| SR. NO | QUESTION | EXAM |
|---|---|---|
| 1. | **What are Multilateral Environmental Agreements (MEA)?** | **Important** |
| ANS: | Most **environmental problems have a transboundary nature** and often a global scope, and they can only be **addressed effectively through international co-operation**.<br><br>A multilateral environmental agreement (MEA) is a **legally binding agreement between three or more states** relating to the environment. They are predominantly produced by the United Nations. It is called a **bilateral environmental agreement if the agreement is between two nation states.**<br><br>Multilateral Environmental Agreements (MEAs) play a critical role in the overall framework of environmental laws and conventions. **Complementing national legislation and bilateral or regional agreements**, MEAs form the over-arching international legal basis for **global efforts to address particular environmental issues.**<br><br>**Division of Environmental Law & Conventions (DELC), of the United Nations Environment Programme (UNEP)** in close cooperation with the **MEA Secretariats** and stakeholders, provides support to States towards the **implementation of MEAs.** DELC works more broadly across MEAs, which have been categorized under the following thematic areas:<br>▪ **Biodiversity and Land-related**<br>▪ **Climate and Atmosphere-related**<br>▪ **Chemicals and Waste**<br><br>India is member of almost all major Multilateral Environmental Agreements (MEAs), under four clusters, namely the following:<br>**A. Nature conservation;**<br>**B. Hazardous material;**<br>**C. Atmospheric emissions;** and<br>**D. Marine environment.**<br><br>There are **20 major multilateral global MEAs,** to which India is a signatory. Some of these are listed below: | |

| | | |
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| | **NATURE CONSERVATION**<br>1. **Ramsar Convention on Wetlands**<br>2. **CITES** (Convention on International Trade in Endangered Species of Fauna and Flora)<br>3. **TRAFFIC** (The Wildlife Trade Monitoring Network)<br>4. **CAWT** (Coalition Against Wildlife Trafficking)<br>5. **CMS** (Convention on the Conservation of Migratory Species)<br>6. **CBD** (Convention on Biological Diversity)<br>7. **ITTC** (International Tropical Timber Organisation)<br>8. **UNFF** (United Nations Forum on Forests)<br>9. **IUCN** (International Union for Conservation of Nature and Natural Resources)<br>10. **GTF** (Global Tiger Forum)<br><br>**HAZARDOUS MATERIAL**<br>1. Cartagena Protocol on Biosafety<br>2. SAICM (Strategic Approach to International Chemicals Management)<br>3. **Stockholm Convention** on Persistent Organic Pollutants (POPs)<br>4. **Basel Convention** on the Control of Trans-boundary Movement of **Hazardous Waste and Their Disposal**<br>5. **Rotterdam Convention** on Prior Informed Consent (PIC) for certain Hazardous Chemicals and Pesticides in International Trade<br><br>**ATMOSPHERIC EMISSIONS**<br>1. **UNFCCC** (United Nations Framework Convention on Climate Change)<br>2. **Kyoto Protocol** (to curb greenhouse gasses emission)<br>3. UNCCD (United Nations Convention to Combat Desertification)<br>4. **Montreal Protocol** (on Ozone Depleting Substances)<br><br>**MARINE ENVIRONMENT**<br>1. **IWC (International Whaling Commission)** | |
| 2. | **What do you understand by 'ENVIRONMENTAL AUDIT' and 'ENVIRONMENTAL MANAGEMENT SYSTEM'? Why are they being used increasingly as environmental management tools? Briefly explain with examples 'ENVIRONMENTAL LABELS AND DECLARATIONS'.** | **April 2014** |

ANS:

**ENVIRONMENTAL AUDITING** is a **systematic, documented, periodic and objective** process in assessing an organization's activities and services in relation to:

- **Assessing compliance** with relevant statutory and internal requirements
- Facilitating **management control** of environmental practices
- Exploring **improvement** opportunities
- **Raising staff awareness** and **enforcing commitment** to environmental policy
- **Establishing the performance baseline** for developing an Environmental Management System (EMS)
- Maintaining **credibility** with the public
- **Promoting good** environmental management

**ADVANTAGES of the environmental audit consist in:** ***(P-E-M-E-R-O)***

- helps **protect** the natural environment;
- helps to identify current or potential **environmental problems**;
- allows **monitoring compliance** with the rules in the field;
- Facilitates the **exchange of comparative information** between enterprises.
- **reduces risks** of disputes, accidents as result of damages to the environment;
- allows the identification of **opportunities for achieving certain savings** through actions such as reducing waste volume;

**Environmental management system** (**EMS**) refers to the **management** of an organization's **environmental** programs in a **comprehensive, systematic, planned and documented** manner.

It includes the organizational structure, planning and resources for developing, implementing and maintaining policy for **environmental** protection.

- Based on the Plan Do Check Act **(PDCA Cycle)**
- Part of an organization's management system used **to develop and implement its environmental policy** and **manage its environmental aspects**
- A management system is a **set of interrelated elements used to establish policy** and objectives and to achieve those objectives

- A management system includes **organizational structure**, **planning activities**, **responsibilities**, **practices**, **procedures**, **processes** and **resources**

**BENEFITS FROM IMPLEMENTATION of an environmental management system:** *(I-O-P-D-C-I-W-S)*

- the decision making receives an advanced **informational support**;
- **new opportunities** are detected through analyzing environmental costs, used then for savings by recycling;
- improving the **pricing policy**;
- assistance in the process of **data reporting**;
- increasing **competitive advantage**;
- improving entity's **image**, mainly by efforts to reduce environmental costs;
- attracting and motivating staff by creating **favorable working conditions** and opportunities;
- **social benefits** by willingness to cooperate for a "cleaner" environment

**ISO 14020: Environmental Labels and Declarations Related**

✓ **Examples of Environmental Labels:** Environmental labelling provides an **indication of the environmental impact**—**related characteristics** of a product, typically on the package containing the product, by private or public institutions.

**Energy Star** (International);

**Blue Angel** (Germany);

**Eco Mark** (Japan);

**Environmental Choice** (Canada);

**Environmental Labeling** (China)

✓ **Examples of Environmental Declarations:** Environmental Product Declaration (EPD) is a standardized way of **quantifying the environmental impact** of a product or system

**Nokia:** Planet ke rakhwale;

**Pepsi:** Water Positive;

**Nerolac:** Low VOC;

Lead free paints from **Asian Paints**

**Reliance energy** use of Flyash for making in their premises of Dahanu plant

| | | |
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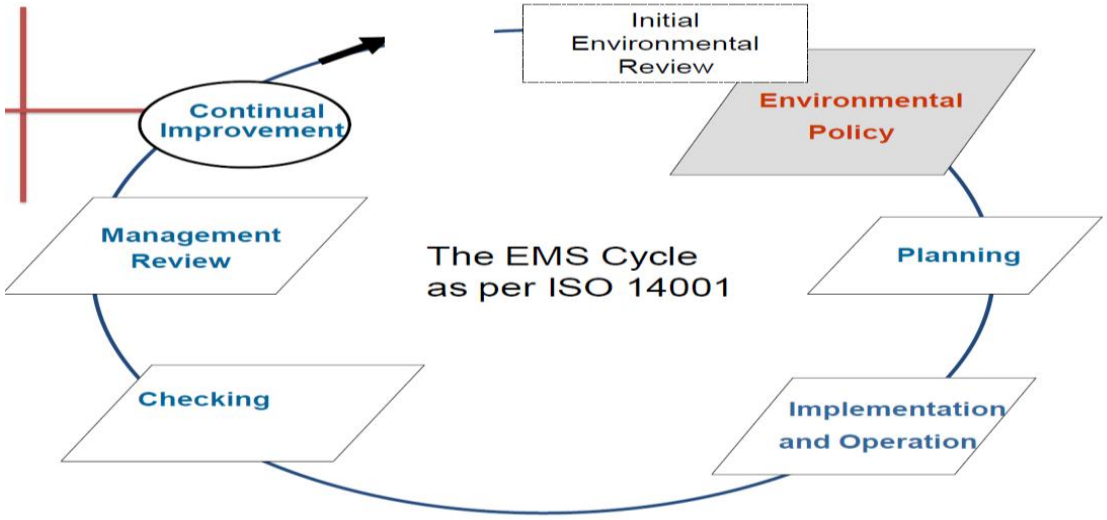
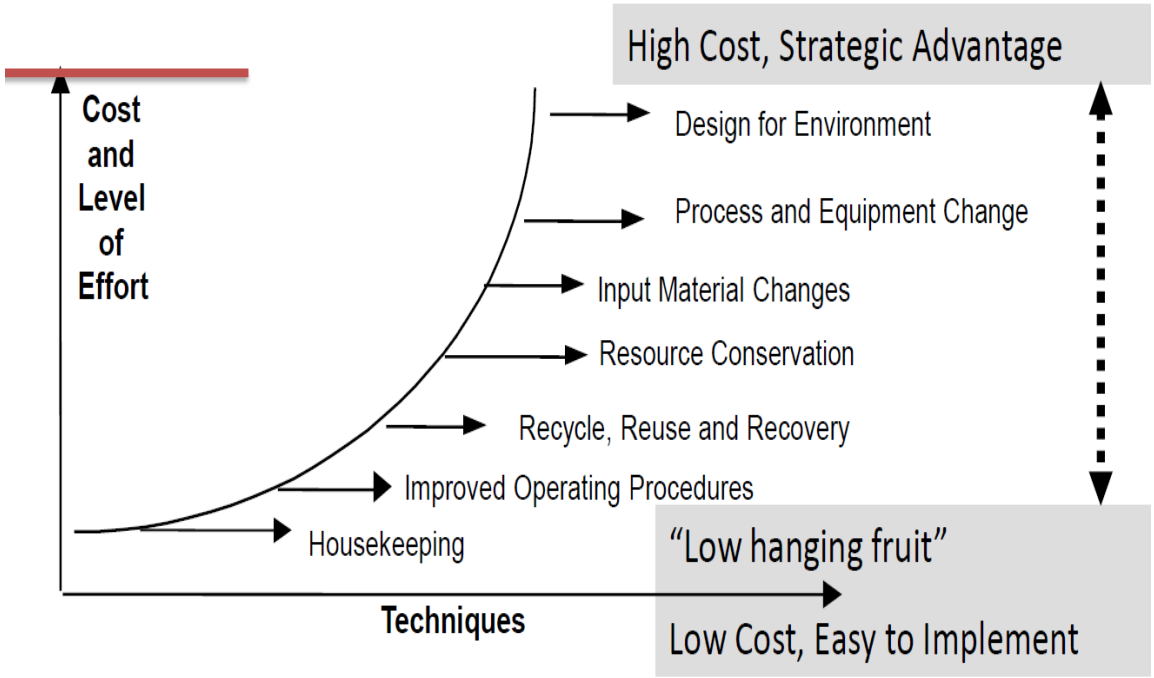
| 3. | **Describe how to put in place an effective Environmental Management System (EMS) which is ISO 14001 compliant** | **April 2013** |

ANS:

**THE 7-STEPS!**




**EMS CAN INCLUDE THE FOLLOWING APPROACHES – COST & EFFORTS**



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| | **1.** Obtain **commitment** from top management.<br>**2.** **Define** responsibilities, appoint management representative(s), establish EMS steering committee,<br>**3.** Have an **Environment Policy** in place. This:<br>o Sets the direction for the way the organisation plans to manages its environmental impacts<br>o Set by top management<br>o Acts as the pinnacle of the EMS<br>o Includes commitments to pollution prevention, legal compliance & continual improvement<br>o Includes framework for objectives & targets<br>o Must be effectively communicated & maintained<br>**4.** **Plan**—identify environmental aspects, legal & other requirements; formulate environmental policy; establish environmental objectives & targets & programs. Planning the EMS involves<br>o Environmental aspects<br>o Legal & other requirements<br>o Objectives, targets & programs<br>**5.** **Implementation & operation**—develop documentation & processes<br>**6.** **Checking**—develop processes for monitoring & measurement & corrective & preventive action<br>**7.** **Develop and deliver presentation on awareness** of the EMS in the agency.<br>**8.** **Establish internal audit program**, including training; conduct initial internal audit to evaluate conformity to requirements of ISO 14001, including evaluation of compliance<br>**9.** **Follow up** internal audit with improvements to system<br>**10.** Conduct initial **management review** of EMS<br>**Implement** improvements from management review | |
| 4. | **The following observations were among those made during an environmental audit of a manufacturing facility on April 5, 2011. Some of these are non-compliances from the environmental legal standpoint (NC). Identify which of the observations are NCs. Further, identify the act, notification under which these would be classified as NC's and how could the facility correct them:**<br>**a. The facility commenced operations in April 2010 – No NC**<br>**b. The facility is classified under the red category by the state pollution control board (SPCB) – No NC**<br>**c. The facility has a consent to operate (CTO) from the SPCB under the provisions of the water act,** | **April 2012** |

| | | |
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| | air act authorization under the hazardous waste rules. The CTO is valid till March 31, 2012 – No NC<br>d. The facility generates used oil, chemical sludge from effluent treatment plant and spent solvent. The CTO mentions only used oil and chemical sludge. There is no mention about the spent solvent. Further, scrutiny of applications made to the SPCB for CTO and subsequent renewals do not mention anything about spent solvent HAZMAT - Chapter II Procedure for handling hazardous wastes. Rule (5) Grant of authorization for handling hazardous wastes - Point (1)<br>e. The facility does not maintain records of hazardous wastes generated - HAZMAT - Chapter II Procedure for handling hazardous wastes - Rule (5) Grant of authorization for handling hazardous wastes - Point (6)<br>Also Chapter VII - Miscellaneous - Rule (22) Point No. 1 is also applicable.<br>However, when you write a NC only single reference to a single NC has to be given.<br>f. The facility has no furnished annual returns to the SPCB regarding hazardous wastes - HAZMAT - Chapter VII - Miscellaneous - Rule (22) Point No. 2<br>g. Hazardous waste is stored typically for a period of 4-6 months and thereafter disposed off with agencies not registered with the SPCB/CPCB. A common hazardous waste facility approved by the SPCB is operating in the state - HAZMAT - Chapter II Procedure for handling hazardous waste - Rule (4) Responsibilities of the occupier for handling of Hazardous Wastes - Point (2)<br>h. No documentation or records are maintained when consignments of hazardous waste leave the facility - HAZMAT - Chapter VI Packaging Labelling & Transport of Hazardous Waste - Rule (21)<br>i. The treated effluent is required to be connected to a particular manhole leading to the common effluent treatment plant in the area. The treated effluent sump (final unit in ETP) is connected to the subject manhole and effluent would normally flow there. However, in case of any overflow or spill or leak in the ETP, there is no way to prevent entry to the adjoining storm water drain. - THE WATER (PREVENTION AND CONTROL OF POLLUTION) RULES, 1975 Chapter V Section25 6(1)(a)<br>j. The facility has separate storages of hazardous (25 chemicals) and non hazardous chemicals (10 chemicals). All chemicals are in 200 lit drums or 25 lit carbuoys and storage quantities are below threshold limits. - HAZMAT - CHAPTER II - RULE 4 5(2)<br>k. The facility does not have an on site emergency management plan. - | |
| INFO | **HAZARDOUS MICRO-ORGANISMS/GENITICALLY ENGINEERED ORGANISMS or CELLS:** | |

Gazette of India

Ministry of Environment and Forest Notification dated **20 Sep 2006**

Part II – Section 3 – Sub Section (ii)

G.S.R.616 (E)

**Powers conferred by:** Rule 20 of the Rules for Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/genetically engineered organism Rules, 1989

**To Amend:** Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/genetically engineered organism

**CHEMICAL ACCIDENTS:**

Gazette of India

Ministry of Environment and Forest Notification dated **01 Aug 1996**

Part II – Section 3 – Sub Section (i)

G.S.R.347 (E)

**Powers conferred by:** Section 6 , 8 & 25 of Environment Protection Act, 1986 (29 of 1986)

**To Amend Rules:** Chemical Accidents (Emergency Planning, Preparedness , and Response) Rules, 1996

**HAZARDOUS WASTE:** *(SPCB/CPCB related)*

Gazette of India

Ministry of Environment and Forest Notification dated **24 Sept 2008**

Part II – Section 3 – Sub Section (ii)

S.O.2265(E)

**Powers conferred by:** Section 6 , 8 & 25 of Environment Protection Act, 1986 (29 of 1986)

**To Amend Rules:** Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008

**PUBLIC LIABILITY INSURANCE:**

Gazette of India

Ministry of Environment and Forest Notification dated **04 Nov 2008**

Part II – Section 3 – Sub Section (i)

G.S.R.768 (E)

**Powers conferred by:** Section 7A of Public Liability Insurance Act, 1991 (16 of 1991)

**To Amend:** Environment Relief Fund Scheme, 2008

**AIR:**

Gazette of India

Ministry of Environment and Forest Notification dated **16 Nov 2009**

Part II – Section 3 – Sub Section (i)

GSR 826 (E)

**Powers conferred by:** Section 6 & Section 25 of Environment Protection Act, 1986 (29 of 1986)

**To Amend:** Environment (Protection) Seventh Amendment Rules, 2009

**ENVIRONMENT IMPACT ASSESSMENT:**

Gazette of India

Ministry of Environment and Forest Notification dated **01 Dec 2009**

Part II – Section 3 – Sub Section (ii)

S.O.3067 (E)

**Powers conferred by:** Section 3 of Environment Protection Act, 1986 (29 of 1986)

**To Amend Rules:** Environment Protection Rules, 1986

**NOISE:**

Gazette of India

Ministry of Environment and Forest Notification dated **11 Jan 2010**

Part II – Section 3 – Sub Section (ii)

S.O.50(E)

**Powers conferred by:** Section 6 & 25 of Environment Protection Act, 1986 (29 of 1986)

**To Amend Rules:** Noise Pollution (Regulation & Control) Rules, 2000

**BATTERIES:**

Gazette of India

Ministry of Environment and Forest Notification dated **04 May 2010**

Part II – Section 3 – Sub Section (ii)

S.O.1002(E)

**Powers conferred by:** Section 6 , 8 & 25 of Environment Protection Act, 1986 (29 of 1986)

| | | |
|---|---|---|
| | **To Amend Rules:** The Batteries Management and Handling Rules, 2001<br><br>**e-WASTE:**<br>Gazette of India<br>Ministry of Environment and Forest Notification dated **12 May 2011**<br>Part II – Section 3 – Sub Section (ii)<br>S.O.1035(E)<br>**Powers conferred by:** Section 6 , 8 & 25 of Environment Protection Act, 1986 (29 of 1986)<br>**To Amend Rules:** e-Waste (Management & Handling) Rules, 2011<br><br>**PLASTIC:**<br>Gazette of India<br>Ministry of Environment and Forest Notification dated **02 Jul 2011**<br>Part II – Section 3 – Sub Section (ii)<br>S.O. 1527 (E)<br>**Powers conferred by:** Section 3, 6 & 25 of Environment Protection Act, 1986 (29 of 1986)<br>**To Amend:** Plastic Waste (Management & Handling) Rules, 2009 | |
| 5. | **"The Bhopal Gas Leak disaster, which took place just after midnight on 3rd December 1984, is undoubtedly the worst industrial accident in history" – What lessons has India learnt from the same? Briefly discuss the factors that are believed to have led to the Bhopal Gas Tragedy. Also, discuss either the lessons learnt by India from the tragedy OR discuss the salient features of the MSIHC rules** | **April 2013**<br><br>**April 2014** |
| ANS: | The Bhopal Gas tragedy is the worst air pollution episode ever witnessed in India. It happened in Bhopal on December 3, 1984.<br>**FACTORS THAT CAUSED THE TRAGEDY:**<br>**1)** The plant was **located in densely populated area** of old Bhopal.<br>**2)** The **factory turned on the public siren about an hour after** the gas started releasing into the atmosphere.<br>**3)** The **water jet had failed to reach at the top of the 120 ft. stack** from which MIC gas was gushing out.<br>**4)** The poisonous gas was **stored in the tanks for more than two months**, violating the safety rules.<br>**5)** The **refrigeration units** for the storage tanks containing MIC gas **were out of order** for several months. | |

6) The plant had two main safety devices:
   - **Scrubber,** which neutralize the gas with caustic soda and
   - **Flare tower,** where the gas can be burnt off.

Both the **safety devices failed** to operate on that particular day.

**LESSONS LEARNT:**

1) **INADEQUATE SAFETY LAWS:** The Bhopal disaster has exposed the safety systems in India. In the Bhopal case, the **safety was ignored even at the time of granting of license for location** of the plant at Bhopal in 1969.
   The accident probably began because of the runaway reaction of MIC with water. One of the reasons could be attributed to an **untrained worker handling it.**
   Several employees of the UCIL stated that factors like **design inadequacies, operation practices, poor quality training of workers, lack of information and illegal plant modifications** were responsible for this disaster.

2) **DOUBLE STANDARD:** Union Carbide Corporation maintained double standards regarding safety measures at the Bhopal plant. Safety measures such as **computerized pressure, temperature sensing system** and other effective alternatives were non-existent in the Bhopal Plant.
   **A West Virginia sister plant was provided** with computerized early warning system which was **not made available to the Indian plant.**
   **In the American plant, MIC could be stored for a maximum period of 15 days**, whereas in India, it was stored for months.
   Many safety systems were **manual in India** but computerized in West Virginia.

3) **SAFETY MEASURES & FINANCIAL HARDSHIPS:** **Safety mechanisms** and **preventive maintenance** were the first to be curtailed when the Union Carbide Plant suffered financial losses. It is really ironic that the **factors that were most important were curtailed to make profits.**

4) **STATE NEGLIGENCE:** The **Govt. of India and the Govt. of Madhya Pradesh also failed to take effective preventive steps while granting the license** for the manufacture of highly toxic pesticide. The Govt. did not possess adequate information regarding the toxic nature of MIC and its medical antidotes in the event of an accident.

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| | **SALIENT FEATURES OF MSIHC RULES:**<br>"Manufacture Storage and Import of Hazardous Chemicals Rules, 1989" to deal with the safety and environmental aspects associated with hazardous chemicals.<br>The 12 salient features of the rules are as follows:<br>**1)** This rule **applies to** an industrial activity in which a hazardous chemical, subject to schedule 1, is or may be involved<br>**2)** The **occupier is required to inform to the authority,** in schedule 6, of any major accident caused due to hazardous chemicals occurring on a site or in a pipeline.<br>**3)** The concerned authority shall undertake **full analysis of the major accident** and **send the requisite information to the MoEF.**<br>**4)** The criteria of industries coming under preview of **isolated storage** is given in the schedule 2.<br>**5)** The occupier is required to **submit a written report** in schedule 7, to the concerned authority.<br>**6)** The occupier is required to **submit safety report** as specified in schedule 8.<br>**7)** The occupier shall prepare and keep updated **on site emergency plan** as per schedule 11, **detailing how major accident will be dealt** in the industry on the site.<br>**8)** **An off-site emergency plan** shall be prepared by the concerned authority, as in schedule 5, to deal with the emergencies.<br>**9)** The **importer** of hazardous chemicals shall inform to the authority in the **prescribed form.**<br>**10)** **Authority at the state is to** **advice to the importer and the concerned port authority** for regarding safety measures to be observed by them.<br>**11)** The **importer shall maintain the records** of hazardous chemicals as specified in schedule 10.<br>**12)** The **road transportation** of hazardous chemicals should be in accordance in the **Central Motor Vehicle Rules 1989.** | |
| 6. | **Explain the procedure specified in the Notification No. SO 1533 (E) dated 14th September 2006 of the ministry of Environment & forests (MOEF), for obtaining prior environmental clearance for new projects.**<br>**Explain with the help of a flow chart, the procedure specified in the Notification No. SO 1533 (E) dated 14th September 2006 of the ministry of environment and forests, for obtaining prior environmental clearance for a 'Category A' project. BRIEFLY EXPLAIN ANY ONE CHANGE YOU SUGGEST TO IMPROVE THE PROCEDURE. Also, briefly explain what is environmental impact assessment and its benefits**<br>**Briefly analyze the EIA notification of September 2006 and identify the key factors upon which the** | **April 2013**<br>**April 2014**<br>**April 2012** |

| | | |
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| | **progress of the overall clearance procedure is dependent. Briefly explain the objectives of Environmental Impact assessment and the steps involved in it** | |
| ANS: | **Environmental Impact Assessment (EIA)** is used to **identify the environmental and social impacts** of a project prior to decision-making. It **aims** to predict environmental impacts at an **early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers.** **By using EIA** both **environmental and economic benefits** can be achieved, such as reduced cost and time of project implementation and design, avoided treatment/clean-up costs and impacts of laws and regulations.<br><br>**OBJECTIVES OF EIA**<br>- Ensuring **environmental factors are considered** in the decision-making process<br>- Ensuring that possible **adverse environmental impacts are identified** and avoided or minimized<br>- **Informing the public** about the proposal<br><br>**CATEGORY A & B**<br>**Category A:** Prior environmental clearance from the Central Government in the Ministry of Environment and Forests (MoEF) on the recommendations of an Expert Appraisal Committee (EAC) constituted by the Central Government. Some projects are categorized as A irrespective of capacity: Nuclear Power, Petroleum refining, Chemical Fertilizers. Cement plants with production capacity more than 1MTPA are A while others are B, Pulp and pulp and paper manufacturing units are A, Paper manufacturing without pulp manufacturing are B<br><br>**Category B:** Prior environmental clearance from the State/Union territory Environment Impact Assessment Authority (SEIAA). The SEIAA shall base its decision on the recommendations of a State or Union territory level Expert Appraisal Committee (SEAC). In the absence of a duly constituted SEIAA or SEAC, a Category B project shall be treated as a Category A project. Category B is further divided into B1 and B2.<br><br>**Projects requiring Prior Environmental Clearance (PEC):**<br>**1) Mining, extraction of natural resources and power generation (for a specified production capacity)**<br>Examples include Mining, Thermal Power Plants, River Valley and Nuclear Projects | |

2) **Primary Processing**

Examples include coal washeries and mineral beneficiation

3) **Materials Production**

Examples include Metallurgical industries and cement plants

4) **Materials Processing**

Examples include petroleum refining, coke oven plants, asbestos based products, chlor-alkali, soda ash and leather processing

5) **Manufacturing/Fabrication**

Examples include chemical fertilizers, pesticides, petrochemical complexes, manmade fibre, synthetic organic chemicals, distilleries, integrated paint, pulp and paper, sugar, bulk drugs and intermediates

6) **Service Sectors**

Oil and gas transportation pipelines,Isolated storages

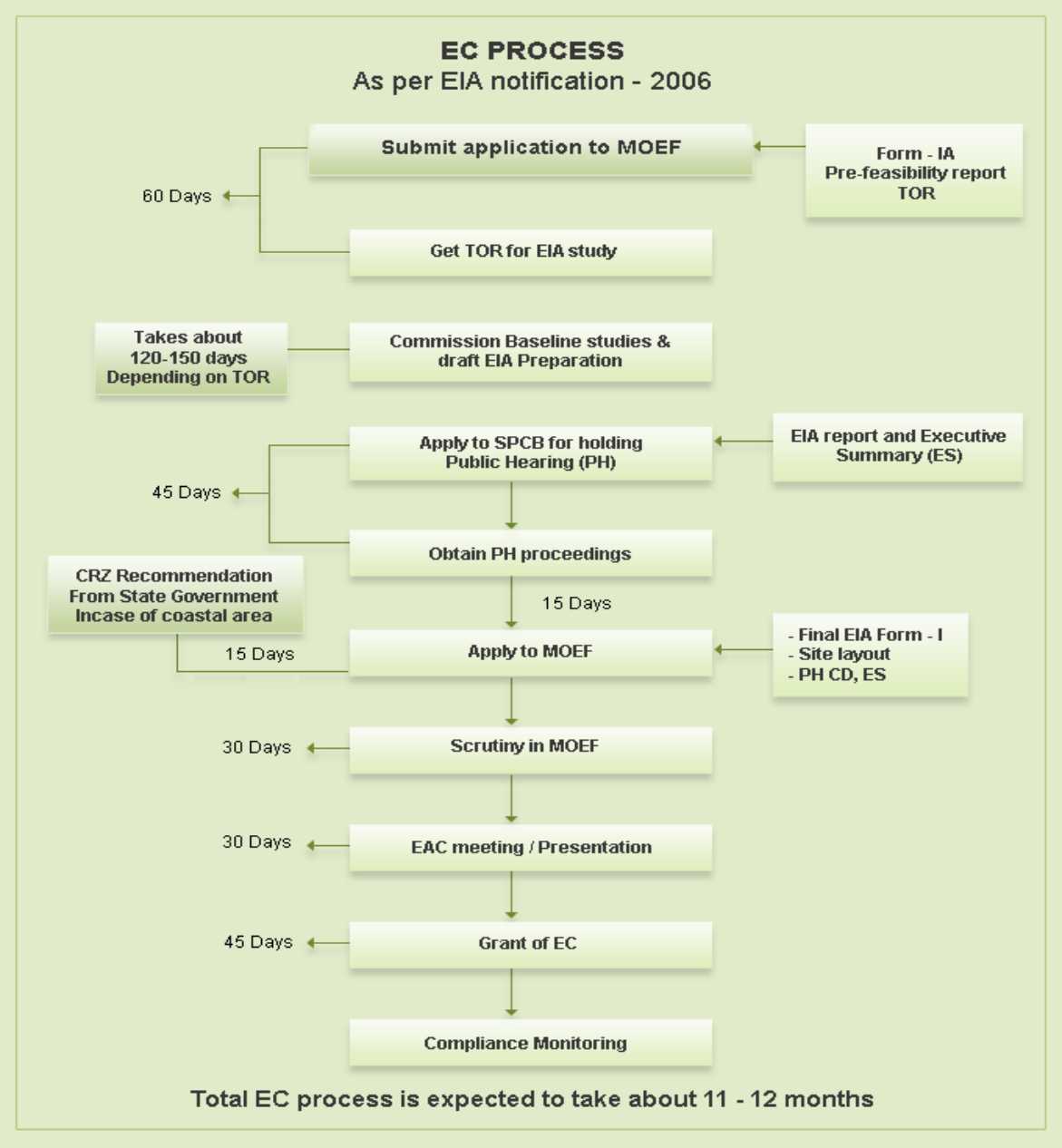
7) **Physical Infrastructure including Environmental Services**

Airports, ship breaking yards, Industrial Estates, EPZs, SEZs, CHWTSDFs, Ports, Harbours, Highways, CETPs

8) **Building /Construction projects/Area Development projects and Townships**

- **Stages in the Prior Environmental Clearance (EC) Process for New Projects**
- Maximum of four stages
- Stage (1) Screening (Only for Category 'B' projects and activities)
- Stage (2) Scoping
- Stage (3) Public Consultation
- Stage (4) Appraisal

TOR (Terms of Reference), CRZ (Coastal Regulation Zone), SPCB (State Pollution Control Board), EAC (Environmental Appraisal Committee), EC (Environmental Clearance), CD (compact disc), MOEF (Ministry of Environment and Forest)




**Validity of Environmental Clearance (EC):**

The period from which a prior environmental clearance is granted by the regulatory authority to the start of production operations by the project or activity, or completion of all construction operations in case of construction

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| | ➢ **Ten years** in the case of River Valley projects ,<br>➢ **Thirty years** for mining projects<br>➢ **Five years** in the case of all other projects and activities.<br>➢ This period of validity **may be extended by the regulatory authority concerned by a maximum period of five years** provided an application is made to the regulatory authority by the applicant within the validity period, together with an updated Form 1, and Supplementary Form 1A, for Construction projects or activities | |
| 7. | **The Judiciary in India, a spectator to Environmental despoliation for more than three decades has assumed a pro-active role of public educator, policy maker, super administrator and more generally, AMICUS (Impartial advisor to the court of law) ENVIRONMENT – Discuss giving examples** | **April 2013** |
| **ANS:** | INDIA employs a range of regulatory instruments to preserve and protect its natural resources. As a system for doing so, the law works badly, when it works at all.<br><br>**LEGISLATURE ONLY INTERESTED IN MAKING LAWS: TOOTHLESS (NO INTEREST IN) IMPLEMENTATION**<br>The legislature is quick to enact laws regulating most aspects of industrial and development activity but is guarded to sanction enforcement budgets or require effective implementation. Across the country, government agencies wield vast power to regulate industry, mines and other polluters but are reluctant to use their power to discipline violators.<br><br>**(After Years Courts take up charge)**<br>The judiciary, a spectator to environmental despoliation for more than two/three decades, has recently assumed the pro-active role of:<br>- Public educator,<br>- Policy-maker<br>- Super administrator,<br>- And more generally, amicus environment.<br><br>**WHY?**<br>Mostly due to **Public Interest Litigations (PILs) & recently RTI.** Initially, since these two tools were hardly used, the judiciary was merely a spectator to environmental despoliation. The **late 80s and 90s** is considered to be the golden era of environmental litigation in India. The Courts came forward to encourage public interest litigations to redress environmental injustices. Many procedural formalities | |

have been waived. The doctrine of locus standi has been considerably relaxed. In a public interest litigation (PIL), anybody who is having genuine concern for the public may file public interest litigations before the High Courts and the Supreme Court under Article 226 and 32 of the Constitution of India respectively.

**(Current State & Result)**

The outbreak of legislation, negligent enforcement and assertive judicial oversight have combined to create a unique implementation dichotomy: **one limb represented by the hamstrung formal** regulatory machinery comprised of the pollution control boards, forest bureaucracies and state agencies; **the other, consisting of a non-formal,** ad hoc citizen and court-driven implementation mechanism. The development of environmental law in the 1990s is largely the story of India's judiciary responding to the complaints of its citizens against environmental degradation and administrative sloth.

**(How and why it happened?)**

Administrative agencies created under environmental statutes are required to implement legislative mandates. **Frequently, for lack of staff, money, or will, these agencies fail to implement the laws under which they operate and ecological degradation continues to be unabated.**

**As the executive failed to discharge its statutory duties,** the public-spirited individuals and voluntary organizations were compelled to move the courts. When the legitimacy of judicial activism was called into question, the Supreme Court minced no words and observed, *"Even though, it is not the function of the court to see the day-to-day enforcement of the law, that being the function of the executive, but because of the non-functioning of the enforcement agencies, the courts as of necessity have had to pass orders directing the enforcement agencies to implement the law for the protection of the fundamental rights of the people passing of appropriate orders requiring implementation of the law, cannot be regarded as the court has taken the functions of the legislature or the executive".*

**(Role of Judiciary in environmental protection)**

Any discussion on environmental law without taking into account the role of judiciary in India will be incomplete. **If there is any aspect of environment, which is protected or any provision of environmental law that has been implemented in the country, it is largely due to the lead role,**

**played by the judiciary.**

The Indian judiciary has always been responsive towards environmental protection and conservation. In fact, the higher judiciary has created a new environmental jurisprudence in the country over the years by delivering many landmark judgments, which changed the state of environment in a significant way.

Before the enactment of special environmental laws such as the Water Act, the Air Act, and the Environment (Protection) Act, the common law principles preserved in the Law of Torts, and the Indian Penal Code 1860, the Code of Criminal Procedure, and the Code of Civil Procedure 1908, were the major legal instruments which dealt with environmental cases as the **judiciary viewed the environmental problems as public nuisance cases.** Lately, the judiciary, though continue using the common law principles, take cognizance of the newer laws and policies in dealing with environmental cases.

**EXAMPLES:**

**The Ratlam Municipality Case** for the first time gave a human rights dimension to Section 133 CrPC. When the municipality failed to discharge the statutory duties such as cleaning the roads and drains, and thereby affecting a large community in the guise of insufficiency of funds, the Supreme Court held that when an order is given under Section 133 CrPC by the Executive Magistrate, the municipality can not wish away its duties by pleading financial inabilities.

In M.C. Mehta vs. Union of India , otherwise called **the Ganga Pollution Case**, the environmental crusader, Shri. M.C. Mehta, filed a public interest litigation before the Supreme Court about the water pollution in the river Ganges caused by the tanneries in the Kanpur area. The Supreme Court ordered the tanneries functioning in Uttar Pradesh to set up effluent treatment plants or otherwise close them.

In **Chhetriya Padushan Mukti Sangarsh Samiti Vs. State of Uttar Pradesh**, the Supreme Court for the first time hinted that the right to environment is contemplated in Article 21 of the Constitution. In Subash Kumar Vs. State of Bihar [17] , Justice K.N. Singh categorically declared that, "the right to life enshrined in Article 21 includes the right to enjoyment of pollution free water and air for full enjoyment of life".

In the **Taj Mahal case** , the Supreme Court dealt with many foundries, chemical industries and the Mathura refinery that damaged the splendor of the Taj through air pollution. In this case, the Court ordered the local authority to establish the Taj Trapezium Zone (TTZ) by creating a green belt around the Taj. It ordered about 292 hazardous industries to either switch over to natural gas as an alternative fuel or relocate themselves as per the directions of the court. Justice Kuldip Singh observed that the old concept of "development and ecology cannot go together" is no longer acceptable and opined that "sustainable development" is the answer.

In **M.C. Mehta vs. Union of India**, the Supreme Court ordered the Delhi Transport Corporation to withdraw buses over 15 years old and directed them to switch over to compressed natural gas (CNG) instead of diesel in order to prevent air pollution. The Court also prescribed a quota regime for registration of private non-commercial vehicles in the National Capital Territory.
Similary, Recently, courts have whole heartedly supported the **odd-even rule** in Delhi (by voluntary support & rejected to stamp it out) and directed government authorities to do more.

**OUTCOME:**

In the process of judicial activism, many new doctrines and principles such as **polluter pays principle**, **precautionary principle** and **sustainable development principle**; **public trust doctrine** and the **principle of absolute liability**, **principles of inter-generational and intra-generational equity**, etc., have been imported by our courts into the Indian legal system.

**PS:** Though the public interest litigation movement provided new vistas of environmental litigations, it also gave room for frivolous cases in the courts, which prompted the Supreme Court to formulate guidelines to entertain public interest cases.

**T**his approach has led the Supreme Court to derive, adopt and apply a range of principles to guide the development of environmental jurisprudence. Notable among the fundamental norms recognized by the court are:

1) **Every person enjoys the right to** a wholesome environment, which is a facet of the right to life guaranteed under Article 21 of the Constitution of India.
2) **Enforcement agencies** are under an obligation to strictly enforce environmental laws.

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| | **3)** **Government agencies** may not plead non-availability of funds, inadequacy of staff or other insufficiencies to justify the non-performance of their obligations under environmental laws.<br>**4)** The **'polluter pays principle'**, which is a part of the basic environmental law of the land, requires that a polluter bear the remedial or clean-up costs as well as the amounts payable to compensate the victims of pollution.<br>**5)** The **'precautionary principle'** requires government authorities to anticipate, prevent and attack the causes of environmental pollution. This principle also imposes the onus of proof on the developer or industrialist to show that his or her action is environmentally benign.<br>**6)** **Government development agencies charged with decision-making** ought to give due regard to ecological factors including **(*a*)** **the environmental policy of the central and state government; (*b*) the sustainable development and utilization of natural resources; and (*c*) the obligation of the present generation to preserve natural resources and pass on to future generations** an environment as intact as the one we inherited from the previous generation.<br>**7)** **Stringent action** ought to be taken against contumacious defaulters and persons **who carry on industrial or development activity for profit without regard to environmental laws**.<br>**8)** The **power conferred under an environmental statute may be exercised only to advance environmental protection** and not for a purpose that would defeat the object of the law.<br>**9)** The **state is the trustee of all natural resources** which are by nature and meant for public use and enjoyment. The public at large is the beneficiary of the seashore, running waters, air, forests and ecologically fragile lands. These resources cannot be converted into private ownership. | |
| 8. | **Write an essay on "The Kyoto Protocol" and the clean development mechanism (CDM) defined in Article 12 of the Protocol**<br>**Write an essay on "The Kyoto Protocol" and the clean development mechanism (CDM) defined in Article 12 of the Protocol. Discuss briefly the steps involved in the CDM process**<br>**Explain the issue of climate change. Explain key provisions of the international protocol which deals with climate change and its implications for developed and developing countries. Briefly describe the CDM project cycle** | **April 2013**<br>**April 2014**<br>**April 2012** |
| ANS: | **THE GOAL OF THE KYOTO PROTOCOL** is **to curb anthropogenic greenhouse gas emissions (specifically carbon dioxide) to curtail global warming.** Recent studies have shown that increased greenhouse gases can lead to climate change and the warming of the planet. By ratifying the Kyoto Protocol, industrialized nations would have to decrease their carbon dioxide emissions by a percentage of their 1990 levels. This decrease in carbon dioxide emissions is believed to decelerate global warming and in | |

turn produce co-benefits.

**THE FOUR PROVISIONS OF KYOTO:**

i. **One approach was to make use of natural processes, called "SINKS,"** that remove greenhouse gases from the atmosphere. The planting of trees, which take up carbon dioxide from the air, would be an example.

*ii.* **Another approach was the international program called the CLEAN DEVELOPMENT MECHANISM (CDM)**, which encouraged developed countries to invest in technology and infrastructure in less-developed countries, where there were often significant opportunities to reduce emissions. Under the CDM, the investing country could claim the effective reduction in emissions as a credit toward meeting its obligations under the protocol. ***An example would be an investment in a clean-burning natural gas power plant to replace a proposed coal-fired plant.***

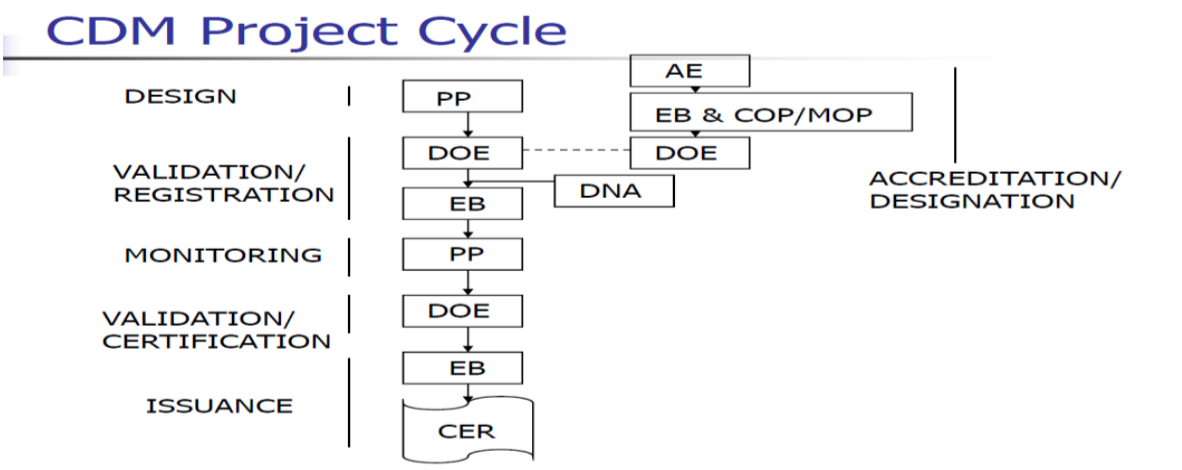
iii. **A third approach was EMISSIONS TRADING**, which allowed participating countries to buy and sell emissions rights and thereby placed an economic value on greenhouse gas emissions. European countries initiated an emissions-trading market as a mechanism to work toward meeting their commitments under the Kyoto Protocol.

iv. **COUNTRIES THAT FAILED TO MEET THEIR EMISSIONS TARGETS** would be required to make up the difference between their targeted and actual emissions, plus a penalty amount of 30 percent, in the subsequent commitment period, beginning in 2012; they would also be prevented from engaging in emissions trading until they were judged to be in compliance with the protocol. The emission targets for commitment periods after 2012 were to be established in future protocols.

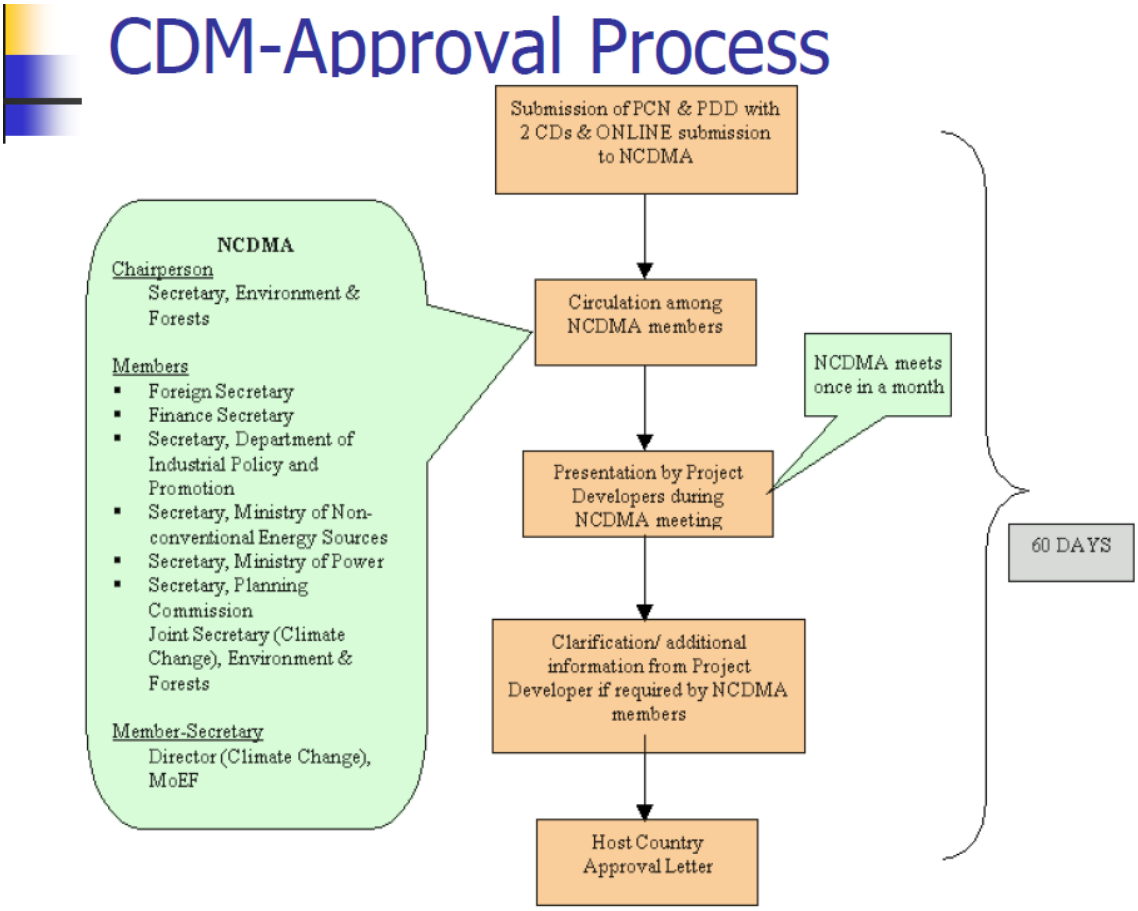
**The purpose of the clean development mechanism (CDM)** is defined in Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change. The CDM has a two-fold purpose:

**(a) to assist developing country** Parties in achieving sustainable development, thereby contributing to the ultimate objective of the Convention, and

**(b) to assist developed country** Parties in achieving compliance with part of their quantified emission limitation and reduction commitments under Article 3.




**AE:** Applicant entity; **EB:** Executive Board; **COP/MOP:** Conference of Parties/Meeting of Parties; **PP:** Project Proponent (promoter/advocate); **DOE:** Designated Operating Entity; **DNA:** Designated National Authority; **CER:** Certified Emission reductions; **NCDMA:** National CDM Authority, **PCN:** Project Concept Note; **PDD:** Project Design Document



**ISSUE OF CLIMATE CHANGE:**

Climate change will have major and unpredictable effects on the world's water systems, including an increase in floods and droughts, causing in turn, an impact on food supply, displacement and conflict.

1. **HIGH TEMPERATURES** are to blame for an **increase in heat-related deaths and illness**, rising seas, increased storm intensity, and many of the other dangerous consequences of climate change. During the 20th century, the Earth's average temperature rose one degree Fahrenheit to its highest level in the past four centuries – believed to be the fastest rise in a thousand years. Scientists project that if emissions of heat-trapping carbon emissions aren't reduced, average surface temperatures could increase by 3 to 10 degrees Fahrenheit by the end of the century.

2. **CHANGING LANDSCAPES: Rising temperatures and changing patterns of rain and snow are forcing trees and plants around the world to move toward Polar Regions and up mountain slopes.** These vegetation shifts will undermine much of the work the conservation community has accomplished to date, with the potential to permanently change the face of Conservancy preserves, local land trusts, and even our national parks. As plant communities try to adjust to the changing climate by moving toward cooler areas**, the animals that depend on them will be forced to move.** Development and other barriers may block the migration of both plants and animals. Some species and communities such as polar bears and alpine meadows may be left without any remaining viable habitat, **putting much of our treasured wildlife at risk.**

3. As the Earth heats up, sea levels rise because **warmer water takes up more room than colder water,** a process known as **THERMAL EXPANSION**. **Melting glaciers** compound the problem by dumping even more fresh water into the oceans. **RISING SEAS** threaten to flood low-lying areas and islands, threaten dense coastal populations, erode shorelines, damage property and destroy ecosystems such as mangroves and wetlands that protect coasts against storms. Sea level rise associated with climate change could **displace tens of millions of people in low-lying areas** – especially in developing countries. Inhabitants of some small island countries that rest barely above the existing sea level are already abandoning their islands, some of the world's first climate change refugees.

4. As temperatures rise, so do the risks of **HEAT-RELATED ILLNESS** and even death for the most vulnerable human populations. In 2003, for example, extreme heat waves caused more than 20,000 deaths in Europe and more than 1,500 deaths in India. Scientists have linked the deadly

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| | heat waves to climate change and warn of more to come. In addition to heat-related illness, climate change may increase **the spread of infectious diseases**, mainly because **warmer temperatures allow disease-carrying insects,** animals and microbes to survive in areas where they were once thwarted by cold weather. **Diseases and pests that were once limited to the tropics — such as mosquitoes that carry malaria — may find hospitable conditions in new areas** that were once too cold to support them.<br><br>**5.** Higher temperatures increase the amount of **moisture that evaporates from land and water,** leading to **DROUGHT** in many areas. **Lands affected by drought are more vulnerable to flooding** once rain falls. As temperatures rise globally, droughts will become more frequent and more severe, with potentially devastating consequences for agriculture, water supply and human health. This phenomenon has already been observed in some parts of Asia and Africa, where droughts have become longer and more intense. **Hot temperatures and dry conditions also increase the likelihood of FOREST FIRES.**<br><br>**6.** Scientific research indicates that climate change will cause **HURRICANES AND TROPICAL STORMS** to become more intense — lasting longer, unleashing stronger winds, and causing more damage to coastal ecosystems and communities. Scientists point to higher ocean temperatures as the main culprit, since **hurricanes and tropical storms get their energy from warm water.** As sea surface temperatures rise, developing storms will contain more energy.<br><br>**7.** Seasonal shifts, extreme weather conditions, change in precipitation patterns caused by climate change will **IMPACT FARMING AND AGRICULTURE**, a source of food and livelihood for more than half of the global population. | |
| 9. | **Requirements for an Environmental Policy are specified in clause of ISO 14001. The requirements are as follows:**<br>**a. The Policy shall be defined by top management**<br>**b. The Policy shall be in line with the nature scale and environmental impacts of the organization**<br>**c. The Policy shall include a commitment to continual improvement and prevention of pollution**<br>**d. The Policy shall include a commitment to comply with legal and other requirements**<br>**e. The Policy shall provide for a framework of objectives and targets**<br>**f. The Policy shall be documented, implemented, maintained and communicated to all persons working on behalf of the organization** | **April 2012** |

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| | **g. The Policy shall be made available to public**<br>**Explain with reasons whether the Environmental Policy of ABC meets the requirements of ISO 14001?**<br>**We at ABC Petrochemicals hereby pledge that environmental concerns are of paramount importance to us in all our activities and we will do everything possible to preserve the environment**<br>**We will in particular:**<br>- **Reduce water usage in the toilets and wash basins**<br>- **Reduce use of paper in our administrative work**<br>- **Provide for sound environmental management with respect to canteen waste**<br>**We will ensure that our environmental policy is documented, implemented and maintained and make it available to all members of the public** | |
| IMP: | **Environmental Policy** is a statement by the organization of its intentions and principles in relation to its overall environmental performance.<br>***The Policy…***<br>▪ provides a framework for action<br>▪ lends an overall sense of direction<br>▪ serves as foundation of the EMS<br>▪ serves as a reference point for revisiting<br>▪ strategies, plans and actions. | |
| 10. | **Explain in your own words the essence of the "GAIA THEORY" developed by James Lovelock** | **April 2013** |
| ANS: | **Overview:**<br>Gaia Theory is a compelling new way of understanding life on our planet. The theory asserts that **living organisms and their inorganic surroundings have evolved together as a single living system** that greatly affects the chemistry and conditions of Earth's surface.<br><br>**Perspectives:**<br>The "Gaia Paradigm" seeks to find a healthy union between science and "cultural narrative." Explore multiple perspectives from great thinkers such as scientists, philosophers, and politicians. | |

**Offerings:**

The Gaia Theory offers insights into climate change, energy, health, agriculture, and other issues of great importance.

The Gaia Paradigm describes a **PRODUCTIVE CONFLUENCE** **between scientific understandings of Earth as a living system with cultural understandings (ancient and new) of human society** as a seamless continuum of that system.

**Detailed Explanation:**

Overall, the Gaia Theory is a compelling new way of understanding life on our planet. It argues that we are far more than just the "Third Rock from the Sun," situated precariously between freezing and burning up. The theory asserts that living organisms and their inorganic surroundings have evolved together as a single living system that greatly affects the chemistry and conditions of Earth's surface. Some scientists believe that this **"Gaian system" self-regulates global temperature, atmospheric content, ocean salinity, and other factors in an "automatic" manner.** Earth's living system appears to keep conditions on our planet just right for life to persist! The Gaia Theory has already inspired ideas and practical applications for economic systems, policy, scientific inquiry, and other valuable work. The future holds more of the same.

**Understanding Gaia Theory:**

The Gaia Theory suggests that the organic and inorganic components of Planet Earth have evolved together as a **single living, self-regulating system.** It suggests that this living system has automatically controlled global temperature, atmospheric content, ocean salinity, and other factors, that maintains its own habitability. In a phrase, **"life maintains conditions suitable for its own survival."** In this respect, the living system of Earth can be thought of analogous to the workings of any individual organism that regulates body temperature, blood salinity, etc.

**EXAMPLE: Even though the luminosity of the sun – the Earth's heat source – has increased by about 30 percent since life began almost four billion years ago, the living system has reacted as a whole to maintain temperatures at levels suitable for life.**

The Gaia theory was developed in the late 1960's by **Dr. James Lovelock,** a British Scientist and inventor, shortly after his work with NASA in determining that there was probably no life on Mars. His research led to profound new insights about life on Earth. The theory gained an early supporter in Lynn

Margulis, a microbiologist at the University of Massachusetts. **In the past 15-20 years, many of the mechanisms by which Earth self-regulates have been identified.**

**EXAMPLE: It has been shown that cloud formation over the open ocean is almost entirely a function of the metabolism of oceanic algae that emit a large sulfur molecule (as a waste gas) that becomes the condensation nuclei for raindrops.** Previously, it was thought that cloud formation over the ocean was a purely chemical/physical phenomenon. The cloud formation not only helps regulate Earth's temperature, it is an important mechanism by which sulfur is returned to terrestrial ecosystems.

**Predictions, tests and results relevant to the Gaia theory. Source: James Lovelock [26]**

| Prediction | Test | Result |
|---|---|---|
| Mars is lifeless (1988) | Atmospheric compositional evidence shows lack of disequilibrium | Strong confirmation, Viking mission 1975 |
| Biogenic gases transfer elements from ocean to land (1971) | Search for oceanic sources of dimethyl sulphide and methyl iodide | Found 1973 |
| Climate regulation through biologically enhanced rock weathering (1973) | Analysis of ice-core data linking temperature and $CO_2$ abundance | Confirmed 2008, by Zeebe and Caldeira |
| Gaia is aged and is not far from the end of its development (1982) | Calculation based on generally accepted solar evolution | Generally accepted |
| Climate regulation through cloud albedo control linked to algal gas emissions (1987) | Many tests have been made but the excess of pollution interferes | Probable for southern hemisphere |
| Oxygen has not varied by more than 5 percent from 21 percent for the past 200 million years (1974) | Ice-core and sedimentary analysis | Confirmed for up to 1 million years ago |
| Boreal and tropical forests are part of global climate regulation | Models and direct observation | Generally accepted |
| Biodiversity a necessary part of climate regulation | By models but not yet in the natural ecosystems | Jury still out |
| The current interglacial is an example of systems failure in a physiological sense (1994) | By models only | Undecided |
| The biological transfer of selenium from the ocean to the land as dimethyl selenide | Direct measurements | Confirmed 2000, Liss |

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| 11. | **Elaborate on the Gandhian concept of "Greed v/s Need". What are the conflicting environmental scenarios in the 21st century?** | **April 2015** |
| | **What is `Sustainable Development? Discuss the important parameters concerning Environment and Development.** | **April 2009** |
| | **Define "Sustainable Development". Who was the first to coin this term and how it is related to the** | **April 2007** |

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| | **Gandhian concept of "Greed v/s Need"?**<br>**Explain in detail "Sustainable Development".**<br>**To what extent is village and community involvement important in conserving the environment?**<br>**Briefly describe the pioneering efforts undertaken in Haryana and Maharashtra.** | **April 2006**<br><br>**Apr 2010, 2008, 2007** |
| ANS: | ***Sustainable Development:*** **economic development that is conducted without depletion of natural resources**<br><br>Sustainable development was a **term first coined in 1980**, when the intent of the concept was merely basic. It was in the **World Conservation Strategy**, a union between three prominent environmental non-governmental organizations IUCN, WWF, and UNEP, where **sustainable development took on the meaning of 'conserving the earth's natural resources'.**<br><br>What the World Conservation Strategy had realized is that **with the world's economic growth, came the near-sighted exploitation of the world's natural resources.**<br><br>In 1987 the white paper, named *Our Common Future*, was published by the **World Commission on Environment and Development (WCED).** The document set the loose foundation of sustainable development with a widely quoted definition, which states **"sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".** The **economy, society, and the environment** were key to sustainable development.<br><br>**Gandhi's Quote:**<br>**"The world has enough for everyone's need, but not enough for everyone's greed"**<br>The environmental concern as we understand today was not there at the time of Gandhi, but his ideas on development, technology, self-sufficiency, village Swaraj etc. disclose his environmental concern. Different streams of environmental philosophy have paid their indebtedness to Gandhi. To my mind Gandhi's greatest contribution to sustainable development was two-fold.<br>✓ Firstly his **experiments in simple living and high thinking**. He believed that with simple living the resources of the planet earth can sustain us comfortably and his famous saying that earth provides us enough for our needs but not for our greed is extremely apt today.<br>✓ Secondly his **insistence on all-inclusive growth of the society** and hence his focus on rural development. | |

**IMPORTANT PARAMETERS FOR SUSTAINABLE DEVELOPMENT:**

The *Rio Declaration on Environment and Development* fleshes out the definition by listing **18 principles of sustainability.**

**1)** People are entitled to a healthy and productive life in harmony with nature.

**2)** **Development today** must not weaken the development and environment needs of present and future generations.

**3)** Nations have the sovereign right to **exploit their own resources**, but without causing environmental damage beyond their borders.

**4)** Nations shall develop international laws to provide **compensation for damage** that activities under their control cause to areas beyond their borders.

**5)** Nations shall use the **precautionary approach** to protect the environment. Where there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone cost-effective measures to prevent environmental degradation.

**6)** In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process, and cannot be considered in isolation from it. **Eradicating poverty and reducing disparities in living standards** in different parts of the world are essential to achieve sustainable development and meet the needs of the majority of people.

**7)** **Nations shall cooperate** to conserve, protect and restore the health and integrity of the Earth's ecosystem. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

**8)** **Nations should reduce and eliminate unsustainable patterns** of production and consumption, and promote appropriate demographic policies.

**9)** Environmental issues are best handled with the **participation of all concerned citizens**. Nations shall facilitate and **encourage public awareness** and participation by making environmental information widely available.

**10)** Nations shall enact effective environmental laws, and **develop national law** regarding liability for the victims of pollution and other environmental damage. Where they have authority, nations shall assess the environmental impact of proposed activities that are likely to have a significant adverse impact.

**11)** Nations should cooperate to promote an open international economic system that will lead to economic growth and sustainable development in all countries. Environmental policies should not

be used as an unjustifiable means of restricting international trade.

**12)** The polluter should, in principle, bear the cost of pollution.

**13)** Nations shall warn one another of natural disasters or activities that may have harmful transboundary impacts.

**14)** Sustainable development requires better scientific understanding of the problems. Nations should share knowledge and innovative technologies to achieve the goal of sustainability.

**15)** The full participation of women is essential to achieve sustainable development. The creativity, ideals and courage of youth and the knowledge of indigenous people are needed too. Nations should recognize and support the identity, culture and interests of indigenous people.

**16)** Warfare is inherently destructive of sustainable development, and Nations shall respect international laws protecting the environment in times of armed conflict, and shall cooperate in their further establishment.

**17)** Peace, development and environmental protection are interdependent and indivisible.

Let me list down how this wealth can be created in **RURAL AREAS** thereby creating all round sustainable development:

- ✓ India produces close to **600-800 million tons/year** of agricultural residues.
- ✓ Most of these residues are **burnt in fields** to solve the waste disposal problem. Not only does this create **tremendous air pollution** but this burning is a **waste of an important energy resource.**
- ✓ These agricultural residues can theoretically produce via **lignocellulosic conversion** about 150 billion liter/year of ethanol which can take care of about **50% of India's total oil demand**.
- ✓ Similarly if we go via the **pyrolysis oil route** then it can provide around **80% of India's diesel** demand. Pyrolysis oil is produced by rapid heating of biomass to 600-700$^0$C and quenching the smoke rapidly to produce oil. This oil with suitable modifications is very close to diesel in characteristics.
- ✓ Alternatively if these residues are **burnt in the biomass-based power plants** then they can produce close to 80,000 MW of electricity or nearly **50% of India's total installed capacity**. Biomass power plant technology is very well developed all over the world and there are close to 91 plants in India with installed capacity of about 500 MW.
- ✓ Presently these residues, which constitute **60-75% of total biomass produced, do not fetch any money for the farmers.**
- ✓ Since these **residues can produce very high-quality energy like electricity and chemicals** they

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| | should be properly priced. With such pricing the **farmer can easily get an extra income of INR. 5000-7000/acre per season.** This extra income can make farming remunerative and change the face of rural India. Besides easing India's present energy crisis it can be an INR. 200,000 crore/year (INR. 2 trillion/year) industry.<br>✓ At the same time the use of biomass for energy production can also **produce about 50 million jobs in rural areas.** Thus farming for energy will lead to a very prosperous India.<br>In coming years quite a lot of these residues may also be diverted to produce organic fertilizer in rural based high-tech units. When farms produce both food and fuel then their utility becomes manifold. In India 65% of its population depends on farming and with energy from agriculture as a major focus, India has the potential of becoming a high-tech farming community. This will help improve the rural environment and create better India, something that Gandhi always stressed. | |
| **12.** | **What is the future of the automobile industry once petroleum reserves are exhausted?** | **April 2015** |
| ANS: | ***Roughly 90% of all vehicles in the world run on oil-derived products - accounts for roughly 70% of all petroleum used.***<br>The earth's natural resources are finite, which means that if we use them continuously, we will eventually exhaust them. **Peak oil** is the point when extraction of crude becomes increasingly more difficult and costly. The result is high energy costs for everything from home heating to transportation. Alternatives to the use of fossil fuels in general, and petroleum in particular, have been sought for many reasons including the limited supply of readily accessible reserves, national security, environmental impact, and profit.<br><br>Because the transportation industry is responsible for using 70% of all crude oil produced, there has been great effort in the last two decades to produce an electric vehicle capable of performance similar to that of petroleum powered vehicles. While there are major obstacles to overcome, recent advances have seen mileage ranges increased from less than 100 to well over 200 miles. The major factors holding back the mainstream production of electric vehicles are the cost of batteries, the production and recycling of batteries, and the time that it takes to charge a battery. In other words, the only thing holding back electric vehicles is how they store electricity when the vehicle is not in use. A cheap, efficient, reliable alternative to current batteries would make electric vehicles instantly practical.<br><br>Many proponents of electric powered vehicles point to **hybrid vehicles** as the logical bridge between petroleum vehicles and vehicles that rely 100% upon electricity. Hybrid vehicles offer the benefits of | |

unlimited mileage obtained from gasoline while increasing fuel economy through the employment of electric motors as well. These hybrid vehicles are slowly but surely progressing from a disproportionate amount of reliance on petroleum to increased reliance on electricity through techniques like adding solar panels, regenerative braking, and plug-in capabilities (allowing them to be charged through the electrical grid rather than by running their petrol motors).

It is worth pointing out that while electric vehicles can reduce petroleum use, the source of electricity used to charge their batteries is of critical importance. If that energy does not come from clean, renewable resources, then the problem is simply being shifted from one location to another and is not being solved. Proponents are clear that the success of electric vehicles also depends upon the implementation of renewable resources for the generation of the majority of electricity. Technologies like solar, wind, hydro, and geothermal are all being investigated and have met with various levels of success throughout different regions of the world.

**1. SOLAR ENERGY** *(Short Note)*

The sun burns hydrogen to produce helium via nuclear fusion, releasing fast amounts of energy. That energy reaches Earth in the forms of ultraviolet light, visible light (the light we see), and infrared light (heat), all of which we term solar energy. Harnessing energy from the sun relies on conversion of those forms of energy into either heat or electricity.

**The benefits** of solar energy are that it does not produce air pollutants, it does not contribute greenhouse gases to the atmosphere, and it has a minimal impact on the environment. **The limitations** to solar are that the sun "does not shine" all hours of the day, a large surface area is needed to collect adequate amounts of light, and storage of the energy for use during "dark times" can be difficult.

The sun provides approximately **12, 180 trillion kilowatts** of power to the Earth's surface every year. By contrast the world consumes about **15 trillion kilowatts** of power each year. Those are staggering numbers. In perspective, the sun provides enough energy in one hour to supply the energy needs of the whole of humanity for an entire year.

**Other Limitations:** At the moment, storage systems are the major inhibitors of solar energy. Batteries are too limited in their capabilities to provide long-term storage for homes and are too bulky to be

used in automobiles. Other methods of storage rely on thermal means, such as heating water or salt solutions. The heat is then later converted into electricity. Solar also suffers from the fact that photovoltaic panels are inefficient and expensive. Large installations for stationary applications are manageable in climates where there is enough sun. However, installing enough panels to power an entire car, even in full sunlight, can be difficult or impossible. At average efficiencies, solar panel arrays can produce roughly 2.6 horsepower. When considering the environmental impact and cost of solar cars, it is important to remember that solar panels are expensive to produce and rely on elements like silicon and phosphorus, which have to be mined. In addition, solar panels have limited life spans of approximately 30 years, after which point they must be replaced.

**2. BIOFUELS** *(Short Note) - Important*

Biofuel is any fuel in which the energy is derived from biological carbon fixation that has occurred relatively recently. Biofuels include biomass derivatives, biogases, and liquid fuels. Biofuels can be widely divided into bio alcohol, biodiesel, green diesel, biogas, syngas, solid biofuels, and even vegetable oil. The previous all constitute what are known as first generation biofuels because they are made from sugar, starch, and vegetable oil. In other words, they are made from things that are part of the food supply.

Second generation biofuels are made from "sustainable" organic material. In general, this refers to any biological carbon that is not a part of the food supply. Any biofuel produced from sustainable feedstock will fit into this category. The basic point is that food is not diverted from the food chain (animal or human) to produce these fuels. Currently, bacteria and fungi are used to produce these fuels. Often this takes the form of cellulose or algae. The recent discovery of a fungus in Patagonia that can produce diesel fuel from cellulose has raised hopes that biodiesel could be produced without any reliance of food stocks and at relatively low cost.

- **Bio-alcohols**

  Alcohols like ethanol and butanol can only be considered "biofuels" if they were produced through the process of fermentation, which involves either bacteria or yeast.

  Ethanol is the most commonly used form of bio alcohol, but bio butanol is gaining in favor because it can be used directly in gasoline engines without their needing to be modified.

  **Ethanol** can be used in engines so long as the percentage of fuel containing ethanol remains at or

below 15%. Above 15%, ethanol causes damage to rubber and plastic components of cars such as fuel lines. In order to run higher percentages of ethanol, vehicles must be modified.

**Butanol** has high net gains in terms of energy when compared to ethanol and is less corrosive to engine components. DuPont and BP are currently working to develop butanol as a viable alternative to gasoline.

- **Bio-diesel**

  Biodiesel is more common in Europe than are bio alcohols. This is in part due to the fact that Europe has historically had a higher adoption rate for diesel power vehicles than has the U.S.

  In general, biodiesel is less corrosive than the bio alcohols. Biodiesel has several advantages over petro diesel, the first of which is that it is renewable. It is also better for the environment in that it produces 57% less greenhouse gas than standard petro diesel.

  Biodiesel is actually a better lubricant and reduces fuel system wear in vehicles. Until recently, it was cheaper than petro diesel as well. Because it is not toxic, biodiesel can be made on site, which is often the case on farms. This leads to reduced costs for farmers.

  Biodiesel is created through the transesterification of fat. In basic terms, animal fat is mixed with vegetable oil and alcohol to produce biodiesel. Biodiesel comes in any mix, but the four standards are 100% (B100), 20% (B20), 5% (B5), and 2% (B2). Blends of 20% or less can be used in diesel equipment without modification. Over 20% and engines often require modification to maintain performance. Many manufactures support the use of B100 (100% biodiesel) in their vehicles. In many countries, 5% biodiesel is quite common.

  There are several **disadvantages** to biodiesel. In terms of utilization, it can gel at low temperatures and it is prone to water contamination. Both gelling and water contamination can lead to harder starting of engines by reducing the heat of combustion. Water also promotes the growth of system clogging bacteria and can cause pitting of the pistons within the engine. Both of these problems are relatively easy to overcome.

  Less simply solved is the **problem of production.** If all arable land in the U.S. were devoted to biodiesel production, it would yield just enough to meet current demand. That includes only vehicles that currently run on diesel and does not make room of any growth in demand. This

leaves no arable land for food production.

- **Green diesel**

  This includes any diesel fuel derived from renewable resources such as canola oil or algae. The real difference between green diesel and biodiesel is how they are produced. Biodiesel is produce through fermentation or, more accurately, transesterification. Green diesel is produced by fractional distillation, which is the same process used to produce crude oils.

- **Biogas**

  Biogas is methane produced from fermentation. It is attractive in some respects because it is produced as a byproduct of mechanical waste treatment and from landfills. Thus, it is already available in some locales. Farmers often produce it from manure.

- **Solid Biofuels**

  Things such as wood, sawdust, grass cuttings, and garbage, which can be directly burned, are included in this category. These fuels, while releasing particulates, have less environmental impact than fossil fuels.

**3. HYDROGEN**

Hydrogen is the smallest of all atoms. It has the atomic number 1 and is the lightest, most abundant chemical in the universe, making up roughly 75% of all matter.

One of the **biggest advantages** of hydrogen as a fuel is that burning it produces only water. Burning hydrogen is a less efficient means of extracting energy than are hydrogen fuel cells. Current fuel cells are roughly 60% efficient, though when heat trapping features are included, they can reach 83% efficiency. Typical combustion engines, whether burning hydrogen or petroleum are 25% efficient at a maximum. Fuel cells are similar to batteries in many ways. The major difference between a fuel cell and a battery is that the chemicals in a battery are finite while in a fuel cell, constant supplies of hydrogen and oxygen are fed in.

There are several major drawbacks to the use of hydrogen as a fuel. The first is economic, both fuel cells and standard internal combustion engines that burn hydrogen are not predicted to be

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| | competitive in terms of price with standard fossil fuels until well beyond 2040. Fuel cells are expensive to produce. Overall, electricity generated from a fuel cell costs approximately $100 per kilowatt, compared to $0.15 to $0.30 per kilowatt for standard fuels.<br><br>In addition to expense, there is no infrastructure in place for delivering hydrogen to consumers, particularly for transportation. Hydrogen requires unique storage conditions and is considerably more explosive than hydrocarbon fuels are. Most nations would have to completely reinvent their fuel delivery infrastructures to accommodate hydrogen.<br><br>Storage is also a major drawback of hydrogen. In its gas form, enough cannot be stored to make it of practical use and it is also exceptionally flammable. In liquid form, hydrogen is much less explosive. However, creating liquid hydrogen requires cooling it in cryogenic tanks or compressing it. While the energy per ass is three times that of gasoline, current technology only allows liquid hydrogen to carry one sixth of the energy per liter than standard gasoline. Some research has been performed on special crystalline storage materials, but they are expensive.<br><br>The biggest drawback to hydrogen, however, is production. There is little molecular hydrogen on the planet, so most of it has to be produced by alternative means. | |
| 13. | **How does deforestation contribute to overall environmental degradation? Discuss some examples of successful reforestation** | **April 2015** |
| ANS: | **Environmental Degradation:** Environmental degradation is the disintegration of the earth **OR** deterioration of the environment through consumption of assets, for example, air, water and soil; the destruction of environments and the eradication of wildlife.<br><br>**Characterized as:** any change or aggravation to nature's turf seen to be pernicious or undesirable. It occurs when earth's **natural resources are depleted** and **environment is compromised in the form of extinction** of species, **pollution** in air, water and soil, and **rapid growth in population**.<br><br>**Caused by:** Ecological effect or degradation is created by the consolidation of an effectively substantial and expanding human populace, constantly expanding monetary development or per capita fortune and the application of asset exhausting and polluting technology. The biggest driver of deforestation is agriculture. Farmers cut forests to provide more room for planting crops or grazing livestock. Often | |

many small farmers will each clear a few acres to feed their families by cutting down trees and burning them in a process known as **"slash and burn" agriculture.**

**DEFORESTATION:** is the cutting down of trees to make way for more homes and industries.

Rapid growth in population and urban sprawl are two of the major causes of deforestation. Apart from that, use of forest land for agriculture, animal grazing, harvest for fuel wood and logging are some of the other causes of deforestation. Deforestation contributes to global warming as decreased forest size puts carbon back into the environment.

**CONTRIBUTION OF DEFORESTATION TO OVERALL ENVIRONMENTAL DEGRADATION:**

- The most dramatic impact is a **loss of habitat** for millions of species. Seventy percent of Earth's land animals and plants live in forests, and many cannot survive the deforestation that destroys their homes.
- Deforestation also drives **climate change.** Forest soils are moist, but without protection from sun-blocking tree cover they quickly dry out. Trees also help perpetuate the water cycle by returning water vapor back into the atmosphere. Without trees to fill these roles, many former forest lands can quickly become barren deserts.
- Removing trees deprives the forest of portions of its canopy, which blocks the sun's rays during the day and holds in heat at night. This disruption leads to more **extreme temperatures swings** that can be harmful to plants and animals.
- Trees also play a critical role in absorbing the greenhouse gases that fuel global warming. Fewer forests means **larger amounts of greenhouse gases entering the atmosphere**—and increased speed and severity of **global warming.**
- **Flooding**
- **Economic Loss**
- **Health Issues**

**EXAMPLES OF SUCCESSFUL REFORESTATION:**

1. **Reforestation in Tanzania: the Kwimba Reforestation Project** (Planting Australian Eucalyptus)

- **Started in 1990**: Kwimba Reforestation Project in Tanzania was a multinational and multi-organization effort **to reforest land around 40 villages.**
- Sub-Saharan Africa suffers from widespread deforestation, the vast majority of which results from

**the use of wood as a cooking fuel.**

- Fuel wood harvesting, plus forest clearing in the early 20th century **to try to get rid of the Tsetse fly,** left the Kwimba area largely bereft of forest cover.
- More efficient use of wood for fuel, as well as overall economic development, drove the tactics of the Kwimba effort, which not only **included the planting of Australian eucalyptus trees** (which grow fast and served the needs of the affected communities well), but also the **establishment of community and school plant nurseries**, and the **design of cleaner, more efficient cook stoves by the women** who lived in the region. Organizations and governmental agencies from both Australia and Africa contributed to this effort. During the project's nine-year run, over **6.4 million trees were planted.**
- One of the most unique aspects of ensuring responsibility for those trees: **"tree ownership certificates"** which gave the owner title to the tree (regardless of who owned the land on which it was planted).

**2. Reforestation in Mexico: the Mixteca Region**

- Before the arrival of Spanish explorers, Mexico's Mixteca region (in the state of Oaxaca) was covered with forests. **Heavy logging and goat herding** turned the area into a desert by the late 20th century. The **introduction of modern farming techniques without erosion control** further degraded the land.
- In the 1980s, farmer Jesús León Santos learned of native farming techniques from Guatemalan immigrants. He **founded the Center for Integral Small Farmer Development in the Mixteca (CEDICAM)** to implement these techniques, which included reforestation as a mean of rebuilding soil.
- Relying on native tree species, terraced agricultural techniques, and containment ditches for preventing hillside erosion, CEDICAM has not only **reforested more than 1000 hectares (with 1 million trees)**, but helped create more economic opportunity and even gender equality within the region.
- Santos was awarded the **Goldman Environmental Prize** in 2008.

**3. Reforestation in Korea**

- South Korea could likely serve as the model for reforestation: Lester Brown noted in *Eco-Economy: Building an Economy for the Earth* that "Perhaps the most successful national reforestation effort

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| | is the one undertaken in South Korea beginning more than a generation ago."<br>- At the end of Korean War hostilities in 1953, the country was almost completely **deforested because of logging and heavy use of firewood during the 35-year Japanese occupation** earlier in the century.<br>- Since then, national and local government efforts have turned bare mountains into forest lands: according to *The Korea Times*, "Between 1961 and 1995, stocked forest land went up from 4 million hectares to 6.3 million hectares. Total timber rose from 30.8 million cubic meters in 1954 to over 164.4 million cubic meters in 1984. **By 2008, 11 billion trees had been planted**. About two-thirds of South Korea is now clothed with forest." Even the DMZ is now "pristine wildlife habitat"… and **while South and North Korea are still on hostile terms, the former has helped the latter with tree-planting efforts.** | |
| 14. | **Write short notes on:**<br>**a) The Clemenceau**<br>- A 27,000-ton warship full of asbestos, PCBs, lead, mercury, and other toxic chemicals was being sent from France to India to be broken up by hand in a scrapyard where impoverished workers are injured and die every day.<br>- The ship left France on December 31, 2005, under a huge cloud of controversy after Greenpeace and other organisations launched a campaign to stop the Clemenceau's export to India to be broken up.<br>- Greenpeace declared that the quantities of hazardous wastes still on board deemed the shipment **as illegal trade under the Basel Convention** - the international treaty that prohibits the export of toxic wastes from developed nations to non-OECD countries. **Green peace** is an independent campaigning organisation that uses **non-violent creative confrontation to expose global environmental problems to force solutions** that are essential to a green and peaceful future.<br>- The case of the Clemenceau has become a symbol of the moral injustice of rich countries dumping their toxic waste on poorer countries. Having tried and failed to offload the ship to other countries, France has finally been forced to clean up a toxic mess of its own making.<br>**b) Biofuels** (as above)<br>**c) Solar Energy** (as above)<br>**d) Ecological Deficit** | **April 2015**<br>**April 2015**<br>**April 2015**<br>**April 2011,** |

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| | - The difference between the bio-capacity and ecological footprint of a region or country. The **Ecological Footprint** is defined as "the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located."<br>- An **ecological deficit** occurs when the footprint of a population exceeds the bio-capacity of the area available to that population. Conversely, an **ecological reserve** exists when the bio capacity of a region exceeds its population's footprint.<br>- If there is a regional or national ecological deficit, it means that the region is importing bio capacity through trade or liquidating regional ecological assets.<br>- In contrast, the global ecological deficit cannot be compensated through trade, and is therefore equal to ecological overshoot. In population dynamics and population **ecology**, **overshoot** occurs when a population exceeds the long term carrying capacity of its environment. The consequence of **overshoot** is called a collapse, a crash or a die-off. | **2009, 2008, 2007** |
| | **e) Wind Energy**<br>- Wind energy is a form of solar energy. Wind energy (or wind power) describes the process by which wind is used to generate electricity.<br>- Wind turbines convert the kinetic energy in the wind into mechanical power. A generator can convert mechanical power into electricity.<br>- Renewable | **April 2011** |
| | **f) Greenhouse Gases**<br>- A gas that contributes to the greenhouse effect by absorbing infrared radiation. Carbon dioxide and chlorofluorocarbons are examples of greenhouse gases.<br>- Greenhouse gases trap heat in the atmosphere, which makes the Earth warmer.<br>- Greenhouse gases come from all sorts of everyday activities, such as using electricity, heating our homes, and driving around town.<br>- These greenhouse gases don't just stay in one place after they're added to the atmosphere. As air moves around the world, greenhouse gases become globally mixed, which means the concentration of a greenhouse gas like carbon dioxide is roughly the same no matter where you measure it.<br>- Even though some countries produce more greenhouse gases than others, emissions from *every* | **April 2011** |

country contribute to the problem. That's one reason why climate change requires global action.

**g) Fuel Cell**

**April 2009, 2007**

- A fuel cell is a device that converts chemical energy into electricity through a reduction-oxidation (redox) reaction.
- In a redox reaction, electrons from one atom or molecule are transferred to another atom or molecule. The element that is oxidized loses electrons (generally speaking) while the element that gains electrons is reduced. *OIL RIG - **O**xidation **I**s **L**oss **R**eduction **I**s **G**ain*
- Rusting metal is an example of a redox reaction that occurs between iron and oxygen. In many cases, oxygen is the "oxidizing agent". Oxygen is a common oxidizing agent in fuel cells, though there are several others that can be used including hydrogen peroxide.
- Fuel cells are not the only devices that convert chemical energy into electrical energy. Batteries do the same thing. The difference between a fuel cell and a battery is that batteries only store energy, they do not create energy.
- Whereas batteries simply store electricity, fuel cells are able to extract and produce electricity, making them useful for power generation.
- Fuel cells actually can be divided into two groups based on operating temperature: normal temperature fuel cells and high temperature fuel cells.
- **Normal Temperature Fuel Cells**: operate at "normal" temperatures (less than about 220 C or 430 F) include proton exchange membrane fuel cells or PEMFCs and alkaline fuel cells (AFCs).
- **High Temperature Fuel Cells**: are broken down into solid fuel cells (SFCs) and molten carbonate fuel cells (MCFCs).
- SFCs have no liquid components at all, which means they can be installed in unique positions and do not have to lie flat. They can even be designed as tubes, making them ideal for applications where space is limited. Their solid nature requires operating temperatures as high as 1000 degrees Celsius (1800 F). Oxygen is used to produce electricity in most SFCs, rather than the much more explosive hydrogen of normal temperature fuel cells.
- MCFCs operate at temperatures around 650 C. The high temperature is needed to create molten salt (lithium potassium carbonate) that acts as the electrolyte in these fuel cells (similar to the membrane in PEMFCs). MCFCs use fossil fuels to produce hydrogen-rich gas that acts much like the hydrogen in a normal temperature fuel cell, producing protons and electrons for energy.
- **Efficiency and Environmental Impact**: Despite the fact that many fuel cells rely on fossil fuels to

produce energy, their efficiency when compared to simply burning fuel gives them an edge in terms of environmental impact. Whereas the standard internal combustion engine is 25% efficient at best, fuel cells commonly reach efficiencies of 40 to 60%. They are theoretically capable of 85 to 90% efficiency, but technology has yet to reach that threshold.

- Fuel cells achieve twice to three times the efficiency of simply burning fossil fuels, which means that the energy returned on energy invested is much greater.
- The result is less greenhouse gas emissions for fuel cells for the same amount of energy produced, making them much more environmentally friendly. In addition, because the reaction is controlled, it is possible to reduce emissions even further by collecting them for safer disposal.
- Fuel cells are costly due to the fact that they require relatively rare and expensive components, like platinum.
- The platinum content and materials used in the anode and cathode make up 70% of the cost of a fuel cell.
- At current prices, fuels cells cost approximately $73 - $100 per kilowatt to run. To be competitive with standard internal combustion engines, that price needs to drop to around $35 per kilowatt.
- The other thing that makes fuel cells less competitive in the current market is infrastructure. Because mobile fuel cells need to run at normal temperatures, hydrogen is the most efficient fuel and has been the target of most research efforts. While it is possible to run mobile fuel cells on hydrocarbons, this reduces many of the benefits that they offer.

### h) Montreal Protocol

**April 2010**

- The **Montreal Protocol** on Substances that Deplete the Ozone Layer (a **protocol** to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production and consumption of Ozone Depleting Substances (ODS)
- The Montreal Protocol on Substances that Deplete the Ozone Layer is one of the first international environmental agreements that includes trade sanctions to achieve the stated goals of a treaty.
- Legally enforces the **phase-out of the production and use of ozone depleting substances** - chemicals often used in refrigeration, air-conditioning, foam manufacturing, aerosol production, and fire extinguishing.
- Since 2010, the agenda of the Protocol has focused on the phase-out of hydro chlorofluorocarbons (HCFCs), an ozone-depleting substance mainly used in cooling and refrigeration applications, and

in the manufacture of foam products.

- It also offers major incentives for non-signatory nations to sign the agreement. The treaty negotiators justified the sanctions because depletion of the ozone layer is an environmental problem most effectively addressed on the global level.
- Furthermore, without the trade sanctions, there would be economic incentives for non-signatories to increase production, damaging the competitiveness of the industries in the signatory nations as well as decreasing the search for less damaging CFC alternatives.
- Since 1991, with more than $1 billion in grant approvals, the Bank has supported the implementation of 700-plus investment and technical assistance phase-out activities in client countries. This has **generated a phase-out of more than 500,000 tons of production** and use of ozone depleting substances, which in turn has **avoided emissions of more than 1.2 billion tons of carbon dioxide equivalent.**

### i) Ozone Depletion

**April 2015**

Ozone is a natural gas that exists in large quantities in the stratosphere, which is one of the upper layers of the Earth's atmosphere. There, ozone works to protect life on earth by absorbing ultraviolet rays and other harmful rays from the sun. This ozone layer is steadily being destroyed by chlorofluorocarbons, halons and other ozone-depleting substances in the atmosphere. As the ozone layer is destroyed, more harmful ultraviolet rays reach the Earth's surface. This causes skin cancer, cataracts and other health problems and may exert dangerous effects on plankton, agricultural products and all kinds of plants and animals.

### j) Dakshin Gangotri

**April 2010, 2008**

- Dakshin Gangotri was the first scientific base station of India situated in Antarctica, part of the Indian Antarctic Program. It is located at a distance of 2,500 kilometres from the South Pole. Before India did so, 12 countries had set up 45 manned stations in Antarctica.
- The research priority is now proposed to be shifted from **ways of exploiting the icy continent's enormous resources of krill (a shrimp-like crustacean) to tapping oil and gas deposits.**
- The original landing site is not suitable for the new priority, and two new bases will now be set up 1,000 km and 5,000 km away from the original base Dakshin Gangotri. Both shifts could have been avoided if the programme had been better conceived at the start.
- And the entire operation could have avoided getting a stigma if those in charge had prevented

drunkenness and the viewing of pornographic films on the part of expedition members - developments that led to brawls and rights during the missions. Even when they were around in their tents nobody seemed worried about polluting the place. Antarctica is still pollution-free and visitors are obliged to observe a strict code of cleanliness. This means that all waste material, even soiled toilet paper, must be carried back on board ship. But apparently the Indian team was unmindful of such considerations and piled up heaps of garbage around their tents.

- The prime minister was so angered by the mismanagement that he recently stopped funds to the Department of Ocean Development (DOD) for a couple of months.
- The initial site chosen was discarded after aerial surveys revealed developing fissures on the grounded ice patches. While the DOD maintains officially that it was an ideal site for a permanent station, some officers in the department concede that if India is really serious about exploiting oil and gas resources it should have really based itself either near the Ross Sea or Weddell Sea, between 1,000 km and 5,000 km away, where most of the deposits are expected to be found. They have now switched the thrust of their programme to the exploitation of oil resources in the near future but the way they are going about the job looks as if it would go the krill way.
- Faced with a barrage of criticism, the department of late has shown signs of mending its ways. Recently it has submitted a 10-year project profile to the prime minister making oil exploration at Antarctica its main aim. The profile was something it should have done years ago.

**k) Noise Pollution**

Noise pollution takes place when there is either excessive amount of noise or an unpleasant sound that causes temporary disruption in the natural balance. **April 2010**

**Effects of Noise Pollution**

1. **Hearing Problems:** Any unwanted sound that our ears have not been built to filter can cause problems within the body. Our ears can take in a certain range of sounds without getting damaged. Man made noises such as jackhammers, horns, machinery, airplanes and even vehicles can be too loud for our hearing range. Constant exposure to loud levels of noise can easily result in the damage of our ear drums and loss of hearing. It also reduces our sensitivity to sounds that our ears pick up unconsciously to regulate our body's rhythm.
2. **Health Issues:** Excessive noise pollution in working areas such as offices, construction sites, bars and even in our homes can influence psychological health. Studies show that the occurrence of

aggressive behavior, disturbance of sleep, constant stress, fatigue and hypertension can be linked to excessive noise levels. These in turn can cause more severe and chronic health issues later in life.

3. **Sleeping Disorders:** Loud noise can certainly hamper your sleeping pattern and may lead to irritation and uncomfortable situations. Without a good night sleep, it may lead to problems related to fatigue and your performance may go down in office as well as at home. It is therefore recommended to take a sound sleep to give your body proper rest.
4. **Cardiovascular Issues:** Blood pressure levels, cardio-vascular disease and stress related heart problems are on the rise. Studies suggest that high intensity noise causes high blood pressure and increases heart beat rate as it disrupts the normal blood flow. Bringing them to a manageable level depends on our understanding noise pollution and how we tackle it.
5. **Trouble Communicating:** High decibel noise can put trouble and may not allow two people to communicate freely. This may lead to misunderstanding and you may get difficult understanding the other person. Constant sharp noise can give you severe headache and disturb your emotional balance.
6. **Effect on Wildlife:** Wildlife faces far more problems than humans because noise pollution since they are more dependent on sound. Animals develop a better sense of hearing than us since their survival depends on it. The ill effects of excessive noise begin at home. Pets react more aggressively in households where there is constant noise.

**l) Biomedical Wastes**

Any **waste** which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biologicals. **April 2006**

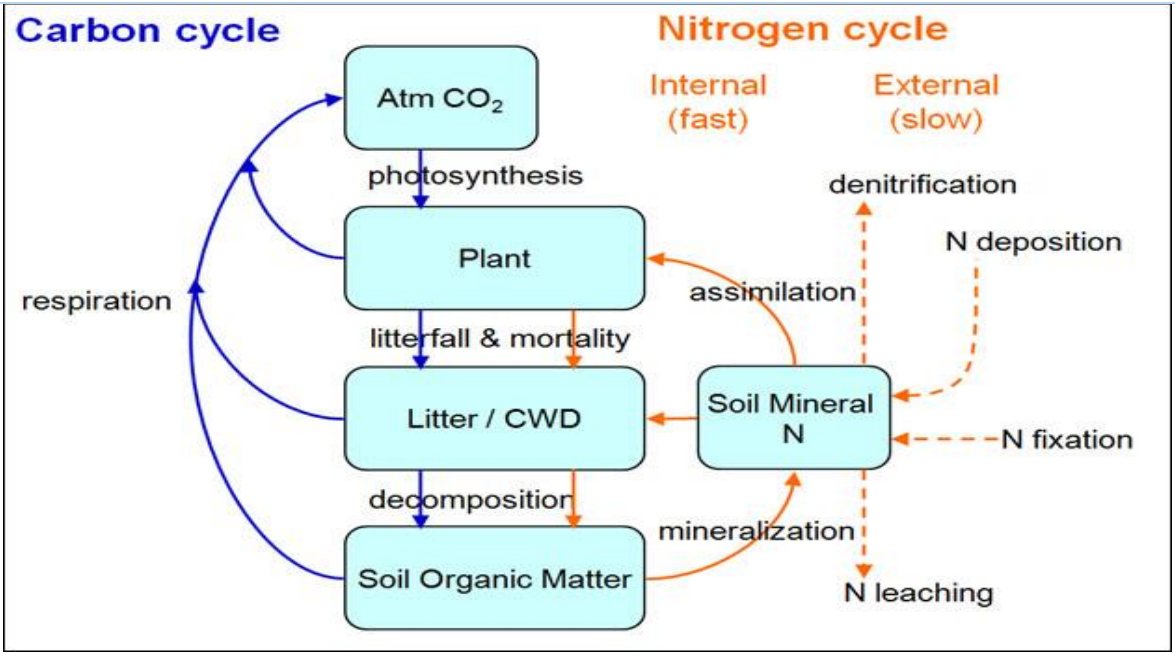
**m) Carbon Cycle** *(See diagram below)*

The series of processes by which carbon compounds are interconverted in the environment, involving the incorporation of carbon dioxide into living tissue by photosynthesis and its return to the atmosphere through respiration, the decay of dead organisms, and the burning of fossil fuels. **April 2006**

**n) Nitrogen Cycle** *(See diagram below)*

The series of processes by which nitrogen and its compounds are interconverted in the environment and in living organisms, including nitrogen fixation and decomposition.

ANS:




15. **India should follow the nuclear energy route in its quest for energy security. Discuss any 3 reasons (each) for and against the foregoing statement** **April 2014**

**Give an overview of the present day energy scenario in India, which is poised to become a "Developed Country" in the current decade. What are the options open to us and why?** **April 2011**

ANS:

**FOR:**

1. We need to use all of the energy sources we have, because **renewables aren't yet able to take over from nuclear power.** The alternatives to nuclear are coal and natural gas – including unconventional gas resources – and these would be (over the long-run) much more polluting and damaging than nuclear.
2. Nuclear Fuel – virtually **unlimited, with larger potential**
3. Nuclear fission process **produces virtually no greenhouse gas emissions** - unlike the burning of fossil fuels such as coal and natural gas.
4. **Reduced Carbon Emissions**
5. Nuclear fission differs from the burning of fossil fuel in that it **produces neither sulfur dioxide nor nitrogen oxides, the pollutants that cause acid rain.** If the world intends to address the threat of global warming and still satisfy its growing appetite for electricity, it needs an ambitious expansion of nuclear power.
6. Nuclear power can provide a **reliable, steady stream of electricity** that's not dependent on a shining sun or blowing winds, giving it an advantage—in some people's minds—over its renewable

competitors.

7. **Increased energy security**

**AGAINST:**

1. Nuclear energy **isn't really a zero-carbon system,** since you still have to manufacture power plants, mine and enrich uranium, and transport processed fuel—all of which typically rely on CO2-emitting fuel sources.
2. While it's commonly accepted that nuclear energy has a relatively dainty footprint, the question of **whether new reactors would be the most cost-effective way** to lower electricity-related emissions is still hotly debated.
3. Like conventional power plants, a **nuclear site cranks out electricity using steam-driven turbines.** Cooling those operations often **requires a whole lot of water,** the drawing and releasing of which can affect aquatic wildlife.
4. **Uranium mining** can also **damage the environment.**
5. Every nuclear power reactor makes **massive amounts of radioactive waste.**
6. Nuclear power's waste is deadly - it **causes cancer and genetic mutations,** and there is no known way to permanently contain, dispose or neutralize it. All claims to the contrary are unfounded.
7. **India is poorly endowed with Uranium.** Available Uranium supply can only fuel 10,000 MW of the Pressurized Heavy Water Reactors (PHWR). FBR technology is critical to developing stage two of India's nuclear power program. Without developing the wide-scale use of FBR technology, India will find it difficult to go beyond 10,000 MW of nuclear capacity based on known indigenous Uranium resources. Because **India is outside the Nuclear Non-Proliferation Treaty** due to its weapons program, it was for 34 years largely excluded from trade in nuclear plant or materials, which hampered its development of civil nuclear energy [production] until 2009.

**ENERGY SCENARIO IN INDIA:**

The electricity consumption per capita for India is just 566 KWh and is far below most other countries or regions in the world. Even though 85% of villages are considered electrified, around 57% of the rural households and 12% of urban households, i.e. 84 million households in the country, do not have access to electricity. Electricity consumption in India is expected to rise to around 2280 BkWh by 2021-22 and around 4500 BkWh by 2031-32.

**COAL:** It is the most important and abundant fossil fuel in India. It accounts for 55% of the country's energy need. The country's industrial heritage has been built upon indigenous coal. Commercial primary energy consumption in India has grown by about 700% in the last four decades. Considering the limited reserve potentiality of petroleum & natural gas, eco-conservation restriction on hydro projects and geo-political perception of nuclear power, coal will continue to occupy center-stage of India's energy. It has been estimated that at current levels of consumption the proven reserves of coal will last for 80 years and if all the inferred reserves also materialize it can last for over 140 years at the current rate of extraction. However, the coal consumption will increase as India tries to meet its energy requirements and thus the reserves will last for fewer years. If domestic coal production continues to increase at a rate of 5% the extractable reserve will run out in around 45 years. Further, it is difficult to predict the long term demand for coal owing to rapid changes in the prices and relative availability of other fuels as well as the technological advancements and new policies in the end use sector. Further, the coal deposits in India are concentrated in the Eastern regions. The setting up of a coal fired power plant in Western or North-west India, entails transporting coal over distances exceeding 1000 Km. and at such distances the economics of coal power become unfavorable.

**PETROLEUM/OIL:** India has total reserves (proved and indicated) of 1201 million metric tonnes of crude oil. Long-term growth in demand of petroleum products depends upon a number of factors such as economic growth (GDP), elasticity of demand for petroleum products with respect to GDP growth, relative price levels of substitute products particularly LNG/CNG, saturation of LPG demand, and the impact of energy conservation measures. The demand for petrol and diesel is dependent on the growth of road infrastructure, the price of oil, the future efficiency of vehicles, the growth of alternate modes of transport and the emergence of substitutes like bio-fuels and/or technologies such as hybrids. Naphtha demand is dependent on the growth plans for fertilizer and petro-chemicals and its price relative to the price and availability of natural gas. The production of automobiles has greatly increased in the last decade in India. As awareness grows about [LPG being a] cleaner fuel along with the increase in purchasing power and improved literacy levels it is anticipated that this sector will see exponential growth.

**NATURAL GAS:** Natural gas can replace existing fuels in various sectors both for feedstock as well as for energy purposes. However, this substitution will depend upon the relative price of gas with respect to other fuels. Therefore, it may be stated that the demand for gas will depend upon the price of

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| | natural gas relative to that of alternatives, mainly Naphtha for fertilizer and petrochemicals and coal for power. With domestic production of just over 140 million standard cubic meters per day meeting barely half the demand, India is importing 10 million tons of liquefied natural gas per annum and is looking at unconventional sources like shale gas. **One of the major issues with use of natural gas in India is that of the discriminatory pricing and fiscal policy adopted for oil and gas where oil produced from domestic fields is priced at international rates while the government caps natural gas price at artificially low levels.** This is due to the fact that the Indian fertilizer sector, which is a dominant user of natural gas, is highly subsidized. The cost of power obtained by using natural gas varies from INR 2.90 to INR 4.60 per KWh and power obtained through natural gas is mainly used as peaking power. Besides this India has around 0.5 million vehicles running on auto gas and per vehicle consumption is 451 Kg per annum compared to the world average of 1428 kg per annum. This is, however, constrained by a lack of appropriate distribution networks. Natural gas has been recognized as a bridge between the more polluting fuels based on hydrocarbons and cleaner renewable sources of energy. | |
| 16. | **You are President – Operations of an FMCG company. Your responsibility extends to three manufacturing plants in an industrial estate located in one of the states in western India. The Operations in the plants involve use of water for various purposes like cooling tower make up, boiler feed, domestic and processing wherein wastewater is biodegradable. Hazardous waste like used oil and effluent treatment plant sludge from primary treatment are generated. Both domestic & industrial effluents are generated in substantial quantities. The plants have LDO (Light Diesel Oil) fired boilers and 30 meter stacks are provided for each of the boilers. Each plant has a diesel generating set of 800 KVA with acoustic enclosure and stack. At each plant, the diesel storage for the DG set is a tank with 10000 liters capacity which is intended to be fully utilized. Enlist the licenses/permits/consents/returns required to be obtained/furnished by the company along with the Act/Rule/Notification under which they are required** | **April 2014** |
| ANS: | | |
| 17. | **"Large dams are often ecologically unsound and economically unjustified if environmental and health costs are fully accounted for" – Discuss with any one example from India** | **April 2013** |
| ANS: | Today big dams are one of the key concerns of the environmentalists across the world. We can discern it from the fact that almost everywhere, there are communities or groups of activists organizing against the proposed building of a dam, in their particular areas of concern. This issue is attracting polemics largely in the developing countries. In the growing international debate over the catastrophic | |

construction of big dams, India has also been trapped. But India's condition, in terms of water resources, is completely different from the other countries of the world as its crucial economic sector, agriculture, is largely dependent on monsoon. The need for building large dams and storage schemes is felt more acutely here.

- ✓ The central issue in the citizen campaign is the **problem of displacement;** the backwaters of a large dam generally displace many thousands of people - often tribal and forest dwellers that are the poorest and most powerless members of society.
- ✓ By the year 1990, an estimated **21** million people, primarily indigenous had been displaced over the years by large projects. Of these, **only 25 percent had been rehabilitated.** By the year 1999, according to Water Fernandes of the Indian Social institute who has studied displacement Issues, the number of people had risen to 30 million.
- ✓ To empower this problem the Indian government often extreme reactions to protests by potentially and actually displaced people has **drawn infavourble attention from the international human rights community.**
- ✓ In addition the structural design of **dams built in seismically unstable areas** had drawn even more attention to the potential **loss of life** and displacement that might result from a dam that fails. **Often the benefits go to large urban populations far down stream and not to the people who pay for the dam with their land and even their lives.**
- ✓ In addition funding for dams, often in the form of loans from other countries or multilateral development banks, raises international issues of responsibility and fault for unmitigated human and environmental damage.
- ✓ Large dams are **often ecologically unsound and economically unjustified** if environmental and health costs are fully accounted for. These costs include the **loss of forests and wildlife, water logging, salutation, loss of arable land and increases in water-borne diseases,** finally, the religious significance that many Indians attribute to the free flowing river and the communities endangered by faulty dam construction may not be adequately accounted for.

Today, large dams are India's most controversial environmental issue, both domestically and internationally. The environmental harm from a large project could be reduced if its probable environmental impacts were explored before the project's inception. If we examine the regulations that govern such environmental impact assessments in India and the land acquisition on regime.

An Environmental Impact Statement for a dam, for example, might include inputs from geologists, forestry experts, wild life experts, anthropologist's economists, agricultural scientists and social

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| | scientists.<br>India ranks among the most important dam building nations. It began building large dams shortly after independence. Large scale river development began in 1930 with the Mettur dam on Cauvrey and accelerated after independence with Bhakra Nangal and Hirakud Projects.<br><br>**EXAMPLES:**<br>**In India, Sardar Sarovar Project** has been arousing much controversy and bitter campaigns since the late '80s, so much so that the World Bank had to step back from funding the project, in 1990, because of pressures from certain groups. The project's impact on environment and net costs and benefit are widely debated. Various documentaries such as; 'Drowned Out (2002) and 'A Narmada Diary (1995) have filmed such protests as their center stage. The figurehead of much of such protests in India is Medha Patekar, the leady who leads the "1991 Right Livelihood Award" winning movement called "Narmada Bachao Andolan". | |
| 18. | **Describe the "Carbon Tracker Initiative" and the strategy being planned by them to educate the financial markets to make them align with emission reduction objectives** | **April 2013** |
| ANS: | A **carbon bubble** is the idea that there is a bubble in valuation of companies dependent on fossil-fuel-based energy production. This is because true costs of carbon dioxide in intensifying global warming are not taken into account in a company's stock market valuation. Currently the price of fossil fuels companies' shares is calculated under the assumption that all fossil fuel reserves will be consumed. An estimate made by Kepler Chevreux puts the loss in value of the fossil fuel companies due to the impact of the growing renewables industry at US$28 trillion over the next two decades. A more recent analysis made by Citi puts that figure at $100 trillion.<br><br>A planned and orderly transition away from dependence on fossil fuels could prevent a disruptive "bursting of the carbon bubble". A number of developments are supporting such a transition:<br><br>• **Government action on climate change**<br>A detailed academic study of the consequences for the producers of the various hydrocarbon fuels concluded in early 2015 that a third of global oil reserves, half of gas reserves and over 80% of current coal reserves should remain underground from 2010 to 2050 in order to meet the target of no more than a 2 °C rise in average global temperature. Hence continued exploration or development of reserves would be extraneous to needs. To meet the 2 °C target, strong measures would be needed to | |

suppress demand, such as a substantial carbon tax leaving a lower price for the producers from a smaller market. The impact on producers would vary widely depending on the cost of production in their areas of operation. For example, the impact in Canada would be far larger than in the U.S. Open-pit mining of bituminous sands in Canada would soon drop to negligible levels after 2020 in all scenarios considered because it is considerably less economic than other methods of production.

- **Awareness in the financial industry**

By 2013, there was significant awareness in the financial industry of the risks associated with exposure to companies involved in extraction of fossil fuels. In early 2014, the FTSE Group, BlackRock and the Natural Resources Defense Council collaborated in the creation of a stock market index series that excludes companies linked to exploration, ownership or extraction of carbon-based fossil fuel reserves. These indices are intended to make it easier for investors to steer their investments away from such companies. It has been proposed that companies be required by law to report on their greenhouse gas emissions and assess the risk this could pose to their future financial performance. According to Christiana Figueres, UNFCCC, companies have a duty to shareholders to move to a low-carbon economy, because of the effects of the carbon bubble.

- **Divestment campaigning**

The ongoing fossil fuels divestment campaign in universities, churches and pension funds contributes to divestiture from fossil fuel companies. By late 2015, this divestiture was reported to reach $2.6 trillion.

- **Cheaper clean energy**

The price of renewable energy is continually dropping. As of 2014 new wind power is cheaper than new coal and gas power in Australia, China and the United States. Also the electricity produced from a photovoltaic roof system is cheaper than the electricity from the grid in many countries and places in the world.

- **Real pollution control**

Fossil fuels are known for their huge negative externalities or hidden costs. Tackling this market failure will make alternative energies more competitive and will reduce the consumption of fossil fuels.

- **Cancellation of government energy subsidies**

According to the International Monetary Fund, governments around the world gave $523 billion direct subsidies for fossil fuels in 2011. If a carbon tax of $25 per ton of $CO_2$ is included the subsidies total $1.9 trillion only for 2011. Removing fossil fuels subsidies will further reduce their consumption and make the alternative energies even more competitive.

- **Renewable corporations lobbying**

As the penetration of the renewable energy increases so will the wealth of the renewable energy corporations. This and the increasing number of employees in the renewable energy sector will inevitably transform into political lobbying against fossil fuels.

- **Electric transportation**

Switching to electricity based transportation like electrical vehicles from fossil fuel based transportation will reduce the demand for fossil fuels particularly petroleum. Combining roof photovoltaics with second hand EV batteries will further reduce the dependence on fossil fuels as they will provide the needed grid storage for the times when the intermittent renewable energy sources are not producing electricity.

- **Efficiency**

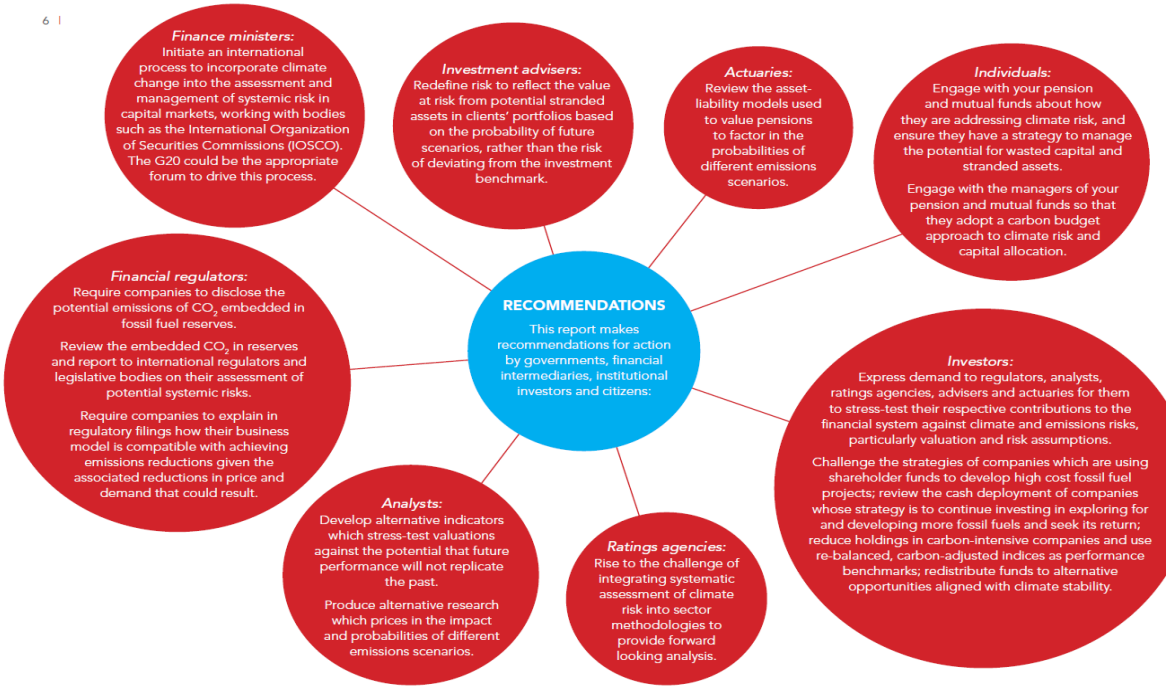
Increased investments in energy efficiency may lead to less consumed energy even when the economy grows. Without growth in energy usage the prices of fossil fuels will decrease and most of the mega energy projects may be uneconomical.

- **Changes in consumer behavior**

According to research by U.S. PIRG Education Fund reported in late 2014: "Over the last decade – after 60-plus years of steady increases – the number of miles driven by the average American has been falling. Young Americans have experienced the greatest changes: driving less; taking transit, biking and walking more; and seeking out places to live in cities and walkable communities where driving is an option, not a necessity." Data from the U.S. Energy Information Administration show that U.S. consumption of both coal and petroleum liquids peaked in 2005, and at the end of 2014 had fallen by 21% and 13% respectively. Consumption of natural gas continued to climb, resulting in the rate of total fossil fuel consumption in terms of energy units falling only 6% from its peak in 2007 to a plateau. On

the other hand, global consumption of petroleum climbed steadily a total of 32% from 1995 to 2014.

| Conclusion | | Recommendation |
|---|---|---|
| Only a fraction of fossil fuels can be burnt unmitigated if we are to limit global warming. | ➡ | **Policymakers:** need to ensure emissions limits are translated into clear signals for the financial markets.<br>**Finance ministers:** the G20 should extend its work to phase-out fossil fuel subsidies and develop an action plan to reduce high carbon exposure on financial markets. |
| The levels of fossil fuels listed on the world's stock exchanges are increasing, especially in London (coal) and New York (oil). | ➡ | **Financial regulators:** require companies to disclose the potential emissions of $CO_2$ embedded in fossil fuel reserves; incorporate climate change risk into the assessment and monitoring of systemic risk in capital markets.<br>**Investors:** call for financial regulator to address climate change as a systemic risk to markets. |
| Companies are spending capital on finding more reserves, even though the current reserves exceed the carbon budget. | ➡ | **Investors:** challenge the strategies of companies who are using shareholder funds to develop high costs fossil fuel projects; review the cash deployment of companies whose strategy is to continue investing in exploring for and developing more fossil fuels and seek its return; reduce holdings in carbon intensive companies and use re-balanced, carbon adjusted indices as performance benchmarks; redistribute funds to alternative opportunities aligned with climate stability. |
| Company reporting on strategy does not address the risk to business models of emissions constraints. | ➡ | **Regulators:** require companies to explain how their business model is compatible with achieving emissions reduction targets given the associated reductions in price and demand that could result. |
| Equity analysis is not pricing in the risk of an emissions ceiling and traditional indicators are not suited to a contracting market. | ➡ | **Investors:** exercise power as the client to demand alternative research which prices in the impact of different emissions pathways on valuation.<br>**Analysts:** develop alternative indicators which stress-test valuations against the potential that future performance will not replicate the past. |
| Credit ratings are not systematically considering the risk of an emissions ceiling. | ➡ | **Investors:** exercise influence as ratings users to demand alternative ratings which consider the impact of different emissions pathways on creditworthiness and business models.<br>**Regulators:** ensure credit ratings agencies are addressing climate change as part of their efforts to tackle systemic risk.<br>**Ratings agencies:** rise to the challenge of integrating systematic assessment of climate risk into sector methodologies to provide forward looking analysis. |
| Investors are tied into benchmarks rather than understanding their exposure to risk. | ➡ | **Investment advisers:** redefine risk to reflect the value at risk based on the probability of future scenarios, rather than the risk of deviating from the benchmark.<br>**Actuaries:** review the way pensions are valued to factor in the probabilities of different emissions scenarios. |



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| 19. | **What are the major sources of water pollution in an industry? Discuss 3 types of standards related to water pollution in the Indian context. Discuss the importance of the roles of people in monitoring and measurement and provision of correct information to pollution control in an industry** | **April 2012** |
| ANS: | Industry is a huge source of water pollution, it produces pollutants that are extremely harmful to people and the environment. Major sources:<br>• Many industrial facilities use freshwater to carry away waste from the plant and into rivers, lakes and oceans.<br>• Pollutants from industrial sources include:<br>✓ **Asbestos –** This pollutant is a serious health hazard and carcinogenic. Asbestos fibres can be inhaled and cause illnesses such as asbestosis, mesothelioma, lung cancer, intestinal cancer and liver cancer.<br>✓ **Lead –** This is a metallic element and can cause health and environmental problems. It is a non-biodegradable substance so is hard to clean up once the environment is contaminated. Lead is harmful to the health of many animals, including humans, as it can inhibit the action of bodily enzymes.<br>✓ **Mercury –** This is a metallic element and can cause health and environmental problems. It is a non-biodegradable substance so is hard to clean up once the environment is contaminated. Mercury is also harmful to animal health as it can cause illness through mercury poisoning.<br>✓ **Nitrates –** The increased use of fertilisers means that nitrates are more often being washed from the soil and into rivers and lakes. This can cause eutrophication, which can be very problematic to marine environments.<br>✓ **Phosphates –** The increased use of fertilisers means that phosphates are more often being washed from the soil and into rivers and lakes. This can cause eutrophication, which can be very problematic to marine environments.<br>✓ **Sulphur –** This is a non-metallic substance that is harmful for marine life.<br>✓ **Oils –** Oil does not dissolve in water, instead it forms a thick layer on the water surface. This can stop marine plants receiving enough light for photosynthesis. It is also harmful for fish and marine birds.<br>✓ **Petrochemicals –** This is formed from gas or petrol and can be toxic to marine life.<br><br>In India, CPCB has identified water quality requirements in terms of a few chemical characteristics, known as primary water quality criteria. Further, Bureau of Indian Standards has also recommended | |

water quality parameters for different uses in the standard IS 2296:1992.

A - Drinking Water Source without conventional treatment but after disinfection

B - Outdoor bathing (Organised)

C - Drinking water source after conventional treatment and disinfection

D - Propagation of Wild life and Fisheries

E - Irrigation, Industrial Cooling, Controlled Waste disposal

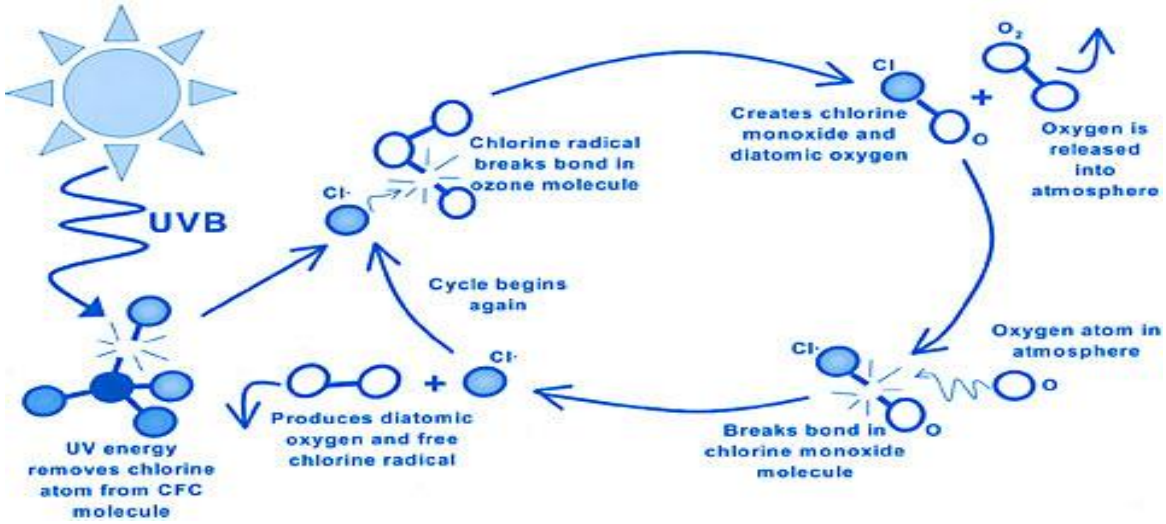
**Water Quality Standards in India (Source IS 2296:1992)**

| Characteristics | Designated best use | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| Dissolved Oxygen (DO)mg/l, min | 6 | 5 | 4 | 4 | – |
| Biochemical Oxygen demand (BOD)mg/l, max | 2 | 3 | 3 | – | – |
| Total coliform organisms MPN/100ml, max | 50 | 500 | 5,000 | – | – |
| pH value | 6.5-8.5 | 6.5-8.5 | 6.0-9.0 | 6.5-8.5 | 6.0-8.5 |
| Colour, Hazen units, max. | 10 | 300 | 300 | – | – |
| Odour | Un-objectionable | | | – | – |
| Taste | Tasteless | – | – | – | – |
| Total dissolved solids, mg/l, max. | 500 | – | 1,500 | – | 2,100 |
| Total hardness (as $CaCO_3$), mg/l, max. | 200 | – | – | – | – |
| Calcium hardness (as $CaCO_3$), mg/l, max. | 200 | – | – | – | – |
| Magnesium hardness (as $CaCO_3$), mg/l, max. | 200 | – | – | – | – |
| Copper (as Cu), mg/l, max. | 1.5 | – | 1.5 | – | – |
| Iron (as Fe), mg/l, max. | 0.3 | – | 0.5 | – | – |
| Manganese (as Mn), mg/l, max. | 0.5 | – | – | – | – |
| Cholorides (as Cu), mg/l, max. | 250 | – | 600 | – | 600 |
| Sulphates (as $SO_4$), mg/l, max. | 400 | – | 400 | – | 1,000 |
| Nitrates (as $NO_3$), mg/l, max. | 20 | – | 50 | – | – |
| Fluorides (as F), mg/l, max. | 1.5 | 1.5 | 1.5 | – | – |
| Phenolic compounds (as $C_2H_5OH$), mg/l, max. | 0.002 | 0.005 | 0.005 | – | – |
| Mercury (as Hg), mg/l, max. | 0.001 | – | – | – | – |
| Cadmium (as Cd), mg/l, max. | 0.01 | – | 0.01 | – | – |
| Salenium (as Se), mg/l, max. | 0.01 | – | 0.05 | – | – |
| Arsenic (as As), mg/l, max. | 0.05 | 0.2 | 0.2 | – | – |
| Cyanide (as Pb), mg/l, max. | 0.05 | 0.05 | 0.05 | – | – |
| Lead (as Pb), mg/l, max. | 0.1 | – | 0.1 | – | – |
| Zinc (as Zn), mg/l, max. | 15 | – | 15 | – | – |
| Chromium (as $Cr^{6+}$), mg/l, max. | 0.05 | – | 0.05 | – | – |
| Anionic detergents (as MBAS), mg/l, max. | 0.2 | 1 | 1 | – | – |
| Barium (as Ba), mg/l, max. | 1 | – | – | – | – |

20. **What are "Ozone Holes"? Explain the exact mechanism by which the ozone layer gets destroyed in the stratosphere?** **April 2011**

**Explain the exact mechanism by which the ozone layer gets destroyed in the stratosphere.** **April 2010**

ANS:




The picture above shows how the ozone layer is slowly destroyed by CFCs.

It was not until 1973 were chlorine radicals found out to act as a catalyst in the mechanism for the destruction of ozone. One atom of chlorine from a CFC molecule can damage up to 100,000 molecules of O3.

**The reaction mechanism of ozone depletion is shown below:**

$CCl_2F_2 \rightarrow CClF_2 + Cl\bullet$

$Cl\bullet + O_3 \rightarrow ClO\bullet + O_2$

$ClO\bullet + O\bullet \rightarrow Cl\bullet + O_2$

$ClO\bullet + O_3 \rightarrow Cl\bullet + 2O_2$

So therefore, the overall equation = $O_3 + O\bullet \rightarrow 2O_2$

In the above reaction mechanism the chlorine radical is reproduced and so acts as a catalyst. The ClO radical is the reaction intermediate as it is produced and used up in the reaction. The overall effect is the destruction of a molecule of ozone by the addition of an oxygen radical, to produce two molecules of oxygen. This destroys the ozone layer and harmful UV radiation reaches earth through the holes in the ozone layer.

Unfortunately, CFCs are not the only ODTs. Other ODTs include the methylhalides, carbon tetrachloride ($CCl_4$), carbon tetrafluoride ($CF_4$), and the halons which contain bromine instead of chlorine. Such compounds are called halocarbons.

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| 21. | **What do you understand by 'Indian Environmental Movement'? What were the factors that** | **April 2011** |

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| | **contributed to its growth?**<br>**Who are the people credited with having initiated the so-called "Indian Environmental Movement?"**<br>**Describe their roles and how they contributed to the ultimate success of the movement.**<br>**The Indian Environmental Movement.**<br>**Environmental Movement & NGO's** | <br>**April 2009**<br><br>**April 2008**<br>**April 2007** |
| ANS: | Environmental and public health is an ongoing struggle within India. The first seed of an environmental movement in India was the foundation in 1964 of *Dasholi Gram Swarajya Sangh*, a labour coperative started by Chandi Prasad Bhatt. It was inaugurated by Sucheta Kriplani and founded on a land donated by Shyma Devi. This initiative was eventually followed up with the Chipko movement.<br><br>**CHIPKO MOVEMENT, 1973:** In the wake of reckless deforestation, a unique movement had bubbled. The 1980s saw the debate on environment move from just deforestation to the larger issues of depletion of natural resources. Chipko movement in the Garhwal Himalayas, shoved aside urban armchair naturalists. Led by **CHANDNI PRASAD BHATT AND SUNDERLAL BAHUGUNA,** it was a people's revolt against mindless deforestation.<br>**And they did it simply by hugging trees when the woodmen came to axe them.**<br>It began as a movement of the hill people in the state of **UTTAR PRADESH** to save the forest resources from exploitation by contractors from outside. It later evolved into an ecological movement that aimed at the maintenance of the ecological stability of the major upland watersheds in India.<br>Spontaneous people's response to save vital forest resources was seen in the Jharkhand area in the Bihar-Orissa border region as well as in the Bastar area of **MADHYA PRADESH.** Here, there were attempts to convert the mixed natural forests into plantations of commercial tree species, to the complete detriment of the tribal people.<br>**In the SOUTHERN PART OF INDIA the Appiko movement,** which was inspired by the success of the Chipko movement in the Himalayas, is actively involved in stopping illegal over-felling of trees in forests and in replanting forest lands with multipurpose broad-leaved tree species.<br>**In Himachal Pradesh,** the Chipko activists intensified their opposition to the expansion of monoculture plantation of the commercial Chir Pine (Pinus roxburghii).<br>**In the Aravalli Hills of RAJASTHAN,** there has been a massive program of tree planting to give employment to those hands, which were hitherto engaged in felling of trees. | |