



# All India Civil Services Coaching Centre

(Under the aegis of Government of Tamil Nadu)

## Answer Key Explanation

### Test 9 – Science and Technology

Maximum Questions: 100

Maximum Marks: 200

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

##### Acids and bases

- Plants require a specific pH range for their healthy growth. It is very interesting to note that our stomach produces hydrochloric acid.
- It helps in the digestion of food without harming the stomach. During indigestion, the stomach produces too much acid and this causes pain and irritation.
- The best way to prevent this is to clean the mouth after eating food. Using toothpaste, which is generally basic, for cleaning the teeth can neutralise the excess acid and prevent tooth decay

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

##### Waves

- Longitudinal waves are waves in which the displacement of the medium is in the same direction as, or the opposite direction to, the direction of propagation of the wave.
- Mechanical longitudinal waves are also called compressional or compression waves, because they produce compression and rarefaction when traveling through a medium, and pressure waves because they produce increases and decreases in pressure.
- Longitudinal waves cause the medium to move parallel to the direction of the wave.
- There are three types of waves: mechanical waves require a material medium to travel (air, water, ropes).

#### These waves are divided into three different types.

- Transverse waves cause the medium to move perpendicular to the direction of the wave.
- Electromagnetic waves are transverse waves that cause the medium to move perpendicular to the direction of the wave. They do not require a medium to travel (light, radio).
- Matter waves are produced by electrons and particles.
- A point of maximum positive displacement in a wave is called crest and a point of maximum negative displacement is called the trough.

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

##### Electrolytic Refining

- Many metals, such as copper, zinc, tin, nickel, silver, gold, etc., are refined electrolytically. In this process, the impure metal is made the anode and a thin strip of pure metal is made the cathode.
- A solution of the metal salt is used as an electrolyte. On passing the current through the electrolyte, the pure metal from the anode dissolves into the electrolyte.
- An equivalent amount of pure metal from the electrolyte is deposited on the cathode. The soluble impurities go into the solution, whereas, the insoluble impurities settle down at the bottom of the anode and are known as anode mud.

#### 4. Correct Answer: (d)

##### Image formation by eye

- The eye has a roughly spherical shape. The outer coat of the eye is white. It is tough so that it can protect the interior of the eye from accidents. Its transparent front part is called the cornea .
- Behind the cornea, we find a dark muscular structure called iris. In the iris, there is a small opening called the pupil.
- The size of the pupil is controlled by the iris. The iris is that part of the eye which gives it its distinctive colour.
- When we say that a person has green eyes, we refer actually to the colour of the iris. The iris controls the amount of light entering into the eye.
- The lens focuses light on the back of the eye, on a layer called the retina . The retina contains several nerve cells. Sensations felt by the nerve cells are then transmitted to the brain through the optic nerve.
- The impression of an image does not vanish immediately from the retina. It persists there for about 1/16th of a second. So, if still images of a moving object are flashed on the eye at a rate faster than 16 per second, then the eye perceives this object as moving.

#### 5. Correct Answer: (c)

##### Reflection of Light

- The process through which light rays fall on the surface and gets bounced back is known as a reflection of light.

##### Law of Reflection

- The angle of incidence is always equal to the angle of reflection.
- The incident ray, the normal at the point of incidence and the reflected ray all lie in the same plane.

#### 6. Correct Answer: (d)

##### Doppler Effect and its applications

- Doppler's effect can be defined as an observed change in frequency of a wave (for eg., Sound wave) when an observer

and source have relative motion between them.

- The Doppler effect has several real-world applications. Some of them are given below.
- Police radar "gun" to check the speed of oncoming vehicles.
- In meteorology, to track storms.
- In the medical field such as to draw echocardiograms and in medical ultrasonography to diagnose heart and vascular problems.
- It is used to measure the speed at which stars and galaxies are approaching or receding from us, in a mechanism named red shift or blue shift.

#### 7. Correct Answer: (a)

##### Leptons

- A lepton is a particle not affected by the strong nuclear forces but is only subjected to the weak forces.
- There are six leptons of two types. Charged leptons viz. electrons, muon, and tau.
- Uncharged leptons viz. three types of neutrinos.

#### 8. Correct Answer: (d)

##### Total internal reflection

- It is the phenomenon that involves the reflection of all the incident light off the boundary.
- Total internal reflection only takes place when both of the following two conditions are met:
- The light is in the more dense medium and approaching the less dense medium.
- The angle of incidence is greater than the so-called critical angle.
- Total internal reflection will not take place unless the incident light is traveling within the more optically dense medium towards the less optically dense medium.

**9. Correct Answer: (b)**

**Microorganisms**

- Water and soil are full of tiny organisms, though not all of them fall into the category of microbes.
- These microorganisms or microbes are so small in size that they cannot be seen with the unaided eye.
- Microorganisms are classified into four major groups. These groups are bacteria, fungi, protozoa, and some algae.
- Microorganisms may be single-celled like bacteria, some algae, and protozoa, or multicellular, such as many algae and fungi.

**10. Correct Answer: (b)**

**Some Common Human Diseases caused by Microorganisms**

Human Disease	Causative Microorganisms	Mode of Transmission	Preventive Measures (General)
Tuberculosis	Bacteria	Air	Keep the patient in complete isolation.  Keep the personal belongings of the patient away from those of the others.  Vaccination to be given at a suitable age
Measles	Virus	Air	
Chicken Pox	Virus	Air/contact	
Polio	Virus	Air/water	
Cholera	Bacteria	Water/Food	Maintain personal hygiene and good sanitary habits  Consume properly cooked food and boiled drinking water.  Vaccination.
Typhoid	Bacteria	Water	
Hepatitis A	Virus	Water	Drink boiled drinking water.  Vaccination.
Malaria	Protozoa	Mosquito	Use mosquito

			net and repellents  Spray insecticides and control the breeding of mosquitoes by not allowing water to collect in the surroundings.
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**11. Correct Answer: (c)**

**Photosynthesis**

- The carbon and energy requirements of the autotrophic organism are fulfilled by photosynthesis.
- It is the process by which autotrophs take in substances from the outside and convert them into stored forms of energy. This material is taken in the form of carbon dioxide and water which is converted into carbohydrates in the presence of sunlight and chlorophyll.
- Carbohydrates are utilised for providing energy to the plant.
- The carbohydrates which are not used immediately are stored in the form of starch, which serves as the internal energy reserve to be used as and when required by the plant.
- A somewhat similar situation is seen in us where some of the energy derived from the food we eat is stored in our body in the form of glycogen.
- The following events occur during Photosynthesis Process:  
 Absorption of light energy by chlorophyll.  
 Conversion of light energy to chemical energy and splitting of water molecules into hydrogen and oxygen.  
 Reduction of carbon dioxide to carbohydrates.

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

**Mode of Nutrition in Plants**

- Plants are the only organisms that can prepare food for themselves by using water, carbon dioxide, and minerals. The

raw materials are present in their surroundings.

- The nutrients enable living organisms to build their bodies, to grow, to repair damaged parts of their bodies and provide the energy to carry out life processes.

#### **Nutrition**

- Nutrition is the mode of taking food by an organism and its utilization by the body.
- The mode of nutrition in which organisms make food themselves from simple substances is called autotrophic (auto = self; trophos = nourishment) nutrition. Therefore, plants are called autotrophs.
- Animals and most other organisms take in food prepared by plants. They are called heterotrophs (heteros= other).

### **13. Correct Answer: (b)**

#### **Antibiotic resistance**

- It is a loss of susceptibility of bacteria to the killing (bacteriocidal) or growth-inhibiting (bacteriostatic) properties of an antibiotic agent.
- When a resistant strain of bacteria is the dominant strain in an infection, the infection may be untreatable and life-threatening.
- Examples of bacteria that are resistant to antibiotics include methicillin-resistant *Staphylococcus aureus* (MRSA), penicillin-resistant *Enterococcus*, and multidrug-resistant *Mycobacterium tuberculosis* (MDR-TB), which is resistant to two tuberculosis drugs, isoniazid, and rifampicin. MDR-TB is particularly dangerous because it can give rise to extensively drug-resistant *M. tuberculosis* (XDR-TB), which requires aggressive treatment using a combination of five different drugs.
- A superbug is usually defined as a microorganism that's resistant to commonly used antibiotics. The number of different antibiotics to which it can be resistant determines the degree of the superbug. Some are resistant to one or

two, but others can be resistant to multiple drugs.

### **14. Correct Answer: (d)**

#### **Tissue culture**

- In tissue culture, new plants are grown by removing tissue or separating cells from the growing tip of a plant.
- The cells are then placed in an artificial medium where they divide rapidly to form a small group of cells or callus.
- The callus is transferred to another medium containing hormones for growth and differentiation. The plantlets are then placed in the soil so that they can grow into mature plants.
- Using tissue culture, many plants can be grown from one parent in disease-free conditions. This technique is commonly used for ornamental plants

### **15. Correct Answer: (b)**

#### **Bio fertilizer-**

- The cultured micro-organisms packed in some carrier material for easy application in the field are called bio-fertilizers.
- Thus, the critical input in Biofertilizers is the microorganisms. Commonly produced biofertilizers are *Rhizobium*, *Azotobacter*, Phosphate Solubilizers, Blue-Green Algae, *Azolla*, *Micorohizae*.
- *Spirogyra*, (genus *Spirogyra*), any member of a genus of some 400 species of freefloating green algae (division Chlorophyta) found in freshwater environments around the world.
- Named for their beautiful spiral chloroplasts, *spirogyras* are filamentous algae that consist of thin unbranched chains of cylindrical cells. They can form masses that float near the surface of streams and ponds, buoyed by oxygen bubbles released during photosynthesis. They are commonly used in laboratory demonstrations.
- *Agaricus* is a genus of mushrooms containing both edible and poisonous

species, with possibly over 300 members worldwide.

- The genus includes the common (“button”) mushroom (*Agaricus bisporus*) and the field mushroom (*Agaricus campestris*), the dominant cultivated mushrooms of the West.

#### 16. Correct Answer: (a)

##### Blood

- Blood is a bright red viscous fluid which flows through all the vessels except the lymph vessels.
- It constitutes 8% of the total body weight. Blood is composed of two portions: formed elements (cell and cell-like structures) and plasma (liquid containing dissolved substances).

##### Plasma

- Plasma is the liquid component of the blood.
- Mammalian blood consists of a liquid (plasma) and a number of cellular and cell fragment components.

##### Red Blood Cells

- Red blood cells are also known as erythrocytes, are flattened, doubly concave cells about 7µm in diameter that carries oxygen associated with the cell’s hemoglobin.

##### White Blood Cells

- White blood cells are also known as leukocytes. They are larger than erythrocytes, have a nucleus, and lack haemoglobin.
- They function in the cellular immune response. White blood cells (leukocytes) are less than 1% of the blood’s volume.
- They are made from stem cells in bone marrow

##### Platelets

- Platelets result from cell fragmentation and are involved with clotting.
- Platelets are cell fragments that bud off megakaryocytes in the bone marrow.

- They carry chemicals essential to blood clotting

#### 17. Correct Answer: (c)

##### Prokaryotic cells

- The nucleus of the bacterial cell is not well organized like the cells of multicellular organisms.
- There is no nuclear membrane.
- The cells having nuclear material without a nuclear membrane are termed prokaryotic cells.
- The organisms with these kinds of cells are called prokaryotes. Examples are bacteria and blue green algae.

##### Eukaryotic cells

- The cells having a well-organized nucleus with a nuclear membrane, are designated as eukaryotic cells.
- All organisms other than bacteria and blue green algae are called eukaryotes.

#### 18. Correct Answer: (c)

##### Blood

- Blood is the fluid that flows in blood vessels. It transports substances like digested food from the small intestine to the other parts of the body.
- It carries oxygen from the lungs to the cells of the body.
- It also transports waste for removal from the body.
- Blood is composed of a fluid, called plasma in which different types of cells are suspended.
- One type of cells in the red blood cells (RBC) which contain a red pigment called haemoglobin.
- Haemoglobin binds with oxygen and transports it to all the parts of the body and ultimately to all the cells.
- It will be difficult to provide oxygen efficiently to all the cells of the body without haemoglobin.
- The presence of haemoglobin makes blood appear red.

- The blood also has white blood cells (WBC) which fight against germs that may enter our body.
- The clot is formed because of the presence of another type of cell in the blood, called platelets.

### 19. Correct Answer: (d)

#### Disease-causing Microorganisms in Plants

- Several microorganisms cause diseases in plants like wheat, rice, potato, sugarcane, orange, apple, and others.
- The diseases reduce the yield of crops.
- They can be controlled by the use of certain chemicals that kill the microbes.

#### Some Common Plant Disease Caused by Microorganisms:

Plant Diseases	Micro-Organism	Mode of Transmission
Citrus Canker	Bacteria	Air
Rust of Wheat	Fungi	
Yellow Vein Mosaic of Bhindi (Okra)	Virus	Insect.

### 20. Correct Answer: (d)

#### Pollination

- The transfer of pollen from the anther to the female stigma is termed pollination.
- This is accomplished by a variety of methods.
- Entomophily is the transfer of pollen by an insect.
- Anemophily is the transfer of pollen by the wind.
- Other pollinators include birds, bats, water, and humans.
- Some flowers (for example garden peas) develop in such a way as to pollinate themselves.
- Others have mechanisms to ensure pollination with another flower.
- Flower colour is thought to indicate the nature of pollinator: red petals are thought to attract birds, yellow for bees, and white for moths.

- Wind pollinated flowers have reduced petals, such as oaks and grasses.

### 21. Correct Answer: (a)

#### Networking

- Bluetooth is a computing and telecommunications industry specification that describes how devices can communicate with each other.
- Devices that use Bluetooth include computers, a computer keyboard and mouse, personal digital assistants, and smartphones.
- It is a radio frequency (RF) technology that operates at 2.4 GHz, has an effective range of 10 meters, and has a transfer rate of 1 Mbps and throughput of 721 Kbps.
- Similar to Bluetooth, Wifi also provides wireless communication and uses radio signals for doing so.
- Bluetooth is essentially used to connect short-range devices (10m) for sharing data while Wifi connects larger-range devices (100m).
- Limited numbers of devices have provision to connect with other devices in Bluetooth.
- On the other hand, Wifi provides access to more number of users.
- Bluetooth is used when speed is not our concern and low bandwidth is allocated to it.
- Wifi provides high bandwidth as the speed of the internet is an important factor.
- The frequency range for Bluetooth operation is 2.400 GHz to 2.483 GHz and for the Wifi, it is 2.4 GHz to 5 GHz.
- 2000 free WiFi zones have been set up in select areas in all districts of Kerala under the K-Fi project of the state government.
- As per the plan, the public can access WiFi on their laptops and mobile phones and use up to 1 GB of free WiFi up to 10 Mbps speed every day.
- The WiFi can be accessed by entering the mobile number.

**22. Correct Answer: (a)****Internet Protocol (IP)**

- The Internet Protocol (IP) is the basic protocol used for communications on the Internet.
- It defines the way information is packetized, addressed, transferred, routed, and received by networked devices.
- Computer scientists Bob Kahn and Vint Cerf developed this protocol in 1974.
- It is more commonly used in conjunction with another protocol called Transmission Control Protocol (TCP). Together they are referred to as TCP/IP.
- IP addresses uniquely identify the source and destination of data transmitted with the Internet Protocol.
- The first major version of the Internet Protocol was version 4, or IPv4. The successor to IPv4 is IPv6. It was designed to eventually replace IPv4. IPv6 governs approximately 20% of all Internet traffic.

**23. Correct Answer: (b)****Edge Computing**

- Edge computing enables data to be analyzed, processed and transferred at the edge of a network.
- Meaning, the data is analyzed locally, closer to where it is stored, in realtime without latency.

**Benefits of edge computing**

- **Speed:** The most important benefit of edge computing is its ability to increase network performance by reducing latency (ability to process very high volumes of data with minimal delay).
- It allows for quicker data processing and content delivery.
- **Versatility:** The scalability of edge computing also makes it incredibly versatile.
- By partnering with local edge data centers, companies can easily target desirable markets without having to invest in expensive infrastructure expansion.

- **Reliability:** With IoT edge computing devices and edge data centers positioned closer to end-users, there is less chance of a network problem in a distant location affecting local customers. This increases reliability.

**24. Correct Answer: (c)****Bharat QR code**

- It is a quick response (QR) code to enable digital payments without card swiping machines.
- It is the world's first interoperable payment acceptance solution launched by the Indian Government to move towards a less-cash economy.
- Bharat QR code has been developed jointly by National Payments Corporation of India (NPCI), Visa, MasterCard and American Express under instructions from Reserve Bank of India (RBI).
- It works as a common interface for the MasterCard/Visa/RuPay platforms and also facilitates acceptance of Aadhaar-enabled payments and Unified Payments Interface (UPI).
- It enables a person to make payments to retailers without using the merchant's ID or number.
- Users can make payments by scanning the code.
- Bharat QR code is of two types static and dynamic.
- In static QR code, the first code needs to be scanned and then the amount is entered to make payment.
- In the case of dynamic QR code, the new QR code will be generated in real-time for every transaction.

**25. Correct Answer: (c)****Artificial Intelligence (AI)**

- It describes the action of machines accomplishing tasks that have historically required human intelligence.
- It includes technologies like machine learning, pattern recognition, big data, neural networks, self algorithms, etc.

- The origin of the concept can be traced back to Greek mythology, although it is only during modern history when stored-program electronic computers were developed.  
Example: Million of algorithms and codes are there around humans to understand their commands and perform human-like tasks.
- Facebook's list of suggested friends for its users, a pop-up page, telling about an upcoming sale of the favorite brand of shoes and clothes, that comes on the screen while browsing the internet, is the work of artificial intelligence.

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

**The potential applications of supercomputers in the Indian context:**

- Recreating the Big Bang: Researchers can run models that require upward of a thousand trillion calculations per second, allowing for the most realistic models of these cosmic mysteries yet.
- Understanding earthquakes: By modeling the three-dimensional structure of the Earth, researchers can predict how earthquake waves will travel both locally and globally.
- Modeling swine flu: Potential pandemics like the H1N1 swine flu require a fast response on two fronts: First, researchers have to figure out how the virus is spreading. Second, they have to find drugs to stop it. Supercomputers can help with both.
- Testing nuclear weapons: The real aim is to create better simulations of nuclear explosions and to do away with real-world nuke testing for good.
- Predicting climate change: The challenge of predicting global climate is immense.
- There are hundreds of variables, from the reflectivity of the earth's surface. Dealing with these variables requires supercomputing capabilities.

**27. Correct Answer: (a)**

**Fourth Industrial Revolution**

- The Fourth Industrial Revolution builds on the Digital Revolution, representing new ways in which technology becomes embedded within societies and even the human body.
- The Fourth Industrial Revolution is marked by emerging technology breakthroughs in a number of fields, including robotics, artificial intelligence, nanotechnology, quantum computing, Cloud Computing, biotechnology, The Internet of Things (IoT), 3D printing and autonomous vehicles.

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

- e-Governance facilitates interaction between different stakeholders in governance.
- These interactions may be described as follows: G2G (Government to Government)– In this case, Information and Communications Technology is used not only to restructure the governmental processes involved in the functioning of government entities but also to increase the flow of information and services within and between different entities.
- This kind of interaction is only within the sphere of government and can be both horizontal i.e. between different government agencies as well as between different functional areas within an organisation.
- G2C (Government to Citizens) – It gives citizens the choice of when to interact with the government (e.g. 24 hours a day, 7 days a week), from where to interact with the government (e.g. service centre, unattended kiosk or from one's home/workplace) and how to interact with the government (e.g. through internet, fax, telephone, email, face-to-face, etc).
- G2B (Government to Business) –The objective is to cut red tape, save time, reduce operational costs and to create a more transparent business environment when dealing with the government.

- The G2B initiatives can be transactional, such as in-licensing, permits, procurement and revenue collection.
- G2E (Government to Employees)– This interaction is a two-way process between the organisation and the employee.
- The use of ICT tools helps in making these interactions fast and efficient on the one hand and increase the satisfaction levels of employees on the other.

**29. Correct Answer: (b)  
Network for Spectrum**

- The NFS project will boost the communication capabilities of the Defence Forces in a major way leading to enhanced national operational preparedness.
- The project is being implemented by staterun Bharat Sanchar Nigam Limited (BSNL).

**30. Correct Answer: (a)  
Difference between LiFi and WiFi**

Feature	LiFi	WiFi
Full form	Light Fidelity	Wireless Fidelity
Operation	LiFi transmits data using light with the help of LED bulbs.	WiFi transmits data using radio waves with the help of a WiFi router.
Interference	Do not have any interference issues similar to radiofrequency waves.	Will have interference issues from nearby access points(routers)
Technology	Present IrDA compliant devices	WLAN 802.11a/b/g/n/ac/ad standard compliant devices.
Applications	Used in airlines, undersea explorations, operation theaters in the hospitals, office and home premises for data transfer and internet browsing	Used for internet browsing with the help of wifi kiosks or wifi hotspots
Merits (advantages)	Interference is less, can pass through salty seawater, works in densy region	Interference is more, cannot pass through seawater works in less densy region

Privacy	In LiFi, light is blocked by the walls and hence will provide more secure data transfer	In WiFi, the RF signal cannot be blocked by the walls and hence need to employ techniques to achieve secure data transfer.
Data transfer speed	About 1 Gbps	WLAN- 11n offers 150Mbps, About 1-2 Gbps can be achieved using WiGig/Giga-IR
Frequency of operation	10 thousand times the frequency spectrum of the radio	2.4GHz, 4.9GHz, and 5GHz
Data density	Works in high dense environment	Works in less dense environment due to interference related issues
Coverage distance	About 10 meters	About 32 meters (WLAN 802.11b/11g), vary based on transmit power and antenna type
System components	Lamp driver, LED bulb(lamp) and photodetector will make up a complete LiFi system.	requires routers to be installed, subscriber devices (laptops, PDAs, desktops) are referred to as stations

**31. Correct Answer: (b)  
5G Technology**

- 5G is a wireless communication technology using radio waves or radio frequency (RF) energy to transmit and receive data.
- 5G technologies will enter services gradually, beginning in 2019 and advance to a full range of services by 202
- The final standard for 5G will be set up by the International Telecommunications Union (ITU).
- South Korea is the world’s first country to launch 5th-Generation (5G) networks AJ Paulraj committee is formed for identifying the 5G deployment roadmap for India.

**32. Correct Answer: (b)  
Bharat Net Project**

- Bharat Net has the vision to establish a scalable network by 2017 towards providing affordable broadband

connectivity of 2 Mbps to 20 Mbps to all rural households and institutions.

- This project has evolved from the earlier National Optical Fibre Network (NOFN) project of providing 100 Mbps to all gram panchayats (GPs).
- At present, a special purpose vehicle, Bharat Broadband Network Ltd (BBNL), under the telecom ministry is handling the rollout of the optical fibre network.
- Bharat Net is being funded through the Universal Service Obligation Fund (USOF).
- The Universal Service Obligation Fund (USOF) was established with the fundamental objective of providing access to 'Basic' telegraph services to people in the rural and remote areas at affordable and reasonable prices.
- Subsequently, the scope was widened to provide subsidy support for enabling access to all types of telegraph services including mobile services, broadband connectivity and creation of infrastructure like OFC in rural and remote areas.

### 33. Correct Answer: (a)

#### Mission Raksha Gyan Shakti

- As part of the ongoing initiatives to enhance self-reliance in defence, in terms of innovation and production, the Department of Defence Production, Ministry of Defence, has instituted a new framework titled 'Mission Raksha Gyan Shakti'.
- It aims to boost the Intellectual Property Rights (IPR) culture in the indigenous defence industry and streamline the Intellectual Property initiatives in the defence sector.
- The initiative has been launched in response to the achievements that Defence Research and Development Organisation (DRDO), Defence Public Sector Undertaking (DPSUs) and Ordnance Factories (OFs) have made in terms of successful filing of IPR applications in the past few decades.
- The initiative aspires to transform the defence procurement system by changing

the culture of seeking Transfer of Technology (ToT) from foreign sources to generate intellectual property, and achieve self-reliance in Defence sector.

### 34. Correct Answer: (c)

#### Young Scientist Programme

- ISRO has launched a special program for School Children called "Young Scientist Programme" "Yuva Vigyani KARYakram from this year.  
About the Young Scientist Programme
- It aims to inculcate and nurture space research fervor in young minds.
- Under this 1-month program, 3 students from each of the 28 States and 9 UTs will be selected.
- Students mostly from class VIII will be given lectures and access to R&D labs and practical experience of building a small satellite.
- It is conceptualized after the similar Programme run by the American Space Agency NASA.
- All the expenses of traveling and boarding will be funded entirely by ISRO.

### 35. Correct Answer: (b)

#### Data Localization

- Data localization is the act of storing data on any device that is physically present within the borders of a specific country where the data was generated.
- RBI's data localization directive RBI's data localization directive RBI issued a directive advising all Payment System Operators (PSOs) to ensure that the entire data relating to payment systems is stored within databases located in India.
- Directives are applicable to Payment System providers authorized by RBI under the Payment and Settlement Systems Act, 200
- This includes many companies from payment gateways like MasterCard and Visa to e-wallets like PayTM.

- It includes end-to-end transaction details and information pertaining to payment or settlement transaction.
- There is no bar on overseas processing of strictly domestic transactions; however, in such cases, the data should be deleted from the systems abroad and brought back to India not later than the one business day or 24 hours from payment processing, whichever is earlier.
- Data can be shared with the overseas regulator, if required, depending upon the nature/origin of the transaction with prior approval of the RBI.

**36. Correct Answer: (b)**

**National Supercomputing Mission**

- The Mission envisages empowering our national academic and R&D institutions to spread over the country by installing a vast supercomputing grid comprising of more than 70 high-performance computing facilities.
- The Mission also includes the development of highly professional High-Performance Computing (HPC) aware human resources for meeting challenges of development of these applications.
- The Mission implementation would bring supercomputing within the reach of the large Scientific & Technology community in the country and enable the country with a capacity of solving multi-disciplinary grand challenge problems.
- The Mission would be implemented and steered jointly by the Department of Science and Technology (DST) and Department of Electronics and Information Technology (DeitY) at an estimated cost of Rs.4500 crore over a period of seven years.
- PARAM Shivay is the first supercomputer designed & built under the mission.

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

**National Optical Fibre Network**

- National Optical Fibre Network (NOFN) aims to connect all Gram Panchayats in the country through optical fibre cable

(OFC) by bridging the connectivity gap between Gram Panchayats and Blocks for providing broadband.

- It is the world's largest rural broadband project.
- It is implemented by the Ministry of Communications.
- It is renamed as Bharat-Net, is being monitored by the Prime Minister's Office.

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

**Council of Scientific and Industrial Research (CSIR)**

- The Council of Scientific and Industrial Research abbreviated as CSIR was established by the Government of India in September of 1942.
- It is an autonomous body and the largest research and development (R&D) organization in India
- Although it is mainly funded by the Ministry of Science and Technology, it operates as an autonomous body registered under the Registration of Societies Act, 1860.
- The research and development activities of CSIR include aerospace engineering, Structural engineering, ocean sciences, Life sciences, metallurgy, chemicals, mining, food, petroleum, leather, and environment.

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

**National Payments Corporation of India (NPCI)**

- National Payments Corporation of India (NPCI), an umbrella organisation for operating retail payments and settlement systems in India, is an initiative of Reserve Bank of India (RBI) and Indian Banks' Association (IBA) under the provisions of the Payment and Settlement Systems Act, 2007, for creating a robust Payment & Settlement Infrastructure in India.

**National Financial Switch (NFS)**

- National Financial Switch (NFS) is the largest network of shared automated teller machines (ATMs) in India.

- It was designed, developed and deployed by the Institute for Development and Research in Banking Technology (IDRBT) in 2004, with the goal of inter-connecting the ATMs in the country and facilitating convenience banking.
- It is run by the National Payments Corporation of India (NPCI).

#### 40. Correct Answer: (b)

##### Internet Corporation for Assigned Names and Numbers (ICANN)

- It is a non-profit organization responsible for coordinating the maintenance and procedures of several databases related to the namespaces and numerical spaces of the Internet, ensuring the network's stable and secure operation.
- Its motto is One World, One Internet.
- It works on the Internet's global Domain Name System (DNS), including policy development for internationalization of the DNS system, introduction of new generic toplevel domains (TLDs), and the operation of root name servers.

##### Public Interest Registry (PIR)

- It is a not-for-profit organisation created by the Internet Society (ISOC) in 2002, originally to manage the ORG domain.
- They served those who want to make a positive impact by improving the world at scales ranging from the local community to an international one.
- Recently, PIR was sold to private equity firm Ethos Capital. Hence PIR no longer manages the ORG domain.

#### 41. Correct Answer: (a)

##### DART Space Probe

- Double Asteroid Redirection Test (DART) is a planned space probe that will demonstrate the kinetic effects of crashing an impactor spacecraft into an asteroid moon for planetary defense purposes.
- DART would be NASA's first mission to demonstrate such capability.
- The mission is intended to test whether a spacecraft impact could successfully

deflect an asteroid on a collision course with Earth.

- The target for DART is an asteroid that will have a distant approach to Earth in October 2022, and then again in 2024.
- The approaching asteroid is called Didymos -- Greek for "twin" -- because it's an asteroid binary system that consists of two bodies: Didymos A, about 780 meters in size, and a smaller asteroid orbiting it called Didymos B, about 160 meters in size.

#### 42. Correct Answer: (c)

##### YUVIKA Programme

- YUva Vigyani KAryakram, a "Young Scientist Programme" has been launched by the Indian Space Research Organisation (ISRO) in 2019 as a special program for School Children in tune with the Government's vision "Jai Vigyan, Jai Anusandhan".
- The Program is primarily aimed at imparting basic knowledge on Space Technology, Space Science and Space Applications to the younger ones with the intent of arousing their interest in the emerging areas of Space activities.
- The program is thus aimed at creating awareness amongst the youngsters who are the future building blocks of our Nation.
- ISRO has chalked out this program to "Catch them young".
- Those who have just completed the 9th standard (in the academic year 2018-19) and waiting to join 10th Std (or just joined 10<sup>th</sup> Std) will be eligible for the online registration.
- The selection is based on the 8th Standard academic performance.

#### 43. Correct Answer: (b)

##### Polar Orbits

- A polar orbit is one in which a satellite passes above or nearly above both poles of the body being orbited (usually a planet such as the Earth) on each revolution.

- These orbits have an inclination near 90 degrees.
- This allows the satellite to see virtually every part of the Earth as the Earth rotates underneath it.

#### **Sun-Synchronous Orbits**

- This orbit is a special case of the polar orbit.
- Like a polar orbit, the satellite travels from the north to the south poles as the Earth turns below it.
- However in a sun-synchronous orbit, satellite after passing over a certain place on Earth, the next day it will again pass over the same place at the same time of day.

#### **44. Correct Answer: (b)**

##### **Space Terminology**

- Eclipse: An event that occurs when the shadow of a planet or moon falls upon a second body.
- A solar eclipse occurs when the Moon's shadow falls upon Earth, which we see as the Moon blocking the Sun.
- When Earth's shadow falls upon the Moon, it causes a lunar eclipse.
- Apogee: It is a point on the orbit where the vertical distance of the satellite from the Earth's surface is maximum.
- Perigee: It is a point on the orbit where the vertical distance of the satellite from the Earth's surface is smallest.
- Sunspot: A temporary dark blemish on the surface of the Sun that is a planet-size region of the gas cooler than its surroundings.

#### **45. Correct Answer: (d)**

##### **Antrix and ISRO**

- Antrix Corporation Limited (Antrix), incorporated on 28 September 1992 (under the Companies Act, 1956), is a wholly-owned Government of India Company under the administrative control of the Department of Space (DOS).

- Antrix is the commercial arm of the Indian Space Research Organisation (ISRO).
- In the year 2008, the Company was awarded 'MINI RATNA' status.

The current business activities of Antrix include:

- Provisioning of communication satellite transponders to various users,
- Providing launch services for customer satellites,
- Marketing of data from Indian and foreign remote sensing satellites,
- Building and marketing of satellites as well as satellite sub-systems,
- Establishing the ground infrastructure for space applications, and
- Mission support services for satellites.

#### **46. Correct Answer: (a)**

##### **Project RAMA**

- NASA in 2018 announced to give funds to a California-based 3D printing company for finding ways to turn asteroids into giant, autonomous spacecraft, which could fly to outposts in space, the media reported.
- Made In Space's project, known as RAMA (Reconstituting Asteroids into Mechanical Automata), aims for finding ways to turn asteroids into giant, autonomous spacecraft, which could fly to outposts in space.
- The project aims to enable asteroid rendezvous missions in which a set of technically simple robotic processes convert asteroid elements into very basic versions of spacecraft subsystems (GNC, Propulsion, Avionics).

#### **47. Correct Answer: (b)**

##### **Pinaka Rocket System**

- Pinaka is a multibarrel rocket launch (MBRL) system used by the Indian Army.
- It was developed by the Defence Research and Development Organisation (DRDO).
- Pinaka Mark-II, an upgraded version of the Pinaka rocket, with enhanced range and guidance system, was successfully

test-fired from Chandipur in Odisha in 2018.

- The earlier Pinaka-I system, which was an unguided one, has now been transformed into a guided version, with a navigation, guidance and control kit developed by the Research Centre Imarat (RCI), Hyderabad.
- Research Centre Imarat (RCI) is a premier DRDO laboratory located in Hyderabad.
- The conversion helped in enhancing the range and accuracy of Pinaka Mark-II from earlier 40 km to 70 km.

**48. 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.
- T 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.

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

**ASTROSAT**

- ASTROSAT is India's first dedicated multiwavelength space observatory.
- This scientific satellite mission endeavours for a more detailed understanding of our universe.

- One of the unique features of the ASTROSAT mission is that enables the simultaneous multi-wavelength observations of various astronomical objects with a single satellite.

The scientific objectives of ASTROSAT mission are:

- To understand high energy processes in binary star systems containing neutron stars and black holes
- Estimate magnetic fields of neutron stars
- Study star birth regions and high energy processes in star systems lying beyond our galaxy
- Detect new briefly bright X-ray sources in the sky
- Perform a limited deep field survey of the Universe in the Ultraviolet region

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

**Goldilocks Zone**

- It refers to a habitable zone in the planetary system where the temperature is neither too high nor too low.
- The habitable zone (or "Goldilocks zone") is the range of orbital distances from a star at which liquid water can exist on the surface of a planet.
- This range of distances changes depending on the size and temperature of the star.

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

**Indian AWACS**

- Airborne Warning and Control System (AWACS) is a mobile, long-range radar surveillance and control centre for air defence.
- Armed with deep penetration and long-range radars, AWACS control the battle theatre in times of hostilities by providing advance information about the movement of air assets of the adversary as well as directing air defence to prevent any breach of home air space.
- IAF has three Israeli built PHALCON AWACS and two more DRDO built early warning systems mounted on an Embraer jet platform.

- The DRDO Airborne Early Warning and Control System (AEW&CS) is a project of India's Defence Research and Development Organisation to develop an airborne early warning and control system for the Indian Air Force.
- It is also referred to as 'NETRA' Airborne Early Warning and Control System (AEW&CS).
- It was this NETRA aircraft that was flying well inside Indian airspace while it was providing surveillance and radar coverage for the "nonmilitary pre-emptive action" carried out by the Mirage jets in the IAF Balakot strike on February 26th, 2019.

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

**Deep-submergence Rescue Vehicles**

- Deep-submergence rescue vehicles (DSRVs) are small submarines that are specially designed to dive to greater depths than most military submarines and rescue stranded crews in the event of an emergency.
- In December 2018, the Indian Navy had inducted two DSRVs. INS Astradharani
- Indian Navy's first totally indigenously designed and built torpedo launch and recovery vessel INS Astradharani was commissioned into service in 2015.
- It is an advanced replacement for Astravahini which was decommissioned on July 17, 2015.

**53. Correct Answer: (a)**

**Air Defence System of India**

- Akash mid-range surface-to-air missile (SAM) system: Built by DRDO, it is a medium-range nuclear-capable supersonic missile.
- The missile system can target aircraft up to 30 km away, at altitudes up to 18,000 meters.
- It is in operational service with the Indian Army and the Indian Air Force.

- Prithvi Air Defence (PAD): PAD is a two stage missile based on the Prithvi missile.
- It is designed for engaging targets in the exo-atmosphere region at altitude 50 km of the earth's atmosphere. It is guided by a high-accuracy Inertial Navigation System (INS) supported by the Redundant Micro Navigation System for estimating the point of interception.
- The system has been tested with a maximum interception altitude of 80 km and has been designed to neutralize missiles within a range of 300-2000 km up to a speed of Mach 5.0.
- S-400 Triumf: India is set to purchase S-400 Triumf air defense missile systems from Russia.
- S-400 Triumf is one of the world's most advanced air defense systems that can simultaneously track numerous incoming objects - all kinds of aircraft, missiles, an UAVs - in a radius of a few hundred kilometer and launch appropriate missiles to neutralize them.

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

**Integrated Guided Missile Development Programme**

- The Integrated Guided Missile Development Programme (IGMDP) was conceived by Dr. A P J Abdul Kalam to enable India to attain selfsufficiency in the field of missile technology.
- Keeping in mind the requirements of various types of missiles by the defence forces, the team recommended the development of five missile systems.
- The missiles developed under the programme were:  
Short-range surface to surface ballistic missile Prithvi Intermediate-range surface to surface ballistic missile Agni Short-range low-level surface to air missile Trishul Medium range surface to air missile Akash 3rd generation anti-tank missile Nag

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

**DRDO Achievements**

- Light Combat Aircraft (LCA) 'Tejas': It is an Indigenously developed having advanced technology, single-seat, single-engine, supersonic, lightweight, all-weather, multirole, air superiority fighter designed for air-to-air, air-to-ground and air-to-sea combat roles.
- Medium Altitude Long Endurance UAV 'Rustom-II': Rustom-II, a multi-mission Unmanned Aerial Vehicle (UAV) is being developed to carry out the intelligence, surveillance, and reconnaissance (ISR) roles for the three Armed Forces with an endurance of 24 hours.
- 'Akash': It is a medium-range surface-to-air missile.

#### **Long Range Surface-to-Air Missile**

- (LRSAM): LRSAM is a joint development programme of DRDO, Indian Navy and Israel Aerospace Industries (IAI), Israel.
- The missiles are intended to equip three guided-missile destroyers of the Indian Navy.

#### **Medium-Range Surface-to-Air Missile**

- (MRSAM): MRSAM is being developed for the IAF for protecting our territory and ground forces from air attacks by intercepting aerial targets like fighter aircraft and guided weapons.
- The system is jointly developed by DRDO, IAF and IAI, Israel.

#### **56. Correct Answer: (b)**

##### **Project 75I**

- Project 75 India (P75I), envisages the construction of six conventional submarines with better sensors and weapons and the Air Independent Propulsion System (AIP).
- The project has been cleared under the strategic partnership model.
- Under the strategic partnership model, an Indian shipyard will be selected by the government, which will also nominate the foreign original equipment manufacturer (OEM) under the overall arch of 'Make in India'.
- Project 75 is an agreement between Mazagon Dock Shipbuilders Ltd. (MDL)

and French defence conglomerate Naval Group (formerly DCNS) for making six Scorpene-class submarines under a transfer of technology arrangement. So far only INS Kalvari and INS Khanderi have been inducted into Navy's fleet.

- While two more – INS Karanjand INS Vela – are undergoing sea trials.
- The P75I project is part of a 30-year submarine building plan that ends in 2030.

#### **57. Correct Answer: (a)**

##### **ICGS Vijaya**

- ICGS Vijaya is the indigenously built patrol vessel and second in the series of 98 m offshore patrol vessels (OPVs) commissioned in 2018 by the Indian Coast Guard.
- It is designed and built indigenously by Larsen & Toubro (L&T).
- The vessel is fitted with advanced technology navigation and communication equipment and sensors.
- It is capable of carrying limited pollution response equipment to contain an oil spill in the sea.
- It can carry one twin-engine helicopter and four high-speed boats, including two inflatable boats for boarding.
- It will be deployed extensively for Exclusive Economic Zone surveillance and will be based at Paradip, Odisha.

##### **SAMUDRIKA Program**

- SAMUDRIKA is a program of DRDO that aims to design and indigenously develop a family of Seven Electronic Warfare Systems to meet the requirements of Navy for different platforms viz., Ships, Helicopters, and Aircraft.
- Electronic warfare uses focused energy, usually radio waves or laser light, to confuse or disable an enemy's electronics and deny the opponent the advantage of, and ensure friendly unimpeded access to, the Electromagnetic spectrum.

- Seven Electronic Warfare systems are grouped under two projects namely Ship-Borne projects & Air-Borne Projects.
- Ship-borne systems are SHAKTI, NAYAN, and TUSHAR.
- Air-Borne systems are SARANG, SARAKSHI, SARVADHARI, and NIKASH.

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

**iDEX**

- Government of India's initiative 'Innovations for Defence Excellence (iDEX)' (launched in April 2018) primarily aims at creation of an ecosystem to foster innovation and technology development in Defence and Aerospace by engaging Industries including MSMEs, startups, individual innovators, R&D institutes & academia, and provide them grants/funding and other support to carry out R&D which has good potential for future adoption for Indian defence and aerospace needs.
- iDEX will be funded and managed by a 'Defence Innovation Organization (DIO)' which has been formed as a 'not for profit' company as per Section 8 of the Companies Act 2013 for this purpose, by the two founder members i.e. Defence Public Sector Undertakings (DPSUs) - Hindustan Aeronautics Limited (HAL) and Bharat Electronics Limited (BEL).
- iDEX will function as the executive arm of DIO, carrying out all the required activities while DIO will provide high-level policy guidance to iDEX.

**59. Correct Answer: (b)**

**Smart Border Management**

- Comprehensive Integrated Border Management System (CIBMS) involves the deployment of a range of state-of-the-art surveillance technologies ranging from thermal imagers, infra-red and laser-based intruder alarms to fiber-optic sensors and a command and control system that shall receive data from all surveillance devices in real-time.

- Implementation of CIBMS projects is to be carried on Indo - Pakistan, and Indo - Bangladesh border to enhance the capabilities of the Border Security Force (BSF).

**60. Correct Answer: (b)**

- Statement 1 is incorrect: The Anti-satellite mission (ASAT) mission was conducted by DRDO.

Supplementary notes:

**Mission Shakti**

- Defense Research and Development Organisation (DRDO) successfully conducted an Anti-Satellite (A-SAT) missile test in March 2019 'Mission Shakti' from the Dr. AP J Abdul Kalam Island in Odisha.
- A DRDO-developed Ballistic Missile Defence (BMD) Interceptor Missile successfully engaged an Indian orbiting target satellite in Low Earth Orbit (LEO) in a 'Hit to Kill' mode.
- The test has demonstrated the Nation's capability to defend its assets in outer space.
- This makes India the fourth nation to possess and test- anti-satellite capability, behind the U.S., Russia, and China.
- The technology is aimed at destroying, if necessary, satellites owned by enemy countries.

**61. Correct Answer: (b)**

**Types of Diseases**

**Congenital diseases:**

- Congenital anomalies are also known as birth defects, congenital disorders or congenital malformations.
- Congenital anomalies can be defined as structural or functional anomalies (for example, metabolic disorders) that occur during intrauterine life and can be identified prenatally, at birth, or sometimes may only be detected later in infancy, such as hearing defects.
- In simple terms, congenital refers to the existence at or before birth.

- Congenital disorders can be due to fault in the chromosome structure or damage inflicted on the developing embryo.
- **Non-Communicable Diseases:**
- Non-communicable diseases (NCDs), also known as chronic diseases, tend to be of long duration and are the result of a combination of genetic, physiological, environmental and behavioral factors.
- The main types of NCDs are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease and asthma) and diabetes.

#### 62. Correct Answer: (b)

##### **Genetic Engineering Appraisal Committee (GEAC)**

- The Genetic Engineering Appraisal Committee (GEAC) functions in the Ministry of Environment, Forest and Climate Change (MoEF&CC).
- As per Rules, 1989, it is responsible for the appraisal of activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle.
- The committee is also responsible for the appraisal of proposals relating to the release of genetically engineered (GE) organisms and products into the environment including experimental field trials.
- GEAC is chaired by the Special Secretary/ Additional Secretary of MoEF&CC and co-chaired by a representative from the Department of Biotechnology (DBT).
- Presently, it has 24 members and meets every month to review the applications in the areas indicated above.  
The functions of GEAC as prescribed in the Rules 1989 are as follows:
  - To appraise activities involving large scale use of hazardous microorganisms and recombinants in research and industrial production from the environmental angle.

- To appraise proposals relating to the release of genetically engineered organisms and products into the environment including experimental field trials.
- The committee or any persons authorized by it has powers to take punitive action under the Environment Protection Act.

#### 63. Correct Answer: (b)

##### **Food Safety and Standards (Fortification of Foods) Regulations, 2018**

##### **As per these rules:**

- The fortification of staples is not compulsory.
- The fortification of the products and use of the +F logo is allowed to FBO only if the enrichment of the food is done according to the standards laid under it.
- Adding iodine to commercial salt is mandatory in India.
- Whenever the food articles standards stated under 'Food Safety and Standards Regulations' instructs for adding specific minerals or vitamins as an obligatory demand of that particular standard, the same shall comply, but the +F logo shall not be used.
- New standards now provide a minimum and a maxima range for the fortification of staples like wheat flour, maida, rice, salt, vegetable oil and milk.
- The dosage of the micronutrients has been adjusted so that they provide 30 to 50 percent of the daily requirements.

#### 64. Correct Answer: (c)

##### **Active and Passive Immunity**

- When a host is exposed to antigens, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body.
- This type of immunity is called active immunity.
- Active immunity is slow and takes time to give its full effective response.
- Injecting the microbes deliberately during immunization or infectious organisms

gaining access into body during natural infection induce active immunity.

- When ready-made antibodies are directly given to protect the body against foreign agents, it is called passive immunity.
- The yellowish fluid colostrum secreted by mother during the initial days of lactation has abundant antibodies (IgA) to protect the infant.
- The foetus also receives some antibodies from their mother, through the placenta during pregnancy.
- These are some examples of passive immunity.

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

**Industrial genetics**

- Industrial genetics means mass-scale production of desired species of plants and animals.
- This field includes activities such as animal breeding, cattle breeding.
- Dairying is an example of industrial genetics.
- For this industrial genetics, cells of the organisms are transformed with a gene coding for a useful protein, such as an enzyme.
- This desired protein is then overexpressed in the organism.
- Mass quantities of the protein can then be manufactured by growing the transformed organism in bioreactor equipment using industrial fermentation and then purifying the protein.
- This transformation of organisms can be done in bacteria, yeast, insect cells and mammals.
- This transformation technique is used to produce medicines such as insulin, human growth hormone, vaccines, supplements (such as tryptophan), aid in the production of food (chymosin in cheese making) and fuels.
- Other applications are making biofuels, cleaning up oil spills, carbon and other toxic waste and detecting arsenic in drinking water, biomining and bioremediation (due to their ability to

extract heavy metals from their environment and incorporate them into compounds that are more easily recoverable).

**66. Correct Answer: (a)**

- A microbial fuel cell (MFC) is a bioelectrochemical device that harnesses the power of respiring microbes to convert organic substrates directly into electrical energy.
- It transforms chemical energy into electricity using oxidation-reduction reactions.
- It relies on living biocatalysts to facilitate the movement of electrons throughout their systems instead of the traditional chemically catalyzed oxidation of fuel at the anode and reduction at the cathode.
- It has various application especially where there is a low power requirement where replacing batteries may be impractical, such as wireless sensor networks, biosensors, etc.

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

**Antimicrobial resistance**

- The Anti-Microbial Resistance (AMR) is the ability of a microbe to resist the effects of medication previously used to treat them.
  - It is also known as antibiotic resistance.
  - The WHO defines antimicrobial resistance as a microorganism's resistance to an antimicrobial drug that was once able to treat an infection by that microorganism.
  - The resistance to antimicrobials is a natural biological phenomenon.
  - It should be noted that it is the microbe that will become resistant to antibiotics and not the person (patient).
  - A person cannot become resistant to antibiotics because the resistance is a property of the microbe, and not by a person or other organism infected by a microbe.
- Reasons for Anti-Microbial Resistance
- The natural resistance in certain types of bacteria.

- The genetic mutation.
- By one species acquiring resistance from another.

**68. Correct Answer: (b)**

**Types of Vaccines**

- Inactivated Vaccines: When inactivated vaccines are made, the bacteria are completely killed using a chemical, usually formaldehyde.
- Dead pieces of disease-causing microorganisms (usually bacteria) are put into the vaccine.
- Because the antigens are dead, the strength of these vaccines tends to wear off over time, resulting in less long-lasting immunity.
- So, multiple doses of inactivated vaccines are usually necessary to provide the best protection.
- They typically provoke more durable immunological responses and are preferred for healthy adults.
- If administered to a person who has an impaired immune system response, e.g. they have leukemia or HIV infection, or are taking immunosuppressing medications; administration of a live attenuated vaccine may cause severe disease as a result of uncontrolled replication (growth) of the vaccine virus. Examples include the viral diseases yellow fever, measles, rubella, and mumps and the bacterial disease typhoid.
- Recombinant Vaccines: The gene segment for a protein from the disease-causing organism that is known to stimulate a protective immune response (protein of interest) is inserted into the gene of another cell, such as a yeast cell.

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

**Embryo Transfer Technology**

- It is a technique of assisted reproduction in which the embryo or zygote is collected from a donor female with higher genetic merit and transferred to a recipient who serves as surrogate for the rest of the pregnancy.

- The technique is being utilized for development and conservation of indigenous breeds through the following programmes:

**Rashtriya Gokul Mission**

- National Mission on Bovine Productivity
- National Dairy Plan-I Breed Improvement Institutes.

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

**Zika Virus**

- Zika virus is primarily transmitted by the bite of an infected mosquito from the Aedes genus, mainly Aedes aegypti, in tropical and subtropical regions.
- Zika virus is also transmitted from mother to fetus during pregnancy, through sexual contact, transfusion of blood and blood products, and organ transplantation.
- Zika virus infection during pregnancy is a cause of microcephaly and other congenital abnormalities in the developing fetus and newborn.
- Zika infection in pregnancy also results in pregnancy complications such as fetal loss, stillbirth, and preterm birth.
- Zika virus infection is also a trigger of Guillain-Barré syndrome, neuropathy and myelitis, particularly in adults and older children.

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

**Fissionable, Fissile and Fertile Nuclear Materials**

- In nuclear engineering, fissionable material (nuclide) is a material that is capable of undergoing fission reaction after absorbing either thermal (slow or low energy) neutron or fast (high energy) neutron.
- Fissile materials undergo fission reaction after absorption of the binding energy of the thermal neutron.
- They do not require additional kinetic energy for fission.
- If the neutron has higher kinetic energy, this energy will be transformed into additional excitation energy of the compound nucleus.

- Fissile materials are thus a subset of fissionable materials as they can be induced to fission with low-energy thermal neutrons with a high probability.
- U-238 is not fissile isotope, because U-238 cannot be fissioned by a thermal neutron.
- Fertile materials consist of isotopes that are not fissionable by thermal neutrons but can be converted into fissile isotopes (after neutron absorption and subsequent nuclear decay).

**72. Correct Answer: (b)**

**Nuclear Fuel Cycle**

- The nuclear fuel cycle is the progression of nuclear fuel from creation to its disposal.  
It typically includes the following stages:
- Uranium recovery to extract Uranium ore and concentrate the ore to produce a Uranium ore concentrates.
- Uranium ore concentrate converted into Uranium hexafluoride.
- Enrichment to increase the concentration of Uranium-235 in Uranium hexafluoride.
- Deconversion to reduce the hazards associated with the depleted Uranium hexafluoride produced in earlier stages of the fuel cycle.
- Fuel fabrication to convert natural and enriched Uranium hexafluoride into UO<sub>2</sub> or Uranium metal alloys for use as fuel for nuclear reactors.
- Use of the fuel in reactors such as nuclear power production, research, or naval propulsion.
- Interim storage of spent nuclear fuel.  
Reprocessing of high-level waste.
- The final disposition of used fuel.
- In the last stage, after getting energy out of the heavy atoms, there must be the disposition of the left-over ones and the dangerously radioactive minor actinides and fission products.
- The most common method of waste disposal is to first ensure that the nuclides are immobilized by putting them in a material with low leachability, good

mechanical strength, and the capability to hold large amounts of waste.

- Then they are placed underground.

**73. Correct Answer: (a)**

**Nuclear Force**

- The force that determines the motion of atomic electrons is the familiar Coulomb force.
- To bind a nucleus together there must be a strong attractive force of a totally different kind which must be strong enough to overcome the repulsion between the (positively charged) protons and to bind both protons and neutrons into the tiny nuclear volume. This force is called the nuclear force.
- The nuclear force is much stronger than the Coulomb force acting between charges or the gravitational forces between masses.
- The nuclear binding force has to dominate over the Coulomb repulsive force between protons inside the nucleus.
- This happens only because the nuclear force is much stronger than the Coulomb force.
- The gravitational force is much weaker than even Coulomb's force.
- The nuclear force between neutron-neutron, proton-neutron, and proton-proton is approximately the same.
- The nuclear force does not depend on the electric charge.

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

**Processing of Nuclear Wastes**

- Nuclear waste must be processed to make it safe for disposal.  
There are three main steps in the processing of nuclear waste:
- Pre-treatment prepares the waste for processing and may include sorting and segregation to separate out contaminated items from non-contaminated ones.
- Sometimes it is necessary to reduce the size of the waste by, for example, cutting or shredding it to optimize its downstream processing.

- Once the waste is suitably prepared, the next step is a treatment to enhance its safety and reduce the costs of further management phases, such as storage or disposal.
- Two common treatment techniques are incineration of solid waste and evaporation of liquid waste.
- The third step in the process – conditioning – brings the waste into a safe, stable and manageable form so it can be transported, stored and disposed of. Conditioning techniques are designed to slow the release of radionuclides from the disposed waste package into the environment.

**75. Correct Answer: (a)**

**Radiation**

- Radiation is energy given off by matter in the form of rays or high-speed particles.
- Radiation can be either ionizing or nonionizing, depending on how it affects matter.
- Non-ionizing radiation includes visible light, heat, radar, microwaves, and radio waves.
- This type of radiation deposits energy in the materials through which it passes, but it does not have sufficient energy to break molecular bonds or remove electrons from atoms.
- The longer wavelength, lower frequency waves (heat and radio) have less energy than the shorter wavelength, higher frequency waves (X and gamma rays).
- Not all electromagnetic(EM) radiation is ionizing.
- Only the highfrequency portion of the electromagnetic spectrum which includes X rays and gamma rays is ionizing.
- The neutron is an indirect ionizing particle. It is indirectly ionizing because it does not carry an electrical charge.
- Ionization is caused by charged particles, which are produced during collisions with atomic nuclei.
- The third type of ionizing radiation includes gamma and X-rays, which are

electromagnetic, indirectly ionizing radiation.

- These are indirectly ionizing because they are electrically neutral (as are all electromagnetic radiations) and do not interact with atomic electrons through columbic forces.

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

**Alpha Decay**

- When a nucleus undergoes alpha-decay, it transforms into a different nucleus by emitting an alpha-particle i.e. helium (He) nucleus.
- In this process, it is observed that since He contains two protons and two neutrons, the mass number and the atomic number of the daughter nucleus decreases by four and two, respectively. For e.g. An alpha particle, because it's very heavy and has a very large charge, doesn't go very far at all. This means an alpha particle can't even get through a sheet of paper.
- An alpha particle outside your body won't even penetrate the surface of your skin.

**77. Correct Answer: (a)**

**Beta Decay**

- A nucleus that decays spontaneously by emitting an electron or a positron (a particle with the same mass as electrons, but with a charge exactly opposite to that of the electron) is said to undergo beta decay.
- Like alpha decay, this is a spontaneous process, with definite disintegration energy and half-life. Again like alpha decay, beta decay is a statistical process that obeys the radioactive laws.
- In beta minus decay, an electron is emitted by the nucleus along with an anti-neutrino. For e.g. In beta-minus decay, a neutron transforms into a proton within the nucleus according to the equation  
In beta plus decay, a positron is emitted by the nucleus along with a neutrino. For e.g. In beta-plus decay, a proton

transforms into a neutron (inside the nucleus) via These processes show why the mass number A of a nuclide undergoing beta decay does not change; one of its constituent nucleons simply changes its character.

- Neutrinos and anti-neutrinos both are neutral particles, with very little or no mass.
- Neutrinos interact only very weakly with matter; they can even penetrate the earth without being absorbed. It is for this reason that their detection is extremely difficult and their presence went unnoticed for long.

#### 78. Correct Answer: (c)

##### Gamma Decay

- Gamma rays are electromagnetic radiations that carry no mass or charge unlike other radiations.
- The amount of energy can range from very low, like in dental x-rays, to the very high levels seen in irradiators used to sterilize medical equipment.
- Gamma rays can penetrate through the body.
- This is why they are useful in medicine—to show whether bones are broken or where there is tooth decay, or to locate a tumor.
- Shielding with dense materials like concrete and lead is used to avoid exposing sensitive internal organs or the people who may be working with this type of radiation.
- Despite their ability to penetrate other materials, in general, gamma rays do not have the ability to make anything radioactive.

#### 79. Correct Answer: (b)

##### Carbon Dating

- Radiocarbon dating is a method that provides objective age estimates for carbonbased materials that originated from living organisms.

- Radiocarbon, or carbon 14, is an isotope of the element carbon that is unstable and weakly radioactive.
- The stable isotopes are carbon 12 and carbon 13.
- Carbon 14 is continually being formed in the upper atmosphere by the effect of cosmic ray neutrons on nitrogen 14 atoms.
- It is rapidly oxidized in air to form carbon dioxide and enters the global carbon cycle.
- Radiocarbon dating is essentially a method designed to measure residual radioactivity.
- Not all materials can be radiocarbon dated.
- Most, if not all, organic compounds can be dated.
- Some inorganic matter, like a shell's aragonite component, can also be dated as long as the mineral's formation involved assimilation of carbon 14 in equilibrium with the atmosphere.

#### 80. Correct Answer: (d)

##### Disadvantages of Nuclear Energy

- Nuclear Radiation Accidents: Nuclear Disasters like Chernobyl and Fukushima pose a great threat to humans and the environment.
- Radioactive Wastes: Although nuclear energy does not produce CO<sub>2</sub> the way fossil fuels do, there is still a toxic byproduct produced from uranium-fueled nuclear cycles: radioactive fission waste.
- High Initial Capital Costs: Another practical disadvantage of using nuclear energy is that it needs a lot of investment to set up a nuclear power station.
- Constructing a nuclear power plant requires massive capital outlay.
- Although the fuel cost to produce power using nuclear energy is relatively low, there is still the necessity of having highly skilled workers to build, maintain and monitor the operations to ensure the safety and process of the plant.

- Thermal Pollution: Local thermal pollution from wastewater affects aquatic life.
- Terrorist Threat: Nuclear power plants could also be ideal targets for terrorists due to the fissile plutonium components of the waste, which could be reused as bomb fuel.
- Also, a terrorist attack on a large reactor would cause a widespread radiation catastrophe at a scale similar to Chernobyl.
- Non-Renewable Energy Source: The raw material for the generation of nuclear energy is uranium.
- Uranium is mined, which means it's not available in many countries. It's also a scarce resource. Most countries export this mineral for nuclear energy production.
- Once uranium is completely extracted, there will be no nuclear energy production.
- Subsequently "Apsara", the first research reactor in Asia became operational in the Trombay campus of Bhabha Atomic Research Centre in August 1954. After providing more than five decades of dedicated service to the researchers, the reactor was shut down in 2009.
- Nearly sixty-two years after Apsara came into existence, a swimming pool type research reactor "Apsara-upgraded", of higher capacity was made at Trombay.
- The reactor, made indigenously, uses plate type dispersion fuel elements made of Low Enriched Uranium (LEU). By virtue of higher neutron flux, this reactor will increase indigenous production of radio-isotopes for medical applications by about fifty percent and would also be extensively used for research in nuclear physics, material science, and radiation shielding.
- This development has reemphasized the capability of Indian scientists and engineers to build, complex facilities for health care, science education and research.

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

**National Physical Laboratory**

- The National Physical Laboratory is the National Metrology Institute of India and a Premier Research Laboratory in the field of Physical Sciences.
- The National Physical Laboratory was conceptualized in 1943 by the Governing Body of Council of Scientific and Industrial Research (CSIR), with a view to pave way for using science and technology as a means for industrial growth and development, as well as to give a fillip to the fledgling Indian industry.
- Jawaharlal Nehru, the then Prime Minister of India, laid the foundation stone for the laboratory on January 4, 1947.

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

**Apsara-U**

- Research reactors are the back bone of Nuclear Programme" said Dr. Homi J. Bhabha, the father of the Indian Nuclear programme, in the early fifties.

**83. Correct Answer: (a)**

**Cold Fusion**

- Cold Fusion is a hypothesized type of nuclear reaction that would occur at, or near, room temperature in contrast to the normal nuclear fusion reactions that require high temperatures and immense pressure.
- Cold fusion seeks to produce nuclear energy without harmful radiation, complex equipment and the application of very high temperatures and pressures.
- But it has no conclusive theory explaining it and flies in the face of a well-established physics law that goes against the easy fusion of nuclei.
- There is no guarantee that every time a cold fusion or LENR experiment is done, energy will be produced, say critics.
- Low energy nuclear reaction (LENR) is regarded as the successor of the cold fusion.

**84. Correct Answer: (a)**

**Thorium Reactors**

- Thorium reactors are based on the thorium fuel cycle and use thorium 232 as a fertile material. During the fuel burning, thorium-232 transforms into a fissile U-233
- Unlike uranium, thorium alone cannot be directly used as nuclear fuel in a reactor because natural thorium contains only trace amounts of fissile material (such as thorium 231), which are insufficient to initiate and sustain a nuclear chain reaction. Therefore, an additional fissile material is necessary to initiate the fuel cycle.
- The thorium fuel cycle offers several potential advantages over a uranium fuel cycle, including thorium's greater abundance, better physical and nuclear properties, reduced plutonium (transuranic element) production, and better resistance to nuclear weapons proliferation when used in traditional light water reactors.

**85. Correct Answer: (a)**

**Treaty on Prohibition of Nuclear Weapons (TPNW)**

- The General Assembly decided to convene in 2017 a United Nations conference to negotiate a legally binding instrument to prohibit nuclear weapons, leading towards their total elimination.
- The Assembly encouraged all Member States to participate in the Conference, with the participation and contribution of international organizations and civil society representatives.
- TPNW includes a comprehensive set of prohibitions on participating in any nuclear weapon activities.
- These include undertakings not to develop, test, produce, acquire, possess, stockpile, use or threaten to use nuclear weapons.
- The Treaty also prohibits the deployment of nuclear weapons on national territory

and the provision of assistance to any State in the conduct of prohibited activities.

- States parties will be obliged to prevent and suppress any activity prohibited under the TPNW undertaken by persons or on territory under its jurisdiction or control.
- The Treaty also obliges States parties to provide adequate assistance to individuals affected by the use or testing of nuclear weapons, as well as to take necessary and appropriate measure of environmental remediation in areas under its jurisdiction or control contaminated as a result of activities related to the testing or use of nuclear weapons.
- The nine countries generally recognized as possessing nuclear weapons—the U.S., Russia, Britain, China, France, India, Pakistan, North Korea, and Israel—were noticeably absent from the negotiations, as were most members of NATO.

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

**Atomic Energy Regulatory Board**

- The Atomic Energy Regulatory Board was constituted on November 15, 1983, by the President of India by exercising the powers conferred by the Atomic Energy Act, 1962 to carry out certain regulatory and safety functions under the Act.
- The regulatory authority of AERB is derived from the rules and notifications promulgated under the Atomic Energy Act and the Environment (Protection) Act, 1986.
- The mission of the AERB is to ensure the use of ionizing radiation and nuclear energy in India does not cause undue risk to the health of people and the environment.
- The Board shall consist of full time and parttime members.
- The Board shall have a full-time Chairman and a full-time Member-Secretary.
- The total number of members including the Chairman and Member-Secretary shall not exceed five.

- The Board shall be responsible for the Atomic Energy Commission.
- **Atomic Energy Commission**
- The Indian Atomic Energy Commission was the first set up in August 1948 in the Department of Scientific Research, which was created a few months earlier in June 1948.
- The Department of Atomic Energy (DAE) was set up on August 3, 1954, under the direct charge of the Prime Minister through a Presidential Order.
- Subsequently, in accordance with a Government Resolution dated March 1, 1958, the Atomic Energy Commission (AEC) was established in the Department of Atomic Energy.
- According to the Resolution constituting the AEC, the Secretary to the Government of India in the Department of Atomic Energy is ex-officio Chairman of the Commission.
- The other members of the AEC are appointed for each calendar year on the recommendation of the Chairman, AEC and after approval by the Prime Minister.

#### **Department of Atomic Energy**

- The Department of Atomic Energy (DAE) came into being on August 3, 1954, under the direct charge of the Prime Minister through a Presidential Order.
- DAE has been engaged in the development of nuclear power technology, applications of radiation technologies in the fields of agriculture, medicine, industry and basic research.
- DAE comprises five research centers, three industrial organizations, five public sector undertakings, and three service organizations.
- It has under its aegis two boards for promoting and funding extra-mural research in nuclear and allied fields, mathematics and a national institute (deemed university).

**87. Correct Answer: (c)**  
**Monazite Reserves in India**

- Two agencies, viz., Atomic Minerals Directorate for Exploration and Research (AMD) and Uranium Corporation of India Limited (UCIL) under the Department of Atomic Energy are engaged in the exploration and mining of uranium, respectively for its exclusive use as fuel in the nuclear power stations owned by Government of India.
- The Atomic Minerals Directorate for Exploration and Research (AMD), a constituent unit of Department of Atomic Energy (DAE), has so far established 11.93 million tons of in situ resources Monazite (Thorium bearing mineral) in the country, which contains about 1.07 million tons of thorium.
- The state-wise resources of in situ monazites established by AMD as of September 2014 are as follows:

State	Monazite (Million Tons)
Odisha	2.41
Andhra Pradesh	3.72
Tamil Nadu	2.46
Kerala	1.90
West Bengal	1.22
Jharkhand	0.22
Total	11.93

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

#### **History of Nuclear Power Plants**

- Electricity was generated by a nuclear reactor for the first time ever on September 3, 1948, at the X-10 Graphite Reactor in Oak Ridge, Tennessee in the United States, and was the first nuclear power plant to power a light bulb.
- The second, larger experiment occurred on December 20, 1951, at the EBR-I experimental station near Arco, Idaho in the United States.
- On June 27, 1954, the world's first nuclear power plant to generate electricity for a power grid started operations at the Soviet city of Obninsk.

- The world's first full-scale power station, Calder Hall in England opened on October 17, 1956
- The first full-scale power station with a PWR type reactor was a Shipping port Atomic Power Station, commissioned on May 26, 1958.

**89. Correct Answer: (a)**

**Nuclear Suppliers Group (NSG)**

- The Nuclear Suppliers Group (NSG) is a group of nuclear supplier countries that seeks to contribute to the non-proliferation of nuclear weapons through the implementation of two sets of Guidelines for nuclear exports and nuclear-related exports.
- The Nuclear Suppliers Group (NSG) was created following the explosion in 1974 of a nuclear device by a non-nuclear-weapon State, which demonstrated that nuclear technology transferred for peaceful purposes could be misused.
- The NSG Guidelines were published in 1978 by the International Atomic Energy Agency (IAEA) to apply to nuclear transfers for peaceful purposes to help ensure that such transfers would not be diverted to an unsafeguarded nuclear fuel cycle or nuclear explosive activities.
- In 1992, the NSG decided to establish Guidelines for transfers of nuclear-related dual-use equipment, material, and technology (items which have both nuclear and nonnuclear applications), which could make a significant contribution to an unsafeguarded nuclear fuel cycle or nuclear explosive activity.
- NSG members are not required to be parties to the NPT, but they all must adhere to instruments that contain equally binding commitments. The NSG Guidelines are designed to strengthen implementation of the non-proliferation undertakings contained in those legal instruments.

**90. Correct Answer: (b)**

**Indian Nuclear Facilities under IAEA**

**Safeguards:**

- The government of India has decided to place four more nuclear reactors under the IAEA safeguards.
- The four reactors will include two Russian designed Pressurized Light Water Reactors and two Pressurized Heavy Water Reactors built with Indian technology.
- With the addition of four new nuclear reactors, a total of 26 Indian nuclear facilities will be under IAEA, the nuclear energy watchdog.
- These reactors are eligible to import uranium to generate nuclear energy for civilian purposes.
- As India is not a party to the Non Proliferation Treaty (NPT), it has classified its nuclear facilities into two types under Separation Plan:
  - Unsafeguarded- where domestic uranium can be used anywhere India wants.
  - Safeguarded- where imported uranium would be used for civilian nuclear energy.
- Since India's use of domestic uranium could not anyway be restricted, this was seen as a balance between the benefits of nuclear energy in emission reduction and the risks of increasing India's military capability.
- A special set of India-specific safeguards, negotiated with the International Atomic Energy Agency (IAEA), a UN body, ensures that imported uranium was not diverted for military use.
- New reactor plants established with foreign collaboration are automatically placed under the IAEA safeguards.

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

**Nano India Mission**

- The Government of India launched the Nano Mission in May 2007 as an "umbrella capacity building program".
- It envisages the overall development of Nanotechnology in the country and taps some of its applied potential for a nation's development.

The objectives of the Nano-Mission include:

- Basic Research Promotion: Funding of basic research by individual scientists and/or groups of scientists and the creation of centers of excellence for pursuing studies related to the Nanoscale.
- Infrastructure Development for Nano Science & Technology Research: It focuses on facility development for technologies like Optical Tweezers, Nano Indenter, Transmission Electron Microscope (TEM), Atomic Force Microscope (AFM), Scanning Tunneling Microscope (STM), Microarray Spotter & Scanner, etc.
- Nano Applications and Technology Development Programmes: The Mission proposes to promote application-oriented R&D Projects, establish Nano Applications and Technology Development Centers, Nano-Technology Business Incubators.
- Human Resource Development: The Mission focuses on providing effective education and training to researchers and professionals in diversified fields so that a genuine interdisciplinary culture for nanoscale science, engineering and technology can emerge.
- International Collaborations: Apart from exploratory visits of scientists, organization of joint workshops and conferences and joint research projects, it focuses to facilitate access to sophisticated research facilities abroad, establish joint centers of excellence and forge academia industry partnerships at the international level wherever required and desirable.

**92. Correct Answer: (a)**

**Carbon Nanotubes**

- Carbon nanotubes (CNTs) are cylindrical molecules that consist of rolled-up sheets of single-layer carbon atoms (graphene).
- Carbon nanotubes are composed of carbon atoms linked in hexagonal shapes, with each carbon atom covalently bonded to three other carbon atoms.

- They can be single-walled with a diameter of less than 1 nanometre (nm) or multiwalled, consisting of several concentrically interlinked nanotubes, with diameters reaching more than 100 nm.
- Carbon Nanotubes are stronger than steel wires and have high thermal and electrical conductivity.
- They are very elastic and have very high tensile strength.
- Carbon nanotubes have the highest strength-to-weight ratio of any known material.
- Carbon nanotubes have the potential to be used as semiconductors, for example, potentially replacing silicon in a wide variety of computing devices.

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

**Buckyball**

- Buckyball or Buckminsterfullerene is a type of fullerene with the formula C<sub>60</sub>.
- It has a cage-like fused-ring structure that resembles a soccer ball, made of twenty hexagons and twelve pentagons.
- It was one of the first nanoparticles discovered in 1985 by a trio of researchers working out of Rice University named Richard Smalley, Harry Kroto, and Robert Curl.
- Buckyballs are composed of carbon atoms linked to three other carbon atoms by covalent bonds.
- The covalent bonds between carbon atoms make buckyballs very strong, and the carbon atoms readily form covalent bonds with a variety of other atoms.
- Buckyballs are used in composites to strengthen the material.
- Buckyballs have the electrical property of being very good electron acceptors. This feature is useful, for example, in increasing the efficiency of solar cells in transforming sunlight into electricity.

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

**Nano fabrics**

- Nano fabrics are textiles embedded with small nanoparticles to give ordinary materials advantageous properties such as the Lotus effect, odor and moisture elimination and even bacterial resistance.
- The lotus effect refers to self-cleaning properties that are a result of water repellent properties as exhibited by the leaves of a lotus flower.
- It is done by a technique known as Nano finishing which includes coating the surface of textiles and clothing with nanoparticles.
- Zinc oxide nanoparticles embedded in polymer matrices like soluble starch are a good example of functional nanostructures with potential for applications such as UV protection ability in textiles and sunscreens.
- Nano-silver coating provides antimicrobial properties to the fabric.
- Nano fabrics can also be used for the delivery of drugs such as antibiotics, anticancer drugs etc in precise quantities.
- It can be done by Electrospinning that creates porous nano fabrics that can be loaded with the desired drug and the drug passes through the skin tissue by the diffusion process.

**95. Correct Answer: (a)**

**Properties of Nanomaterial**

- The properties of nanomaterials differ from the same materials present in the bulk stage i.e. materials exhibit different properties on size reduction. This happens because:
  - Electromagnetic forces on size reduction become disproportionately predominant over the force of gravity acting on the particles.
  - On size reduction, the surface to volume ratio increases and the rules of Quantum mechanics start controlling the behaviour of particles instead of laws of Newtonian mechanics.
  - In terms of physical properties, the strength of substance increases while the melting point and boiling point would

decrease on size reduction. This is the reason why graphite is soft while graphene becomes the strongest material.

- The chemical reactivity of the substances increases drastically on nanotransformation. For example Aluminium in its bulk form is stable but it becomes explosive when transformed to the nanoparticle.

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

**Sona 1.5 Robot**

- Raebareli railway coach factory is set to be modernized with the introduction of humanoid robot 'Sona 1.5' to transport documents and greet visitors.
- A humanoid robot 'Sona 1.5' is a full-service robot made in India which can be used to transport documents from one place to another in the modern railway coach factory.
- The humanoid robot 'Sona 1.5' was built by Najavunjpavad Jaipur.
- It is the first robot in the world with humanlike spine technology due to which they are able to balance.
- The most important thing about this robot is that it has auto docking programming, which allows the auto to go to the charging point itself before the battery is discharged.
- This robot can also function in dark due to high technology sensors like vision, ultrasonic, touch, laser and heat.

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

**Daksh Robot**

- Daksh is an electrically powered Remotely Operated Vehicle (ROV) designed and developed by the Indian state-owned Defence Research and Development Organisation (DRDO) at the Research and Development Establishment Pune, India.
- Primarily designed to recover improvised explosive devices (IEDs), ROV Daksh can safely locate, handle and destroy all types of hazardous objects.
- The DRDO transferred its ROV technology for production to three Pune based firms

namely Dynalog, Theta Controls, and Bharat Electronics.

- Daksh will serve bomb disposal units (BDU) of the army, police and paramilitary forces in handling IEDs and other hazardous materials.
- The Indian Army has the requirement for 100 ROVs.
- ROV Daksh is equipped with multiple cameras, IED handling equipment, nuclear biological chemical (NBC) reconnaissance systems, a master control station (MCS) and a shotgun.
- The ROV Daksh and MCS are transported by a specially designed carrier vehicle.
- Daksh is equipped with a radiation measurement and automatic control unit (RADMAC) and portable gas chromatograph (PGC) to monitor the contamination level in NBC (nuclear, biological, chemical) affected surroundings.

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

**Grey goo**

- Grey goo (also spelled gray goo) is a hypothetical end-of-the-world scenario involving molecular nanotechnology in which out-of-control self-replicating robots consume all biomass on Earth while building more of themselves, a scenario that has been called ecophagy (“eating the environment”, more literally “eating the habitation”).
- The original idea assumed machines were designed to have this capability, while popularizations have assumed that machines might somehow gain this capability by accident.

**99. Correct Answer: (a)**

**GROWTH Robotic Telescope**

- The GROWTH (Global Relay of Observatories Watching Transients Happen) project focuses on three scientific themes in the field of time domain astronomy i.e. cosmic explosions (supernovae), small near-earth asteroids

and the electromagnetic identification of gravitational wave sources.

- GROWTH India Robotic Telescope is a part of this global GROWTH project.
- The telescope is located at the Indian Astronomical Observatory (IAO) at Hanle in Ladakh.
- It is the country’s first robotic telescope and the first one designed to observe dynamic or transient events in the universe.
- The fully robotic optical research telescope is designed to capture cosmic events occurring in timescales much shorter than light years – years, days and even hours. GROWTH India is a joint project of the Bangalore-based Indian Institute of Astrophysics (IIA) and the Indian Institute of Technology Bombay (IITB).
- The project is fully funded by the Science and Engineering Research Board (SERB) of the Department of Science and Technology (DST) under the PIRE project, administered by Indo US Science and Technology Forum.

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

**Centre for Artificial Intelligence and Robotics (CAIR)**

- Centre for Artificial Intelligence and Robotics (CAIR), Bengaluru and Research and Development Establishment (Engineers) {R&DE(E)}, Pune are prime laboratories of Defence Research and Development Organisation (DRDO) working in the area of artificial intelligence and robotics.