

## 5

## Towards Green Energy

**Q. 1. (A) 1. Fill in the blanks and rewrite the statement:**

- (1) The principle of ..... was invented by Michael Faraday.
- (2) To rotate the magnet in the generator, we need a device called .....
- (3) The water in a cooling tower in thermal power plant is circulated through the .....
- (4) In thermal power plants, the ..... energy in the coal is converted into electrical energy through several steps.
- (5) In nuclear fission, the energy released by fission of nuclei of atoms like ..... and ..... is used.
- (6) Natural gas does not contain element ....., so burning of natural gas results in less pollution.
- (7) In Hydroelectric plants, the ..... energy of the flowing water drives the turbine
- (8) ..... is a factor necessary for wind - energy generation, but is not available everywhere.
- (9) A silicon solar cell of dimension  $1 \text{ cm}^2$  generates current of about ..... mA.
- (10) Solar cells are made of a special type of material called ..... such as silicon.
- (11) Many solar panels connected in series form a solar strings and many solar strings connected in parallel form a solar .....
- (12) If 36 solar cells, each of size  $100 \text{ cm}^2$  are connected in series in a solar panel, it will give potential difference of ..... V and current of ..... A.
- (13) A transformer transforms the ..... and current levels of the generated power.
- (14) Incomplete combustion of fossil fuels leads to formation of ..... gas which adversely affects our health.
- (15) An electronic device that converts D.C. Solar power into AC power is called .....
- (16) ..... and ..... fuels are obtained from Natural gas.

**Ans.** (1) *electro magnetic induction* (2) *turbine* (3) *condenser* (4) *chemical* (5) *Uranium and Plutonium* (6) *Sulphur* (7) *kinetic* (8) *Wind velocity* (9) *30* (10) *Semi conductor* (11) *array* (12) *18, 3* (13) *voltage* (14) *carbon monoxide* (15) *inverter* (16) *LPG, CNG*

**Q. 1. (A) 2. Find the odd one out:**

- (1) Boiler, turbine, generator, solar cell.
- Ans.** Solar cell: It is part of Solar power station while, others are parts of thermal power station.
- (2) Thermal energy, atomic energy, wind energy, natural gas power.
- Ans.** Wind energy: It is clean source of energy while others create air pollution.
- (3) Uranium, plutonium, coal, thorium.
- Ans.** Coal - It is a fuel used in thermal power plant while others are used as fuels in nuclear power plant
- (4) Flowing water, water stored in dam, moving fan, running train.
- Ans.** Water stored in dam: It is an example of potential energy, while others are examples of kinetic energy.
- (5) LPG, CNG, coal, methane.
- Ans.** Coal: It is solid fuel while others are gaseous fuels.
- (6) Edible oil, LPG, CNG, crude oil.
- Ans.** Edible oil: It is used in food products, while others are used as fossil fuels.
- (7) Solar energy, nuclear energy, tidal energy, wind energy.
- Ans.** Nuclear Energy: It creates nuclear pollution while others are clean sources of energy.
- (8) Carbon dioxide, oxygen, sulphur dioxide, nitrogen dioxide.
- Ans.** Oxygen: It is a pure gas while others are harmful gases released by burning of coal.

**Q. 1. (A) 3. Find out the correlation:**

(1) Thermal power plant : Coal : : Nuclear power plant : .....

**Ans.** Uranium - Coal is used as a fuel to generate energy in a thermal power plant whereas uranium is used as a fuel to generate energy in Nuclear power plant.

(2) Series arrangement of modules : Strings : : parallel arrangement of string : .....

**Ans.** Solar array - Many modules are connected in series to form solar strings while many solar strings are connected in parallel to form a solar array.

(3) Coal consumption of world : 41% : : coal consumption in India : .....

**Ans.** 60% - The coal consumption of the world is 41% whereas coal consumption of India is 60%.

(4) Natural gas : CNG and LPG : : Nuclear power : .....

**Ans.** Uranium and plutonium - CNG and LPG are used as fuels in Natural gas power plant whereas uranium and plutonium are used as fuels in a nuclear power plant.

(5) Silicon solar cell of 1 cm<sup>2</sup> : 30 mA : : 100 cm<sup>2</sup> : .....

**Ans.** 3A - A silicon solar cell of dimension 1 cm<sup>2</sup> generates current of about 30 mA while silicon solar cell of dimension 100cm<sup>2</sup> generates current of about 3A.

(6) Water stored in dam : Potential energy : : Flowing water : .....

**Ans.** Kinetic energy - Water stored in dam is an example of potential energy and flowing water is an example of Kinetic energy.

(7) Atomic power plant : Steam turbine : : Natural power plant : .....

**Ans.** Gas turbine - The turbine used in atomic power plant is rotated using steam and the turbine used in thermal power plant is rotated using gas.

(8) Inverter : DC to AC : : Photovoltaic cell : .....

**Ans.** Solar energy to Electrical energy - Inverter converts the DC current to AC current while photovoltaic cell converts solar energy to electrical energy.

**Q. 1. (A) 4. Match the columns and complete the table:**

\* (1)

Column 'A'	Column 'B'	Column 'C'
(1) Coal	(a) Potential energy	(A) Wind electricity plant
(2) Uranium	(b) Kinetic energy	(B) Hydro electric plant
(3) Water reservoir	(c) Nuclear energy	(C) Thermal plant
(4) Wind	(d) Thermal energy	(D) Nuclear power station

**Ans.** (1 - d - C); (2 - c - D); (3 - a - B); (4 - b - A)

(2)

(2) Column 'A'	Column 'B'	Column 'C'
(1) Electromagnetic induction	(a) Silicon	(A) Uncontrolled chain
(2) Nuclear plant	(b) Heat from coal	(B) DC
(3) Photovoltaic cell	(c) Faraday	(C) Chemical energy
(4) Thermal power plant	(d) U - 235	(D) Changing magnetic field

**Ans.** (1 - c - D); (2 - d - A); (3 - a - B); (4 - b - C)

(3)

Column 'A'	Column 'B'
(1) Thermal power	(a) Only available in day time
(2) Wind power	(b) Air pollution
(3) Solar power	(c) Atomic radiation
(4) Atomic power	(d) Wind velocity

**Ans.** (1 - b); (2 - d); (3 - a); (4 - c)

(4)

Column 'A'	Column 'B'
(1) Series of solar cells	(a) Solar cell
(2) Series of solar panels	(b) Solar String
(3) Solar strings in parallel	(c) Solar panel
(4) semiconductor silicon	(d) Solar array

**Ans.** (1 - c); (2 - b); (3 - d); (4 - a)

(5) Column 'A'	Column 'B'
(1) Thermal power station.	(a) CNG
(2) Nuclear power station	(b) Coal
(3) Solar cell	(c) Uranium
(4) Natural gas power	(d) Silicon

**Ans.** (1 - b); (2 - c); (3 - d); (4 - a)

**Q. 1. (A) 5. State whether the following statements are true or false and correct the false statement:**

- (1) There is heat energy stored in coal.
- (2) In thermal power plant water is boiled using cooling tower.
- (3) In thermal power plant, turbine rotates because of steam.
- (4) In the nuclear reactor, aluminium is used as a fuel.
- (5) The reaction in the atomic reactor is a type of uncontrolled chain reaction.
- (6) If U-235 is bombarded with a neutron, it gets converted into U-237.
- (7) Atomic energy is a very good energy source.
- (8) The efficiency of natural gas plant is less than that of thermal power station working on coal.
- (9) Energy released during fission is measured in joules.
- (10) The product after fission of nuclear fuels are harmless.
- (11) Carbon dioxide generated due to burning of fuels like coal, diesel leads to problems like acid rain.
- (12) In wind turbine the function of the gearbox is to increase rotations per unit time
- (13) Wind turbine of specific capacity is selected depending on altitude.
- (14) In Nuclear fission, Uranium 236 releases two neutrons and converts into Barium and krypton.
- (15) Solar cells are made up of Silicon.

**Ans.** (1) False. Coal has chemical energy. (2) False. Water is boiled using boiler. (3) True. (4) False. Uranium is the fuel used in nuclear reactor. (5) False. The atomic reaction carried out in the nuclear reactor is a type of controlled chain reaction. (6) False. It gets converted into U-236. (7) True. It is a clean source as there is no combustion. (8) False. The efficiency of natural gas plant is more than that of thermal power plant that works on coal. (9) False. The energy released during fission is measured in MeV. (10) False. The product after fission of nuclear fuel are radioactive and emit harmful radiation. (11) False. Acid rains are caused by Nitrogen dioxide (12) True. (13) False. It depends on wind velocity. (14) False. 3 neutrons and Barium and Krypton. (15) True.

**Q. 1. (A) 6. Answer the following in one sentence.**

\* (1) What is Energy?

**Ans.** Energy is the capacity or stored ability of a body to do work.

(2) Write the types of mechanical energy?

**Ans.** Mechanical energy is of two types potential energy and kinetic energy.

(3) Where can we install wind turbines?

**Ans.** The wind velocity is usually high near the sea shore. Therefore, we can install wind turbines there.

(4) Can electrical energy be generated without using the principle of electromagnetic induction?

**Ans.** Yes, Solar radiation using solar cells.

(5) What is meant by Green energy? Give examples of green energy?

**Ans.** Green energy is the eco-friendly form of energy which does not cause environmental pollution.

Examples: Solar energy, wind energy, Hydroelectricity etc.

\* (6) Which electricity generation process is eco-friendly and which is not?

(Lets think Text book pg no. 52)

**Ans.** Wind mill, solar thermal plant are eco-friendly while thermal and nuclear power generation are not eco-friendly.

**Q. 1. (B) Choose and write the correct option:**

(1) Electromagnetic induction was discovered by .....

(a) Edison (b) Newton

(c) Michael Faraday (d) Archimedes

- (2) In combustion of coal.....gas is not released.  
(a)  $\text{SO}_2$  (b)  $\text{NO}_2$  (c)  $\text{NH}_3$  (d)  $\text{CO}_2$
- (3) Each nuclear fission of uranium nucleus releases ..... neutrons.  
(a) one (b) two (c) three (d) four
- (4) Water stored in the dam possess .....energy.  
(a) chemical (b) potential  
(c) kinetic (d) electric
- (5) The electric energy obtained from solar photovoltaic cell is of ..... type.  
(a) DC (b) AC  
(c) static (d) magnetic
- (6) Solar cell can work during ..... only.  
(a) night (b) morning  
(c) day time (d) evening
- (7) Each nuclear fission of uranium nucleus release ..... energy.  
(a) 20 MeV (b) 236 MeV  
(c) 237 MeV (d) 200 MeV
- (8) Wind turbines with capacity right from less than ..... to about ..... are commercially available.  
(a) 1 kW, 7000 kW (b) 10 kW, 700 kW  
(c) 1 MW, 700MW (d) 1 kW, 10kW
- (9) A good solar cell can have an efficiency of around .....  
(a) 50% (b) 10% (c) 15% (d) 51%
- (10) The natural gas based power plant in Maharashtra is at.....  
(a) Koyana (b) Chandrapur  
(c) Anjanvel (d) Tarapur
- (11) It took millions of years for the formation of ..... fuels.  
(a) chemical (b) solid  
(c) gaseous (d) fossil
- (12) The photovoltaic cells convert ..... energy into electrical energy.  
(a) mechanical (b) solar  
(c) chemical (d) sound
- (13) ..... is not a component of nuclear power plant.  
(a) control rods (b) gas turbine  
(c) steam turbine (d) condenser

**Ans.** (1) (c) Michael Faraday (2) (b)  $\text{NH}_3$  (3) (c) three (4) (b) potential (5) (a) DC (6) (c) daytime (7) (d) 200 MeV (8) (a) 1kW, 7000kW (9) (c) 15% (10) (c) Anjanvel (11) (d) fossil (12) (b) solar (13) (b) gas turbine.

### Q.2.1. Define the following:

#### (1) Electric generator

**Ans.** The device that converts mechanical energy to electrical energy is called an Electric Generator.

#### (2) Thermal power plant

**Ans.** The plant in which thermal energy is used to generate electrical energy is called thermal power plant.

#### (3) Nuclear power plant

**Ans.** The plant in which the nuclear energy is used to generate electrical energy is called nuclear power plant.

#### (4) Green energy

**Ans.** The energy generated by using wind, water, sunlight which is environment friendly is called green energy.

#### (5) Solar photovoltaic effect

**Ans.** Solar photovoltaic cell converts the solar radiation energy directly into electrical energy. This effect is called solar photovoltaic effect.

#### (6) Solar panel

**Ans.** Many solar cells come together to form a solar panel.

#### (7) Solar string

**Ans.** Many solar panels connected in series form a solar string.

#### (8) Hydro-electric power plant

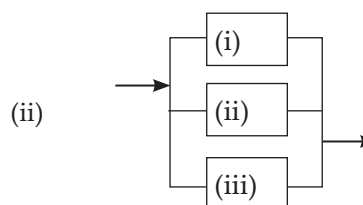
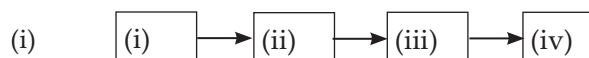
**Ans.** The plant in which the potential energy of the water stored in dam is converted into kinetic energy and this kinetic energy drives the turbine to generate electrical energy is called hydro-electric power plant.

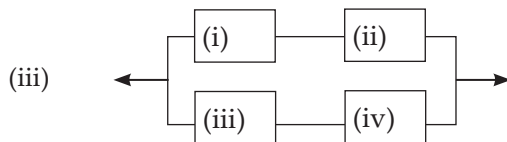
#### (9) Energy

**Ans.** The capacity or stored ability of a body to do work is called energy.

### Q.2.2. Solve the numerical problems:

**\* (1) In the diagrams below, silicon solar cells with dimensions  $1 \text{ cm}^2$  are connected. Find the potential difference and electric current?**



**Ans.**

- (i) A silicon solar cell of dimension  $1 \text{ cm}^2$  can yield 30 mA electric current and the potential difference of 0.5 V. In the diagram, four cells are connected in series.

$\therefore$  Total potential difference = Sum of the individual potential difference

$$\therefore V = V_1 + V_2 + V_3 + V_4$$

$$\therefore V = 0.5 + 0.5 + 0.5 + 0.5$$

$$\therefore V = 2\text{V}$$

There is no change in the electric current as cells are in series

$$\therefore I = 30 \text{ mA}$$

- (ii) From the silicon solar cell with dimension  $1 \text{ cm}^2$ , we get electric current of 30 mA and a potential difference of 0.5 V

Since the cells are connected in parallel, there is no change in potential difference.

$$\therefore V = 0.5 \text{ V}$$

Total current = Sum of individual currents.

$$I = I_1 + I_2 + I_3$$

$$\therefore I = 30 + 30 + 30$$

$$\therefore I = 90 \text{ mA}$$

$\therefore$  The potential difference is 0.5 V and current of 90 mA is produced.

- (iii) 30 mA electric current and 0.5 V potential difference can be obtained from  $1 \text{ cm}^2$  silicon solar cell.

Since cells (i), (ii) are in series,

Potential difference = Sum of the individual Potential differences.

$$V_a = V_1 + V_2$$

$$\therefore = 0.5 + 0.5$$

$$\therefore V_a = 1\text{V}$$

Electric current will be the same  $I_a = 30 \text{ mA}$

Since iii and iv are in series,

$$V_b = V_3 + V_4$$

$$= 0.5 + 0.5$$

$$\therefore V_b = 1 \text{ V}$$

Since (i) and (ii), (iii) and (iv) are in parallel,

$\therefore$  Potential difference will remain the same.

$$V = V_a = V_b = 1 \text{ V}$$

$$\begin{aligned} \therefore \text{ Total electric current } (I) &= I_a + I_b \\ &= 30 + 30 \\ &= 60 \text{ mA} \end{aligned}$$

$\therefore$  Potential difference is 1V and electric current of 60 mA can be obtained

- \* (2) How much potential difference and electric current we can get from  $100 \text{ cm}^2$  dimension of silicon solar cell?**

**Ans.** The electric current is proportional to the area but the potential difference is independent of the area.

Area of  $1 \text{ cm}^2$  can yield 30 mA current

$\therefore$  The current obtained from  $100 \text{ cm}^2$  area

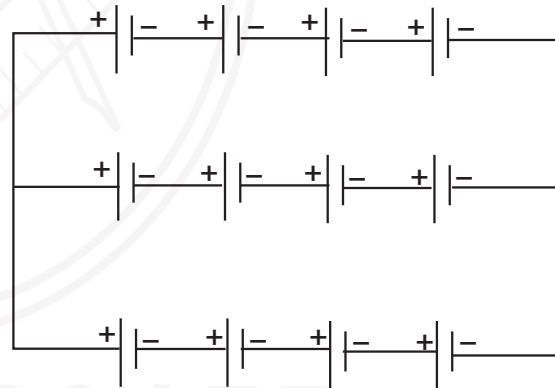
$$= 100 \times 30$$

$$= 3000 \text{ mA} = 3 \text{ A}$$

The potential difference will remain 0.5 V.

Potential difference is 0.5 V and electric current of 3 A is produced.

- \* (3) One solar panel produces a potential difference of 18 V and current of 3 A. Describe how you can obtain a potential difference of 72 volts and current of 9 A with a solar array using solar panels. You can use sign of a battery for a solar panel.**

**Ans.**

**Q.2.3. Answer the following questions:**

- \* (1) What are the different forms of energy?**

(Can you recall Text book pg no. 47)

**Ans.** Following are the forms of energy : (i) Mechanical energy (ii) Heat energy (iii) Light energy (iv) Sound energy (v) Electrical energy (vi) Magnetic energy (vii) Chemical energy (viii) Nuclear energy

- \* (2) How is Electric energy produced?**

(Can you tell Text book pg no. 47)

**Ans.**

- (i) Most of the electric power plants are based on the principle of electro - magnetic induction invented by Michael Faraday.

(ii) According to this, whenever magnetic field around a conductor changes a potential difference is generated across the conductor and electrical energy is produced.

**\* (3) Why the energy in the coal is called as chemical energy?**

(Lets Think Text book pg no. 49)

**Ans.**

(i) Coal contains carbon and hydrocarbons which produce heat on combustion.

(ii) Hence energy in coal is called chemical energy.

**\* (4) How does nuclear fission take place?**

(Can you tell Text book pg no. 50)

**Ans.**

(i) When a slow moving neutron is bombarded on Uranium - 235 nucleus, it absorbs the neutron and gets converted into its isotope Uranium - 236.

(ii) Uranium - 236 being extremely unstable, converts into atoms of Barium and Krypton through a process of fission releasing three neutrons and 200 MeV energy.

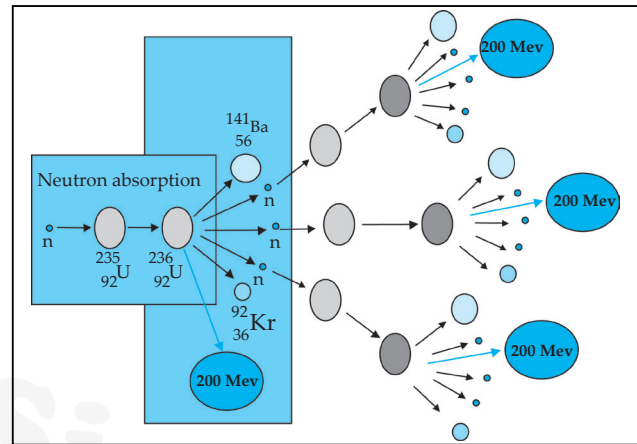


Fig. 5.1 : Nuclear fission (chain reaction)

**(5) What are the problems associated with hydroelectric power plant?**

**Ans.**

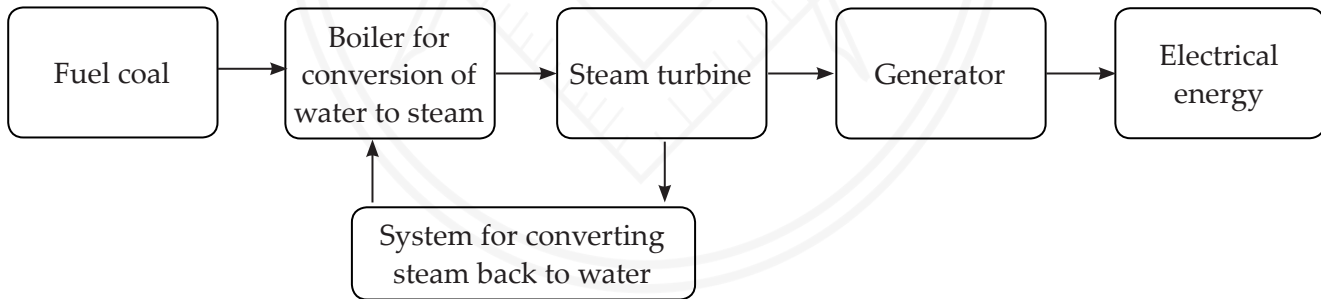
(i) The back water due to storage of water in dam may submerge villages or towns in that area as well as forests and fertile lands.

(ii) This leads to the problems of rehabilitation of the displaced population.

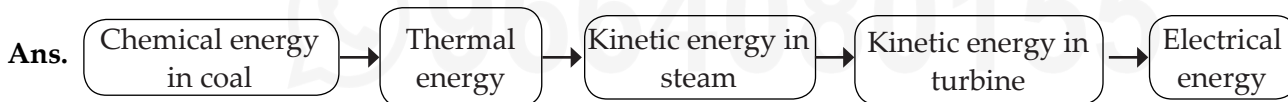
(iii) The obstruction of the flow of river water may have adverse effects on the aquatic world in the river.

**Q. 2.4 Complete the following flowchart:**

**(1) Stages in the generation of Electrical Energy from thermal energy.**

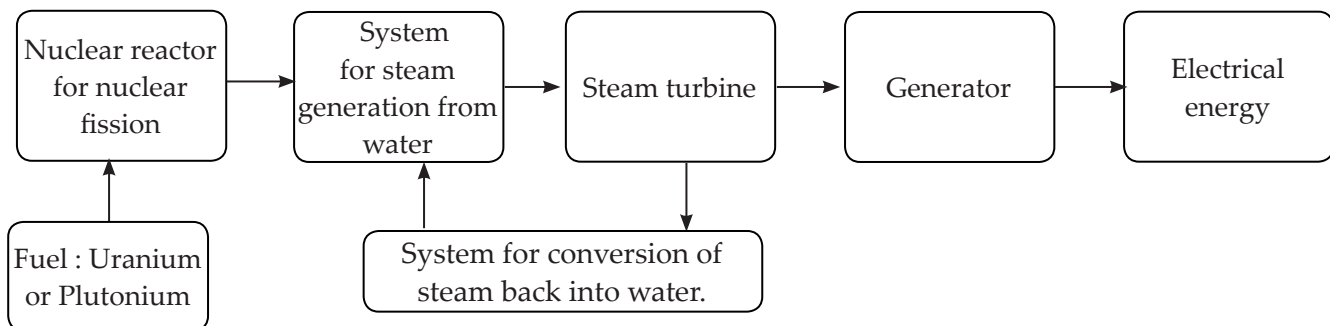


**\* (2) Step by step Energy Conversion in thermal power plant.**



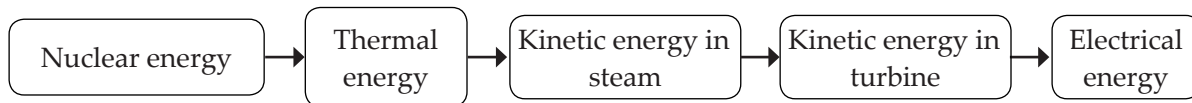
**(3) Stages in generation of Electrical energy from nuclear energy.**

**Ans.**



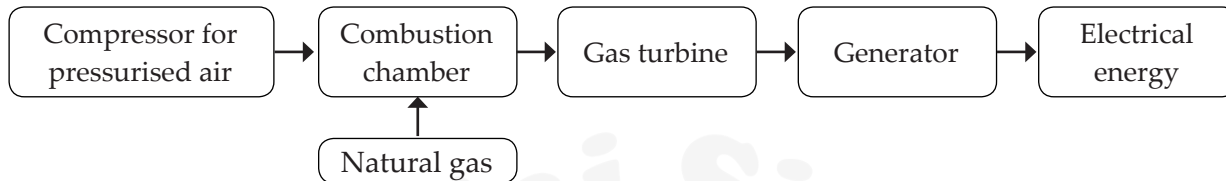
**\*(4) Step by step Energy conversion in nuclear power plant.**

**Ans.**



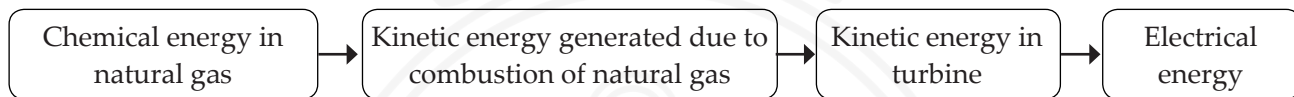
**(5) Stages in generation of electrical energy from natural gas.**

**Ans.**

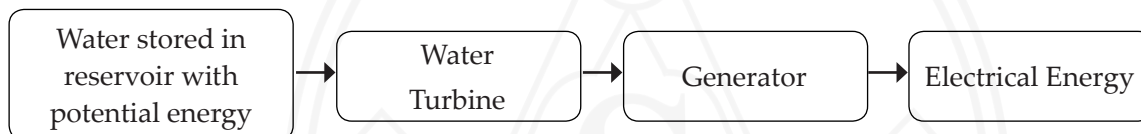


**(6) Step by step energy conversion in power plant of natural gas.**

**Ans.**

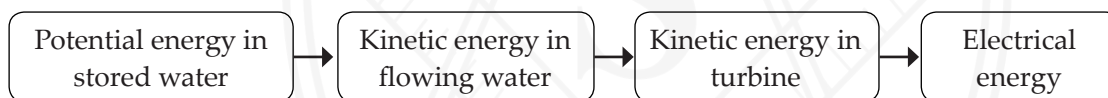


**(7) Stages of generation of Electrical energy from hydroelectric power station.**



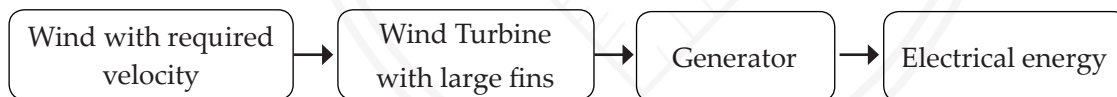
**\*(8) Step by step energy conversion in hydroelectric power plant.**

**Ans.**



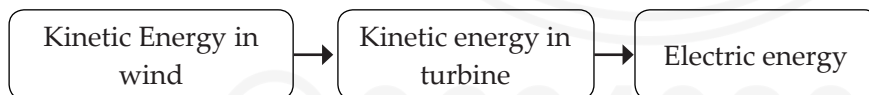
**(9) Stages in generation of Electrical energy from wind energy.**

**Ans.**



**(10) Step by step energy conversion using wind energy.**

**Ans.**



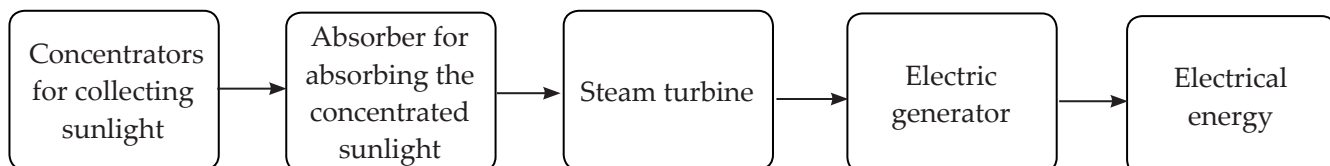
**(11) Conversion of energy generated by solar cells to AC formed using inverter.**

**Ans.**



**(12) Different stages of generation of electrical energy is solar thermal power plant. OR  
Step by Step energy conversion in solar thermal power plant.**

**Ans.**



**Q.2.5 Distinguish between:****(1) Bio-fuels and Fossil fuels**

Bio-fuels	Fossil fuels
(1) The fuels obtained from the decomposition of excretory products of animal and plants are called bio-fuels.	(1) Fuels obtained from the burials of plants and animal from the Earth's crust are called fossil fuels.
(2) These fuels are eco-friendly and cause comparatively less pollution.	(2) These fuels are not eco-friendly as their combustion causes pollution.
(3) These fuels are inexhaustible.	(3) These fuels are exhaustible.
(4) Examples: Gobar gas, ethanol, bio-diesel, etc.	(4) Examples: Coal, natural gas, crude oil, etc.

**\* (2) Conventional energy sources and Non-conventional energy sources.**

Conventional energy sources	Non-conventional energy sources.
(1) Conventional energy sources are exhaustible.	(1) Non-conventional sources of energy are inexhaustible
(2) Conventional sources of energy cause pollution.	(2) Non - conventional sources of energy are pollution free.
(3) Conventional sources are used extensively by us.	(3) Non-conventional sources of energy are not used as extensively as conventional sources.
(4) These sources require thousands of years to form.	(4) They are abundantly available in nature.
(5) Examples: Coal, Crude oil, Natural gas, etc.	(5) Examples: Solar energy, wind energy, bio-gas etc.

**\*(3) Thermal electricity generation and Solar thermal electricity generation**

Thermal electricity generation	Solar thermal electricity generation
(1) In thermal power plant coal, natural gas, etc are used as sources (fuels).	(1) In solar power plant, solar radiations are used as the source.
(2) Working of thermal power plant can cause air pollution.	(2) Solar power plant does not causes air pollution.
(3) The rate of electric power generation is very high.	(3) The rate of electric power generation is very low.
(4) This energy source is not eco-friendly.	(4) This energy source is absolutely eco-friendly.

**(4) Solar Cells and Solar thermal plant**

Solar Cells	Solar thermal plant
(1) Solar or photovoltaic cells convert solar energy into electrical energy directly.	(1) Solar thermal plant converts solar energy into heat energy then into kinetic energy and then into electrical energy.
(2) Solar photovoltaic cells make use of a semiconductor like silicon.	(2) It uses reflectors to concentrate sunlight on absorbers.
(3) Its design is simple and easy to use.	(3) Its design is complex like a thermal power plant.



**Q.2.6 Give scientific reasons:****(1) Atomic energy is an extensive source of energy.****Ans.**

- (i) Atomic energy involves two reactions, viz. Nuclear fission and Nuclear fusion.
- (ii) Both these reactions result in the release of tremendous amount of energy.
- (iii) Nuclear fission reaction is used in Nuclear power plants to produce electrical energy.
- (iv) Nuclear fusion reaction takes place in the sun giving us solar energy.
- (v) Therefore, atomic energy is an extensive source of energy.

**\*(2) The construction of turbine is different for different types of power plants.****Ans.**

- (i) Every power plant uses a different kind of source to rotate the turbine.
- (ii) In thermal and nuclear power plants, steam produced rotates the turbine.
- (iii) In hydroelectric power plant, flowing water is used to rotate turbines and wind is the medium in windmills.
- (iv) Also the power output of every power plant is different.
- (v) Hence, there should be turbines of different designs for different power plants.

**\*(3) It is absolutely necessary to control the fission reaction in nuclear power plants.****Ans.**

- (i) Nuclear power plants work on the principle of controlled chain reaction.
- (ii) When slow moving neutrons strike the uranium nucleus, it splits into Barium and Krypton with release of three neutrons and tremendous amount of energy (200 MeV).
- (iii) Three neutrons strike on three more uranium nucleus and fission continues creating tremendous energy which is harmful.
- (iv) Reaction is controlled by using neutron absorbent material like boron steel and cadmium rods which absorb excess neutrons and heat generated can be used for welfare of mankind.
- (v) Hence, it is absolutely necessary to control the fission reaction in nuclear power plants.

**\*(4) Hydroelectric energy, Solar energy and Wind energy are called renewable energies.****Ans.**

- (i) Hydroelectric energy, solar energy and wind energy are all obtained without burning of a fuel.
- (ii) They do not cause air pollution and are thus, eco-friendly.
- (iii) Sunrise, rainfall, wind are natural phenomena.
- (iv) These phenomena are constantly and continuously happening on earth.
- (v) By setting up hydroelectric power plant, solar panel and wind mills we can obtain these energies continuously, uninterrupted and at low cost. Hence, these sources are called renewable energy sources.

**\*(5) It is possible to produce energy from mW to MW using solar photovoltaic cells OR How can we get the required amount of energy by connecting solar photovoltaic cells?****Ans.**

- (i) A silicon solar cell of dimension  $1 \text{ cm}^2$  generates a current of about 30 mA and potential difference of about 0.5 V. Thus a silicon solar cell of dimension  $100 \text{ cm}^2$  will generate about 3 A ( $30 \text{ mA} / \text{cm}^2 \times 100 \text{ cm}^2 = 3000 \text{ mA}$ ) current and 0.5 V.
- (ii) If solar cells are connected in series the potential difference gets added but current remains the same. If solar cells are connected in parallel the potential difference remains the same but the current generated is the summation of current from individual cells.
- (iii) By using this principle we can obtain power of desired quantity.
- (iv) We can decide the number of solar panels to be used and what type of combination we can have to get required amount of electric power.
- (v) Hence, solar photovoltaic cells can be used to obtain mW to MW power.

**(6) In all types of thermal power plants, steam is used to rotate turbines.****Ans.**

- (i) In order to obtain electricity from a power plant, it is necessary to rotate the turbines.
- (ii) Water is easily available and when water is heated steam can be formed. When pressure is applied on steam and allowed to pass through a small opening we can easily obtain kinetic energy.
- (iii) Kinetic energy of the steam helps to rotate turbines easily and can be reused

(iv) Hence, in all types of thermal power plants steam is used to rotate turbines.

**(7) Boilers of the thermal power plants have tall chimneys.**

**Ans.**

(i) The thermal power plants mainly use coal and natural gas as a fuel which have chemical energy.

(ii) The combustion of coal or natural gas result in the formation of various gases like carbon dioxide and sulphur dioxide, nitrogen oxide gas which are very dangerous and cause air pollution.

(iii) These gases and the produced soot can be hazardous if released at the normal height.

(iv) Tall chimney release them at a height in such a way that they disperse easily and do not sediment

(v) Therefore, the chimneys of boilers are much taller.

**(8) Though nuclear energy is an extensive source but the amount of electric power generation from nuclear power plants is much less.**

**Ans.**

(i) The technology of nuclear power plant is highly expensive.

(ii) Similarly, the fuel Uranium required to run these plants is not available in all countries.

(iii) The fission products sometimes are radioactive and can cause environmental pollution.

(iv) Disposal of radioactive wastes from the nuclear power plant is much more difficult as it can cause health hazards.

(v) Therefore, these plants are used on a limited scale thus energy production is also less.

**Q. 3. 1. Explain the following statements:**

**\*(1) 'Save energy' is the need of the hour.**

**Ans.**

(i) Energy is necessary to perform work.

(ii) Day by day the use of energy for various purposes is rising.

(iii) If we do not harness new sources of energy, the reserves of fossil fuels would get exhausted faster.

(iv) It is estimated that the current reserves would get over in nearly 200 years.

(v) If we save energy today, we may use it for longer period of time.

(vi) Thus it is important to take every possible measure to save energy.

**(2) Energy obtained from fossil fuels is not green energy.**

**Ans.**

(i) Fossil fuels cause pollution during combustion.

(ii) Burning of coal results in emission of gases like carbon dioxide which is harmful to health.

(iii) Coal and oil release sulphur dioxide and soot, which causes problems related to respiration and acid rain.

(iv) As fossil fuels harm the environment they cannot be considered as green energy.

**Q.3.2.Explain with diagram step-by-step energy conversion in.**

**\*(1) Thermal power plant:**

**Ans.** Refer Q.2.4 (2) for flow chart

(i) Coal has stored chemical energy and it is used as a fuel.

(ii) Coal is burnt to obtain heat energy. This is used to boil water to obtain steam.

(iii) Steam of very high temperature and pressure is generated.

(iv) The kinetic energy of the steam drives the turbines thus the generator connected to the turbines rotates and electricity is generated.

**\*(2) The Nuclear power plant**

**Ans.** Refer Q.2.4 (4) for flow chart

(i) When fuel U-235 is bombarded with a neutron it becomes unstable and splits into Barium, Krypton and 3 neutrons with a lot of energy (200 MeV)

(ii) By using this energy, water is boiled to form steam.

(iii) By using kinetic energy of steam the turbine is rotated.

(iv) Then the kinetic energy of the turbine is used to rotate the generator and electricity is produced.

**(3) Hydro-electric power plant**

**Ans.** Refer Q.2.4 (8) for flow chart

(i) Water stored in a dam's reservoir has potential energy.

(ii) When this water flows, the potential energy gets converted into Kinetic energy.

(iii) With the help of this Kinetic energy, the turbines are rotated.

(iv) The turbine in turn drives the generator to generate electricity.

**(4) Solar thermal power plant:**

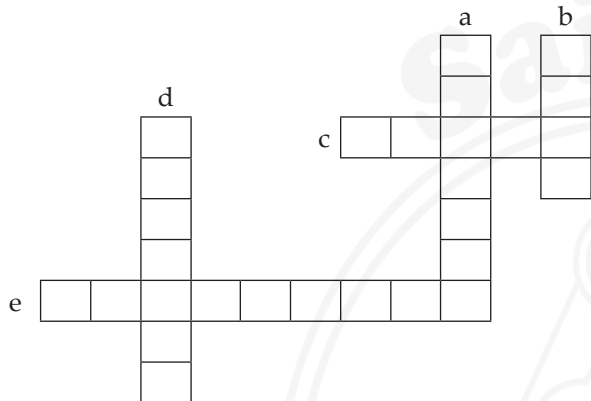
Refer Q.2.4 (12)

**Ans.**

- (i) Solar energy is initially converted into heat by concentrating it.
- (ii) The absorbed sunlight is utilized to boil water and steam is obtained.
- (iii) Kinetic energy of steam is used to drive turbines.
- (iv) The kinetic energy of turbine is used to drive generators which produce electricity.

**Q. 3.3 Solve the following crossword puzzle:**

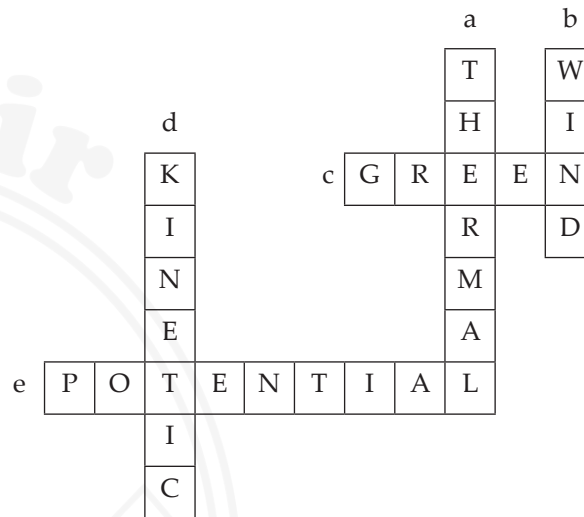
**\*(1)**



- (a) Maximum energy generation in India is done using ..... energy.

- (b) ..... energy is a renewable source of energy.
- (c) Solar energy can be called ..... energy.
- (d) ..... energy of wind is used in wind mills.
- (e) ..... energy of water in dams is used for generation of electricity.

**Ans.** (a) Thermal (b) Wind (c) Green (d) Kinetic (e) Potential



**Q.3.4. Answer following questions based on figures.**

- \*(1) Compare: Observe the schematic of thermal power plant and the nuclear power plant. Discuss what are the similarities and differences between the two?**

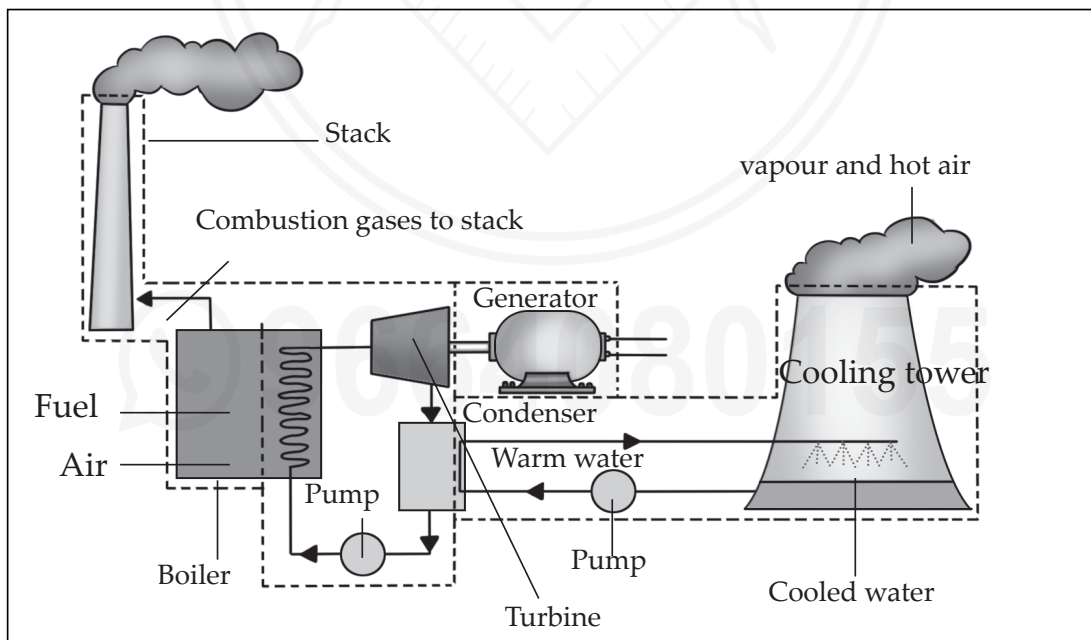


Fig. 5.2 Thermal Power Plant

**Ans. Similarity:** In both the power plants water is boiled to form steam and kinetic energy of the steam rotates the turbine.

**Differences :** In the thermal power plant coal is a main fuel that is burnt. In the nuclear power plant Uranium - 235 is the fuel which undergoes nuclear fission.

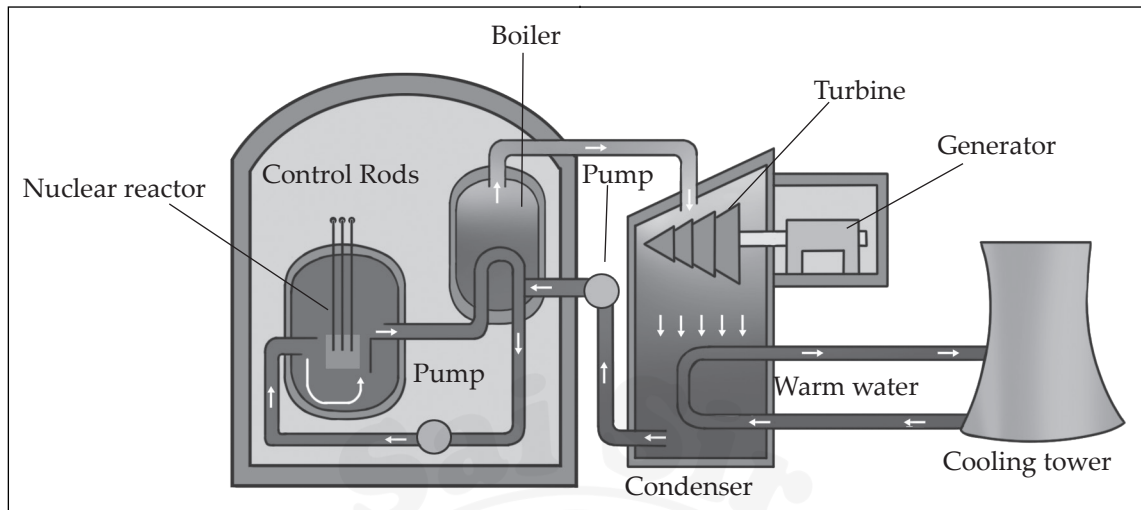


Fig 5.3 : Nuclear Power Plant

(2) Use your brain Power Text book Pg. No. 54)

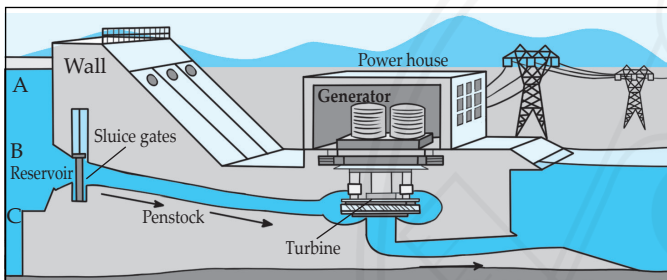


Fig 5.4. hydroelectric plant

(a) With reference to point B, potential energy of how much water reservoir in the dam will be converted into kinetic energy?

Ans. The potential energy of water stored in the region A to B, will be converted into kinetic energy.

(b) What will be the effect on electricity generation; if the channel taking water to turbines starts at point A?

Ans. The energy generation will increase as the water at A It will have higher potential energy that can generate higher kinetic energy as it flows.

(c) What will be the effect on electricity generation, if the channel taking water to turbine starts at point C.

Ans. The energy generation will decrease as the water at C will have lower potential energy that will generate lower kinetic energy as it flows.

(3)

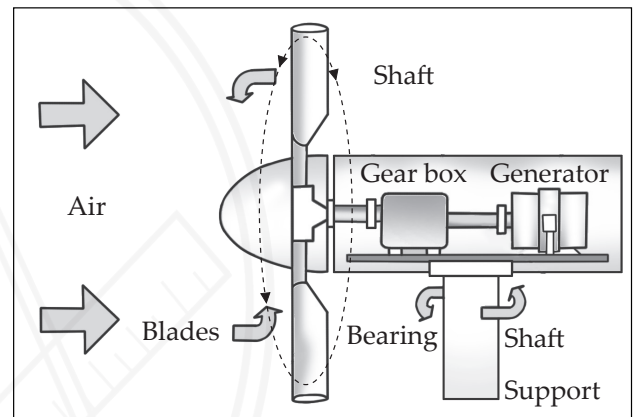


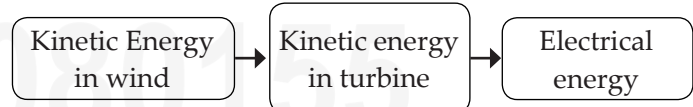
Fig 5.5 : wind mill

(a) What is the process shown in the diagram?

Ans. The process is the conversion of wind energy into electrical energy using a wind mill.

(b) Give the conversion of energy of the process.

Ans.



(c) Is this process environment friendly? Explain.

Ans. Yes, this process is environmentally friendly as it does not involve the burning of fuels which produce harmful gases as by products.

(d) What are the disadvantages of this process?

Ans. The disadvantage of this process is that the minimum wind velocity necessary for wind energy generation is not available every where.

(4)

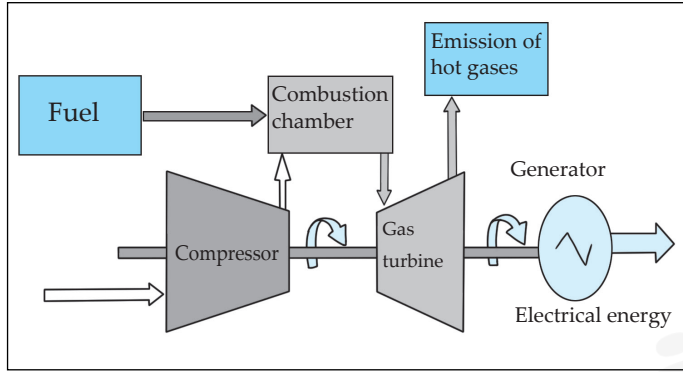


Fig. 5.6

(a) Which energy is produced?

Ans. Electrical energy.

(b) What is this power plant based on?

Ans. Generation of electricity from natural gas

(c) Is this energy generation eco-friendly? Why?

Ans.

(i) No, this energy generation is not eco-friendly as it leads to emission of certain gases and soot particles which leads to air pollution.

(ii) Also it takes millions of years for formation of natural gases and their reserves are limited.

(5)

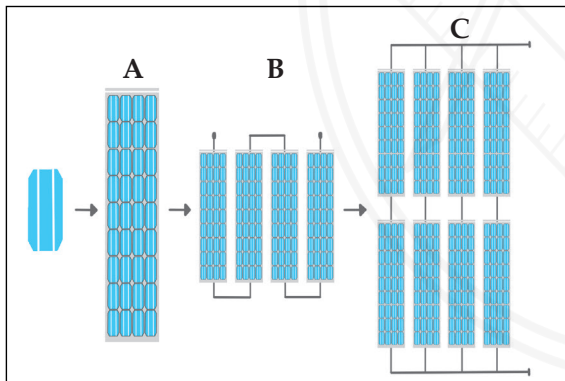


Fig. 5.7

(a) Label A, B and C in the diagram

Ans. A : Module, B : String, C : Array

(b) What is considered as a basic unit of a solar electric plant?

Ans. A Solar cell is the basic unit of a solar electric plant.

(c) What are the modules connected in series called?

Ans. The modules connected in series are called as string.

(d) What is the type of current obtained from a solar cell?

Ans. DC current.

(6)

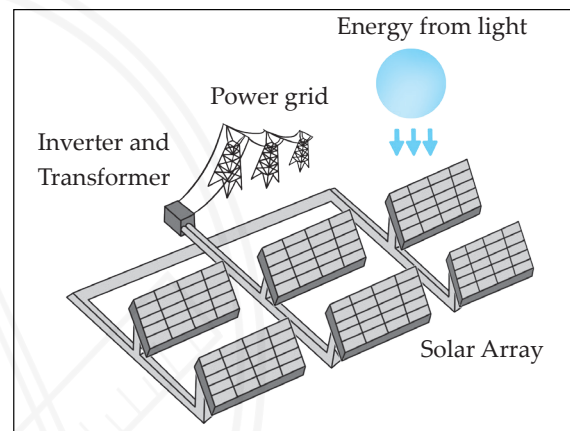


Fig. 5.8

(a) What is the diagram about?

Ans. It is a schematic diagram of a solar photovoltaic station.

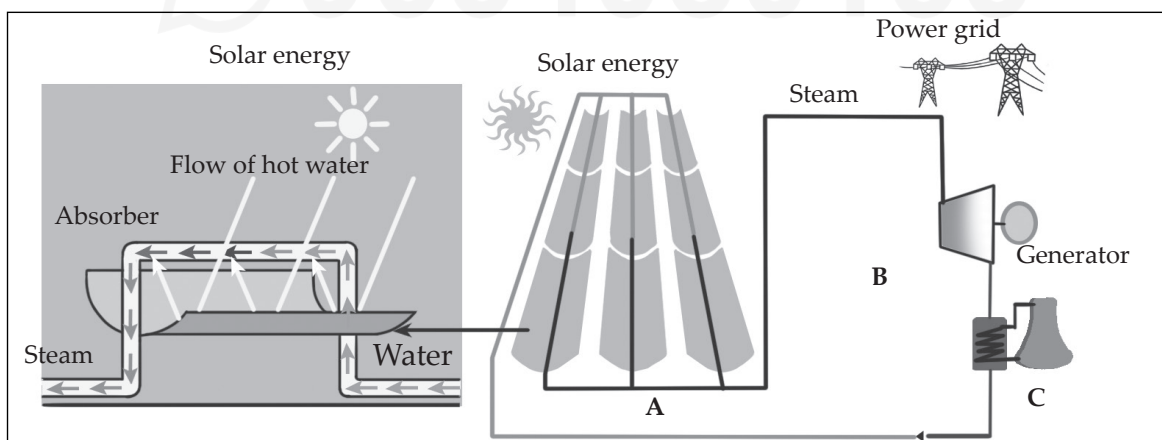
(b) What is the device used to convert DC solar power to AC solar power called?

Ans. An Inverter is used to convert DC solar power to AC solar power.

(c) What is the use of transformer?

Ans. A transformer transforms the voltage and current levels of generated power which is then fed into electricity distribution network.

(7)



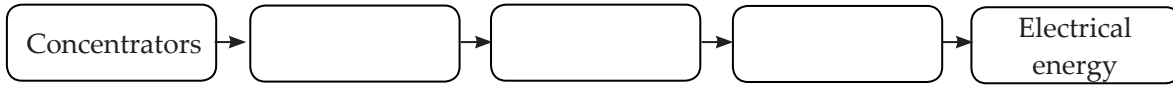
(a) Name the power plant shown in the diagram

Ans. Solar Thermal Power Plant.

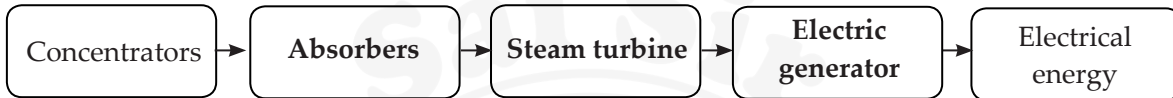
(b) Label A, B and C in the diagram.

Ans. A - Solar Panel, B - Condenser, C - Cooling Tower.

(c) Complete the flow chart for stages of energy generation in the above power plant.



Ans.



(8)

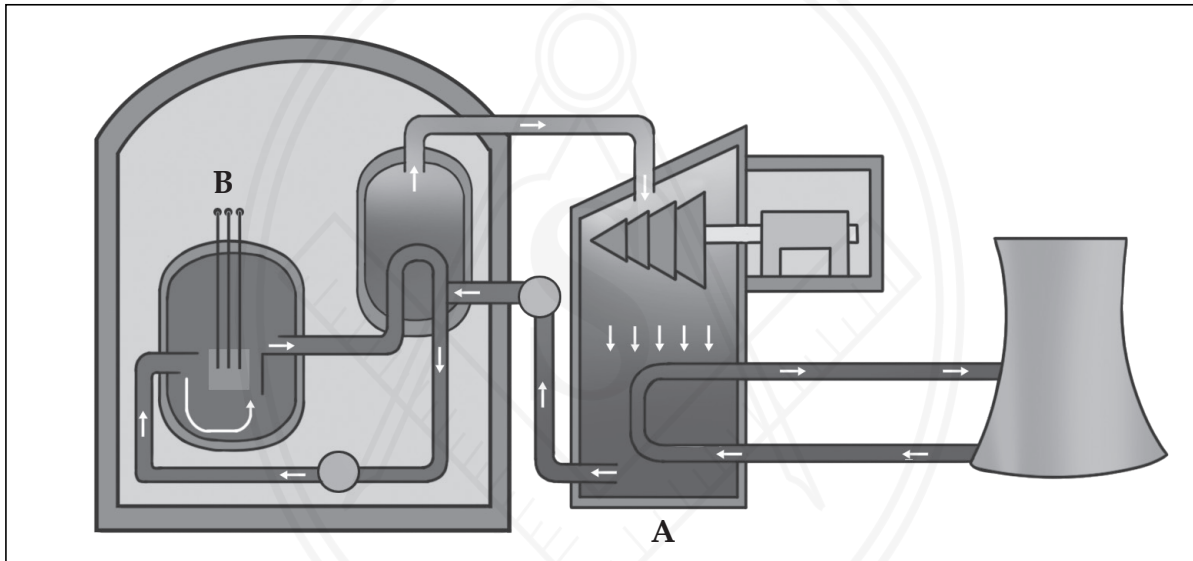


Fig. 5.10

(a) Label A and B in the diagram

Ans. A - Condenser,  
B - Control rods.

(b) Define nuclear fission.

Ans. The splitting of heavy nucleus of Uranium into Barium, Krypton and three neutrons, with release of energy is called nuclear fission.

(c) State the drawbacks of a nuclear power plant.

Ans.

- (i) Products of nuclear fission called nuclear waste are all radioactive. The disposal of nuclear waste is a big challenge.
- (ii) Sometimes accident can occur which can leak harmful radiations.
- (iii) Radiation pollution can be most dangerous.

Q.3.5. Draw neat and labelled diagrams for the following

(1) Electromagnetic Induction

Ans.

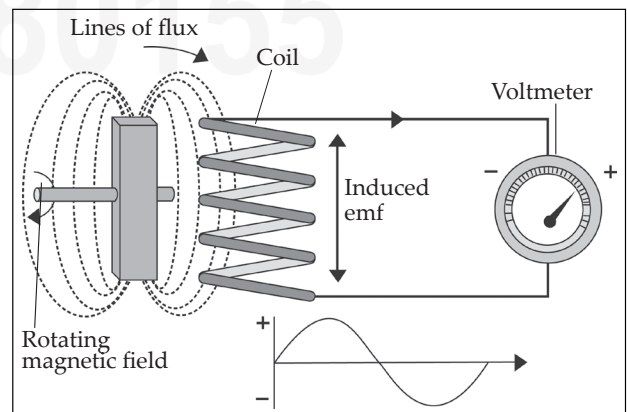


Fig. 5.11. Electromagnetic Induction

(2) Schematic of electric generator

Ans.

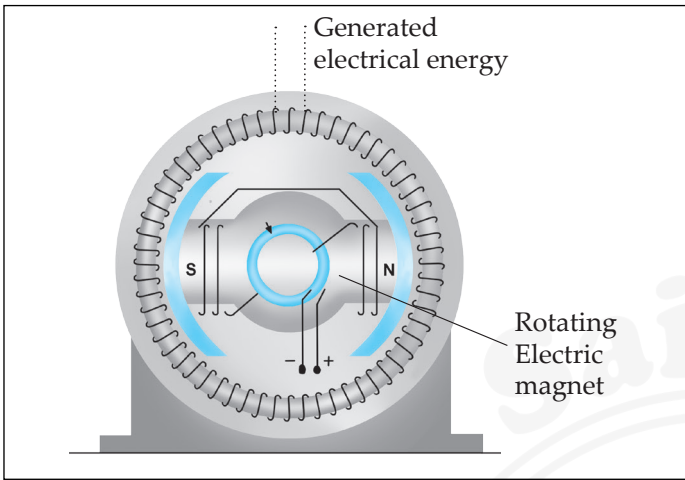


Fig. 5.12. Electric generator

(3) Series combination of solar cell.

Ans.

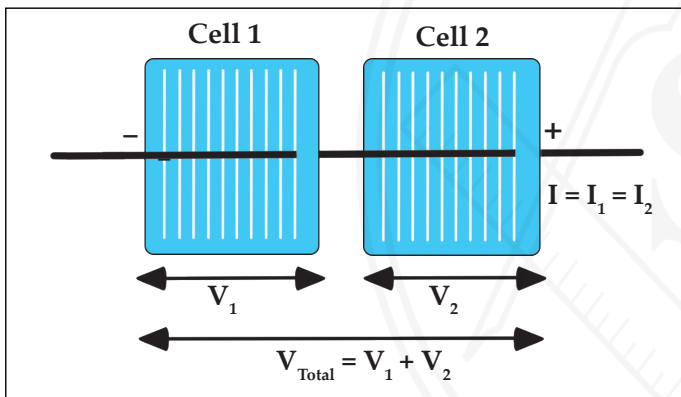


Fig 5.13. Solar cells in series

(4) Solar cells in parallel

Ans.

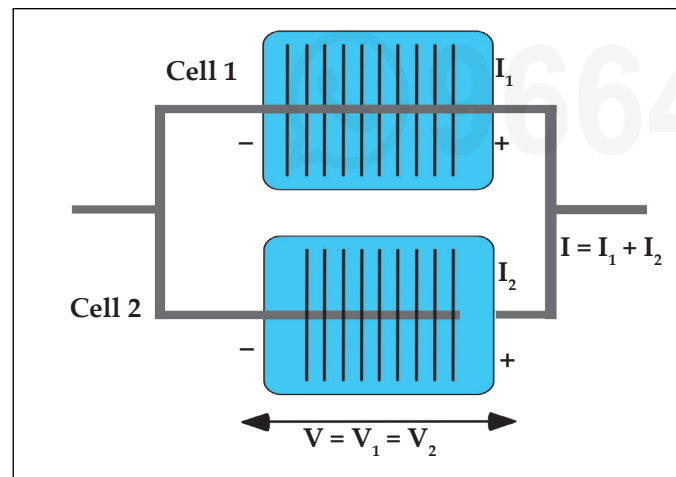


Fig 5.14. Solar cells is parallel

(5) A solar panel made from 36 solar cells.

Ans.

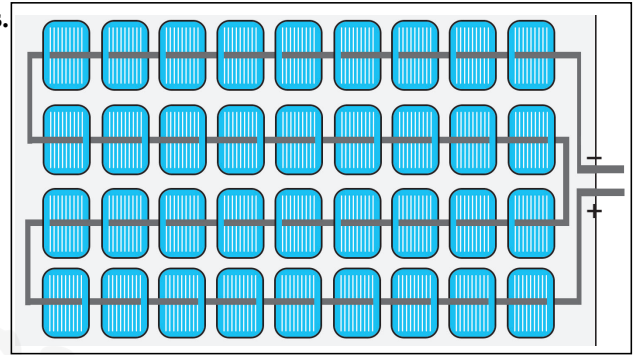


Fig 5.15. Solar panel made from 36 solar cells

Q.4. Answer the following questions in brief:

\*(1) Which fuel is used in thermal power plant? What are the problems associated with this type of power generation?

Ans. In the thermal power plant coal is used as a fuel.

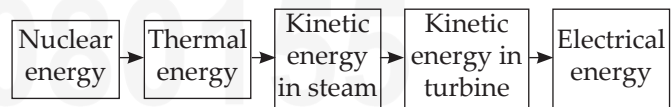
**Problems created by thermal power plant:**

- (i) The combustion of coal results in emission of gases like CO<sub>2</sub>, NO<sub>2</sub>, SO<sub>2</sub>, which causes air pollution.
- (ii) During combustion of coal, soot is formed thus carbon particles added to air can cause respiratory problems.
- (iii) Large amount of coal is required for this plant which may deplete the coal reserves rapidly. In the shortage or lack of coal the thermal power plant could be shut down.

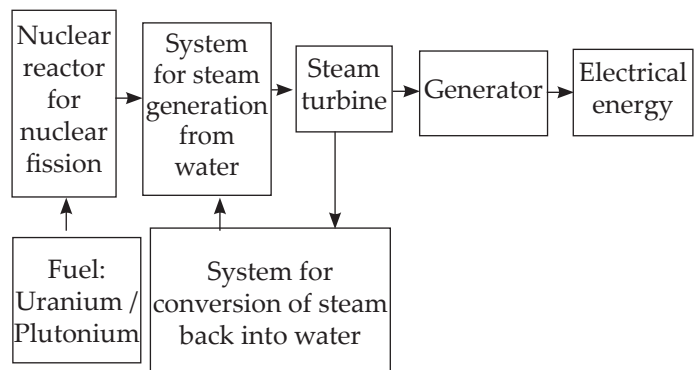
\*(2) Which types of power generation involve maximum number of steps of energy conversion? In which type of power generation is the number minimum?

Ans.

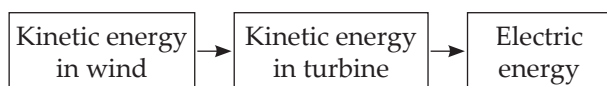
(i) The nuclear power plant has maximum steps for the generation of electricity.



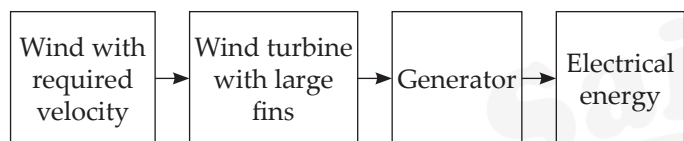
(ii) The flow chart of nuclear power plant



- (iii) The transformation of energy in an electric generator using wind energy has minimum number of steps:



- (vi) Stages in electric energy generation using wind energy.



- \* (3) Other than thermal power plant, which power plants use thermal energy for power generation? In what different ways is the thermal energy obtained?**

**Ans.**

- Thermal energy is used in power plants using coal, Uranium, Natural gas, (LPG and CNG) as fuels.
  - Generally, thermal power plant uses coal to produce heat and chemical energy of coal is converted into heat during the combustion.
  - Apart from coal, natural gas, LPG and CNG are also used as fuel for the thermal power plant.
  - Nuclear power plant uses uranium as the source of energy.
  - In the nuclear power plant the nuclear fission of uranium results in the production of heat which is utilized for the production of steam.
  - In the solar thermal plant, the heat is obtained by concentrating solar radiations and then steam is produced.
- (4) What is green energy? Which energy sources can be called as green energy source and why? Give examples.**

**Ans.**

- The eco-friendly energy is called green energy.
- The energy production which does not cause any damage to environment is actually a green energy.
- Solar energy, wind energy, hydro electric energy do not harm the environment as there is no combustion involved and there is no air pollution caused.

- (iv) Thus, energy obtained from these sources are called as green energy.

- (5) How does the nuclear fission process takes place in the nuclear power plant?**

**Ans.** (For diagram refer Fig. 5.1)

- The nuclear power plant works on the principle of converting nuclear energy to electrical energy.
- The Uranium nucleus U-235 is bombarded with a slow moving neutron. The uranium nucleus absorbs it and is converted into its isotope U-236 which is extremely unstable splits into Barium and Krypton with release of three neutrons and tremendous amount of energy.
- The released neutrons carry out fission of three more uranium nuclei and the process continues. This sets the chain reaction which is uncontrolled and may result in an explosion. But it is controlled in the process by using neutron absorbing material.
- Boron steel and cadmium rods are used to absorb neutrons
- Thus the reaction gets controlled and the energy released can be used for generating electricity.
- Hence the basis of nuclear power plant is controlled chain reaction.

- \* (6) How can you obtain the required amount of energy by connecting solar panels?**

**Ans.**

- Solar cells contain the semiconductor Silicon
  - A Silicon solar cells of area  $1 \text{ cm}^2$ , can generate 30 mA of electricity and 0.5V potential difference is obtained.
  - If two solar cells are connected in series the potential difference get added to 1V but electric current remains the same.
  - If two solar cells are connected in parallel, the current becomes 60 mA but potential difference remains the same. In this manner we can get the required potential difference and electric current.
- \* (7) What are the advantages and limitations of solar energy?**

**Ans. Advantages of solar energy:**

- Solar energy is a clean source of energy.
- It is a sure source of energy.
- It is eco-friendly source of energy.
- Since there is no combustion of fuel there is no pollution of air.



- (v) This energy source is in-exhaustible.
- (vi) Solar energy can be easily converted into electricity for use.

**Limitations of using solar energy:-**

- (i) Solar radiations are available only in day time.
- (ii) Storage equipment are costly and initial installation cost is very high.
- (iii) Radiation intensity is not constant throughout the day, hence it is not an even or uniform source.
- (iv) Solar panels occupy lot of space, hence there is an issue of space for installation.
- (v) It is not concentrated source as solar energy is scattered.
- (vi) Sunlight of power  $100 \text{ W/cm}^2$  can produce only  $15 \text{ W}$  power. i.e. the efficiency of equipments is  $15\%$  which is low.

**(8) Write the advantages and limitation of Nuclear energy:**

**Ans. Advantages of Nuclear energy:**

- (i) Use of nuclear energy does not emit gases which lead to air pollution.
- (ii) Storage of fuel and transport issues do not arise.
- (iii) Nuclear energy is an extensive and good source of energy .

**Limitation of nuclear energy.**

- (i) Products of nuclear fission called nuclear waste are all radioactive. The disposal of nuclear waste is a big challenge.
- (ii) Sometimes accident can occur which can leak harmful radiations.
- (iii) Radiation pollution can be most dangerous.

**\* (9) Give your opinion about whether hydroelectric plants are environment friendly or not?**

**Ans.**

- (i) In the hydroelectric power plant, kinetic energy of water get converted into electricity.
- (ii) The water stored in the dam possess potential energy. As this water is allowed to flow, this energy gets converted into kinetic energy.
- (iii) The kinetic energy of water is used to rotate the turbines and electricity is generated.
- (iv) In this, since no fuel is burnt, there is no air pollution and thus it is eco-friendly
- (v) Water mass does not get polluted as there are no effluents. This water can be used for agricultural purposes.

- (vi) Compared to thermal and nuclear power plants the hydroelectric power plant, is definitely eco-friendly.

- (vii) Rehabilitation of people is necessary for people whose land is used for construction of dam.

**(10) Write the advantages and limitation of wind power?**

**Ans. Advantages of wind power.**

- (i) Wind possess kinetic energy which rotates turbines and electricity is generated.
- (ii) In the entire process there is no combustion of any fuel, hence no air pollution.
- (iii) Thus wind energy is really a clean and eco-friendly source of energy.
- (iv) Since no fuel is required, there is no fear of getting raw material exhausted.
- (v) The area under the wind mill can be used for agriculture.

**Limitations of wind power :**

- (i) Slower wind produces  $9 \text{ kW}$  power while if there is lot of wind then around  $7 \text{ MW}$  power can be generated. If there is not enough speed of wind, generation of power will be less.

**\* (11) Write short notes on: Electrical energy generation and environment**

**Ans.**

- (i) The environment impact of electricity generation is significant because modern society needs large amount of electrical power.
- (ii) The power is normally generated at power plants that converts some other kind of energy into electrical power.
- (iii) Each system has some advantages and disadvantages, but many of them pose environmental concerns.
- (iv) Thermal power plants give out  $\text{CO}_2$ ,  $\text{NO}_2$ ,  $\text{SO}_2$  which causes air pollution.
- (v) Nuclear power plant pose the threat of disposal of nuclear waste and radiation leakage.
- (vi) Wind mills and solar power plants are eco-friendly but installation cost is high hence is used less frequently.
- (vii) Hydroelectric power plants are Eco-friendly and generate sufficient electricity but rehabilitation of people is necessary, whose land is used for construction of dam.

