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Emerging Technologies *and* **Their Applications**





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- During the Procedure of the examination, Students have to fill the Attendance Sheet also (containing photograph of each student).
- \circ $\,$ Candidates are requested to FILL the OMR using black ball point pen only.
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Prelims PYQ+

Question Booklet

GENERAL STUDIES PYQ PRACTICE TEST (SCIENCE & TECHNOLOGY)

Time Allowed: 40 Min.

Maximum Marks: 50

INSTRUCTIONS

- 1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES *NOT* HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.
- 2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number carefully without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.
- 3. You have to enter your Roll Number on the test booklet in the Box provided alongside. *DO NOT* write anything else on the Test Booklet.

- 4. This Test Booklet contains **25** items (questions). Each item is printed in English. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
- 5. You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.
- 6. All items carry equal marks.
- 7. Before you proceed to mark in the Answer Sheet in response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.
- 8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator **only the Answer Sheet**. You are permitted to take away with you the Test Booklet.
- 9. Sheets for rough work are appended in the Test Booklet at the end.
- 10. Penalty for wrong answers:

THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

- (i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third** of the marks assigned to that question will be deducted as penalty.
- (ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that question.
- (iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no** penalty for that question.

- Consider the following statements: 1.
 - 1. Some microorganisms can grow in environments with temperature above the boiling point of water.
 - 2. Some microorganisms can grow in environments with temperature below the freezing point of water.
 - 3. Some microorganisms can grow in highly acidic environments with a pH below 3.
 - (a) Only one
 - Only two (b)
 - All three (c)
 - (d) None
- 2. Consider the following statements:
 - 1. Ballistic missiles are jet-propelled at subsonic speeds throughout their flights, while cruise missiles are rocket-powred only in the initial phase of flight.
 - 2. Agni-V is a medium-range supersonic cruise missile, while BrahmMos is a solid-fuelled intercontinental ballistic missile.

Which of the statements given above is/are correct?

- (a) 1 only
- 2 only(b)
- Both 1 and 2 (c)
- Neither 1 nor 2 (d)
- Which one of the following countries has its 3. own Satellite Navigation System?
 - Australia (a)
 - (b) Canada
 - (c) Israel
 - (d) Japan
- 4. Consider the following action:
 - 1. Detection of car crash/collision which results in the deployment of airbags almost instantaneously.
 - 2. Detection of accidental free fall of a laptop towards the ground which results in the immediate turning off the hard drive.
 - 3. Detection of the tilt of the smart-phone which results in the rotation of display between portrait and landscape mode.

In how many of the above actions is the function of accelerometer required?

- Only one (a)
- Only two (b)
- All three (c)
- None (d)
- 'Microsatellite DNA' is used in the case of 5. which one of the following?
 - Studying the evolutionary relationships (a) among various species of fauna
 - Stimulating 'stem cells' to transform into (b) diverse functional tissues
 - Promoting clonal of (c) propagation horticultural plants
 - Assessing the efficacy of drugs by (d) conducting series of drug trials in a population
- 'Aerial metagenomics' best refers to which one 6. of the following situations?
 - Collecting DNA samples from air in a (a) habitat at one go
 - Understanding the genetic makeup of (b) avian species of a habitat
 - (c) Using air-borne devices to collect blood samples from moving animals
 - (d) Sending drones to inaccessible areas to collect plant and animal samples from land surfaces and water bodies
- 7. With reference to communication technologies, what is/are the difference/differences between LTE (Long-Term Evolution) and VoLTE (Voice over Long-Term Evolution)?
 - 1. LTE is commonly marketed as 3G and VoLTE is commonly marketed as advanced 3G.
 - 2. LTE is data-only technology and VoLTE is voice-only technology.

Select the correct answer using the code given below:

- (a) 1 only
- (b) 2 only
- Both 1 and 2 (c)
- Neither 1 nor 2 (d)

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- **8.** Consider the following statements :
 - 1. According to the Indian Patents Act, a biological process to create a seed can be patented in India.
 - 2. In India, there is no Intellectual Property Appellate Board.
 - 3. Plant varieties are not eligible to be patented in India.

Which of the statements given above is/are correct?

- (a) 1 and 3 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3
- **9.** In the context of digital technologies for entertainment, consider the following statements:
 - 1. In Augmented Reality (AR), a simulated environment is created and the physical world is completely shut out.
 - 2. In Virtual Reality (VR), images generated from a computer are projected into reallife objects or surroundings.
 - 3. AR allows individuals to be present in the world and improves the experience using the camera of smart-phone or PC.
 - 4. VR closes the world, and transposes an individual, providing complete immersion experience.

Which of the statements given above is/are correct?

- (a) 1 and 2 only
- (b) 3 and 4
- (c) 1, 2 and 3
- (d) 4 only
- **10.** With reference to the recent developments in science, which one of the following statements is not correct?
 - (a) Functional chromosomes can be created by joining segments of DNA taken from cells of different species.
 - (b) Pieces of artificial functional DNA can be created in laboratories.
 - (c) A piece of DNA taken out from an animal cell can be made to replicate outside a living cell in a laboratory.

- (d) Cells taken out from plants and animals can be made to undergo cell division in laboratory petri dishes.
- **11.** In the context of wearable technology, which of the following tasks is/are accomplished by wearable devices?
 - 1. Location identification of a person
 - 2. Sleep monitoring of a person
 - 3. Assisting the hearing impaired person

Select the correct answer using the code given below:

- (a) 1 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3
- **12.** 'RNA interference (RNAi)' technology has gained popularity in the last few years. Why?
 - 1. It is used in developing gene silencing therapies.
 - 2. It can be used in developing therapies for the treatment of cancer.
 - 3. It can be used to develop hormone replacement therapies.
 - 4. It can be used to produce crop plants that are resistant to viral pathogens.

Select the correct answer using the code given below:

- (a) 1, 2 and 4 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1 and 4 only
- **13.** Recently, scientists observed the merger of giant 'blackholes' billions of light-years away from the Earth. What is the significance of this observation?
 - (a) 'Higgs boson particles' were detected.
 - (b) 'Gravitational waves' were detected.
 - (c) Possibility of inter-galactic space travel through 'wormhole' was confirmed.
 - (d) It enabled the scientists to understand 'singularity'.
- **14.** Which of the following are the reasons for the occurrence of multi-drug resistance in microbial pathogens in India?

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- 1. Genetic predisposition of some people
- 2. Taking incorrect doses of antibiotics to cure diseases
- 3. Using antibiotics in livestock farming
- 4. Multiple chronic diseases in some people

Select the correct answer using the code given below:

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1, 3 and 4 only
- (d) 2, 3 and 4 only
- **15.** What is Cas9 protein that is often mentioned in news?
 - (a) A molecular scissors used in targeted gene editing
 - (b) A biosensor used in the accurate detection of pathogens in patients
 - (c) A gene that makes plants pest-resistant
 - (d) A herbicidal substance synthesized in genetically modified crops
- **16.** For the measurement/estimation of which of the following are satellite images/remote sensing data used?
 - 1. Chlorophyll content in the vegetation of a specific location
 - 2. Greenhouse gas emissions from rice paddies of a specific location
 - 3. Land surface temperatures of a specific location

Select the correct answer using the code given below.

- (a) 1 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3
- **17.** Consider the following statements:
 - 1. In tropical regions, Zika virus disease is transmitted by the same mosquito that transmits dengue.
 - 2. Sexual transmission of Zika virus disease is possible.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 only

- (c) Both 1 and 2
- (d) Neither 1 nor 2
- **18.** Which of the following statements is/are correct?
 - 1. Viruses lack enzymes necessary for the generation of energy.
 - 2. Viruses can be cultured in any synthetic medium.
 - 3. Viruses are transmitted from one organism to another by biological vectors only.

Select the correct answer using the codes given below:

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3
- **19.** Recombinant DNA technology (Genetic Engineering) allows genes to be transferred
 - 1. across different species of plants
 - 2. from animals to plants
 - 3. from microorganisms to higher organisms

Select the correct answer using the codes given below:

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3
- **20.** Fruits stored in a cold chamber exhibit longer storage life because
 - (a) exposure to sunlight is prevented
 - (b) concentration dioxide in the is increased of carbon environment
 - (c) rate of respiration is decreased
 - (d) there is an increase in humidity
- **21.** With reference to 'stem cells', which of the following statements is/are correct?
 - 1. Stem cells can be derived from mammals only.
 - 2. Stem cells can be used for screening new drugs.
 - 3. Stem cells can be used for medical therapies.



Select the correct answer using the codes given below:

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 3 only
- (d) 1, 2 and 3
- **22.** A company marketing food products advertises that its items do not contain trans-fats. What does this campaign signify to the customers?
 - 1. The food products are not made out of hydrogenated oils.
 - 2. The food products are not made out of animal fats/oils.
 - 3. The oils used are not likely to damage the cardiovascular health of the consumers.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3
- **23.** Widespread resistance of malarial parasite to drugs like chloroquine has prompted attempts to develop a malarial vaccine to combat malaria. Why is it difficult to develop an effective malaria vaccine?
 - (a) Malaria is caused by several species of Plasmodium
 - (b) Man does not develop immunity to malaria during natural infection
 - (c) Vaccines can be developed only against bacteria

- (d) Man is only an intermediate host and not the definitive host
- **24.** Consider the following statements about Graphene:
 - 1. It is a two-dimensional material and has good electrical conductivity.
 - 2. It is one of the thinnest but strongest materials tested so far.
 - 3. It is entirely made of silicon and has high optical transparency.
 - 4. It can be used as 'conducting electrodes' requires for touch screens, LCD's and organic LED's

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 3 and 4 only
- (c) 1, 2 and 3 only
- (d) 1, 2, 3 and 4
- **25.** Consider the following phenomena:
 - 1. Light is affected by gravity.
 - 2. The Universe is constantly expanding.
 - 3. Matter warps its surrounding spacetime.

Which of the above is/are the predictions of Albert Einstein's General Theory of Relativity, often discussed in media?

- (a) 1 and 2 only
- (b) 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

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Prelims PYQ+

Answer Booklet

GENERAL STUDIES PYQ PRACTICE TEST (SCIENCE & TECHNOLOGY)

			Answer Key		
Q. 1	(c)	Q.6 (a)	Q. 11 (d)	Q. 16 (d)	Q. 21 (b)
Q. 2	(d)	Q. 7 (d)	Q. 12 (a)	Q. 17 (c)	Q. 22 (c)
Q. 3	(d)	Q.8 (b)	Q. 13 (b)	Q. 18 (a)	Q. 23 (a)
				v - ()	
Q. 4	(c)	Q.9 (b)	Q. 14 (b)	Q. 19 (d)	Q. 24 (a)
Q. 5	(a)	Q. 10 (d)	Q. 15 (a)	Q. 20 (c)	Q. 25 (d)

1. Correct Option: (c) All three

Step 1: Read and Understand the Given Statements

The question asks whether microorganisms can survive in extreme **temperature** and **pH** conditions. We need to analyze if they can grow **above boiling point**, **below freezing point**, and in **highly acidic environments**.

Step 2: Analyze Each Statement One by One

Statement 1: Some microorganisms can grow in environments with temperature above the boiling point of water.

- True
 - Thermophiles and Hyperthermophiles are microorganisms that thrive in extremely high temperatures.
 - Some hyperthermophiles (e.g., *Pyrolobus fumarii*) can survive and grow at temperatures above 100°C (boiling point of water at sea level), especially in deep-sea hydrothermal vents where pressure is high.

Statement 2: Some microorganisms can grow in environments with temperature below the freezing point of water.

- True
 - **Psychrophiles (Cryophiles)** are microorganisms that thrive in extremely cold environments.
 - Some psychrophiles (e.g., *Psychrobacter* and *Chryseobacterium*) can grow below 0°C in permafrost, glaciers, and deep-sea polar waters.

Statement 3: Some microorganisms can grow in highly acidic environments with a pH below 3.

- True
 - Acidophiles are microorganisms that thrive in highly acidic environments.
 - Some acidophiles, such as *Acidithiobacillus ferrooxidans* and *Picrophilus oshimae*, can grow at pH **as low as 1** (extremely acidic environments like volcanic springs and acid mine drainage sites).

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Statement 3 Correct
- Total correct statements = 3

Step 4: Match the Answer with the Given Options

- **Only one** Incorrect
- Only two Incorrect
- All three Correct
- None Incorrect

2. Correct Option: (d) Neither 1 nor 2

Step 1: Read and Understand the Given Statements

The question asks about the characteristics of **ballistic and cruise missiles**, and the specifications of **Agni-V and BrahMos**.

Step 2: Analyze Each Statement One by One

Statement 1: Ballistic missiles are jetpropelled at subsonic speeds throughout their flights, while cruise missiles are rocket-powered only in the initial phase of flight.

- False
 - Ballistic missiles are rocketpropelled, not jet-propelled and travel at supersonic speeds (much faster than subsonic speeds). They follow a parabolic trajectory, leaving and re-entering the atmosphere.
 - Cruise missiles are jet-powered throughout their flight and maintain a low-altitude trajectory for accuracy. They do not use rockets only in the initial phase; instead, they have sustained jet propulsion (e.g., BrahMos uses a ramjet engine for supersonic speed).

Thus, **Statement 1 is incorrect**.

Statement 2: Agni-V is a medium-range supersonic cruise missile, while BrahMos is a solid-fuelled intercontinental ballistic missile.

- False
 - Agni-V is not a medium-range cruise missile; it is an intercontinental ballistic missile (ICBM) with a range of over 5,000 km.
 - BrahMos is not an ICBM; it is a supersonic cruise missile jointly developed by India and Russia with a range of 290-450 km.
 - Also, **BrahMos is powered by a ramjet** engine, not a solid-fuel system.

• Thus, **Statement 2 is incorrect**.

Step 3: Match the Answer with the Given Options

- 1 only Incorrect
- 2 only Incorrect
- Both 1 and 2 Incorrect
- Neither 1 nor 2 Correct

3. Correct Option: (d) Japan

Step 1: Understand the Concept of Satellite Navigation Systems

A Satellite Navigation System (SatNav) is a global or regional system that provides positioning, navigation, and timing (PNT) services. Some countries have developed their own independent satellite navigation systems instead of relying on global systems like GPS (USA).

Step 2: Identify Countries with Their Own Navigation Systems

- Australia No
 - Australia **does not** have an independent satellite navigation system.
 - It relies on the **United States' GPS** and is developing an augmentation system to improve GPS accuracy.
- Canada No
 - Canada **does not** have an independent satellite navigation system.
 - It depends on the GPS (USA) and Galileo (EU) systems.
- Israel No
 - Israel **does not** have a fully independent navigation system.
 - It relies on GPS (USA) but has developed regional enhancements for military use.
- Japan Yes
 - Japan has its own **regional satellite navigation system** called **Quasi-Zenith Satellite System (QZSS)**.
 - QZSS enhances **GPS signals over Japan and nearby regions** and is expected to become fully independent in the future.

Step 3: Select the Correct Answer

The only country in the given options that has **its own satellite navigation system** is **Japan**.

4. Correct Option: (c) All three

Step 1: Understand the Role of an Accelerometer

An **accelerometer** is a device that measures **acceleration forces** acting on an object. It helps detect changes in motion, orientation, and impact forces.

Common applications include:

- **Crash detection** in vehicles (airbag deployment).
- Free fall detection in devices (e.g., laptops).
- Screen rotation in smartphones.

Step 2: Analyze Each Statement One by One

Statement 1: Detection of car crash/collision which results in the deployment of airbags almost instantaneously.

- Accelerometer required
 - Carairbagsystemsuseaccelerometers to detect sudden deceleration or impact.
 - When a collision occurs, the accelerometer senses the extreme force and triggers the **airbag deployment system**.

Statement 2: Detection of accidental free fall of a laptop towards the ground which results in the immediate turning off of the hard drive.

- Accelerometer required
 - Laptops with **Hard Disk Drive (HDD)** use an **accelerometer-based free fall sensor** to detect if the laptop is falling.
 - This helps in **immediately stopping the hard drive to prevent damage** from the impact.

Statement 3: Detection of the tilt of the smartphone which results in the rotation of the display between portrait and landscape mode.

- Accelerometer required
 - Smartphones use an accelerometer to detect changes in orientation.
 - Whenthephoneistilted, the accelerometer detects the **gravitational vector shift** and signals the operating system to **adjust the screen orientation**.

Step 3: Count the Number of Correct Statements

- Statement 1 Requires accelerometer
- Statement 2 Requires accelerometer

- Statement 3 Requires accelerometer
- Total correct = 3

Step 4: Match the Answer with the Given Options

- **Only one** Incorrect
- **Only two** Incorrect
- All three Correct
- None Incorrect
- 5. Correct Option: (a) Studying the evolutionary relationships among various species of fauna

Step 1: Understand What Microsatellite DNA Is

- Microsatellite DNA refers to short, repetitive sequences of DNA that are highly variable among individuals.
- They are widely used in **genetic studies**, forensic science, and evolutionary biology due to their high mutation rates and genetic diversity.
- They are also known as Short Tandem Repeats (STRs) and are useful for DNA fingerprinting and studying genetic relationships.

Step 2: Analyze Each Option One by One

- Studyingtheevolutionaryrelationships among various species of fauna
 - Correct Answer
 - Microsatellite DNA is used in **phylogenetics and evolutionary studies** to analyze genetic variations among species.
 - It helps in understanding species divergence, migration patterns, and genetic linkages in populations.
- Stimulating 'stem cells' to transform into diverse functional tissues
 - Incorrect
 - Stem cell differentiation is driven by **gene regulation and biochemical signals**, not microsatellite DNA.
 - Microsatellites do not play a role in **directly inducing stem cell transformation**.
- Promoting clonal propagation of horticultural plants
 - Incorrect

- Clonal propagation involves **tissue culture**, **grafting**, **and vegetative reproduction** techniques, not microsatellite DNA.
- Microsatellite markers may be used for genetic analysis of clones, but they do not promote propagation.
- Assessing the efficacy of drugs by conducting a series of drug trials in a population
 - Incorrect
 - Drug trials use **pharmacogenomics and clinical testing methodologies**, not microsatellite DNA.
 - SingleNucleotidePolymorphisms (SNPs) are more relevant in drug response studies than microsatellites.

Step 3: Select the Correct Answer

Since microsatellite DNA is primarily used in studying genetic variations and evolutionary relationships, the correct answer is: Studying the evolutionary relationships among various species of fauna

- 6. Correct Option: (a) Collecting DNA samples from air in a habitat at one go
 - Step 1: Understand the Concept of Metagenomics
 - **Metagenomics** is the study of genetic material (DNA/RNA) obtained directly from environmental samples, without the need for individual organism isolation.
 - It helps in analyzing microbial communities, environmental biodiversity, and pathogen surveillance.
 - Step 2: Understand What 'Aerial Metagenomics' Means
 - Aerial Metagenomics involves collecting airborne DNA to study microbial, plant, or animal genetic material present in the air.
 - It is useful for monitoring airborne diseases, biodiversity assessments, and tracking environmental changes.
 - Step 3: Analyze Each Option One by One

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- Collecting DNA samples from air in a habitat at one go
 - Correct Answer
 - This correctly defines Aerial Metagenomics, as it refers to sampling and analyzing DNA present in the air from various organisms (microbes, plants, animals).
 - Scientists use **air samplers** to capture genetic material from airborne particles.
- Understanding the genetic makeup of avian species of a habitat
 - Incorrect
 - This focuses specifically on birds, whereas aerial metagenomics applies to all organisms whose DNA is present in the air.
 - It is not limited to avian species.
- Using air-borne devices to collect blood samples from moving animals
 - Incorrect
 - Aerial metagenomics **does not involve direct sampling of blood** from animals.
 - It focuses on **airborne environmental DNA (eDNA)** rather than direct biological sampling.
- Sending drones to inaccessible areas to collect plant and animal samples from land surfaces and water bodies
 - Incorrect
 - This describes **remote environmental sampling**, but **not metagenomics**, as it involves **directly collecting plant/animal material rather than airborne DNA**.

Step 4: Select the Correct Answer

Since Aerial Metagenomics involves capturing DNA from the air in a habitat, the correct answer is: Collecting DNA samples from air in a habitat at one go

7. Correct Option: (d) Neither 1 nor 2

Step 1: Understand LTE (Long-Term Evolution) and VoLTE (Voice over LTE)

• LTE (Long-Term Evolution) is a 4G technology that provides high-speed mobile data connectivity but does not inherently support voice calls.

- VoLTE (Voice over LTE) is an advanced technology that allows voice calls to be transmitted over the LTE (4G) network instead of traditional circuit-switched networks (used in 2G/3G).
- VoLTE improves call quality (HD voice), reduces call setup time, and allows simultaneous use of data and voice.

Step 2: Analyze Each Statement One by One

Statement 1: LTE is commonly marketed as 3G and VoLTE is commonly marketed as advanced 3G.

- False
 - LTE is not a 3G technology; it is a 4G (Fourth Generation) technology.
 - VoLTE is not an advanced 3G technology; it is an enhancement of 4G LTE that enables voice communication.
 - Hence, this statement is incorrect.

Statement 2: LTE is data-only technology and VoLTE is voice-only technology.

- False
 - LTE is primarily a data technology, but with VoLTE, it can support both voice and data simultaneously.
 - VoLTE is not a voice-only technology; it allows voice transmission over LTE networks while also enabling data usage.
 - Hence, this statement is also incorrect.

Step 3: Select the Correct Answer

Since **both statements are incorrect**, the correct answer is: (d) Neither 1 nor 2

8. Correct Option: (b) 2 and 3 only

Step 1: Understand the Key Concepts in Indian Patent Law

- The Indian Patents Act, 1970, governs patents in India and excludes certain categories from patentability.
- The Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001, governs plant variety protection separately.
- The Intellectual Property Appellate Board (IPAB) was abolished in 2021, with its functions transferred to High Courts.

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Step 2: Analyze Each Statement One by One

Statement 1: According to the Indian Patents Act, a biological process to create a seed can be patented in India.

- False
 - Section 3(j) of the Indian Patents Act, 1970 states that plants, seeds, and biological processes for the production of plants and animals are not patentable.
 - Thus, a biological process to create a seed cannot be patented in India.

Statement 2: In India, there is no Intellectual Property Appellate Board.

- **True**
 - The Intellectual Property Appellate Board (IPAB) was abolished in 2021 through the Tribunals Reforms (Rationalization and Conditions of Service) Ordinance, 2021.
 - Now, all cases related to intellectual property rights (IPR), including **patents**, **trademarks**, **and copyrights**, **are handled by the respective High Courts**.
 - Thus, this statement is **correct**.

Statement 3: Plant varieties are not eligible to be patented in India.

- True
 - Under Section 3(j) of the Indian Patents Act, 1970, plants and plant varieties cannot be patented in India.
 - However, plant varieties are protected under a separate law, the **Protection of Plant Varieties and Farmers' Rights** (**PPV&FR**) Act, 2001.
 - Thus, this statement is **correct**.

Step 3: Count the Number of Correct Statements

- Statement 1 Incorrect
- Statement 2 Correct
- Statement 3 Correct
- Total correct statements = 2

Step 4: Match the Answer with the Given Options

- 1 and 3 only Incorrect
- 2 and 3 only Correct
- **3 only** Incorrect
- **1, 2, and 3** Incorrect

9. Correct Option: (b) 3 and 4 only

Step 1: Understand the Key Concepts of AR and VR

- Augmented Reality (AR) enhances the real world by overlaying digital elements (e.g., Pokémon GO, AR filters on Snapchat).
- Virtual Reality (VR) creates a fully immersive digital environment that replaces the real world (e.g., VR gaming, VR simulations).

Step 2: Analyze Each Statement One by One

Statement 1: In Augmented Reality (AR), a simulated environment is created and the physical world is completely shut out.

- False
 - AR does not shut out the real world; it enhances it by adding digital elements.
 - VR, not AR, completely immerses users in a simulated environment.
 - Thus, this statement is **incorrect**.

Statement 2: In Virtual Reality (VR), images generated from a computer are projected into real-life objects or surroundings.

- False
 - This definition describes Augmented Reality (AR), not Virtual Reality (VR).
 - VR creates a fully simulated environment with no interaction with real-life surroundings.
 - Thus, this statement is **incorrect**.

Statement 3: AR allows individuals to be present in the world and improves the experience using the camera of a smartphone or PC.

- True
 - AR overlays **digital content** onto realworld surroundings and works through **smartphone cameras**, **AR glasses**, **and PC applications**.
 - Examples: Google Lens, Pokémon GO, AR filters on social media.
 - Thus, this statement is **correct**.

Statement 4: VR closes the world, and transposes an individual, providing a complete immersion experience.

- True
 - VR blocks out the real world and immerses users in a completely virtual environment.



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- Example: Oculus VR headsets, PlayStation VR, and VR flight simulators.
- Thus, this statement is **correct**.

Step 3: Count the Number of Correct Statements

- Statement 1 Incorrect
- Statement 2 Incorrect
- Statement 3 Correct
- Statement 4 Correct
- Total correct statements = 2

Step 4: Match the Answer with the Given Options

- 1 and 2 only Incorrect
- **3 and 4 only** Correct
- **1, 2 and 3** Incorrect
- 4 only Incorrect

10. Correct Option: (d) 1, 2 and 3

Step 1: Understand Wearable Technology

- Wearable technology refers to smart electronic devices that can be worn on the body and perform various functions such as tracking health metrics, navigation, and communication.
- Examples include smartwatches, fitness trackers, hearing aids, smart glasses, and GPS-enabled devices.

Step 2: Analyze Each Statement One by One

Statement 1: Location identification of a person

- True
 - Many wearable devices, such as smartwatches, fitness trackers, and GPS-enabled smart bands, can track a person's location.
 - Example: Apple Watch, Fitbit, GPSenabled running watches, smart tags.
 - Use Case: Used for navigation, emergency tracking, and child safety monitoring.

Statement 2: Sleep monitoring of a person

- True
 - Manyfitnessbandsandsmartwatches monitor sleep patterns using heart rate sensors and motion tracking.
 - Example: Fitbit, Oura Ring, Apple Watch, Samsung Galaxy Watch.

• Use Case: Helps in analyzing sleep cycles, sleep duration, and sleep quality.

 ${\small Statement 3: Assisting the hearing-impaired} \\ {\small person}$

- True
 - Smart hearing aids and AI-powered auditory devices help hearingimpaired individuals by amplifying and filtering sounds.
 - Example: Cochlear implants, Bluetooth-enabled hearing aids, smart auditory enhancement devices like Bose Hearphones.
 - Use Case: Enhances speech clarity, noise reduction, and real-time translation for hearing-impaired users.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Statement 3 Correct
- Total correct statements = 3

Step 4: Match the Answer with the Given Options

- **1 only** Incorrect
- 2 and 3 only Incorrect
- 3 only Incorrect
- **1, 2 and 3** Correct

11. Correct Option: (d) 1, 2 and 3

Step 1: Understand the scope of wearable technology

- Wearable devices are electronic technologies or computers incorporated into items that can be comfortably worn on a body. These devices are often used for tracking health metrics, aiding disabilities, and enhancing day-to-day functions like navigation.
- Common examples include smartwatches, fitness trackers, GPS bands, hearing aids, smart rings, and health monitoring patches.

Step 2: Evaluate each statement

- Statement 1: Location identification of a person
 - This is correct. Wearables like smartwatches and GPS trackers provide real-time location data using inbuilt



GPS systems. They are widely used for tracking children, patients, and for navigation purposes.

- Statement 2: Sleep monitoring of a person
 - This is correct. Fitness bands and smartwatches use motion sensors and heart rate variability to monitor sleep cycles, duration, and sleep quality. These features are standard in devices from brands like Fitbit, Apple, and Xiaomi.
- Statement 3: Assisting the hearing impaired person
 - This is correct. Advanced hearing aids are now wearable tech devices that amplify sound and reduce background noise. Some smart wearables use bone conduction to transmit sound directly to the inner ear, aiding those with hearing impairments.

Step 3: Conclusion

• All three statements describe tasks that are currently accomplished using wearable technology.

Conceptual Takeaway for UPSC Prelims

• When solving questions on emerging technologies, applyreal-worldunderstanding of gadgets and their functions. UPSC tests awareness of how technologies impact governance, health, communication, and society, not just definitions.

12. Correct Option: (a) 1, 2 and 4 only

Step 1: Understand RNA Interference (RNAi) Technology

- RNA interference (RNAi) is a biological process in which RNA molecules inhibit gene expression by neutralizing targeted mRNA molecules.
- It is widely used in gene silencing, therapeutic treatments, and agricultural applications.

Step 2: Analyze Each Statement One by One

Statement 1: It is used in developing gene silencing therapies.

- True
 - RNAi is a **powerful gene-silencing tool** that **blocks the expression of specific genes** by degrading their mRNA.
 - Example: Used in genetic disorder treatments and research.

Statement 2: It can be used in developing therapies for the treatment of cancer.

- True
 - RNAi-based therapies target and silence cancer-causing genes (oncogenes).
 - **Example:** RNAi-based drugs are being tested to treat **liver cancer**, **leukemia**, **and other malignancies**.

Statement 3: It can be used to develop hormone replacement therapies.

- False
 - RNAi does **not** produce or replace hormones.
 - Hormone replacement therapy involves **administering synthetic or bioidentical hormones**, not gene silencing.

Statement 4: It can be used to produce crop plants that are resistant to viral pathogens.

- True
 - RNAi technology helps develop virusresistant crops by silencing viral genes.
 - **Example:** RNAi-based **Papaya ringspot virus-resistant papaya**, and virus-resistant tomatoes and potatoes.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Statement 3 Incorrect
- Statement 4 Correct
- Total correct statements = 3

Step 4: Match the Answer with the Given Options

- 1, 2 and 4 only Correct
- 2 and 3 only Incorrect
- 1 and 3 only Incorrect
- 1 and 4 only Incorrect
- 13. Correct Option: (b) 'Gravitational waves' were detected.

Step 1: Understand the Context of the Question

• When **two black holes merge**, they produce **intense cosmic phenomena** that can be detected from Earth.

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- Scientists have been able to observe such mergers using advanced telescopes and detectors.
- The key discovery related to black hole mergers in recent years has been the detection of **gravitational waves**.

Step 2: Analyze Each Option One by One

- 'Higgs boson particles' were detected.
 - Incorrect
 - The **Higgs boson** is related to **particle physics** and was discovered in 2012 at **CERN's Large Hadron Collider (LHC)**.
 - It has no direct connection with **black** hole mergers.
- 'Gravitational waves' were detected.
 - Correct
 - The Laser Interferometer Gravitational-Wave Observatory (LIGO) first detected gravitational waves in 2015, confirming Einstein's General Theory of Relativity.
 - These waves are produced when massive celestial objects like black holes or neutron stars merge.
 - The merger of two giant black holes billions of light-years away led to the detection of these waves.
- Possibility of inter-galactic space travel through 'wormhole' was confirmed.
 - Incorrect
 - Wormholes are hypothetical and have not been observed or confirmed through black hole mergers.
 - The concept of **wormholes** exists in **theoretical physics**, but there is **no experimental confirmation**.
- It enabled the scientists to understand 'singularity'.
 - Incorrect
 - Singularity refers to the infinitely dense core of a black hole, but black hole mergers do not directly help scientists understand singularity.
 - Singularity remains a theoretical concept that cannot be directly observed due to the event horizon blocking information.

Step 3: Select the Correct Answer

Since **gravitational waves were detected** due to the black hole merger, the correct answer is: (b) 'Gravitational waves' were detected.

14. Correct Option: (b) 2 and 3 only

Step 1: Understand the Concept of Multi-Drug Resistance (MDR)

- Multi-drug resistance (MDR) occurs when microbial pathogens become resistant to multiple antibiotics due to misuse, overuse, or natural mutations.
- Factors contributing to MDR include improper antibiotic use, antibiotic use in livestock, and lack of regulation in prescribing antibiotics.

Step 2: Analyze Each Statement One by One

Statement 1: Genetic predisposition of some people

- False
 - MDR occurs in microbes, not in humans.
 - Human genetics does not directly contribute to microbial drug resistance, though weakened immune systems may make infections harder to treat.
 - Since MDR is a microbial adaptation, not a human genetic condition, this statement is incorrect.

Statement 2: Taking incorrect doses of antibiotics to cure diseases

- True
 - **Misuse of antibiotics** (taking incorrect doses, stopping early, or using without prescription) allows **some bacteria to survive and develop resistance**.
 - Example: Tuberculosis (TB) and MRSA (Methicillin-resistant Staphylococcus aureus) have become resistant due to incomplete antibiotic courses.

Statement 3: Using antibiotics in livestock farming

- True
 - Antibiotics are frequently used in livestock to promote growth and prevent disease, even in healthy animals.
 - This contributes to **antibiotic resistance in bacteria**, which can

spread to humans through **food**, water, and the environment.

• **Example:** Drug-resistant Salmonella and *E. coli* have emerged due to excessive antibiotic use in animals.

Statement 4: Multiple chronic diseases in some people

- False
 - Chronic diseases **do not cause** MDR in microbes.
 - However, people with chronic illnesses may require **frequent antibiotic use**, which **can contribute indirectly** to resistance but is **not a direct cause** of MDR.
 - MDR occurs due to bacterial adaptation, not because people have chronic diseases.

Step 3: Count the Number of Correct Statements

- Statement 1 Incorrect
- Statement 2 Correct
- Statement 3 Correct
- Statement 4 Incorrect
- Total correct statements = 2

Step 4: Match the Answer with the Given Options

- 1 and 2 only Incorrect
- 2 and 3 only Correct
- 1, 3 and 4 only Incorrect
- 2, 3 and 4 only Incorrect

15. Correct Option: (a) A molecular scissors used in targeted gene editing

Step 1: Understand Cas9 Protein and Its Function

- Cas9 (CRISPR-associated protein 9) is an enzyme that plays a key role in the CRISPR-Cas9 gene-editing technology.
- It acts as **"molecular scissors"** that can **precisely cut DNA** at specific locations, allowing for targeted gene editing.
- It is widely used in **genetic engineering**, **biotechnology**, and **medical research** for correcting genetic disorders.

Step 2: Analyze Each Option One by One

• A molecular scissors used in targeted gene editing

- Correct Answer
 - Cas9 cuts specific DNA sequences in CRISPR-Cas9 technology, enabling gene editing.
 - It is used in gene therapy, disease research, and genetic modifications.
- A biosensor used in the accurate detection of pathogens in patients
 - Incorrect
 - While CRISPR technology is sometimes used for disease detection, Cas9 itself is not a biosensor.
 - CRISPR-based diagnostics (e.g., SHERLOCK and DETECTR) use modified Cas proteins for pathogen detection, but Cas9 is not its primary function.
- A gene that makes plants pestresistant
 - Incorrect
 - Cas9 is **not a gene**; it is an **enzyme** used for gene editing.
 - Pest-resistant plants are developed using genetic modifications (e.g., Bt gene in Bt cotton), but Cas9 is not directly responsible for pest resistance.
- A herbicidal substance synthesized in genetically modified crops
 - Incorrect
 - Cas9 is not a herbicide.
 - Herbicides are **chemical substances** used to kill unwanted plants, whereas **Cas9 is a gene-editing enzyme**.

Step 3: Select the Correct Answer

Since Cas9 is a molecular scissors used in targeted gene editing, the correct answer is: (a) A molecular scissors used in targeted gene editing

16. Correct Option: (d) 1, 2 and 3

Step 1: Understand Remote Sensing and Its Capabilities

- Remote sensing uses satellite images, aerial photography, and sensors to collect data about Earth's surface without direct contact.
- It is widely used for **environmental monitoring**, **agriculture**, **climate studies**, **and land-use analysis**.

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Step 2: Analyze Each Statement One by One

Statement 1: Chlorophyll content in the vegetation of a specific location

- True
 - Satellite sensors can estimate chlorophyll content using spectral reflectance data.
 - NDVI (Normalized Difference Vegetation Index) and chlorophyll fluorescence techniques are used to assess vegetation health and photosynthetic activity.
 - **Example:** Sentinel-2, MODIS, and Landsat satellites measure vegetation indices to estimate **chlorophyll levels** in plants.

Statement 2: Greenhouse gas emissions from rice paddies of a specific location

- True
 - Remote sensing can estimate methane (CH₄) emissions from rice paddies based on vegetation indices, soil moisture, and thermal imaging.
 - Satellite-based spectrometry (e.g., TROPOMI, OCO-2, and GOSAT) detects greenhouse gases (GHGs) from rice paddies.
 - Example: NASA's OCO-2 satellite and ESA's TROPOMI instrument track methane emissions from wetlands and rice fields.

Statement 3: Land surface temperatures of a specific location

- True
 - Thermal infrared remote sensing is widely used to measure land surface temperature (LST) from space.
 - Example: The MODIS sensor on NASA's Terra and Aqua satellites measures global land surface temperatures.
 - Applications: Climate studies, urban heat mapping, and monitoring heatwaves.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Statement 3 Correct
- Total correct statements = 3

Step 4: Match the Answer with the Given Options

- 1 only Incorrect
- 2 and 3 only Incorrect
- 3 only Incorrect
- 1, 2 and 3 Correct

17. Correct Option: (c) Both 1 and 2

Step 1: Understand Zika Virus and Its Transmission

- Zika virus is a mosquito-borne virus that primarily spreads through Aedes mosquitoes.
- It is associated with microcephaly (birth defects in babies) and neurological disorders.
- It can be transmitted through mosquito bites, sexual contact, blood transfusion, and from mother to fetus during pregnancy.

Step 2: Analyze Each Statement One by One

Statement 1: In tropical regions, Zika virus disease is transmitted by the same mosquito that transmits dengue.

- True
 - The Aedes aegypti and Aedes albopictus mosquitoes, which transmit dengue and chikungunya, also spread Zika virus.
 - These mosquitoes are **abundant** in **tropical and subtropical regions**, making Zika outbreaks common in such areas.

Statement 2: Sexual transmission of Zika virus disease is possible.

- True
 - Zika virus can be transmitted sexually from an infected person to their partner.
 - It has been found in **semen**, **vaginal fluids**, **and other body fluids**, and can persist longer in **semen than in blood**.
 - The CDC and WHO have confirmed sexual transmission of Zika, advising protective measures.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Total **correct statements = 2**

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Step 4: Match the Answer with the Given Options

- 1 only Incorrect
- 2 only Incorrect
- Both 1 and 2 Correct
- Neither 1 nor 2 Incorrect

18. Correct Option: (a) 1 only

Step 1: Understand the Fundamental Properties of Viruses

- Viruses are acellular (not living cells) and obligate intracellular parasites, meaning they cannot reproduce or generate energy independently.
- They require a **host cell** to replicate and do not grow on synthetic media.
- Viruses can be transmitted through biological vectors (mosquitoes, ticks, etc.) as well as non-biological means (airborne transmission, direct contact, contaminated surfaces, etc.).

Step 2: Analyze Each Statement One by One

Statement 1: Viruses lack enzymes necessary for the generation of energy.

- True
 - Viruses **do not have metabolic machinery** (like mitochondria or enzymes) to generate **ATP** (energy).
 - They depend entirely on the **host cell's metabolism** for survival and replication.

Statement 2: Viruses can be cultured in any synthetic medium.

- False
 - Viruses cannot be cultured in synthetic nutrient media, unlike bacteria.
 - Since they **require a living host cell**, they can only be grown in:
 - Live animals or plants
 - Embryonated eggs (used for vaccine production)
 - Cell cultures (e.g., HeLa cells, Vero cells for research and vaccine development)

Statement 3: Viruses are transmitted from one organism to another by biological vectors only.

- False
 - Viruses can be transmitted **both through biological vectors and nonbiological means**:

- **Biological vectors** (e.g., mosquitoes transmitting Zika, dengue; ticks transmitting Crimean-Congo hemorrhagic fever).
- Non-biological transmission:
 - ♦ **Airborne transmission** (e.g., COVID-19, influenza).
 - ♦ **Direct contact transmission** (e.g., HIV, herpes).
 - ♦ **Fomite transmission** (e.g., contaminated surfaces).

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Incorrect
- Statement 3 Incorrect
- Total correct statements = 1

Step 4: Match the Answer with the Given Options

- 1 only Correct
- 2 and 3 only Incorrect
- 1 and 3 only Incorrect
- 1, 2 and 3 Incorrect

19. Correct Option: (d) 1, 2 and 3

Step 1: Understand Recombinant DNA Technology (Genetic Engineering)

- **Recombinant DNA technology (rDNA)** involves modifying the genetic material of an organism by **introducing genes from another organism**, even across different species.
- This technology has been widely used in **agriculture**, **medicine**, **and biotechnology** to develop **genetically modified organisms (GMOs)**, diseaseresistant crops, and biopharmaceuticals.

Step 2: Analyze Each Statement One by One

Statement 1: Genes can be transferred across different species of plants.

- True
 - Genetic engineering has been used to transfer genes between different plant species to enhance traits like drought resistance, pest resistance, and improved yield.
 - **Example: Bt cotton**, where a gene from *Bacillus thuringiensis* (a bacterium) was inserted into cotton plants to provide pest resistance.

Statement 2: Genes can be transferred from animals to plants.

- True
 - While less common, genetic engineering allows animal genes to be introduced into plants.
 - **Example:** A plant was engineered to **produce spider silk proteins**, which originally come from spiders.
 - Scientists have experimented with transferring certain mammalian genes into plants for pharmaceutical production (e.g., edible vaccines in bananas and tomatoes).

Statement 3: Genes can be transferred from microorganisms to higher organisms.

- True
 - Genes from **bacteria and viruses have been inserted into plants, animals, and humans** for various applications.
 - Example: The human insulin gene was inserted into *E. coli* to produce genetically engineered insulin (Humulin).
 - Example: The CRISPR gene-editing tool, derived from *Streptococcus pyogenes* bacteria, is used for human genetic modifications.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Statement 3 Correct
- Total correct statements = 3

Step 4: Match the Answer with the Given Options

- 1 only Incorrect
- 2 and 3 only Incorrect
- 1 and 3 only Incorrect
- 1, 2 and 3 Correct

20. Correct Option: (c) Rate of respiration is decreased

Step 1: Understand the Science Behind Fruit Preservation

- Fruits undergo **respiration**, where they consume **oxygen** and release **carbon dioxide**, water, and heat.
- The rate of respiration determines the ripening and spoilage rate.

• Cold storage slows down respiration, reducing ripening and decay, thus extending shelf life.

Step 2: Analyze Each Option One by One

- Exposure to sunlight is prevented
 - Incorrect
 - While avoiding sunlight prevents photo-oxidation, fruit ripening is mainly controlled by respiration and ethylene production, not sunlight exposure.
- Concentration of carbon dioxide in the environment is increased
 - Incorrect
 - Controlled Atmosphere (CA) storage sometimes increases CO₂ levels, but cold storage alone does not significantly alter CO₂ concentrations.
 - While high CO_2 can slow respiration, temperature control is the main factor in cold storage.
- Rate of respiration is decreased
 - Correct
 - Cold temperatures **slow down metabolic activities**, including **respiration**, which delays ripening and spoilage.
 - Lower respiration = lower ethylene production = extended fruit storage life.
- There is an increase in humidity
 - Incorrect
 - Humidity prevents fruit dehydration, but does not directly slow ripening.
 - Cold storage reduces respiration, which is the primary reason for extended shelf life.

Step 3: Select the Correct Answer

Since cold storage slows respiration, reducing ripening and decay, the correct answer is: (c) Rate of respiration is decreased

21. Correct Option: (b) 2 and 3 only

Step 1: Understand the Concept of Stem Cells

• Stem cells are undifferentiated cells that have the ability to differentiate into specialized cell types and self-renew. • They are used in **medical therapies**, drug testing, and regenerative medicine.

Step 2: Analyze Each Statement One by One

Statement 1: Stem cells can be derived from mammals only.

- False
 - Stem cells are not exclusive to mammals; they are found in other vertebrates, invertebrates, and even plants.
 - Example: Planaria (a flatworm) regenerates entire body parts using stem cells.
 - **Conclusion:** This statement is incorrect.

Statement 2: Stem cells can be used for screening new drugs.

- True
 - Stem cell-derived tissues can be used for drug testing and toxicity screening before human trials.
 - Example: Induced Pluripotent Stem Cells (iPSCs) are used to test how a drug affects heart, liver, and nerve cells.
 - **Conclusion:** This statement is correct.

Statement 3: Stem cells can be used for medical therapies.

• True

- Stem cells are widely used in **regenerative medicine** and treating diseases like **leukemia**, **Parkinson's disease**, and spinal cord injuries.
- Example: Bone marrow transplants use hematopoietic stem cells to treat blood disorders.
- **Conclusion:** This statement is correct.

Step 3: Count the Number of Correct Statements

- Statement 1 Incorrect
- Statement 2 Correct
- Statement 3 Correct
- Total correct statements = 2

Step 4: Match the Answer with the Given Options

- 1 and 2 only Incorrect
- **2 and 3 only** Correct
- **3 only** Incorrect
- 1, 2 and 3 Incorrect

22. Correct Option: (c) 1 and 3 only

Step 1: Understand What Trans-Fats Are

- Trans-fats (trans fatty acids) are harmful unsaturated fats that increase the risk of heart disease, obesity, and diabetes.
- They are mainly produced through **hydrogenation of vegetable oils** and are found in **processed foods, margarine, and fried snacks**.
- Naturally occurring trans-fats are also present in some animal products (dairy, meat, etc.), but in much smaller amounts compared to artificial sources.

Step 2: Analyze Each Statement One by One

Statement 1: The food products are not made out of hydrogenated oils.

- True
 - Partially hydrogenated oils (PHOs) are the primary source of artificial trans-fats.
 - If a food product does not contain transfats, it means it **does not contain hydrogenated oils**.

Statement 2: The food products are not made out of animal fats/oils.

- False
 - Trans-fats are mostly found in industrially processed foods, but small amounts occur naturally in animal fats.
 - A "trans-fat-free" label does not necessarily mean that the product is free from all animal fats.
 - Products can **still contain animal fats** while being free of artificial trans-fats.

Statement 3: The oils used are not likely to damage the cardiovascular health of the consumers.

- True
 - Trans-fats are directly linked to heart disease, as they raise LDL (bad cholesterol) and lower HDL (good cholesterol).
 - If a product is **free from trans-fats**, it is **less likely to harm cardiovascular** health.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Incorrect

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- Statement 3 Correct
- Total correct statements = 2

Step 4: Match the Answer with the Given Options

- 1 only Incorrect
- 2 and 3 only Incorrect
- 1 and 3 only Correct
- **1, 2 and 3** Incorrect

23. Correct Option: (a) Malaria is caused by several species of Plasmodium

Step 1: Understand the Challenges in Developing a Malaria Vaccine

- Malaria is caused by **Plasmodium parasites**, which are transmitted by **Anopheles mosquitoes**.
- Unlike bacterial infections, Plasmodium has a complex life cycle and multiple stages in both human and mosquito hosts, making vaccine development challenging.
- Current malaria vaccines, such as **RTS**,**S** (Mosquirix) and **R21**, have limited effectiveness and require booster doses.

Step 2: Analyze Each Option One by One

- Malaria is caused by several species of *Plasmodium*
 - Correct
 - Malaria is caused by **different species of** *Plasmodium*, primarily:
 - ◊ Plasmodium falciparum (most deadly)
 - ◊ Plasmodium vivax
 - ◊ *Plasmodium malariae*
 - ◊ *Plasmodium* ovale
 - ◊ Plasmodium knowlesi (zoonotic malaria)
 - A **single vaccine** needs to be effective against multiple species, which **complicates vaccine development**.
- Man does not develop immunity to malaria during natural infection
 - Incorrect
 - Humans can develop partial immunity to malaria after repeated infections, especially in endemic regions.

- However, this immunity is not long-lasting and does not provide complete protection, making vaccination still necessary.
- Vaccines can be developed only against bacteria
 - Incorrect
 - Vaccines are not limited to bacterial infections; they are also developed for viral diseases (e.g., polio, COVID-19) and parasites (e.g., malaria, leishmaniasis).
 - Malaria vaccines **like RTS,S** (Mosquirix) have already been developed, proving that vaccines can target **parasites**.
- Man is only an intermediate host and not the definitive host
 - Incorrect
 - In malaria, humans are the primary host for disease transmission, but the definitive host is the mosquito, where sexual reproduction of *Plasmodium* occurs.
 - While this fact is biologically important, it does not directly explain the difficulty in vaccine development.

Step 3: Select the Correct Answer

Since the presence of multiple *Plasmodium* species makes it difficult to create a universal vaccine, the correct answer is: (a) Malaria is caused by several species of Plasmodium

24. Correct Option: (a) 1 and 2 only

Step 1: Understand the Properties of Graphene

- Graphene is a two-dimensional material consisting of a single layer of carbon atoms arranged in a hexagonal lattice.
- It has **exceptional electrical conductivity, mechanical strength, and optical transparency**.
- It is used in electronics, flexible displays, batteries, and medical applications.

Step 2: Analyze Each Statement One by One

Statement 1: It is a two-dimensional material and has good electrical conductivity.

- True
 - Graphene is a **single layer of carbon atoms**, making it a **2D material**.

 It has very high electrical conductivity due to delocalized π-electrons, allowing fast electron mobility.

Statement 2: It is one of the thinnest but strongest materials tested so far.

- True
 - Graphene is just one atom thick, making it the thinnest known material.
 - It is 200 times stronger than steel, making it one of the strongest materials tested.

Statement 3: It is entirely made of silicon and has high optical transparency.

- False
 - Graphene is made of carbon, not silicon.
 - While it has **high optical transparency** (~97%), the material itself is composed **entirely of carbon atoms**.

Statement 4: It can be used as 'conducting electrodes' required for touch screens, LCDs, and organic LEDs.

- True
 - Graphene's high conductivity and transparency make it an ideal material for touchscreens, LCDs, and OLEDs.
 - It can replace **indium tin oxide (ITO)** in flexible and transparent electronics.

Step 3: Count the Number of Correct Statements

- Statement 1 Correct
- Statement 2 Correct
- Statement 3 Incorrect
- Statement 4 Correct
- Total correct statements = 3

Step 4: Match the Answer with the Given Options

- 1 and 2 only Incorrect
- 3 and 4 only Incorrect
- 1, 2 and 3 only Incorrect
- **1, 2, 3 and 4** Incorrect

25. Correct Answer: (d) 1, 2 and 3

Step 1: Recall the Core Concepts of General Theory of Relativity (GTR)

• Albert Einstein's General Theory of Relativity, published in 1915, describes gravity not as a force, but as a **curvature of spacetime caused by mass and energy**. It replaced Newton's idea of gravity and led to numerous predictions about the universe, many of which have been experimentally verified.

Step 2: Evaluate Each Statement

- Statement 1: Light is affected by gravity
 - This is a correct prediction of General Relativity. The bending of light around massive objects (gravitational lensing) is one of the most famous verifications of GTR, observed during solar eclipses and widely used in astronomy today.
- Statement 2: The Universe is constantly expanding
 - This observation was made later (by Edwin Hubble), but the framework to allow an expanding (or contracting) universe is permitted within Einstein's field equations. Though Einstein initially added a "cosmological constant" to keep the universe static, he later called this his "biggest blunder" once the expansion was observed. GTR allows for dynamic cosmologies including expansion, hence the statement aligns with the theory.
- Statement 3: Matter warps its surrounding spacetime
 - This is the central idea of General Relativity. The presence of mass and energy curves the fabric of spacetime, and this curvature is what we perceive as gravity.

Step 3: Conclusion

• All three statements are valid predictions or consequences of the General Theory of Relativity.

Additional Insight

• Other major confirmations of General Relativity include gravitational redshift, time dilation near massive objects (used in GPS technology), and the detection of gravitational waves (first observed in 2015).

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