pt, Pd, and Ag are used in the fuel cells.

20. What is wind energy? How is it obtained?

Moving air is called wind. Energy recovered from the force of the wind is called wind energy. The energy possessed by wind is because of its high speed. The wind energy is harnessed by making use of wind mills.

21. Write any four methods adopted for harnessing wind energy?

- Sky sail
- Ladder mill
- Kite ship

- Sky wind power
- Briza technologies (hovering wind turbine)
- Sequoia automation (the kite wind generator)

22. What are the merits of wind energy?

- It does not cause any air pollution.
- It is very cheap and economic.
- It is renewable.
- It does not cause any pollution

23. Why do fission and fusion reactions produce large quantities of energy?

The enormous amount of energy released during the nuclear fission is due to the loss in some mass, when the reaction takes place. The loss in mass gets converted into energy according to Einstein equation.

$$E=mc^2$$

24. What are non-conventional energy source.

- Wind energy
- Solar energy
- Hydropower
- Tidal energy

25. What is a battery? How does it differ from a cell?

A battery is an arrangements of several electrochemical cells connected in series, that can be used as a source of direct electric current. Thus,

A Cell: Contains only one anode and cathode

A Battery: Contains several anodes and cathodes

26. What is primary battery? Give an example. (or) What are primary cells?

Primary cells are cells in which the electrode and the electrode reactions cannot be reversed by passing an external electrical energy. The reactions

occur only once and after use they become dead. Therefore, they are not chargeable. Example: Leclanche's cell.

27. What are secondary cells?

Secondary cells are cells in which the electrode reactions can be reversed by passing an external energy. Therefore, they can be recharged by passing electric current and used again and again. These are also called storage cells or accumulators. Ex: Lead acid storage cell, Nickel- cadmium cell.

28. What are the advantages of alkaline battery over dry battery?

- Zinc does not dissolved readily in a basic medium
- The life of alkaline battery is longer than dry battery because there is no corrosion on Zn.
- Alkaline battery maintains its voltage , as the current is drawn from it

29. Write the cell representation of lead storage cell?

The cell may be represented as



30. Write the cell representation of lead storage cell?

The cell may be represented as



31. What are the applications of lead acid storage cell?

- Lead acid storage cell is used to supply current mainly in automobiles such as cars, buses, trucks, etc.
- It is also used in gas engine ignition, telephone exchanges, hospitals, power stations, etc.

32. How are anodic and cathodic electro active materials made in Ni-Cd battery? (OR) How is NICAD battery constructed?

Ni-Cd cell consists of a cadmium anode and a metal grid containing paste of NiO₂ acting as cathode. The electrolyte in this cell is KOH.

33. What are the advantages and disadvantages of NICAD battery

Advantage

- It is smaller and lighter.
- It has longer life than lead storage cell.
- Like a dry cell, it can be packed in a sealed container.

Disadvantage

- It is more expensive than lead acid storage cell.

34. Describe lithium battery.

The lithium battery consists of a lithium anode and a TiS_2 cathode. A solid electrolyte, generally a polymer, is packed in between the electrodes. The electrolyte (polymer) permits the passage of ions but not that of electrons.

35. What are the advantages of Li-S battery?

- Li-S battery has light weight unlike the lead-acid battery.
- It possesses a high energy density.
- It is used in electric cars.

36. Li battery is the cell of future. Why? Or List any two advantages of Li batteries.

- a. Its cell voltage is high, (3V)
- b. Since Li is a light weight metal only 7g material is required to produce 1mole of electrons
- c. Since Li has the most negative E^0 value it generates the higher voltage than the other types of cells.
- d. All the constituents of the battery are solids there is no risk of leakage from the battery
- e. This battery can be made in a variety of sizes and shapes.

37. What are the advantages of using lithium as anode in batteries?

- Since Li has the most negative E° value, it generates a higher voltage than other types of cells.
- Since Li is a light-weight metal, only 7g (1 mole) material is required to produce 1 mole of electrons.
- Its cell voltage is high, 3.0V

PART-B

1. Define nuclear fission and fusion reaction. Bring out the difference between them.
2. Discuss the characteristics of nuclear fission when uranium undergoes nuclear fission?
3. What is a nuclear reactor? How is energy produced in a reactor?
4. What is a nuclear reactor? Describe the components of a light water nuclear power plant with a suitable diagram? Or With a neat sketch explain the functioning of a nuclear reactor?
5. Give an account of breeder reactor.
6. What is nuclear energy? What is the cause for the release of nuclear energy illustrated with a suitable example?
7. What are nuclear chain reactions explain how to improve the amount of nuclear energy with illustration
8. State the principle and application of solar battery or describe the construction and working of a solar cell.
9. What is wind energy? How is it harvested?
10. What is a primary battery? Give an example.
11. What is a reversible battery? Write a brief note on lead acid storage cell. Or explain the construction and working of lead acid battery (accumulator) with the reactions occurring during discharging and recharging.
12. How is Nickel- cadmium battery constructed? Explain with the cell reaction. Or how does a NICAD battery function? How can it be recharged?
13. Write a note on lithium battery. Or what are the important advantages envisaged for a Li electrode. Explain the construction of any one battery with Li as the negative electrode.
14. Explain the construction and working of hydrogen oxygen fuel cell. Or what are fuel cells? Explain the construction & working of fuel cell.
15. How are batteries classified? Describe the construction and functioning of an alkaline battery.

16. Discuss the various methods adopted for pollution abatement.