All India Civil Services Coaching Centre

(Under the aegis of Government of Tamil Nadu)

Answer Key Explanation

Test 5 – NCERT Science and Technology

Maximum Questions: 100 **Maximum Marks: 200**

1. **Correct Answer: (d)**

Chemical Change

- A change in which one or more new substances are formed is called a chemical change. A chemical change is also called a chemical reaction. Chemical changes are very important in our lives.
- Rusting of iron familiar is a familiar chemical change. When we leave a piece of iron in the open for some time, it acquires a film of brownish substance. This substance is called rust and the process is called rusting.
- All new substances are formed as a result of chemical changes. For example, if a metal is to be extracted from an ore, such as iron from iron ore, we need to carry out a series of chemical changes.

Example of chemical change are:

- Change of state
- Change of colour
- Evolution of gas
- Change in Temperature

1. **Correct Answer: (c)**

Refractive Index

- Light propagates with different speeds in different media. The relative speed of propagation of light in different media is related to an important quantity known as a refractive index. It is defined as the ratio of the speed of light in a vacuum to that in a medium. Light travels the fastest in a vacuum with the highest speed of 3×108 m s–1.
- In the air, the speed of light is only marginally less, compared to that in a vacuum. It reduces considerably in glass or water. The value of the refractive index for a given pair of media depends upon the speed of light in the two media.
- The ability of a medium to refract light is also expressed in terms of its optical density. Optical density has a definite connotation. It is not the same as mass density. It actually means 'optically rarer medium' and 'optically denser medium', respectively.

2. **Correct Answer: (c)**

Effect of Temperature on the matter

- On increasing the temperature of solids, the kinetic energy of the particles increases. Due to the increase in kinetic energy, the particles start vibrating with greater speed. The energy supplied by heat overcomes the forces of attraction between the particles.
- The particles leave their fixed positions and start moving more freely. A stage is reached when the solid melts and is converted to a liquid. The temperature at which solid melts to become a liquid at the atmospheric pressure is called its melting point.
- The state of a matter changes at a constant temperature when pressure is fixed and there is no increase or decrease in temperature when the state changes. Example: When a solid melts, its temperature remains the same.

3. **Correct Answer: (c)**

Vision Defects

- Myopia A person with Myopia can see nearby objects clearly. A person with myopia cannot see faraway objects clearly. The far point for the myopic eye is

nearer than infinity occurs due to excessive curvature of the eye lens and elongation of the eyeball.

- The image of a distant object is formed in front of the retina and not on the retina.
- Defected is corrected by using Concave lenses such that the lens will bring the image back on to the retina.
- Hypermetropia A person with Hypermetropia can see far away objects clearly.
- A person with Hypermetropia cannot see nearby objects clearly.
- The near point of the eye is more than 25cm. This arises mostly during latter stages in life, as a result of the weakening of the ciliary muscles and/or the decreased flexibility of the lens.
- The image of a distant object is formed behind the retina and not on the retina.
- Defected is corrected by using Convex lenses such that the lens will bring the image back on to the retina.
- Presbyopia The power of accommodation of the eye usually decreases with aging.
- The ciliary muscles weaken and thereby the flexibility of the eye lens reduces.
- The near point moves away.
- Spectacles with bifocal lenses are recommended.

5. **Correct Answer: (a)**
   Venusian winds
   - Scientists have characterised wind and cloud patterns of the night side of planet Venus for the first time and found that it behaves very differently from the part facing the Sun.
   - Scientists found that the cloud patterns there are different from those on the dayside, and influenced by Venus' topography on the dark side.
   - Venus' atmosphere is dominated by strong winds that whirl around the planet far faster than Venus itself rotates.
   - This phenomenon, known as 'super-rotation', sees Venusian winds rotating up to 60 times faster than the planet below, pushing and dragging along clouds within the atmosphere as they go.

6. **Correct Answer: (b)**
   Gastric secretion
   - The gastric mucosa secretes 1.2 to 1.5 litres of gastric juice per day. Gastric juice renders food particles soluble, initiates digestion (particularly of proteins), and converts the gastric contents to a semiliquid mass called chyme, thus preparing it for further digestion in the small intestine.
   - Gastric juice is a variable mixture of water, hydrochloric acid, electrolytes (sodium, potassium, calcium, phosphate, sulfate, and bicarbonate), and organic substances (mucus, pepsins, and protein). This juice is highly acidic because of its hydrochloric acid content, and it is rich in enzymes.
   - Pure Water Water, a substance composed of the chemical elements hydrogen and oxygen and existing in gaseous, liquid, and solid states.
   - It is one of the most plentiful and essential compounds.
   - A tasteless and odourless liquid at room temperature, it has the important ability to dissolve many other substances. Indeed, the versatility of water as a solvent is essential to living organisms.
   - Life is believed to have originated in the aqueous solutions of the world's oceans, and living organisms depend on aqueous solutions, such as blood and digestive juices, for biological processes.
   - Lemon Juice Lemon juice is a characteristic ingredient in many pastries and desserts, such as tarts and the traditional American lemon meringue pie.
   - The distinctive astringent flavour of the fruit, either fresh or preserved, is also used to enhance many poultry, fish, and vegetable dishes worldwide.
   - Citric acid may amount to 5 percent or more by weight of the lemon's juice, which is also rich in vitamin C and contains smaller amounts of the B vitamins, particularly thiamin, riboflavin, and niacin.

7. **Correct Answer: (c)**
Electromagnetic waves
- Electromagnetic waves or EM waves are waves that are created as a result of vibrations between an electric field and a magnetic field. Examples are radio waves, microwaves, infrared waves, X-rays, gamma rays, etc.
- All EM waves travel with a constant velocity of 3.00 x 108 ms-1 in a vacuum.
- They differ in their frequencies and hence, wavelengths.
- The decreasing order of the frequencies is- Gamma Ray (300 EHz), X-Rays (3 EHz), UV (30-3 PHz), Visible Rays including green Light (3 PHz-300 THz), Infrared (300 THz-300 GHz), Micro Waves, and Radio Waves.

8. **Correct Answer: (b)**
Combustion
- Combustion, or burning, is a high-temperature exothermic redox chemical reaction between a fuel and an oxidant, usually, atmospheric oxygen, that produces oxidized, often gaseous products, in a mixture termed as smoke.

Ignition temperature
- The minimum temperature at which a substance starts to burn is called its ignition temperature.
- Different fuels have different ignition temperatures. Some fuels have low ignition temperature and some have high ignition temperature.
- The fuels that have low ignition temperatures are highly inflammable and burn quickly at the spark of fire. While some fuels that have high ignition temperature do not burn quickly. They require heating to burn. For example, kerosene oil does not burn unless it is heated up to its ignition temperature.

Fuel	Calorific Value (kJ/kg)
Cow dung cake	6000-8000
Wood	17000-22000
Coal	25000-33000
Petrol	45000
Kerosene	45000
Diesel	45000
Methane	50000
CNG	50000
LPG	55000
Biogas	35000-40000
Hydrogen	150000

Calorific value
- The amount of heat energy produced on a complete combustion of 1 kg of a fuel is called its calorific value.
- The calorific value of a fuel is expressed in a unit called kilojoule per kg (kJ/kg).

9. **Correct Answer: (d)**
Uses of Concave mirrors and Convex mirrors
- Concave mirrors Concave mirrors are commonly used in torches, search-lights and vehicle headlights to get powerful parallel beams of light.
- They are often used as shaving mirrors to see a larger image of the face.
- The dentists use concave mirrors to see large images of the teeth of patients.
- Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.
- Convex mirrors Convex mirrors are commonly used as rear-view (wing) mirrors in vehicles.
- These mirrors are fitted on the sides of the vehicle, enabling the driver to see traffic behind him/her to facilitate safe driving.
- Convex mirrors are preferred because they always give an erect, though diminished, image.
- Also, they have a wider field of view as they are curved outwards. Thus, convex mirrors enable the driver to view a much larger area than would be possible with a plane mirror.

10. **Correct Answer: (a)**
Gravitation Force
- Gravitational force is a universal force and governs the motion of all the heavenly objects in the universe.

- Gravitational force is inversely proportional to the square of the distance. Therefore, it decreases with the distance between the objects.
- Gravitational force is directly proportional to the mass of the objects. Therefore, it is dependent on the masses of the object involved.

11. Correct Answer: (d)

Some naturally occurring acids

Natural	Source Acid
Vinegar	Acetic acid
Orange	Citric acid
Tamarind	Tartaric acid
Tomato	Oxalic acid
Sour milk (Curd)	Lactic acid
Lemon	Citric acid
Ant sting	Methanoic acid
Nettle sting	Methanoic acid

12. Correct Answer: (b)

Lysosomes

- They are organelle which is mostly found in animal cells; very rarely in plant cells. It is also called 'suicidal bags' because they are responsible for digestion.
- Each lysosome is surrounded by a membrane that maintains an acidic environment within the interior via a proton pump. Lysosomes contain a wide variety of hydrolytic enzymes (acid hydrolases) that break down macromolecules such as nucleic acids, proteins, and polysaccharides.
- These enzymes are active only in the lysosome's acidic interior; their acid-dependent activity protects the cell from self-degradation in case of lysosomal leakage or rupture, since the pH of the cell is neutral to slightly alkaline.

13. Correct Answer: (c)

Vegetative Propagation

- There are many plants in which parts like the root, stem, and leaves develop into new plants under appropriate conditions.
- Unlike in most animals, plants can indeed use such a mode for reproduction. This property of vegetative propagation is used in methods such as layering or grafting to grow many plants like sugarcane, roses, or grapes for agricultural purposes.
- Plants raised by vegetative propagation can bear flowers and fruits earlier than those produced from seeds. Such methods also make possible the propagation of plants such as banana, orange, rose and jasmine that has lost the capacity to produce seeds.
- Another advantage of vegetative propagation is that all plants produced are genetically similar enough to the parent plant to have all its characteristics.

14. Correct Answer: (c)

Annelida

- Annelid animals are also bilaterally symmetrical and triploblastic, but in addition, they have a true body cavity.
- This allows true organs to be packaged in the body structure. There is extensive organ differentiation. This differentiation occurs in a segmental fashion, with the segments lined up one after the other from head to tail.
- These animals are found in a variety of habitats– freshwater, marine water as well as land. Earthworms and leeches are familiar examples

15. Correct Answer: (d)

Digestion in Humans

- We take in food through the mouth, digest and utilise it. The unused parts of the food are defecated.
- The food passes through a continuous canal which begins at the buccal cavity and ends at the anus.

The canal can be divided into various compartments:

- buccal cavity
- food pipe or oesophagus
- stomach
- small intestine
- large intestine
- the rectum

- the anus
- Small intestine The small intestine is highly coiled and is about 7.5 metres long. It receives secretions from the liver and the pancreas. Besides, its wall also secretes juices.
- Large intestine The large intestine is wider and shorter than the small intestine. It is about 1.5 metre in length. Its function is to absorb water and some salts from the undigested food material.

16. Correct Answer: (b)

Nutrition in Animals

- Animals get their food from plants, either directly by eating plants or indirectly by eating animals that eat plants.
- Some animals eat both plants and animals. Recall that all organisms including humans require food for growth, repair, and functioning of the body.
- Animal nutrition includes the nutrient requirement, mode of intake of food and its utilization in the body.
- Different Ways of Taking Food

The mode of taking food into the body varies in different organisms.

- Bees and humming-birds suck the nectar of plants, infants of humans and many other animals feed on mother's milk.
- Snakes like the python swallow the animals they prey upon.
- Some aquatic animals filter tiny food particles floating nearby and feed upon them.

17. Correct Answer: (b)

The Hierarchy of Classification- Groups

- Biologists, such as Ernst Haeckel (1894), Robert Whittaker (1969) and Carl Woese (1977) have tried to classify all living organisms into broad categories, called kingdoms.
- The classification Whittaker has proposed five kingdoms: Monera, Protista, Fungi, Plantae and Animalia, and is widely used.
- These groups are formed on the basis of their cell structure, mode, and source of nutrition and body organisation. The modification Woese introduced by dividing the Monera into Archaebacteria (or Archaea) and Eubacteria (or Bacteria) are also in use.

Further classification is done by naming the sub-groups at various levels as given in the following scheme:

- Kingdom
- Phylum (for animals)
- Class
- Order
- Family
- Genus
- Species

18. Correct Answer: (c)

Viral disease

- Measles and Hepatitis are caused by a virus. Measles is also called rubeola, a contagious viral disease marked by fever, cough, conjunctivitis, and a characteristic rash.
- Measles is most common in children but may appear in older persons who escaped it earlier in life. Infants are immune up to four or five months of age if the mother has had the disease.
- Hepatitis, inflammation of the liver that results from a variety of causes, both infectious and non-infectious.
- Infectious agents that cause hepatitis include viruses and parasites. Non-infectious causes include certain drugs and toxic agents.
- In some instances, hepatitis results from an autoimmune reaction directed against the liver cells of the body.
- Tuberculosis (TB), an infectious disease that is caused by the tubercle bacillus, Mycobacterium tuberculosis.
- In most forms of the disease, the bacillus spreads slowly and widely in the lungs, causing the formation of hard nodules (tubercles) or large cheese like masses that break down the respiratory tissues and form cavities in the lungs.

- Blood vessels also can be eroded by the advancing disease, causing the infected person to cough up bright red blood.

19. Correct Answer: (c)

Plant Hormones

- These are chemical compounds released by stimulated cells. These chemical compounds help in the growth and development of plants.
- When growing plants detect light, a hormone called auxin, synthesised at the shoot tip, helps the cells to grow longer. When light is coming from one side of the plant, auxin diffuses towards the shady side of the shoot.
- This concentration of auxin stimulates the cells to grow longer on the side of the shoot which is away from light. Thus, the plant appears to bend towards the light.
- Another example of plant hormones is gibberellins which, like auxins, help in the growth of the stem.
- Cytokinins promote cell division, and it is natural then that they are present in greater concentration in areas of rapid cell division, such as in fruits and seeds. These are examples of plant hormones that help in promoting growth. But plants also need signals to stop growing.
- Abscisic acid is one example of a hormone that inhibits growth. Its effects include wilting of leaves.

20. Correct Answer: (b)

Some Important hormones and their functions

- Hormones are secreted by endocrine glands and have specific functions.

Hormone Endocrine Gland Functions

- Growth Hormone - Pituitary Gland - Stimulates growth in all organs
- Insulin - Pancreas - Controls blood glucose by lowering blood glucose levels
- Glucagon – Pancreas - Increases blood glucose, stimulates the breakdown of glycogen and fat
- Renin - Kidneys - Assists in blood pressure control
- Releasing Hormones – Hypothalamus - Stimulates the pituitary gland to release hormones
- Oestrogen – Ovaries - Development of female sex organs, regulates menstrual cycle, etc.
- Testosterone – Gonads - Development of male sex organs, facial hair and change in voice.

21. Correct Answer: (b)

5G Network

- With 5G, the peak network data speeds are expected to be in the range of 2-20 Gigabit per second (Gbps).
- This is in contrast to 4G link speeds in averaging 6-7 Megabit per second (Mbps) in India as compared to 25 Mbps in advanced countries.
- With 5G technology, consumers will be able to download data-heavy content such as 8K movies and games with better graphics in just a few seconds.
- 5G is expected to form the backbone of emerging technologies such as the Internet of Things (IoT) and machine to machine communications, thereby supporting a much larger range of applications and services, including driverless vehicles, telesurgery and real-time data analytics.
- The ultra-low latency offered by 5G makes the technology desirable for such use cases. Latency is the amount of time data takes to travel between its source and destination.
- The committee was set up in September 2017 and submitted its report on August 24, 2018, under the chairmanship of AJ Paulraj to suggest a road map for 5G adoption.

22. Correct Answer: (c)

Spectrum

- The radio frequency spectrum (which is simply referred to as spectrum) is only a comparatively small part of the electromagnetic spectrum, covering the range from 30 Hz to 300 GHz. It includes a

range of a certain type of electromagnetic waves, called the radio waves, generated by transmitters and received by antennas or aerials.

- Depending on the frequency range, the radio spectrum is divided into frequency bands and sub-bands.
- Lower frequencies have less bandwidth capacity than higher frequencies. It means that signals that carry a lot of information (such as television, broadband or mobile phones) are better placed in the higher frequency bands while simple radio (audio) signals can be carried by the low-frequency waves.
- Spectrum has been internationally accepted as a scarce, finite and renewable natural resource that is susceptible to degradation in case of inefficient utilization. It has a high economic value in the light of the demand for it on account of the tremendous growth in the telecom sector.

23. Correct Answer: (b)

Uniform Resource Locator (URL)

- Uniform Resource Locator (URL) is the address of a resource (such as a document or website) on the Internet that consists of a communications protocol followed by the name or address of a computer on the network and that often includes additional locating information (such as directory and file names).
- URLs and IP addresses both are identifiers for the path of the resource which we need to find.

The main difference between URL and IP address is what they point to:

- An IP address basically points to a computer, whether it is the physical hardware or a virtual one.
- In comparison, a typical URL contains the protocol to be used (i.e. HTTP, FTP), the domain name or IP address, the path, and optional fragment identifier. Hence we see that an IP address can be part of a URL.

http:// or https://

- The "http" stands for Hypertext Transfer Protocol. It let the browser know which protocol it is going to use to access the information specified in the domain.

www.

- It stands for World Wide Web and is used to distinguish the content.

24. Correct Answer: (c)

Web Cookie

- A web cookie is a small piece of data sent from a website and stored in user's web browser while a user is browsing the website and is used to remember stateful information about the user's operations on the website.
- This can help the website provide a better browsing experience to the user.

25. Correct Answer: (c)

Cloud Computing

- It provides the infrastructures (both software and hardware) as services on a semi-permanent (rented) basis
- User need not add physical assets (server computers, Air conditioners, special IT staff to maintain those server rooms, etc.) instead user are provided with great flexibility and choice in your purchase is known as Cloud computing
- Based on different computing resources, services include

Type Purpose Provider(Eg)

- Infrastructure as a service (IaaS) Entire systems (virtual machines) will be provided to the users. Users can access the systems through internet Service providers charge based on the resource allocated Amazon
- Platform as a service (PaaS) In this model entire system along with the operating

systems, the software is provided. Google App Engine

- Software as a service (SaaS) This one is more common Software created by the service provider.End-users use these services on a subscription basis Yahoo, Gmail
- Storage as a service (STaaS) Storage is provided for getting rid of maintaining separate storage devices. Windows Skydrive

26. Correct Answer: (b)

Big Data Analytics

- Data mining is the process of sorting through large data sets to identify patterns and establish relationships to solve problems through data analysis. Data mining tools allow enterprises to predict future trends.
- "data mining" is, in fact, a misnomer, because the goal is the extraction of patterns and knowledge from large amounts of data, not the extraction (mining) of data itself.
- Data mining techniques are used in many research areas, including mathematics, cybernetics, genetics, and marketing. While data mining techniques are a means to drive efficiencies and predict customer behaviour, if used correctly, a business can set itself apart from its competition through the use of predictive analysis.

27. Correct Answer: (c)

Data Transmission

- Fiber optics transmit data in the form of light particles -- or photons -- that pulse through a fiber optic cable. The glass fiber core and the cladding each have a different refractive index that bends incoming light at a certain angle. When light signals are sent through the fiber optic cable, they reflect off the core and cladding in a series of zig-zag bounces, adhering to a process called Total Internal Reflection.
- The light signals do not travel at the speed of light because of the denser glass layers (with higher refractive index), instead of travel about 30% slower than the speed of light.

Advantages of Optical Fibre Cable

- Bandwidth Fibre optic cables have much greater bandwidth than metal cables. The amount of information that can be transmitted per unit time of fiber over other transmission media is its most significant advantage.
- Low Power Loss Optical fibre offers low power loss, which allows for longer transmission distances. In comparison to copper, in a network, the longest recommended copper distance is 100m while with fiber, it is 2km.
- Interference Fibre optic cables are immune to electromagnetic interference. It can also be run in electrically noisy environments without concern as electrical noise will not affect fiber.
- Size In comparison to copper, a fiber optic cable has nearly 4.5 times as much capacity as the wire cable has and a cross-sectional area that is 30 times less.
- Weight Fiber optic cables are much thinner and lighter than metal wires. They also occupy less space with cables of the same information capacity. The lighter weight makes fiber easier to install.
- Security Optical fibers are difficult to tap. As they do not radiate electromagnetic energy, emissions cannot be intercepted. As physically tapping the fiber takes great skill to do undetected, fiber is the most secure medium available for carrying sensitive data.
- Flexibility An optical fibre has greater tensile strength than copper or steel fibers of the same diameter. It is flexible, bends easily and resists most corrosive elements that attack copper cable.
- Cost The raw materials for glass are plentiful, unlike copper. This means glass can be made more cheaply than copper.

28. Correct Answer: (d)

Computer forensics

- Computer forensics is the application of investigation and analysis techniques to gather and preserve evidence from a particular computing device in a way that is suitable for presentation in a court of law.
- The goal of computer forensics is to perform a structured investigation while maintaining a documented chain of evidence to find out exactly what happened on a computing device and who was responsible for it.
- Investigators use a variety of techniques and proprietary software forensic applications to examine the copy, searching hidden folders and unallocated disk space for copies of deleted, encrypted, or damaged files.
- Any evidence found on the digital copy (Hard disk, Call records, Network Devices, etc) is carefully documented in a "finding report" and verified with the original in preparation for legal proceedings that involve discovery, depositions, or actual litigation

29. Correct Answer: (a)

Digitising India:

- Digital India is a Programme to prepare India for a knowledge future. Its vision is to transform the country into a digitally empowered society and knowledge economy. It would ensure that government services are available to citizens electronically.
- Early Harvest Programme basically consists of those projects which are to be implemented within a short timeline.
- **The projects under the Early Harvest Programme are as follows:** IT Platform for Messages: A mass messaging application developed by MeitY (Ministry of Electronics and Information Technology) will cover elected representatives and all Government employees and registered citizens.
- **Biometric attendance:** It will cover all Central Government offices in Delhi, to begin with. Over 40,000 Government employees from 150 organisations have already registered on the common Bio-metric attendance portal at http:// attendance.gov.in. (link is external) Over 1000 bio-metric attendance terminals are under installation at entry gates of various Central Government buildings which will be connected with Wi-Fi Access points and mobile connectivity.
- Government employees will be able to mark their attendance from any of the central government offices in Delhi.
- **Wi-Fi in All Universities:** All universities on the National Knowledge Network (NKN) shall be covered under this scheme. Ministry of Human Resource Development (MHRD) is the nodal ministry for implementing this scheme.
- **Secure Email within Government:** Email would be the primary mode of communication within the government. The government's e-mail infrastructure would be suitably enhanced and upgraded. Upgradation of the infrastructure under Phase-I for 10 lakh employees has already been completed. MeitY is the nodal department for this scheme.
- **Standardize Government Email Design:** Standardised templates for Government email would be prepared. This is being implemented by MeitY (Ministry of Electronics and Information Technology)
- **Public Wi-fi hotspots:** Cities with a population of over 1 million and tourist centres (not all cities) would be provided with public wi-fi hotspots to promote digital cities. The scheme is implemented by DoT (Department of Telecommunication) and Ministry of Urban Development (MoUD)
- **School Books to be eBooks:** All books shall be converted into eBooks. Ministry of HRD/ MeitY are the nodal agencies for this scheme
- SMS based weather information, disaster alerts SMS based weather information and disaster alerts would be provided. MeitY's

Mobile Seva Platform has been made available for this purpose.

- **National Portal for Lost & Found children:** This would facilitate real-time information gathering and sharing on the lost and found children and would go a long way to check crime and improve timely response. MeitY and Department of Women and Child Development (DoWCD) are the nodal departments for this project

30. Correct Answer: (b)

Virtual Private Network (VPN)

- It extends a private network across a public network and enables users to send and receive data across shared or public networks as if their computing devices were directly connected to the private network.
- Applications running on a computing device, e.g., a laptop, desktop, Smartphone, across a VPN may, therefore, benefit from the functionality, security, and management of the private network.
- Encryption is a common, though not an inherent, part of a VPN connection.

31. Correct Answer: (d)

E-Kranti

- E-KRANTI is a national e-governance plan to accelerate e-governance across India.
- **Its vision is to:** "Ensure government-wide transformation by delivering all government services electronically to citizens via integrated, interoperable systems through multiple modes."

The objectives of 'e-Kranti' are as follows:

- To redefine NeGP with transformational and outcome-oriented e-Governance initiatives.
- To enhance the portfolio of citizen-centric services.
- To ensure optimum usage of core Information & Communication Technology (ICT).
- To promote rapid replication and integration of eGov applications.
- To leverage emerging technologies.
- To make use of more agile implementation models.
- The thrust areas of the e-Kranti - electronic delivery of services under the Digital India programme are:
- Technology for Education (e-Education), Health (e-Healthcare), Farmers, Financial Inclusion, Planning, Justice, Security, Planning, and Cyber Security.

32. Correct Answer: (d)

Cyber Swachhta Kendra

- The "Cyber Swachhta Kendra " (Botnet Cleaning and Malware Analysis Centre) is a part of the Government of India's Digital India initiative under the Ministry of Electronics and Information Technology (MeitY) to create a secure cyberspace by detecting botnet infections in India and to notify, enable cleaning and securing systems of end-users so as to prevent further infections.
- The "Cyber Swachhta Kendra " (Botnet Cleaning and Malware Analysis Centre) is set up in accordance with the objectives of the "National Cyber Security Policy", which envisages creating a secure cyber ecosystem in the country.
- This centre operates in close coordination and collaboration with Internet Service Providers and Product/Antivirus companies. This website provides information and tools to users to secure their systems/devices.
- This centre is being operated by the Indian Computer Emergency Response Team (CERT-In) under provisions of Section 70B of the Information Technology Act, 2000.

33. Correct Answer: (b)

IPrism

- IPrism is an IP Competition for students enrolled and currently studying at graduate, postgraduate, MPhil and Ph.D. levels in India.
- This competition aims to help foster a culture of innovation and creativity by spreading awareness of Intellectual Property Rights (IPR) and empower the

young innovators to protect their inventions.

- IPrism will provide a unique opportunity for students to learn and showcase their understanding of IPRs.
- It has been organized by ASSOCHAM in collaboration with the Department of Industrial Policy and Promotion (DIPP) – Cell for IPR Promotion and Management (CIPAM) and ERICSSON.

34. Correct Answer: (c)

National E-Governance Plan (NeGP)

- In today's digital era, a large number of efforts have been made by the government at multiple levels to improve the delivery of public services and simplify the process of accessing them by using digital technology.
- The Government approved the National e-Governance Plan (NeGP), comprising of 31 Mission Mode Projects (MMPs).
- The Government has accorded approval to the vision, approach, strategy, key components, implementation methodology, and management structure for NeGP.
- In order to promote e-Governance in a holistic manner, various policy initiatives and projects have been undertaken to develop core and support infrastructure.
- The major core infrastructure components are State Data Centres (SDCs), State Wide Area Networks (S.W.A.N), Common Services Centres (CSCs) and middleware gateways i.e National e-Governance Service Delivery Gateway (NSDG), State e-Governance Service Delivery Gateway (SSDG), and Mobile e-Governance Service Delivery Gateway (MSDG).
- The important support components include Core policies and guidelines on Security, HR, Citizen Engagement, Social Media as well as Standards related to Metadata, Interoperability, Enterprise Architecture, Information Security, etc.
- In order to utilise and harness the benefits of Cloud Computing, the Government of India has embarked upon an ambitious initiative - "GI Cloud" which has been named "MeghRaj".
- The focus of this initiative is to accelerate the delivery of e-services in the country while optimizing ICT spending of the Government.
- This will ensure optimum utilization of the infrastructure and speed up the development and deployment of eGov applications.

35. Correct Answer: (b)

Digital Literacy

- Pradhan Mantri Gramin Digital Saksharta Abhiyaan (PMGDISHA) is the scheme to make six crore persons in rural areas, across States/ UTs, digitally literate, reaching to around 40% of rural households by covering one member from every eligible household by 31st March 2020.
- The scheme would empower the citizens in rural areas by training them to operate computer or digital access devices, send and receive e-mails and even undertake digital payment.
- The scheme aims to bridge the digital divide, specifically targeting the rural population including the marginalised sections of society like Scheduled Castes (SC) / Scheduled Tribes (ST), Minorities, Below Poverty Line (BPL), women and differently-abled persons.

36. Correct Answer: (b)

Cyber-Physical Systems (CPS)

- Cyber-Physical Systems (CPS) are a new class of engineered systems that integrate computation and physical processes in a dynamic environment.
- CPS encompasses technology areas of Cybernetics, Mechatronics, Design and Embedded systems, Internet of Things (IoT), Big Data, Artificial Intelligence (AI) and many more.
- The CPS systems are intelligent, autonomous and efficient and are expected to drive innovation in sectors as diverse as agriculture, water, energy,

transportation, infrastructure, security, health, and manufacturing. Thus, it is heralded as the next paradigm shift in technology that can exponentially spur growth and development.

- National Mission on Interdisciplinary Cyber- Physical Systems (NM-ICPS)
- To harness the potential of this new wave of technology and make India a leading player in CPS, the Union Cabinet approved the launch of the National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS) to be implemented by the Department of Science & Technology (DST) with a total outlay of Rs. 3660 Crore for a period of five years.
- The Mission aims to create a strong foundation and a seamless ecosystem for CPS technologies by coordinating and integrating nationwide efforts encompassing knowledge generation, human resource development, research, technology and product development, innovation, and commercialization.
- The mission will be implemented through a network of 15 Technology Innovation Hubs (TIHs), 6 Sectoral Application Hubs (SAHs) and 4 Technology Translation Research Parks (TTRPs).

37. Correct Answer: (c)

Cyber Law

- Cyber law provides legal recognition to electronic documents and a framework to support e-filing and e-commerce transactions and also provides a legal framework to mitigate, check cyber-crimes.
- An inter-ministerial committee was constituted by the Ministry of Electronics and Information Technology (MeitY) to discuss the issues related to online child sexual abuse materials (CSAM) and its blocking in India.
- Based on the recommendation of the committee and the approval of Hon'ble Minister of Electronics and Information Technology, MeitY has issued an order to Internet Service Providers (ISPs) to adopt and implement the Internet Watch Foundation (IWF) resources to prevent the distribution and transmission of Online CSAM into India.

38. Correct Answer: (d)

Big Data

- Big Data simply refers to a large amount of complex data which is of structured, semi-structured or unstructured nature from different data sources and is so voluminous that traditional data processing software just can't manage them.

Various Applications

- Prevent cyber-attacks, detect credit card fraud, foil terrorism and even predict criminal activity
- Optimizing treatment and even predicting diseases
- Enables data gathering from social media, web visits, call logs, and other sources to improve the interaction experience of customers
- Product Development through predictive models for new products and services by classifying key attributes of past and current products or services.
- Identifying patterns in data that indicate fraud and aggregate large volumes of information to make regulatory reporting much faster.

39. Correct Answer: (a)

CERT-In (the Indian Computer Emergency Response Team)

- It is the national nodal agency under the Ministry of Electronics and Information Technology (MeitY) for responding to computer security incidents as and when they occur, operational since January 2016
- GravityRAT was first detected by the Computer Emergency Response Team (CERT-In) in 2017.

40. Correct Answer: (c)

Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA)

- The Pradhan Mantri Gramin Digital Saksharta Abhiyan (PMGDISHA) being initiated under Digital India Programme would cover 6 crore households in rural areas to make them digitally literate.

Features

- The Scheme is applicable only to rural areas of the country.
- Eligible Household: A household is defined as a unit comprising of the Head of family, spouse, children, and parents. All such households where none of the family members is digitally literate will be considered as an eligible household under the Scheme.

41. Correct Answer: (c)

Mars Orbiter Mission (MOM)

- The Mars Orbiter Mission (MOM), also called Mangalyaan is a space probe orbiting Mars.
- It is India's first interplanetary mission to planet Mars.
- It has been configured to carry out observation of physical features of mars and carry out a limited study of Martian atmosphere with the following five payloads:
- Mars Colour Camera (MCC) Thermal Infrared Imaging Spectrometer (TIS)
- Methane Sensor for Mars (MSM) Mars Exospheric Neutral Composition Analyser (MENCA)
- Lyman Alpha Photometer (LAP) It made ISRO the fourth space agency to reach Mars, after Roscosmos, NASA, and the European Space Agency.
- It made India the first Asian nation to reach Martian orbit and the first nation in the world to do so on its maiden attempt.
- MOM was launched aboard PSLV C-25, which was an XL variant of the PSLV, one of the world's most reliable launch vehicles.

42. Correct Answer: (b)

Outer Space Missions

- Hayabusa 2 It is an asteroid sample-return mission operated by the Japanese space agency, JAXA.
- Gaia Mission It is a European Space Agency (ESA) mission to chart a three-dimensional map of our Galaxy, the Milky Way, in the process revealing the composition, formation, and evolution of the Galaxy.
- MAVEN spacecraft It is NASA's mission that was launched in November 2013 and went into orbit around Mars in September 2014.
- Hongyun project China started the Hongyun project in September 201

43. Correct Answer: (c)

NISAR Mission

- NISAR is a joint NASA-ISRO (Indian Space Research Organization) Earth-observing mission with the goal to make global measurements of the causes and consequences of land surface changes.
- NISAR will be the first satellite mission to use two different radar frequencies (L-band and S-band) to measure changes in our planet's surface less than a centimetre across.
- The NASA and ISRO teams are working closely together toward launch in 2022.
- The satellite will be launched from India aboard a Geosynchronous Satellite Launch Vehicle.
- The orbit will be a Sun-synchronous and the planned mission life is three years.

44. Correct Answer: (c)

Gravitational Waves

- Gravitational waves are disturbances in the curvature of spacetime, generated by accelerated masses, that propagate as waves outward from their source at the speed of light.
- While formulating his General Theory of Relativity, Einstein proposed that gravitational attraction was a result of the

bending of the fabric of space-time by the equivalent of a heavy object.

- Discovery of gravitational waves would establish the correctness of General Theory of Relativity and opposes the Sir Isaac Newton's visualization of gravitational force as a pulling force between objects.
- Gravitational waves, however, are allowing scientists to view black hole directly. They are sort of a messenger of the spacetime around these objects, without using any intermediate.
- LIGO (Laser Interferometer Gravitational-Wave Observatory) helps in recording these gravitational waves. First such detection was done in 2015 by the two LIGO detectors in the U.S., in Louisiana, and Washington.
- The LIGO India project will come up in Maharashtra, near Aundha in Hingoli district.

45. Correct Answer: (a)

Spitzer Space Telescope

- The "Great Observatories" are four big-ticket space telescopes designed to view the universe in different and complementary wavelengths of light.

These include:

- Spitzer
- Hubble Space Telescope
- The Compton Gamma Ray Observatory (CGRO)
- The Chandra X-ray Observatory
- It is managed and operated by the Jet Propulsion Laboratory (JPL) of NASA.
- It captures infrared light, which is often emitted by "warm" objects that are not quite hot enough to radiate visible light.
- Spitzer has illuminated some of the oldest galaxies in the universe, revealed a new ring around Saturn, and peered through shrouds of dust to study newborn stars and black holes. It assisted in the discovery of planets beyond our solar system, including the detection of seven Earth-size planets orbiting the star TRAPPIST-1, among other accomplishments.
- NASA's Spitzer Space Telescope will be switched off permanently on January 30, 2020, after nearly 16 years of exploring the cosmos in infrared light

46. Correct Answer: (b)

Neutrino

- A neutrino is a subatomic particle that is very similar to an electron but has no electrical charge.
- Neutrinos are one of the most abundant particles in the universe and they come in three flavors; one associated with electrons and the others with their heavier cousins the muon and the Tau.

INO Project

- The India-based Neutrino Observatory (INO) Project is a multi-institutional effort aimed at building a world-class underground laboratory with a rock cover for Non-accelerator based high energy and nuclear physics research in India.
- The project includes construction of an underground laboratory, Iron Calorimeter (ICAL) detector and associated surface facilities at Pottipuram in Bodi West hills of the Theni District of Tamil Nadu.
- The Tata Institute of Fundamental Research is the nodal institution. The observatory is to be built jointly with the Department of Atomic Energy and the Department of Science and Technology.

47. Correct Answer: (a)

Chandra X-ray Observatory

- The Chandra X-ray Observatory is part of NASA's fleet of "Great Observatories" along with the Hubble Space Telescope, the Spitzer Space Telescope and the now deorbited Compton Gamma Ray Observatory.
- It is named after Nobel Prize-winning astrophysicist Subrahmanyan Chandrasekhar, who first calculated the ultimate fate of stars like our sun.

- It was launched in 1999 and is the largest and most sensitive X-ray telescope ever built.
- The Chandra X-ray Observatory is the world's most powerful X-ray telescope. It has eight-times greater resolution and is able to detect sources more than 20-times fainter than any previous X-ray telescope.

48. Correct Answer: (d)

Aditya-L1 mission

- Aditya-L1 mission (originally Aditya-1) is the 1st Indian space-based Solar Coronagraph intended to study the outermost region of the sun called 'Corona'. The project will increase our understanding of the Sun. It is scheduled to be launched by 2020-21
- It will be placed in the Lagrangian point 1 (L1) of the Sun-Earth orbit which has the advantage of continuously viewing the Sun without any obstructions that eclipses may offer.

49. Correct Answer: (b)

Global Navigation Satellite System (GNSS)

- **GPS:** The United States is the first country to introduce satellite technology with the global positioning system (GPS).
- **QuaSi-Zenith Satellite System (QZSS):** It is Japan's satellite system which is similar to a GPS satellite with some slight variations.
- **GLONASS:** Russia also has its own satellite system called the Russian Global Navigation Satellite System (GLONASS).
- **BeiDou:** BeiDou Navigation Satellite System (formerly referred to as Compass) is the navigational system of China.
- **Galileo:** Galileo system of Europe is a Global Navigation Satellite System (GSNN).
- The Indian Regional Navigation Satellite System (IRNSS), which was later given the operational name of NavIC or NAVigation with Indian Constellation, is the regional satellite navigation system of India. It was launched and operated by the Indian Space Research Organisation (ISRO).IRNSS covers India and nearby regions extending up to 1,500 km.

50. Correct Answer: (a)

Graveyard Orbit

- A Graveyard Orbit also called a Junk Orbit or Disposal Orbit, is an orbit that lies away from common operational orbits.
- One significant graveyard orbit is a super synchronous orbit well above Geosynchronous orbit. Satellites are typically moved into such orbits at the end of their operational life to reduce the probability of colliding with operational spacecraft and generating space debris.

51. Correct Answer: (d)

BrahMos Missile

- It is the fastest, medium-range, supersonic cruise missile that can be launched from submarine, ships, aircraft, or land cruise missile of its class in the world.
- It flies almost three times the speed of sound at Mach 2.8 and has a range of 290 km. Hence it is also described as the world's fastest supersonic cruise missile.
- The missile has been jointly developed with Russia and is named after the rivers Brahmaputra and Moskva in Russia.

52. Correct Answer: (c)

Cruise Missile

- The cruise missile is an unmanned self-propelled guided vehicle that sustains flight through aerodynamic lift for most of its flight path and whose primary mission is to place ordnance or special payload on a target.
- They fly within the earth's atmosphere and use jet engine technology.
- Examples of cruise missile include BrahMos (Super sonic cruise missile), Nirbhay (sub sonic cruise missile) ,Shaurya (Hyper sonic cruise missle).

Ballistic Missile

- The Ballistic missile is targeted as a projectile from a single launch force with not much-added guidance.

- Since it depends on gravity to reach its target, it's called a ballistic missile.
- Ballistic missiles can travel extremely quickly along their flight path. An Inter - Continental Ballistic Missile can strike a target within a 10,000 km range in about 30 to 35 minutes.
- Long- and medium-range ballistic missiles are generally designed to deliver nuclear weapons because their payload is too limited for conventional explosives to be cost-effective.
- Ballistic missiles can be launched from ships and land-based facilities.
- Prithvi I, Prithvi II, Agni I, Agni II and Dhanush ballistic missiles are currently operational in the Indian defense forces.

53.Correct Answer: (a)

Indian Aircraft Carrier

- India currently has only one aircraft carrier, INS Vikramaditya.
- The country's first Indigenous Aircraft Carrier (IAC-1) — to be formally named INS Vikrant — is being built in Cochin Shipyard. Its Construction began in 2005 and is expected to be out for sea trials only by 2020.
- This list of India's aircraft carriers till date includes: INS Vikrant: 19,500 tonnes, Majestic-class carrier, formerly the HMS Hercules. In service from 1961 to 199Used as a museum until 2012, and scrapped in 2014-15.
- **INS Viraat:** 28,700 tonnes, Centaur-class carrier, formerly HMS Hermes. In service from 1987 to 201Decommissioned on March 6, 2017.
- **INS Vikramaditya:** 45,400 tonnes, modified Kiev-class carrier, formerly Admiral Gorshkov. In service since 2013.
- **INS Vikrant (IAC-1):** 44,000 tonnes, Vikrant-class carrier. Under construction at Cochin Shipyard, sea trials scheduled in 2020.
- Recently Indian Navy's first aircraft-carrier dry dock was inaugurated in September 2019 in Mumbai.

54. Correct Answer: (c)

Doppler Weather Radar

- Doppler Weather Radar (DWR) is used for forecasting storms, cyclones, and other severe weather conditions.
- The Doppler Weather Radar provides advance information, enhancing the lead-time so essential for saving lives and property, in the event of natural disasters associated with severe weather.
- The DWR has been designed and developed by Radar Development Area, ISRO Telemetry Tracking and Command Network (ISTRAC), ISRO and manufactured by Bharat Electronics Limited (BEL), Bengaluru.
- It is the first indigenously developed Polarimetric Doppler Weather Radar (DWR) and is installed at Cherrapunjee, Meghalaya.
- Though the conventional radars are able to track and predict cyclones, the DWR provides detailed information on storm's internal wind flow and structure. The severity of the weather systems can thus be quantitatively estimated more accurately than ever before and more precise advance warnings can be generated for saving human lives and property.

55. Correct Answer: (a)

Unmanned Aerial Vehicle

- Drones are an unmanned aerial vehicle (UAV) either controlled by 'pilots' from the ground or autonomously following a pre-programmed mission. Drones basically fall into two categories: those that are used for reconnaissance and surveillance purposes and those that are armed with missiles and bombs.

UAVs typically fall into one of six functional categories (although multi-role airframe platforms are becoming more prevalent):

- **Target and decoy –** providing ground and aerial gunnery a target that simulates an enemy aircraft or missile

- **Reconnaissance –** providing battlefield intelligence
- **Combat –** providing attack capability for high-risk missions (see Unmanned combat air vehicle)
- **Logistics –** UAVs specifically designed for cargo and logistics operation
- **Research and development –** used to further develop UAV technologies to be integrated into field deployed UAV aircraft
- **Civil and Commercial UAVs –** UAVs specifically designed for civil and commercial applications

UAV of India

- Nishant is a multi-mission Unmanned Aerial Vehicle with Day/Night capability used for battlefield surveillance and reconnaissance, target tracking & localization, and artillery fire correction.
- Rustom(Warrior) is a Medium Altitude Long Endurance unmanned combat air vehicle (UCAV) being developed by the Defence Research and Development Organisation.
- Panchi UAV has autonomous flight capabilities and is the wheeled version of unmanned aerial vehicle (UAV) Nishant, capable of taking-off and landing by using small airstrips controlled from a user-friendly Ground Control Station (GCS).
- AURA is stealth UCAV, capable of releasing missiles, bombs and precision-guided munitions.

56. Correct Answer: (a)

Stealth technology

- Stealth technology, also termed "low-observable" technology, is a set of techniques that render military vehicles, mostly aircraft, hard to observe.
- RADAR—an acronym for Radio Detection and Ranging—is the primary detection technology for aircraft, most stealth technologies are directed at suppressing RADAR returns from aircraft, but stealth technology minimizes other "observables" as well, including energy emissions that of any kind that might be observed by an opponent.
- Stealth technology is deployed today on several types of aircraft and a few surface ships.
- For a submarine, stealth is the most important protection.
- Stealth is a relative concept. It can be increased relative to varying levels by adopting several measures right from the design of the platform to operational measures to reduce noise and vibrations to stay away from prowling radars and sonars.

57. Correct Answer: (d)

Sagarika

- It is a two-stage Submarine-Launched Ballistic Missile (SLBM) with a range of 750 km.
- Sagarika missile is integrated with India's nuclear powered Arihant-class submarine.

Astra

- The Astra is a beyond-visual-range air-to-air missile using a solid-propellant.
- It is the first air-to-air missile developed by India and the smallest missile developed by the DRDO.
- It is envisaged to intercept and destroy enemy aircraft at supersonic speeds in the head-on mode at a range of 80 km.
- Astra has an active radar seeker to find targets and electronic counter-measure capabilities which permits it to jam radar signals from an enemy surface-to-air battery, thus ensuring that it's not tracked or shot down.

Prahaar

- The Prahaar is India's latest surface-to-surface ballistic missile with a range of 150 km.
- The primary objective of the conventionally armed Prahaar missile is to bridge the gap between the unguided Pinaka multi-barrel rocket launcher (ranging 45 km) and the guided Prithvi missile variants.

- Stated to be a unique missile, the Prahaar boasts of high maneuverability, acceleration, and accuracy.
- The export variant of the system is the Pragati surface to surface missile.

Shaurya

- A variant of the K-15 Sagarika, Shaurya missile is a canister launched hypersonic surface-to-surface tactical missile developed by DRDO for use by the Indian Armed Forces.
- It has a range of 700 km and it gives the potential to strike in the short-intermediate range against any adversary.
- This nuclear-capable missile aims to enhance India's 2nd-strike capability.
- Shaurya missile can carry a one-tonne nuclear warhead over 750 km and striking within 20- 30 meters of its target.

58. Correct Answer: (c)

Dhanush

- Dhanush is the indigenously upgraded variant of the Swedish Bofors gun imported in the 1980s. These indigenously built Dhanush artillery guns are often referred to as the 'DesiBofors'.
- It is also the first long-range artillery gun to be produced in India, having a range of 38 km.
- Dhanush is a joint effort by the Ordnance Factory Board the Army, Defence Research and Development Organisation, Directorate General Quality Assurance, PSUs Bharat Electronics Limited, SAIL, and private firms.

59. Correct Answer: (b)

Anti-Tank Guided Missile System

- The defence acquisition council of India cleared the procurement of 5,000 French-made second-generation MILAN (MILAN 2T) anti-tank guided missiles (ATGM) from France in 2019.
- Currently, the Indian Army uses the imported Milan 2T and Konkurs Russian anti-tank missiles in the infantry but they are vintage missiles and the force is looking for a third-generation ATGM.

60. Correct Answer: (b)

INS Arihant

- The ship submersible ballistic nuclear (SSBN) submarine INS Arihant was launched on July 26, 2009, the anniversary of Kargil War Vijay Diwas, by then Prime Minister Dr. Manmohan Singh.
- It is India's first indigenously built nuclear submarine which was jointly developed by the Indian Navy, Bhabha Atomic Research Centre (BARC) and Defence Research and Development Organisation (DRDO) at the naval dockyard in Visakhapatnam with the assistance of Russian designers.
- Arihant's design is based on the Russian Akula-1 Class submarine. It is longest in the Indian Navy's fleet of submarines and can accommodate a crew of 9

61. Correct Answer: (b)

Gene Therapy

- Gene therapy is designed to introduce genetic material into cells to compensate for abnormal genes or to make a beneficial protein.

How does Gene therapy work?

- A gene is not inserted directly, but through a genetically engineered carrier known as vector, also called a retrovirus.
- The retro-virus can be programmed to carry a gene or a DNA that will overwrite the mutation and correct it.
- The retro-viruses are modified as well so that they do not cause any disease when used in people.

62.Correct Answer: (c)

Oxytocin

- It is also known as the 'love hormone', is a hormone secreted by the pituitary glands of mammals during sex, childbirth, lactation or social bonding. However, it can also be chemically manufactured and

is sold by pharma companies for use during childbirth.

- Oxytocin is a uterine stimulant hormone, prescribed for the initiation of uterine contractions and induction of labour in women as well as stimulation of contractions during labour. It is also used to help abort the fetus in cases of incomplete abortion or miscarriage, and control bleeding after childbirth.
- It may promote the release of breast milk. Its use is especially crucial to prevent new mothers from excessively bleeding after giving birth—a common cause of maternal deaths.
- Oxytocin is listed in the National List of Essential Medicines (NLEM) for reproductive health.

63. Correct Answer: (a)

Measles-Rubella (MR) Vaccine

- Measles-Rubella (MR) Vaccine was introduced in the Universal Immunization Programme in 2017, as the Measles-Rubella combination vaccine to provide protection against congenital birth defects caused by Rubella infection for children aged between 9 months and 15 years.
- Recently, the New Delhi High Court stopped the implementation of the 'Measles and Rubella Vaccine Immunization Campaign' by the Delhi government. Court's order said that 'measles vaccination cannot be administered "forcibly" and without the consent of parents,' it introduced a dimension to vaccination — the question of consent — that had not been adequately dealt with earlier.
- Measles and Rubella are two different viral diseases. Generally, Rubella causes milder infections than measles but it is of concern when a pregnant woman is infected by the virus because it results in severe birth defects.
- Both Measles and Rubella are caused by an RNA virus and are generally spread through respiratory droplets of sick people.
- It is important to note that Rubella is not the same as measles. Though both diseases share the same characteristics including the red rash and have similar symptoms, they are distinct.
- Measles is far more contagious and severe an illness than rubella (also called German Measles).
- Swollen lymph nodes always occur with rubella but not often with measles.

64. Correct Answer: (b)

Hemophilia

- Hemophilia is usually an inherited bleeding disorder in which the blood does not clot properly. This can lead to spontaneous bleeding as well as bleeding following injuries or surgery.
- In the most common types of hemophilia, the faulty gene is located on the X chromosome. Everyone has two sex chromosomes, one from each parent. A female inherits an X chromosome from her mother and an X chromosome from her father.
- A male inherits an X chromosome from his mother and a Y chromosome from his father. This means that hemophilia almost always occurs in boys and is passed from mother to son through one of the mother's genes. Most women with the defective gene are simply carriers and experience no signs or symptoms of hemophilia. But some carriers can experience bleeding symptoms if their clotting factors are moderately decreased.

65. Correct Answer: (a)

Disorders Caused by Vitamin Deficiency

- **Osteomalacia:** This disorder occurs in adults when their food is deficient in vitamin D (calciferol), calcium or phosphorus. Bones of the vertebral column become weak. Pelvic and other bones bend and become soft.

- **Xerophthalmia:** It is vitamin A (retinol) deficiency disorder which is caused by the stoppage of lacrimal activity. Cornea and eyelids become dry and ulcerated. It leads to swelling of dry eyelids and the opacity of the cornea. Xerophthalmia, if untreated leads to blindness.
- **Beri-Beri:** It is a disease caused by a vitamin B-1 deficiency, also known as thiamine deficiency. There are two types of disease: wet beriberi and dry beriberi. Wet beriberi affects the heart and circulatory system. In extreme cases, wet beriberi can cause heart failure.

66. Correct Answer: (d)

Acquired Immuno Deficiency Syndrome (AIDS)

- AIDS means deficiency of the immune system, acquired during the lifetime of an individual indicating that it is not a congenital disease. 'Syndrome' means a group of symptoms. AIDS was first reported in 1981 and in the last twenty-five years or so, it has spread all over the world killing more than 25 million persons.
- AIDS is caused by the Human Immunodeficiency Virus (HIV), a member of a group of viruses called a retrovirus, which has an envelope enclosing the RNA genome.

Transmission of HIV-infection generally occurs by

a. sexual contact with an infected person,
b. by transfusion of contaminated blood and blood products,
c. by sharing infected needles as in the case of intravenous drug abusers and
d. from infected mother to her child through the placenta.

- A widely used diagnostic test for AIDS is enzyme-linked immunosorbent assay (ELISA).

67. Correct Answer: (a)

Genetic Blood Disorders

- **Sickle Cell Anemia:** Sickle cell anemia is an inherited form of anemia — a condition in which there aren't enough healthy red blood cells to carry adequate oxygen throughout your body.
- The sickle cell gene is passed from generation to generation in a pattern of inheritance called autosomal recessive inheritance. This means that both the mother and the father must pass on the defective form of the gene for a child to be affected.
- **Thalassemia:** Thalassemia is a blood related genetic disorder that involves the absence of or errors in genes responsible for the production of haemoglobin, a protein present in the red blood cells.
- People who have thalassemia can have mild or severe anemia.

68. Correct Answer: (b)

Some Important Communicable Diseases

- **Syphilis:** It is a sexually transmitted disease (STD) caused by bacteria. It is a highly infectious disease that can cause irreversible damage to the nerves, body tissues and brain if left untreated. The disease is sometimes called "The Great Imitator" because so many of the symptoms are identical to those of other diseases. Syphilis is transferred person to person via syphilis sores.
- **Dengue:** It is a mosquito-borne viral infection causing severe flu-like illness and, sometimes causing a potentially lethal complication called severe dengue. The Aedesaegypti mosquito is the main vector that transmits the viruses that cause dengue.
- **Rabies:** It is an infectious viral disease that is almost always fatal following the onset of clinical symptoms. In up to 99% of cases, domestic dogs are responsible for rabies virus transmission to humans.
- **Malaria:** It is caused by Plasmodium parasites. The parasites are spread to people through the bites of infected

female Anopheles mosquitoes, called "malaria vectors."

69. Correct Answer: (d)

Transgenic animals

- Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are known as transgenic animals.
- Transgenic rats, rabbits, pigs, sheep, cows, and fish have been produced, although over 95 percent of all existing transgenic animals are mice.

Benefit from Transgenic animals

- Normal physiology and development: Transgenic animals can be specifically designed to allow the study of how genes are regulated, and how they affect the normal functions of the body and its development, g., the study of complex factors involved in growth such as insulin-like growth factor.
- By introducing genes from other species that alter the formation of this factor and studying the biological effects that result, information is obtained about the biological role of the factor in the body.
- **Study of disease:** Many transgenic animals are designed to increase our understanding of how genes contribute to the development of the disease. These are specially made to serve as models for human diseases so that the investigation of new treatments for diseases is made possible. Today transgenic models exist for many human diseases such as cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's.
- **Biological products:** Medicines required to treat certain human diseases can contain biological products, but such products are often expensive to make. Transgenic animals that produce useful biological products can be created by the introduction of the portion of DNA (or genes) which codes for a particular product such as human protein. Similar attempts are being made for the treatment of phenylketonuria (PKU) and cystic fibrosis. In 1997, the first transgenic cow, Rosie, produced human protein-enriched milk (2.4 grams per liter). The milk contained the human alpha-lactalbumin and was nutritionally a more balanced product for human babies than natural cow-milk.
- **Vaccine safety:** Transgenic mice are being developed for use in testing the safety of vaccines before they are used on humans. Transgenic mice are being used to test the safety of the polio vaccine. If successful and found to be reliable, they could replace the use of monkeys to test the safety of batches of the vaccine.

70. Correct Answer: (d)

About "three-parent" babies

- Mitochondrial Replacement Therapy (MRT) is a form of In Vitro Fertilization (Assisted Reproductive Technology).
- It is used to replace the mother's faulty Mitochondrial DNA with healthy Mitochondria from a donor woman during the IVF process, thus the name- "three-parent" baby.
- The resulting child is still conceived from two parents and will have nuclear DNA from the woman and her partner, and mitochondrial DNA from the donor.
- The United Kingdom became the first country in 2015, to have officially approved procedures to create "three-parent" babies.
- Recently, a team of Greek and Spanish doctors has produced a baby from three people using the maternal spindle transfer technique(similar to Pronuclear Transfer in its effort to prevent the transmission of mitochondrial disease). (a method of Mitochondrial Replacement Therapy).

71. Correct Answer: (d)

Graphene

- Graphene is a single layer of carbon atoms, tightly bound in a hexagonal honeycomb structure.

- It is an allotrope of carbon in the form of a plane of sp2-bonded atoms and forms the basis of all graphitic nanostructures.
- Layers of graphene stacked on top of each other form graphite, with an interplanar spacing of 0.335 nanometres.

Properties of Graphene are:

- Graphene is the thinnest compound known to man (one atom thick).
- It is the lightest material known and is strongest compound discovered which is more than 100 times stronger than steel.
- It is the best conductor of heat at room temperature and also the best conductor of electricity known.
- Graphene has photosensitive properties and can be used in solar cells and photo-detection devices.
- It is highly impermeable and can be used in water filtration or purification technology.

72. Correct Answer: (d)

Nuclear Fission

- Nuclear fission is a process in nuclear physics in which the nucleus of an atom splits into two or more smaller nuclei as fission products, and usually some by-product particles.
- The fission of heavy elements is an exothermic reaction and can release substantial amounts of useful energy both as gamma rays and as the kinetic energy of the fragments (heating the bulk material where fission takes place). The disintegration energy in fission events first appears as the kinetic energy of the fragments and neutrons. Eventually, it is transferred to the surrounding matter appearing as heat.
- The enormous energy released in an atom bomb comes from uncontrolled nuclear fission.
- In nuclear physics, nuclear fission is either a nuclear reaction or a radioactive decay process. The case of the decay process is called spontaneous fission and it is a very rare process that is found only in very heavy chemical elements.

73. Correct Answer: (b)

Radioactive Waste

- Low-level Radioactive Wastes (LLW) comes from reactor operations and from medical, academic, industrial, and other commercial uses of radioactive materials. These include paper, rags, tools, clothing, filters, and other materials which contain small amounts of mostly short-lived radioactivity.
- LLW usually does not require shielding during handling and transport, most LLW is suitable for shallow land burial. To reduce its volume, it is often compacted or incinerated before disposal.
- Intermediate-Level Radioactive Wastes (ILW) contains higher amounts of radioactivity and it generally requires shielding, but the heat it generates is not sufficient to be taken into account in the design or selection of storage and disposal facilities. They include ion-exchange resins, chemical sludge, contaminated materials from reactor decommissioning and some radioactive sources used in radiation therapy.
- High-Level Radioactive Wastes (HLW) is primarily spent fuel removed from reactors after producing electricity. It is also created by the reprocessing of spent nuclear fuel. They require cooling and sufficient shielding because of the high decay heat.

74. Correct Answer: (d)

Beta Particles

- A beta particle is an electron that is not attached to an atom. It has a small mass and a negative charge. Tritium, which is produced by cosmic radiation in the atmosphere and exists all around us, emits beta radiation.
- Carbon-14, used in carbon-dating of fossils and other artifacts, also emits beta particles. Carbon-dating simply makes use of the fact that carbon-14 is radioactive. If you measure the beta particles, it tells you how much carbon-14 is left in the fossil,

which allows you to calculate how long ago the organism was alive.

- In general, beta particles are lighter than alpha particles, and they generally have a greater ability to penetrate other materials. As a result, these particles can travel a few feet in the air and can penetrate the skin. They can get into your body but can't go all the way through. Nonetheless, a thin sheet of metal or plastic or a block of wood can stop beta particles.

75. Correct Answer: (c)

X-Rays

- X-rays, also known as X-radiation, refers to electromagnetic radiation (no rest mass, no charge) of high energies. X-rays are high-energy photons with short wavelengths and thus very high frequency.
- X-ray wavelengths are shorter than those of UV rays and typically longer than those of gamma rays. The distinction between X-rays and gamma rays is that X-rays are emitted by electrons outside the nucleus, while gamma rays are emitted by the nucleus.

Effective shielding of X-rays is in most cases based on the use of materials with two following material properties:

- High-density of material
- High atomic number of material (high Z materials)
- A lead is widely used as an X-rays shield. The major advantage of the lead shield is its compactness due to its higher density.

76. Correct Answer: (c)

Radioactivity

- Becquerel discovered radioactivity in 1896 purely by accident. While studying the fluorescence and phosphorescence of compounds irradiated with visible light,
- Experiments performed subsequently showed that radioactivity was a nuclear phenomenon in which an unstable nucleus undergoes a decay. This is referred to as radioactive decay.

Three types of radioactive decay occur in nature:

- Alpha Decay in which a helium nucleus (He) is emitted
- Beta Decay in which electrons or positrons (particles with the same mass as electrons, but with a charge exactly opposite to that of the electron) are emitted
- Gamma Decay in which high energy (hundreds of keV or more) photons are emitted

77. Correct Answer: (d)

Units of Radioactivity

- A measure of radioactivity (activity) is based on the counting of disintegrations per second.
- The Becquerel is the SI unit of radioactivity defined in 197It is named in honor of Henri Becquerel, a French physicist who discovered radioactivity in 189One Becquerel (1Bq) is equal to one disintegration per second.
- A curie is a non-SI unit of radioactivity defined in 19It was originally defined as equivalent to the number of disintegrations that one gram of radium-226 will undergo in one second. Currently, a curie is defined as 1Ci = 3.7 x 10^ (10) disintegrations per second.
- Rutherford (symbol Rd) is also a non-SI unit defined as the activity of a quantity of radioactive material in which one million nuclei decay per second.

78. Correct Answer: (d)

Sources of Radioactive Waste

- Radioactive waste comes from a number of sources.

Nuclear Fuel Cycle:

- Radioactive waste from the front end of the nuclear fuel cycle is usually alpha-emitting waste from the extraction of uranium. It often contains radium and its decay products.

Medical Waste:

- In general, radiation exposures from medical diagnostic examinations are low (especially in diagnostic uses). Doses may be also high (only for therapeutic uses), but in each case, they must be always justified by the benefits of accurate diagnosis of possible disease conditions or by benefits of accurate treatment. Radioactive medical waste tends to contain beta particle and gamma-ray emitters.

Industrial Waste:

- The industrial waste can contain alpha, beta, neutron or gamma emitters.
- Gamma emitters are used in many industrial uses such as radiography, which is a method of non-destructive testing where many types of manufactured components can be examined to verify the internal structure and integrity of the specimen.

Naturally occurring radioactive materials (NORM):

- Radioactive waste is also naturally occurring radioactive materials (NORM) that can be concentrated as a result of the processing or consumption of coal, oil and gas, and some minerals.
- For e.g. burning coal gasifies its organic materials, concentrating its inorganic components into the remaining waste, called fly ash.

79. Correct Answer: (d)

Nuclear Technology and its Applications

- **Energy:** Energy is essential for sustainable economic growth and improved human welfare. Nuclear energy provides access to clean, reliable and affordable energy, mitigating the negative impacts of climate change.
- **Health:** The nuclear energy can also help monitor and address malnutrition in all its forms, from under-nutrition to obesity. Nuclear-derived techniques can help detect, control and prevent the spread of some of the world's most dangerous diseases, such as Malaria, Ebola and Zika. Diagnostic imaging tests – using radiographs, ultrasound, fluoroscopy or nuclear medicine to create visual representations of a body's interior – are used to deal with a variety of non-communicable or chronic diseases. Using stable isotope techniques, nutrition and health professionals can develop and evaluate nutrition actions to combat all forms of malnutrition.
- **Water Resource Management:** The IAEA promotes the application of nuclear techniques to all aspects of freshwater resource assessments and water management and protection. Isotope tracers provide critical data about the origins and behaviour of pollutants in the water cycle.
- **Agriculture:** In many parts of the world, agricultural workers use radiation to prevent harmful insects from reproducing. Reducing the numbers of pests and bugs protects crops, providing the world with more food. Nuclear and related techniques are used to induce variability in crops that make them tolerant of drought, salinity or pests.
- **Space Exploration:** Nuclear technology makes deep space exploration possible. The generators in unmanned spacecraft use the heat from plutonium to generate electricity and can operate unattended for years. This reliable, long-term source of electricity powers these spacecraft, even as they venture deep into space.
- **Industrial Applications:** Nuclear techniques are used to identify and assess the properties of different materials, measure pollution levels, sterilize and disinfect components, monitor and optimize industrial processes and change chemical, physical and biological properties to produce novel materials.

80. Correct Answer: (c)

Radiological Environmental Remediation

- Environmental remediation aims to reduce radiation exposure from contaminated soil, waste storage facilities or other contaminated infrastructure, groundwater or surface water.
- Its purpose is to return affected lands and water resources for safe public use.
- Returning a contaminated site to its original state is often neither necessary nor possible. While environmental remediation aims to reduce radiation exposure to protect people, remediated sites can still be used for various purposes, for example, industrial operations and even housing.

To encapsulate the main principles of environmental remediation, four major aspects should be taken into account:

- A contaminated site may not necessarily impose significant health risks to people living on it.
- The focus should be on radiation doses and risks that the exposure might pose. Reduction of doses — and not necessarily reduction of concentrations — is the ultimate objective of a remediation project.
- Returning a site to the conditions before the event that caused the contamination is not necessary and many times not even reasonably achievable.
- The major driver for a remediation project will be less scientific evidence of eventual health risks but rather a public perception.

81. Correct Answer: (d)

Nuclear Power Corporation of India Limited (NPCIL)

- NPCIL is a Public Sector Enterprise under the administrative control of the Department of Atomic Energy (DAE), Government of India.
- The Company was registered as a Public Limited Company under the Companies Act, 1956 in September 1987 with the objectives of operating atomic power plants and implementing atomic power projects for generation of electricity in pursuance of the schemes and programmes of the Government of India under the Atomic Energy Act, 1962.
- NPCIL also has equity participation in BHAVINI, another PSU of Department of Atomic Energy (DAE) which implements the Fast Breeder Reactors programme in the country.
- NPCIL is responsible for the design, construction, commissioning and operation of nuclear power reactors.
- NPCIL is presently operating 22 commercial nuclear power reactors with an installed capacity of 6780 MW.

BHAVINI

- Bharatiya Nabhikiya Vidyut Nigam Limited (BHAVINI) is a Government company under the administrative control of Department of Atomic Energy incorporated on 22nd October 2003 as a Public Limited Company under the Companies Act, 1956 with the objective of constructing and commissioning the first 500 MWe Fast Breeder Reactor at Kalpakkam in Tamil Nadu and to pursue construction, commissioning, operation and maintenance of subsequent Fast Breeder Reactors for generation of electricity in pursuance of the schemes and programmes of Government of India under the provisions of Atomic Energy Act, 1962.

82. Correct Answer: (b)

Nuclear Power Plants in India

- Currently, India has 22 nuclear reactors operating in 7 nuclear power plants with a total installed capacity of 6780 MW which contributed to less than 3% of the country's electricity generation.

Power Station	State
1. Tarapur Atomic Power Station (TAPS)	Maharashtra
2. Rajasthan Atomic Power Station (RAPS)	Rajasthan
3. Madras Atomic Power Station (MAPS)	Tamil Nadu

4. Kaiga Generating Station (KGS) Karnataka
5. Kundankulam Nuclear Power Station (KKNPS) Tamil Nadu
6. Narora Atomic Power Station (NAPS) Uttar Pradesh
7. Kakrapar Atomic Power Station (KAPS) Gujarat

83. Correct Answer: (b)

Classification of Nuclear Reactors

- Depending upon the average energy of neutrons that sustain the fission chain reaction, reactors can be classified into two types:

Thermal Reactors:

- Almost all of the current reactors which have been built to date use thermal neutrons to sustain the chain reaction.
- These reactors contain a neutron moderator that slows neutrons from fission until their kinetic energy is more or less in thermal equilibrium with the atoms in the system.

Fast Reactors:

- Fast reactors contain no neutron moderator and use less-moderating primary coolants because they use fast neutrons to cause fission in their fuel.
- There is also a difference in the number of neutrons produced per fission, which is higher in fast reactors than in thermal reactors.

84. Correct Answer: (d)

Uranium Enrichment

- Uranium is element 92 on the periodic table– every molecule has 92 protons in its nucleus. The number of neutrons can vary, and that's the difference between the three isotopes of uranium that we find here on Earth. Uranium-238 (92 protons plus 146 neutrons) is the most abundant form, and about 99.3 percent of all uranium is U-238. The rest is U-235 (0.7 percent), with a trace amount of U-234.
- However, the more abundant U-238 isn't fissile i.e. it can't start a nuclear reaction and sustain it whereas U-235 is fissile. But that 0.7 percent in naturally occurring uranium isn't enough to make a bomb or even a nuclear reactor for a power plant.
- A power plant requires uranium with three to four percent U-235 (this is known as low-enriched or reactor-grade uranium), and a bomb needs uranium with a whopping 90 percent U-235 (highly enriched uranium).
- Uranium enrichment is the process by which a sample of uranium has its proportion of U-235 increased.
- Low enriched uranium (LEU) has a lower than 20% concentration of U-235 while highly enriched uranium (HEU) has a concentration of 20% or more.
- The most common methods for enriching uranium today are centrifugation and gaseous diffusion. And other methods are being developed, including several based on laser techniques.

85. Correct Answer: (b)

Light Water Reactors

- Most common nuclear reactors are Light Water Reactors (LWR), in which light water (ordinary water) is used as a moderator as well as the cooling medium.

In general, LWR's are divided into two categories:

Pressurized Water Reactors (PWRs):

- These are characterized by the high-pressure primary circuit (to keep the water in liquid state).
- These use a reactor pressure vessel (RPV) to contain the nuclear fuel, moderator, control rods and coolant. They are cooled and moderated by high-pressure liquid water. At high pressures, water boils at higher temperatures and can thus cool the heated core as it flows through the core.

Boiling Water Reactors (BWRs):

- These are characterized by controlled boiling in the primary circuit.

- Unlike a PWR, there is no primary and secondary loop and they don't have a steam generator.
- The thermal efficiency of these reactors can be higher, and they can be simpler, and even potentially more stable and safe.

Characteristics Light Water Reactors

- Boiling Water Reactor (BWR) Pressurized Water Reactor (PWR)
- Purpose Electricity Electricity, nuclear powered naval ships
- Coolant Type Water - Water
- Moderator Type Water - Water
- Fuel-chemical Composition Uranium Dioxide - Uranium Dioxide
- Fuel enrichment level Low-enriched - Low-enriched
- Steam Generation Steam generated inside the reactor goes directly to the turbine Steam is generated outside the reactor in a secondary heat transfer loop

86. Correct Answer: (c)

Breeder Reactors

- A nuclear reactor generating more fissile material than what it consumes is called a breeder reactor.
- This is possible because their neutron economy is high enough to create more fissile fuel than they use, by irradiation of fertile material, such as uranium-238 or thorium-232 that is loaded into the reactor along with fissile fuel.

These can be of two types:

- Fast Breeder Reactor (FBR): These use fast (i.e. high energy) neutrons to breed fissile plutonium from fertile uranium-238.
- Thermal Breeder Reactor: These use thermal (i.e. slow or low energy) neutrons to breed fissile uranium-233 from thorium.

Research Reactors

- Research reactors are nuclear reactors used for research, development, education, and training. They produce neutrons for use in industry, medicine, agriculture and forensics, among others.
- The neutrons produced by a research reactor are used for neutron scattering, non-destructive testing, analysis and testing of materials, production of radioisotopes, research and public outreach and education. Research reactors that produce radioisotopes for medical or industrial use are sometimes called isotope reactors.

87.Correct Answer: (c)

Pressurized Heavy Water Reactors (PHWRs)

- PHWRs are a subset of PWRs but instead of ordinary water, it uses heavy water as moderator and coolant. Heavy water generally costs hundreds of dollars per kilogram, though this is a trade-off against reduced fuel costs.
- Heavy Water is a very efficient moderator and thus PHWRs generally use natural uranium i.e. not enriched.
- PHRWs are used for electricity generation and plutonium production.
- Instead of using a single large reactor vessel as in a PWR or BWR, the nuclear core is contained in hundreds of pressure tubes.
- The PHWRs produce more energy per kilogram of mined uranium than other designs, but also produces a much larger amount of used fuel per unit output.

88. Correct Answer: (c)

Treaty on Non-Proliferation of Nuclear Weapons (NPT)

- The NPT is a landmark international treaty whose objective is to prevent the spread of nuclear weapons and weapons technology, to promote cooperation in the peaceful uses of nuclear energy and to further the goal of achieving nuclear disarmament and general and complete disarmament.
- The Treaty represents the only binding commitment in a multilateral treaty to the goal of disarmament by the nuclear-weapon States.
- Opened for signature in 1968, the Treaty entered into force in 1970.

- The Treaty is regarded as the cornerstone of the global nuclear non-proliferation regime and an essential foundation for the pursuit of nuclear disarmament.
- To further the goal of non-proliferation and as a confidence-building measure between States parties, the Treaty establishes a safeguards system under the responsibility of the International Atomic Energy Agency (IAEA).
- The NPT requires only that internationally-traded nuclear material and technology be safeguarded.

89. Correct Answer: (b)

Multilateral Export Control Regimes

Wassenaar Arrangement

- The Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies is one of four multilateral export control regimes. The Arrangement's purpose is to contribute to regional and international security and stability by promoting transparency and greater responsibility in transfers of conventional arms and dual-use (i.e. those having civil and military uses) goods and technologies to prevent destabilizing accumulations of those items.
- The Wassenaar Arrangement establishes lists of items for which member countries are to apply export controls. In addition, the Wassenaar Arrangement imposes some reporting requirements on its member governments.

Nuclear Suppliers Group

- The Nuclear Suppliers Group (NSG) is a group of 48 member countries focusing on stemming the proliferation of nuclear weapons.

Australia Group

- The formation of the Australia Group (AG) in 1985 was prompted by Iraq's use of chemical weapons during the Iran-Iraq War (1980-1988). Australia concerned with Iraq's development of chemical weapons, recommended harmonization of international export controls on chemical weapons precursor chemicals. As the AG membership grew, it expanded its focus to include chemical production equipment and technologies and measures to prevent the proliferation of biological weapons. Today the AG is composed of 42 member countries.

Missile Technology Control Regime

- MTCR formed in 1987 focuses on limiting the proliferation of missiles capable of delivering weapons of mass destruction. Initially, the MTCR consisted of only seven members. The MTCR has grown to include 35 member countries that have agreed to coordinate their national export controls to stem missile proliferation.
- India is a member of all except Nuclear Suppliers Group while China is a member of only Nuclear Suppliers Group.

90. Correct Answer: (c)

Working of a Nuclear Reactor

- In reactors, light nuclei called moderators are provided along with the fissionable nuclei for slowing down fast neutrons. The moderators commonly used are water, heavy water and graphite. The Apsara reactor at the Bhabha Atomic Research Centre (BARC), Mumbai, uses water as a moderator. The other Indian reactors, which are used for power production, use heavy water as a moderator.
- Because of the use of moderator, it is possible that the ratio, K, of a number of fission produced by a given generation of neutrons to the number of fission of the preceding generation may be greater than one.
- This ratio is called the multiplication factor; it is the measure of the growth rate of the neutrons in the reactor.
- The reaction rate is controlled through control-rods made out of neutron-absorbing material such as cadmium.
- A nuclear reactor coolant — usually water but sometimes a gas or a liquid metal (like

liquid sodium) or molten salt — is circulated past the reactor core to absorb the heat that it generates. The heat is carried away from the reactor and is then used to generate steam.

- In some reactors, the coolant also acts as a neutron moderator. If the coolant is a moderator, then temperature changes can affect the density of the coolant/moderator and therefore change power output. A higher temperature coolant would be less dense, and therefore a less.

91. Correct Answer: (d)

Nanotechnology in Food Processing

- Nanotechnology offers some exciting potential benefits for the quality and safety of our foods such as:
- **Contamination Sensor:** Flashlight to reveal the presence of E. coli bacteria.
- **Antimicrobial Packaging:** Edible food films made with cinnamon or oregano oil, or nanoparticles of zinc, calcium other materials that kill bacteria.
- **Improved Food Storage:** Nano-enhanced barrier keeps oxygen-sensitive foods fresher.
- **Enhanced Nutrient Delivery:** Nano-encapsulating improves the solubility of vitamins, antioxidants, healthy omega oils and other 'nutraceuticals'.
- **Green Packaging:** Nano-fibers made from lobster shells or organic corn are both antimicrobial and biodegradable.
- **Pesticide Reduction:** A cloth saturated with nanofibers slowly releases pesticides, eliminating the need for additional spraying and reducing chemical leakage into the water supply.
- **Tracking, Tracing Brand Protection:** Nanobarcodes can be created to tag individual products and trace outbreaks.
- **Texture:** Food spreadability and stability improve with nano-sized crystals and lipids for better low-fat foods.
- **Flavour:** Trick the tongue with bitter blockers or sweet and salty enhancers.
- **Bacteria Identification and Elimination:** Nano carbohydrate particles bind with bacteria so they can be detected and eliminated.

92. Correct Answer: (c)

Quantum Dots

- Quantum dots are semiconductor nanoparticles that glow a particular colour after being illuminated by light. The colour they glow depends on the size of the nanoparticle. When the quantum dots are illuminated by UV light, some of the electrons receive enough energy to break free from the atoms.
- This capability allows them to move around the nanoparticle, creating a conductance band in which electrons are free to move through a material and conduct electricity.
- When UV light hits these semiconducting nanoparticles, they can emit light of various colours.
- Nanoparticles of semiconductors – quantum dots – were theorized in the 1970s and initially created in the early 1980s.
- Due to their particular electronic properties, they can be used as active materials in single-electron transistors.
- The properties of a quantum dot are not only determined by its size but also by its shape, composition, and structure.
- Quantum dots have found applications in composites, solar cells and fluorescent biological labels (for example to trace a biological molecule) which uses both the small particle size and tunable energy levels.
- Advances in chemistry have resulted in the preparation of monolayer-protected, high-quality, monodispersed, crystalline quantum dots as small as 2 nm in diameter, which can be conveniently treated and processed as a typical chemical reagent.
- Quantum dots are both photoluminescent and electro-active and hence find their

most common use nowadays in display screens.
- Quantum Dots can be deposited on any substrate and can be used to make even rollable display screens.

93. Correct Answer: (d)

ChatBots

- A Chatbot or Chatter Robot is a computer program designed to simulate conversation with human users, especially over the Internet.
- It is an assistant that communicates with us through text messages, a virtual companion that integrates into websites, applications or instant messengers and helps entrepreneurs to get closer to customers.
- Chatbots works in two ways- Rule-based and Smart machine-based.
- Rule-based chatbots provide predefined responses from a database, based on the keywords used for the search.

There are two main types of chatbots:

- Task-oriented (declarative) chatbots are single-purpose programs that focus on performing one function. Interactions with these chatbots are highly specific and structured and are most applicable to support and service functions.
- Data-driven and predictive (conversational) chatbots are often referred to as virtual assistants or digital assistants, and they are much more sophisticated, interactive, and personalized than task-oriented chatbots. Digital assistants can learn a user's preferences over time, provide recommendations, and even anticipate needs.
- In addition to monitoring data and intent, they can initiate conversations. Apple's Siri and Amazon's Alexa are examples of consumer-oriented, data-driven, predictive chatbots.

94. Correct Answer: (d)

Robotics Terminology

- Robotics is a branch of engineering that involves the conception, design, manufacture, and operation of robots.
- This field overlaps with electronics, computer science, artificial intelligence, mechatronics, nanotechnology, and bioengineering.
- Few terminologies related to Robotics include: Actuator: A power mechanism used to affect motion, or maintains the position of the robot, for example, a motor which converts electrical energy to effect motion of the robot. The actuator responds to a signal received from the control system.
- **Degrees of Freedom:** The number of independent directions or joints of the robot, which would allow the robot to move its end-effector through the required sequence of motions.
- **Optical Encoder:** A detection sensor, which measures linear or rotary motion by detecting the movement of markings past a fixed beam of light. This can be used to count revolutions, identify parts, etc.
- **Through-beam:** An object detection system used within a robot's imaging sensor system. A finely focused beam of light is mounted at one end and a detector at the other. When the beam of light is broken, an object is sensed.
- **Transducer:** A device that converts energy from one form to another. Generally, a device that converts an input signal into an output signal of a different form. It can also be thought of as a device that converts static signals detected in the environment (such as pressure) into an electrical signal that is sent to a robot's control system.

95. Correct Answer: (a)

Nanomaterial

- The nanomaterial is any organic, inorganic material that presents distinct chemical, physical, and/or electrical properties owing to their ultrasmall size, typically in the nanoscale region.

- Nanomaterial can be classified into the following categories:
- **Natural nanomaterial:** These are made by nature through bio-geochemical or mechanical processes, without direct or indirect connection to human activity or anthropogenic process. Nanomaterials that are naturally occurring include volcanic ash, soot from forest fires.
- **Incidental nanomaterial:** These are unintentionally produced as a result of any form of direct or indirect human influence or anthropogenic process. Sources of incidental nanoparticles include vehicle engine exhausts, welding fumes, combustion processes from domestic solid fuel heating and cooking.
- **Engineered nanomaterial:** A nanomaterial conceived, designed, and intentionally produced by humans. A titanium dioxide nanoparticle is a prominent example of it. It is used in sunscreens due to its ability to block UV radiation while remaining transparent on the skin.

96. Correct Answer: (c)

Nanocomposites

- These are heterogeneous materials composed of two or more substances, of which at least one has a Nanoscale dimension, such as nanoparticles dispersed throughout another solid material.
- The result of the addition of nanoparticles is a drastic improvement in properties that can include mechanical strength, toughness, and electrical or thermal conductivity.
- This happens because nanoparticles have an extremely high surface to volume ratio which dramatically changes their properties when compared with their bulk-sized equivalents.
- It also changes the way in which the nanoparticles bond with the bulk material. The result is that the composite can be many times improved with respect to the component parts. Some Nanocomposite materials have been shown to be 1000 times tougher than the bulk component materials.
- The effectiveness of the nanoparticles is such that the amount of material added is normally only between 0.5 and 5% by weight.

97. Correct Answer: (c)

Use of Nano-Technology in Health Sector

- Targeted drug delivery is made possible by nanotechnology. Medical nanotechnology can largely contribute to gene therapy and improvement.
- Diseases can be easily treated if approached at the genetic level. So instead of treating diseases based on the symptoms, nanotechnology will help medical practitioners treat the problem by looking at the root cause.

98. Correct Answer: (c)

Classification of Nanomaterials

- Nanomaterials can be classified on the basis of their dimensions into the following categories: Zero Dimensional Nanomaterials (0D): These nanomaterials have all the dimensions within the nanoscalee. no dimensions are larger than 100 nm. Most commonly, 0D nanomaterials are nanoparticles.
- One Dimensional Nanomaterials (1D): These have one dimension outside the nanoscale. This class includes nanotubes, nanorods, and nanowires.
- Two Dimensional Nanomaterials (2D): These have two dimensions outside the nanoscale. This class exhibits plate-like shapes and includes graphene, nanofilms, nanolayers, and nanocoatings.
- Three Dimensional Nanomaterials (3D): These are materials that are not confined to the nanoscale in any dimension. This class can contain bulk powders, dispersions of nanoparticles, bundles of nanowires, and multi-nano layers.

99. Correct Answer: (b)

Telerobotic Coronary Intervention

- Telerobotic Coronary intervention is a robotic method of performing cardiac surgery.
- India became the first country in the world to perform a telerobotic operation.
- The robotic system was placed in the operation theatre and cardiologist was connected to it through high-speed wireless internet.
- In telerobotic operations, if any failure or delay in the internet speed is noted, the surgeons present would be able to take over the operation manually within 30 seconds.
- The telerobotic operation has the potential to contribute largely to the cardiovascular medical emergencies.
- This technology is especially important for high emergency situations of heart attacks and stroke, where ideal treatment must be received within 90 minutes or 24 hours.
- This technology will benefit especially to those groups, who have geographical barriers and socio-economic status.

100.Correct Answer: (a)

Quantum Spin Liquid

- In condensed matter physics, the quantum spin liquid is a state that can be achieved in a system of interacting quantum spins. The state is referred to as a "liquid" as it is a disordered state in comparison to a ferromagnetic spin state, much in the way liquid water is in a disordered state compared to crystalline ice.
- However, unlike other disordered states, a quantum spin liquid state preserves its disorder to very low temperatures.