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**(1) Defence Technology, Space Technology and Satellites**

1. Consider the following statements regarding Defence Research and Development Organisation (DRDO):

(A) It was established in 1958 by merging Technical Development Establishment and Directorate of Technical Development and Production.

(B) It functions under the PMO.

(C) Its headquarters is located in Bengaluru.

Which of the above statements is/are False?

- (1) Only (A)
- (2) Only (A) & (B)
- (3) Only (B) & (C)
- (4) (A), (B) & (C)
- (5) Question not attempted

Answer: (3)

Explanation:

(A) ✓	DRDO was established in 1958 by merging Technical Development Establishment and Directorate of Technical Development & Production.
(B) ✗	DRDO functions under the Ministry of Defence (MoD), not under the Prime Minister's Office (PMO).
(C) ✗	DRDO headquarters is located in New Delhi , not Bengaluru.

Parameter	DRDO	ISRO
Type of Institution	Defence R&D wing	Space agency
Dept./ Ministry	Ministry of Defence	Dept. of Space (under PMO)
Establishment	1958 (merger of Technical Development Establishment (TDE - Indian Army) and Directorate of Technical Development & Production (DTDP - Defence Science Organisation))	15 August, 1969 in place of INCOSPAR (which was set up in 1962)
Motto	Balasya Mulam Vigyanam.	Space technology in the service of mankind.
HQ	New Delhi	Bangalore

2. Consider the following missiles

(A) Nag (B) Trishul

(C) Brahmos (D) Nirbhay

(E) Prithvi

Which of the above is/are part of the Integrated Guided Missile Development Program?

- (1) (A), (B) and (D) only
- (2) (B), (D) and (E) Only
- (3) (A), (B) and (E) Only
- (4) (A), (B), (C) and (D) Only
- (5) Question not attempted

Answer: (3)

Explanation:

- ❖ India developed 5 missiles under the Integrated Guided Missile Development Programme (IGMDP).
➤ Agni, Prithvi, Nag, Trishul and Akash.
- ❖ Nirbhay and BrahMos are cruise missiles of India.

3. Which city is not included in Uttar Pradesh Defence Industrial Corridor:

- (1) Agra
- (2) Kanpur
- (3) Chitrakoot
- (4) Meerut
- (5) Question not attempted

Answer: (4)

Explanation:

- ❖ Two Defence Industrial Corridors are being developed in India— in Uttar Pradesh and Tamil Nadu.
- 1. Uttar Pradesh: Total six nodes → Agra, Aligarh, Chitrakoot, Jhansi, Kanpur and Lucknow.
- 2. Tamil Nadu: Total five nodes → Chennai, Coimbatore, Hosur, Salem and Tiruchirappalli.

4. With reference to Agni-P Missile, which of the following statements is false?

- (1) It is a medium-range surface-to-air missile.
- (2) It has a range of 1000-2000 km.
- (3) It can carry both conventional and nuclear warheads.
- (4) It was developed by DRDO.
- (5) Question not attempted



Answer: (1)

Explanation:

- | | |
|-------|---|
| (1) X | Agni-P is not a Surface-to-Air Missile (SAM). It is a Surface-to-Surface Ballistic Missile (SSBM). |
|-------|---|

Additional Information

Agni-P or Agni Prime

- ❖ It is a **nuclear-capable (+ conventional), two-stage, canisterised solid propellant ballistic** missile.
- ❖ It is the sixth and most recent variant of the Agni missile series.
- ❖ This is a **surface-to-surface** ballistic missile developed by **DRDO**.
- ❖ **Range:** 1000-2000 Km (**Medium Range** Ballistic Missile - MRBM)
- ❖ **Payload:** Around 1,000 Kg
- ❖ Agni-Prime may be **launched by train or road** and stored for an extended period of time.
- ❖ It can be used to target enemy ships in the **Indian Ocean**.

5. With reference to BrahMos missile, consider the following statements:

- (A) It is a hypersonic cruise missile.
(B) It is a joint venture of India and Russia.
(C) It can carry only conventional warheads.

Select the correct answer using the codes given below:

- (1) Only (A) is correct.
(2) Only (B) and (C) are correct.
(3) Only (A) and (C) are correct.
(4) Only (A) and (B) are correct.
(5) Question not attempted

Answer: (2)

Explanation:

- | | |
|-------|---|
| (A) X | BrahMos is a supersonic cruise missile (speed - Mach 2.8–3.0), not hypersonic. |
|-------|---|

Additional Information

BrahMos Missile

- ❖ A **supersonic**, anti-ship and land attack **cruise** missile.
- ❖ **India** (50.5%) and **Russia's** (49.5%) **Joint venture**
- ❖ It is named for rivers **Brahmaputra** (India) and **Moskva** (Russia)

❖ Key Features

- **Range - 290 Km** (short range), now **450 km** (post-MTCR membership in 2016).
- **Speed - 2.8 Mach** (supersonic)
- **Propulsion - Two-stage missile** (solid propellant engine in first stage and liquid ramjet in second stage).
- **Launch Platforms** - Land, Sea, Submarine, Air.
- **Warhead:** Only **Conventional** (200–300 kg), precision strike capability.

❖ Fire-and-forget missiles.

❖ India has exported the BrahMos to the **Philippines**.

BrahMos-NG (Next Generation)

- ❖ **Miniaturised, lighter version** of BrahMos.
- ❖ Designed for **air-launch** from platforms like **LCA Tejas**.
- ❖ **Speed:** Up to **Mach 3.5**.

BrahMos 2.0

- ❖ In development stage
- ❖ Range - 500-600 Km
- ❖ Speed - 7 Mach (**hypersonic**).

6. The S-400 air defence system used by India is popularly known as:

- (1) Vajra Dhanush
(2) Sudarshan Chakra
(3) Nagastra
(4) Akashteer
(5) Question not attempted

Answer: (2)

Explanation:-

- ❖ The S-400 Triumf is popularly known in India as "**Sudarshan Chakra**."

Additional Information

S-400 Triumph (SA-21 Growler)

- ❖ Mobile, **Long Range Surface-to-Air** (SAM) Missile System.
- ❖ Developed by **Russia** (Almaz Central Design Bureau).
- ❖ **Nickname:** "**Sudarshan Chakra**" in the Indian military - symbolizing **swift, precise, and powerful destruction**, like **Lord Vishnu's** divine weapon.
- ❖ **Key Features**
 - **Range:** Up to **400 km**.

**(2) Inheritance, Variation, Genetic Engineering and Biotechnology**

1. Match List I with List II :

List I (Cell organelles)	List II (Functions)
A. Nucleus	i. Protein production
B. Mitochondria	ii. DNA storage
C. Ribosomes	iii. Protein destruction
D. Lysosomes	iv. Energy production

Choose the correct answer from the options given below:

- (1) A-ii, B-iii, C-i, D-iv
- (2) A-i, B-ii, C-iii, D-iv
- (3) A-ii, B-iv, C-i, D-iii
- (4) A-iv, B-i, C-ii, D-iii
- (5) Question not attempted

Answer: (3)**Explanation:**

Cell organelles and their functions	
Nucleus	• DNA storage
Mitochondria	• Energy production (ATP) • Powerhouse of the cell
Ribosomes	• Protein production
Lysosomes	• Break down and recycle cellular waste (cell's digestive system) • Protein destruction • Suicide bags
Vacuole	• Store water, nutrients, and the waste materials of the cell

2. Consider the following statements regarding mitochondrial DNA (mtDNA):

(A) It is inherited only from the father in humans.

(B) It is circular in shape.

Which of the above statements is/are correct?

- (1) (A) Only
- (2) (B) Only
- (3) Both (A) and (B)
- (4) Neither (A) nor (B)
- (5) Question Not Attempted

Answer: (2)**Explanation:****(A) ✗**mtDNA is inherited exclusively from the **mother**, not the father.**(B) ✓**Human mitochondrial DNA is a small **circular** double-stranded DNA molecule.**Additional Information****Mitochondrial DNA (mtDNA)**

Aspect	Details
Location	Found in mitochondria (cell cytoplasm), separate from nuclear DNA.
Structure	Small, circular , double-stranded DNA (~16,500 base pairs; 37 genes in humans).
Genes (37)	13 proteins (oxidative phosphorylation) + 22 tRNAs + 2 rRNAs (mitochondrial protein synthesis). (mRNA → absent)
Inheritance	Maternal inheritance → transmitted almost exclusively from mother .
Function	Energy production (ATP), metabolism regulation, signaling, apoptosis (programmed cell death).
Differences from Nuclear DNA	- Separate genome, circular (vs linear in nucleus). - Lacks histones → mutates faster than nuclear DNA. - Smaller, limited coding capacity. - Inherited exclusively from the mother (Nuclear DNA → paternal + maternal).
Medical Importance	Mutations cause mitochondrial diseases (e.g., Leigh syndrome, MELAS).
Other Significance	Used in forensics (maternal lineages, degraded samples), ancestry studies , linked to aging & cancer .



3. Which of the following statements is NOT correct about DNA and RNA?
- (1) DNA is double-stranded; RNA is single-stranded.
 - (2) RNA contains thymine; DNA contains uracil.
 - (3) RNA is generally less stable than DNA.
 - (4) DNA has deoxyribose sugar; RNA has ribose sugar.
 - (5) Question Not Attempted

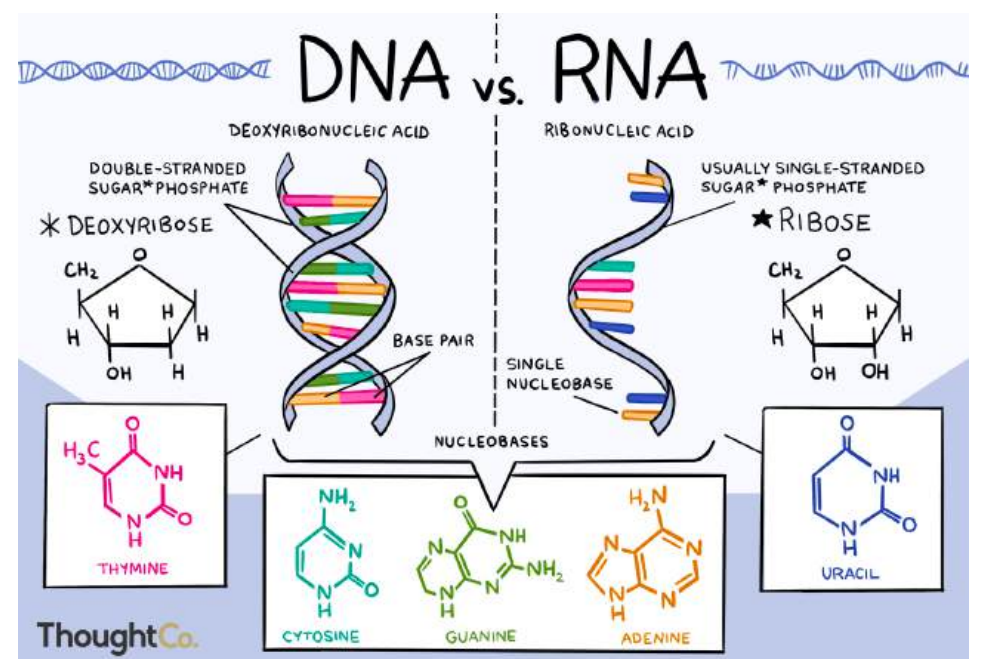
Answer: (2)

Explanation:

(1) ✓	DNA usually exists as a double helix; RNA is generally single-stranded.
(2) ✗	DNA contains Thymine (T), RNA contains Uracil (U).
(3) ✓	RNA has an extra –OH group, making it more reactive and less stable.
(4) ✓	DNA has deoxyribose sugar; RNA has ribose sugar.

Key Differences Between DNA and RNA

Feature	DNA (Deoxy ribonucleic Acid)	RNA (Ribonucleic Acid)
Sugar	Deoxyribose	Ribose
Structure	Double-stranded helix	Single-stranded
Nitrogen Bases	A, T, G, C	A, U, G, C (Uracil replaces Thymine)
Location	Nucleus & mitochondria	Nucleus, cytoplasm, ribosomes
Function	Long-term genetic storage	Helps in transfer and expression of information → Protein synthesis (mRNA, tRNA, rRNA)
Stability	More stable	Less stable (due to the presence of an extra -OH group), short-lived
Replication	Self-replicating	Synthesized from DNA



4. Genome sequencing refers to:
- (1) Studying the shape and structure of DNA molecules.
 - (2) Determining the precise order of nucleotides in the genome.
 - (3) Measuring the number of genes in a chromosome.
 - (4) Identifying the proteins synthesized by an organism.
 - (5) Question not attempted

Answer: (2)

Explanation:

Genome Sequencing

- ❖ **Genome sequencing** is the process of determining the **exact order of nucleotides** (A, T, C, G) in an organism's complete set of DNA.
- ❖ **Genome**: Organism's complete set of DNA.
 - Genome includes both **coding & non-coding DNA**.
- ❖ **Human genome** = ~3 billion base pairs across 23 pairs of chromosomes.
- ❖ **Whole Genome Sequencing (WGS)**: A laboratory method that reads the order of all four bases across the entire genome in a single process.

Additional Information

Other Important Terms

- ❖ **Chromosomes** - In the nucleus of each cell, the DNA molecule is packaged into thread-like structures called chromosomes.
- ❖ **Gene** – functional sequence of DNA.
- ❖ **Genotype** (backend) – pattern of genes in an organism's DNA responsible for particular traits.
- ❖ **Phenotype** (frontend) – observable physical properties of an organism.



(3) Nanotechnology

1. The term nanotechnology was first coined by:

- (1) Richard Feynman
- (2) Norio Taniguchi
- (3) K. Eric Drexler
- (4) C.N.R. Rao
- (5) Question not attempted

Answer: (2)

Explanation:

- ❖ The **term** nanotechnology was **coined** by Professor **Norio Taniguchi**.

Additional Information

Nanotechnology

- ❖ Nanotechnology involves the manipulation and control of matter at the nanoscale, typically in the **range of 1 to 100 nanometers**. (1 nm = 10^{-9} metres)
- ❖ The **properties** of nanomaterials are **different** from those of micromaterials or bulk materials **due to their size and surface effects**.
- ❖ **Richard Feynman** proposed the **concept of nanotechnology** in his research paper "**There's Plenty of Room at the Bottom (1959)**", but Japanese scientist **Norio Taniguchi** coined the term "**Nanotechnology**" in 1974 while describing precision machining at the nanoscale.

2. Consider the following:

- (A) CNTs are stronger than steel.
- (B) Graphene is transparent.
- (C) Fullerene is 2D in structure.

Which of the above options is/are correct?

- (1) (A) and (B) only
- (2) (B) and (C) only
- (3) (A) and (C) only
- (4) (A), (B) and (C)
- (5) Question not attempted

Answer: (1)

Explanation:

- | | |
|-------|--|
| (A) ✓ | Carbon Nanotubes (CNTs) have extremely high tensile strength and are stronger than steel while being much lighter. |
| (B) ✓ | Graphene is almost perfectly transparent and absorbs only about 2% of visible light. |

- | | |
|-------|--|
| (C) ✗ | Fullerene has a 3D cage-like or tubular structure , not a 2D structure. |
|-------|--|

Additional Information

Carbon Nanotubes (CNTs)

- ❖ Graphene can be rolled up to form CNTs which are **cylindrical in shape** with diameter in nanoscale.
- ❖ Properties:
 - High tensile strength (stronger than steel) and light-weight.
 - High electrical and thermal conductivity.
 - CNTs have a large surface area and are chemically stable.

Graphene

- ❖ An allotrope of carbon consisting of a **single layer** of Carbon atoms arranged in a **two-dimensional hexagonal (honeycomb) lattice**.
- ❖ Properties:
 - **Thinnest** compound (one atom thick).
 - **Lightest** material known
 - Strongest material discovered (between 100-300 times stronger than steel) yet more flexible than rubber.
 - **Best conductor of heat** at room temperature and **best conductor of electricity**.
 - Almost perfectly **transparent** as it **absorbs only 2% of light**.

Fullerene

- ❖ Fullerene is a family of carbon allotropes that consists of **cage-like or tubular** structures.
- ❖ The most well-known fullerene is **buckminsterfullerene (C60)**, which resembles a **soccer ball** with 60 carbon atoms forming pentagons and hexagons.
- ❖ Fullerenes, though not typically abundant, are **found naturally** in soot, volcanic eruptions, interstellar dust clouds and lightning strikes.



3. Cordy Gold Nanoparticles (Cor-AuNPs), recently patented internationally, were developed by Indian scientists for which purpose?

- (1) Drug delivery system
- (2) Space material strengthening
- (3) Quantum computing hardware
- (4) Nano-fertilizer development
- (5) Question Not Attempted

Answer: (1)

Explanation:

- ❖ Cor-AuNPs were developed to improve **drug delivery**, making medicines reach target sites faster, safer, and more effectively.

Additional Information

Cordy Gold Nanoparticles (Cor-AuNPs)

- ❖ Combination of Cordyceps fungi extract + gold nanoparticles.
- ❖ **Innovation:** Developed collaboratively by four Indian scientific institutions; recently patented internationally (Germany).
- ❖ **Applications:** Enhance **drug delivery** making it faster and safer inside the human body.
- ❖ **Significance:** Advances nanomedicine and targeted therapies.

4. With reference to Nano Urea Liquid, consider the following statements:

- (A) It was developed by Indian Council of Agriculture Research (ICAR) in 2022.
 - (B) It reduces the requirement of conventional urea by 50%.
 - (C) Its particle size is less than 100 nanometers.
- Which of the statements given above is/are correct?
- (1) (A) and (B) Only
 - (2) (B) and (C) Only
 - (3) (A) and (C) Only
 - (4) (A), (B) and (C)
 - (5) Question Not Attempted

Answer: (2)

Explanation:

(A) ✗	Nano Urea Liquid was developed by IFFCO (Indian Farmers Fertiliser Cooperative Limited) , not ICAR.
(B) ✓	One bottle of Nano Urea can replace approximately 50% of conventional urea requirement.

(C) ✓

Nano Urea particles are **less than 100 nm**, enabling better absorption and nutrient-use efficiency.

Additional Information

Nano Fertilizer

- ❖ Nano fertilisers are highly efficient types of fertilisers that provide nutrients like nitrogen to crops through fine granules.

Nano Urea Liquid

- ❖ Developed in **2022** by **Indian Farmers and Fertiliser Cooperative (IFFCO)** to replace conventional urea and reduce its requirement by 50%.
- ❖ Particle size < 100 nm → allows higher surface area → better absorption.

5. The Nano Filter for environmental purification was developed in collaboration between:

- (1) IFFCO and ICAR
- (2) ICAR and DRDO
- (3) IIT Madras and BHU
- (4) IIT Guwahati and IISc Bangalore
- (5) Question Not Attempted

Answer: (3)

Explanation:

- ❖ The Nano Filter was developed jointly by **IIT Madras** and **Banaras Hindu University (BHU)** for environmental purification.

Additional Information

Nano Filter

- ❖ **Developers:** IIT Madras & BHU.
- ❖ **Type:** Nanotechnology-based Advanced **filtration/purification**.
- ❖ **Function:** Removes **contaminants, heavy metals, pathogens** from water/soil.
- ❖ **Application:**
 - **Clean drinking water solutions** in rural areas.
 - Agricultural use to reduce heavy-metal contamination in irrigation.



6. With reference to NANOPTA, consider the following statements:

- (A) It is a Phospores-based nanozyme that mimics natural oxidases.
- (B) It is used only in industrial wastewater treatment.
- (C) It has potential diagnostic applications in neurodegenerative diseases.

Which of the above is/are correct?

- (1) (A) and (C) Only
- (2) (B) and (C) Only
- (3) (C) Only
- (4) (A), (B) and (C)
- (5) Question Not Attempted

Answer: (3)

Explanation:

(A) ✗	NANOPTA is a Platinum-based synthetic nanozyme , not phosphorus-based.
(B) ✗	Besides environmental applications, it also has biomedical and diagnostic applications .
(C) ✓	It can detect neurotransmitters like dopamine and adrenaline, helping in diagnosis of diseases such as Parkinson's and Alzheimer's.

Additional Information

NANOPTA (Platinum-based Synthetic Nanozyme)

- ❖ **Nature:** Platinum-containing synthetic nanozyme (artificial enzyme).
- ❖ **Function:** Mimics oxidase enzymes - removes hydrogen from substrates in oxygen's presence, producing water.
- ❖ **Applications**
 - **Environmental Use**
 - Can **oxidise pollutants** in **industrial wastewater**.
 - Works in the presence of **sunlight** → reduces **wastewater toxicity**.
 - **Highly robust** → withstands **pH & temperature variations**.
 - **Biomedical Use**
 - Can oxidise neurotransmitters (**dopamine, adrenaline**) → leads to **colour change** in solution.

- Enables **measurement of neurotransmitter levels**.
- Potential application in **diagnosis of neurodegenerative diseases** like **Parkinson's & Alzheimer's**.

7. Who is known as the "Father of Indian Nanotechnology" and leads the Nano Mission Council?

- (1) Dr. Anil Kakodkar
- (2) Prof. C.N.R. Rao
- (3) K. Kasturirangan
- (4) Dr. A.P.J. Abdul Kalam
- (5) Question Not Attempted

Answer: (2)

Explanation:

(1) ✗	Dr. Anil Kakodkar is a renowned nuclear scientist and former Chairman of the Atomic Energy Commission.
(2) ✓	Prof. C.N.R. Rao is known as the " Father of Indian Nanotechnology " and heads the Nano Mission Council (NMC) under the Nano Mission.
(3) ✗	K. Kasturirangan is a distinguished space scientist and former ISRO Chairman.
(4) ✗	Dr. Kalam is known as the " Missile Man of India " and former President of India.

Additional Information

Nano Mission (India)

- ❖ **Launch:** 2007, by Department of Science & Technology (DST).
- ❖ **Leadership:** Directed by **Nano Mission Council (NMC)** under **Prof. C.N.R. Rao** (Father of Indian Nanotechnology).
- ❖ **Objectives:**
 - Building research infrastructure
 - Developing human resources
 - Fostering public-private partnerships
 - Developing international partnerships.



**(5) Computers, Information and Communication Technology**

1. Arrange the following computer generations in chronological order of development:

- (A) Integrated Circuits (IC)
- (B) Vacuum Tubes
- (C) Microprocessors
- (D) Transistors

Options:

- (1) (B) → (D) → (A) → (C)
- (2) (D) → (B) → (A) → (C)
- (3) (B) → (A) → (D) → (C)
- (4) (C) → (A) → (B) → (D)
- (5) Question not attempted

Answer: (1)

Explanation:

Example	Generation
(A) Integrated Circuits (IC)	III
(B) Vacuum Tubes	I
(C) Microprocessors	IV
(D) Transistors	II

Additional Information

Comparative table summarizing the generations of computers based on hardware technology and system examples:

Table 2.1 Generations of computer

Generations	Hardware Technology	Systems Examples
First Generation (1942–1954)	Main electronic component: vacuum tubes Input/Output device: punch card	ENIAC, EDVAC, EDSAC, UNIVAC, IBM 701
Second Generation (1955–1964)	Main electronic component: transistors Input/Output device: floppy disk and tape	IBM 7030, IBM 7094, IBM 1400 series, CDC 164, UNIVAC series
Third Generation (1964–1975)	Main electronic component: integrated circuits (IC) Input/Output device: keyboard and mouse as input device, high capacity disk for secondary storage	IBM 360/370, UNIVAC 1108, UNIVAC AC 9000, PDP 11, CDC 6600
Fourth Generation (1975–Present)	Very large scale integrated circuits (VLSI) technology, microprocessor Input/Output device: keyboard and mouse as input device, high capacity disk for secondary storage	STAR 1000, CRAY-X-MP (super computer), DEC 10, PDP 11 CRAY-1, IBM 4341, ALTAIR 8800, Apple computers, VAX9000
Fifth Generation (Present–Future)	These machines will incorporate bio-chip and VVLSI (very very large scale integration) or ultra-large scale integration (ULSI) artificial intelligence (AI)	IBM notebooks, Pentium PCs, SUN workstations

2. According to functioning, which of the following is not a category of computers ?

- (1) Digital
- (2) Analog
- (3) Hydrobid
- (4) Hybrid
- (5) Question not attempted

Answer: (3)

Explanation:

❖ **Hydrobid** is not a standard computer classification.

Additional Information**Classification of Computers****1. On the Basis of Application/Functioning****a. Analog Computers**

- i. Work with continuous data.
- ii. Example: Speedometer, Thermometer.

b. Digital Computers

- i. Work with discrete (binary) data (0s and 1s).
- ii. Example: PCs, Laptops.

c. Hybrid Computers

- i. Combine features of analog and digital computers.
- ii. Example: ECG machines in hospitals.

2. On the Basis of Size**d. Microcomputers**

- i. Smallest, designed for individual users.
- ii. **Subclassification:** Desktop computer, Laptop computer, Palmtop computer, Notebook, Tablet computer

e. Minicomputers

- i. Mid-sized, less powerful than mainframes but serve multiple users.
- ii. Used in industries and small organizations.

f. Mainframe Computers

- i. Large and powerful, used by big organizations for bulk data processing.
- ii. Examples: Banking, Railway reservations.

g. Supercomputers

- i. Most powerful and fastest computers.





- ii. Used for weather forecasting, nuclear simulations, space research.
- iii. Example: **CRAY X-MP**, **PARAM**, Summit.

3. On the Basis of Purpose

h. General Purpose Computers

- i. Designed to perform a wide variety of tasks.
- ii. Examples: Personal Computers (PCs), Laptops.

i. Special Purpose Computers

- i. Designed to perform a specific task.
- ii. Examples: Embedded Systems, Weather Forecasting Computers.

3. With reference to National Supercomputing Mission (NSM), consider the following statements:

- (A) It was launched in 2015 for a period of 7 years with an outlay of ₹4,500 crore.
- (B) It is implemented by the National Informatics Centre (NIC).
- (C) The mission aims to establish more than 70 High-Performance Computing (HPC) facilities across India.

Which of the statements given above are **correct**?

- (1) (A) and (B) only
- (2) (B) and (C) only
- (3) (A) and (C) only
- (4) All of the above
- (5) Question not attempted

Answer: (3)

Explanation:

(A) ✓	NSM was launched in 2015 for 2015–2022 (7 years) with an approved outlay of ₹4,500 crore .
(B) ✗	NSM is implemented by C-DAC (Pune) and IISc Bengaluru , not NIC.
(C) ✓	One of the main objectives is to connect institutions through 70+ HPC facilities via the National Knowledge Network (NKN).

Additional Information

National Supercomputing Mission (NSM)

- ❖ **Launched:** In **2015** (For 7 years 2015-2022) (Budget: ₹4,500 crore)
- ❖ **Aim:** To connect national academic and R&D institutions with a grid (**National Knowledge Network**) of more than 70 high-performance computing facilities.
- ❖ **Objectives:** Create an ecosystem for positioning India as a major power for supercomputing and attain global competitiveness and self-reliance in HPC.
- ❖ **Leadership** → Department of Science & Technology (DST) + Ministry of Electronics & IT (MeitY)
- ❖ **Implemented by** → C-DAC (Pune) & IISc (Bengaluru)
- ❖ **Achievements of the mission**
 - A total capacity of **24.83 PF** HPC machines are built. [Example: PARAM Siddhi-AI (5.26 petaflops, among Top 100 globally, PARAM Pravega (3.3 petaflops, IISc Bengaluru), PARAM Shivay (IIT-BHU), PARAM Shakti (IIT-Kharagpur)]
 - Development of **Rudra server board 1.0**, **Trinetra HPC interconnects**, HPC system software stack 1.1 and various benchmarks (cloud, HPC) applications.
 - So far 17,500 people have been trained in High Performance Computing (HPC).

4. In a computer system, the CPU consists of:

- (1) Registers, Arithmetic Logic Unit (ALU), Control Unit (CU)
- (2) Memory Unit, Input Unit, Output Unit
- (3) Hard Disk, SSD, RAM
- (4) Monitor, Mouse, Keyboard
- (5) Question not attempted

Answer: (1)

Explanation:

CPU Components:

1. Registers:

- a. Local memory within the CPU for temporarily storing data, instructions, and intermediate results.



- b. Registers are limited in size and number. It is **fastest** but also **smallest** in size.

2. Arithmetic Logic Unit (ALU):

- a. Executes all arithmetic and logical operations required by the program.

3. Control Unit (CU):

- a. Oversees sequential instruction execution.
b. Interprets instructions and manages data flow between memory, the ALU, and input/output devices.

Additional Information

Central Processing Unit (CPU)

- ❖ The **CPU** (Central Processing Unit) is the "**brain**" of a computer.
- ❖ The CPU is fabricated as a single Integrated Circuit (IC) and is also known as **microprocessor**.
- ❖ The CPU works in tandem with the memory and input/output units to ensure smooth operation of the system.

Functions of the CPU:

1. The CPU retrieves program instructions and data from the memory.
2. It performs all arithmetic and logical operations specified in the instructions.
3. The processed results are stored back in the memory.

5. Which memory unit is typically non-volatile and used for permanent storage in computers?
- (1) Registers
 - (2) Cache
 - (3) RAM
 - (4) Hard Disk Drive
 - (5) Question not attempted

Answer: (4)

Explanation:

(1) ✗	Registers are the fastest CPU memory but are volatile and temporary .
(2) ✗	Cache stores frequently used data temporarily and is volatile.

- (3) ✗ RAM is primary memory and loses data when power is turned off.

- (4) ✓ HDD is non-volatile secondary storage and permanently stores data.

Additional Information

1. **Registers:** These are the **smallest** and **fastest** storage units, located directly on the CPU. They are **volatile**.
2. **Cache:** This is a small, very fast memory that stores frequently accessed data from RAM to speed up the CPU. It's also **volatile**.
3. **RAM (Random Access Memory):** This is the main memory, providing fast but temporary access for the CPU. It's **volatile**.
4. **Hard Disk Drive (HDD) / Solid State Drive (SSD):** These are forms of **secondary storage**. They are the **largest** and **slowest units** in the hierarchy, but they are **non-volatile**, making them **ideal for storing data permanently**, like the operating system, applications, and user files. They retain data even when the computer is shut down.

6. Which of the following statements about RAM and ROM are correct?
- (A) ROM is volatile memory.
 - (B) RAM is non-volatile memory.
 - (C) Data in RAM is erased when power is switched off.
 - (D) ROM can be frequently rewritten by the user.

Options:

- (1) (A) and (B) Only
- (2) (A), (B) and (C) Only
- (3) (C) only
- (4) (C) and (D) Only
- (5) Question not attempted

Answer: (3)

Explanation:

(A) ✗	ROM is non-volatile memory.
(B) ✗	RAM is volatile memory.
(C) ✓	RAM requires continuous power to retain data.



(D) X

ROM is primarily read-only. Some types (EEPROM) can be rewritten, but not frequently by ordinary users.

Comparison of RAM and ROM	
RAM	ROM
Random Access Memory. (It is a read/write type of memory and thus can be read and written by the user.)	Read Only Memory. (User can read only, not able to write)
It is Volatile or temporary memory.	It is Non Volatile or permanent memory.
Data gets erased when power supply is off.	Data stored permanently.
Faster memory.	Slow memory.
It is used in normal operations after OS loading.	A ROM chip is used during computer startup (BIOS - Basic Input Output System).
Types: 1. SRAM (Static RAM) 2. DRAM (Dynamic RAM)	Types: 1. PROM (Programmable ROM) 2. EPROM (Erasable PROM) 3. EEPROM (Electrically Erasable PROM)

7. Which of the following units of computer memory is wrongly paired?
- (1) 1024 TB (Terabyte) = 1 PB (Petabyte)

(2) 1024 GB (Gigabyte) = 1 TB (Terabyte)

(3) 8 bits = 4 Nibble

(4) 1024 KB (Kilobyte) = 1 MB (Megabyte)

(5) Question not attempted

Answer: (3)

Explanation:

- ❖ 1 Nibble = 4 bits, therefore, 8 bits = 2 Nibbles, not 4 Nibbles.

Additional Information

Basic Units of Memory Measurement

❖ Bit is the **smallest unit** capable of storing information. Each bit operates as a binary switch, effectively storing a single value of either 0 or 1.

❖ **GeopByte** is the **highest** memory measurement unit.

❖ A byte can represent 256 (0-255 or 2^8) distinct values.

❖ **Word:** A Word is a fixed length sequence of bits which the processor can handle at a time.

➤ Group of bits on which the CPU can work as a single unit. Can be 8 bits, 16 bits, 32 bits or 64 bits depending on CPU Architecture.

❖ Bit < Nibble < Byte < Kilobyte < Megabyte < Gigabyte < Terabyte < Petabyte < Exabyte < Zettabyte < Yottabyte.

Memory Unit	Equivalent
1 Bit	0 or 1 (Binary Digit)
4 Bits	1 Nibble
8 Bits	1 Byte (2 Nibbles)
1024 Bytes	1 KB (Kilobyte)
1024 KB	1 MB (Megabyte)
1024 MB	1 GB (Gigabyte)
1024 GB	1 TB (Terabyte)
1024 TB	1 PB (Petabyte)
1024 PB	1 EB (Exabyte)
1024 EB	1 ZB (Zettabyte)
1024 ZB	1 YB (Yottabyte)
1024 YB	1 Brontobyte
1024 BB	1 Geopbyte (largest unit)

**(6) Contribution of Indians in Science & Technology**

1. The mathematical treatise 'Lilavati' forms the first section of the monumental work 'Siddhanta Shiromani'. Which scholar authored this text?

- (1) Bhaskara II
- (2) Brahmagupta
- (3) Bhaskara I
- (4) Sangamagrama Madhavan
- (5) Question not attempted

Answer: (1)

Explanation:

- ❖ "Lilavati" is the first section of Siddhanta Shiromani, authored by **Bhaskara II**.

Additional Information
Bhaskara II (Bhaskaracharya - 1114–1185 CE) ❖ A 12th-century mathematician who authored the Siddhanta Shiromani (Crown of Treatises), which consists of four parts: Lilavati, Bijaganita, Grahaganita, and Goladhyaya. ❖ Faizi translated Bhaskara's Bijaganit during the Mughal period. ❖ He is credited as a pioneer in discovering the principles of differential calculus.

2. Which combination of cities correctly represents the locations where Maharaja Sawai Jai Singh-II established the five astronomical observatories known as Jantar Mantars?

- (1) Delhi, Indore, Varanasi, Ujjain, Jaipur
- (2) Delhi, Ujjain, Varanasi, Mathura, Jaipur
- (3) Agra, Ujjain, Varanasi, Mathura, Jodhpur
- (4) Delhi, Ujjain, Prayagraj, Mathura, Jaipur
- (5) Question not attempted

Answer: (2)

Explanation:

- ❖ **Maharaja Sawai Jai Singh-II** established five astronomical **observatories** (Jantar Mantar) in **Delhi, Ujjain, Varanasi, Mathura, and Jaipur**.

3. Consider the following pairs of ancient texts and their authors:

- (A) Hayayurveda - Salihotra
- (B) Gajayurveda - Palakapya
- (C) Mrga-paksi-sastra - Vrinda
- (D) Siddhayoga - Hamsadeva

How many pairs given above are **correctly** matched?

- (1) Only one pair
- (2) Only two pairs
- (3) Only three pairs
- (4) All four pairs
- (5) Question not attempted

Answer: (2)

Explanation:

Ancient Text	Author
Hayayurveda	Salihotra
Gajayurveda	Palakapya
Mrga-paksi-sastra	Hamsadeva
Siddhayoga	Vrinda

Additional Information
Veterinary Science ❖ Hayayurveda by Salihotra: Focused on the treatment and anatomy of horses. ❖ Gajayurveda by Palakapya: Devoted to the treatment of elephants. ❖ Hamsadeva compiled Mrga-paksi-sastra (13th century), a work on hunting animals and birds. Chemistry and Metallurgy ❖ Key treatises include Siddhayoga by Vrinda and Chakradatta by Chakrapani Dutta → Focused heavily on synthetic metallic preparations. Both acknowledged Nagarjuna as an authority. ❖ Nagarjuna, author of Rasaratnakara, and Rasa Vagbhata (Rasaratna Samuccaya) were prominent figures.

4. Which pair of mathematical treatises was authored by the notable figure Narayana Pandit?

- (1) Suddhantadipika and Lilavati Vyakhya
- (2) Rasaratnakara and Rasarnava
- (3) Siddhayoga and Chakradatta
- (4) Ganitakaumudi and Bijaganitavatamsa
- (5) Question not attempted

Answer: (4)

Explanation:

(1) X	Suddhantadipika and Lilavati Vyakhya: These works were written by Gangadhara , not Narayana Pandit.
(2) X	Rasaratnakara (Nagarjuna) and Rasarnava: These are works related to Rasashastra



	(Alchemy/Chemistry).
(3) X	Siddhayoga by Vrinda and Chakradatta by Chakrapani Dutta : These are famous Ayurvedic medical texts .
(4) ✓	Both mathematical works were authored by Narayana Pandit .

Additional Information

Mathematics and Astronomy

- ❖ Notable figures like **Narayana Pandit** (**Ganitakaumudi** and **Bijaganitavatamsa**) and **Gangadhara** (**Lilavati Karamdipika**, **Suddhantadipika**, and **Lilavati Vyakhya**) made significant contributions.
- ❖ **Mahendra Suri** developed the astronomical instrument "**Yantraja**".

5. Maharshi Kanad formulated an atomic theory proposing indestructible particles called 'parmanu'. He is famously associated with founding which orthodox school of Indian philosophy?

- (1) Mimamsa
- (2) Samkhya
- (3) Nyaya
- (4) Vaisheshika
- (5) Question not attempted

Answer: (4)

Explanation:

- ❖ Maharishi Kanada is regarded as the founder of the **Vaisheshika** school of Indian philosophy, which propounded the concept of indivisible particles called **Paramanu** (atoms).

Additional Information

Maharshi Kanad

- ❖ Founded the **Vaisheshika school**.
- ❖ Recognized for its naturalism and early physics.
- ❖ Formulated an atomic theory centuries before John Dalton, proposing that all matter consists of indestructible, invisible particles called **parmanu** (atoms).

6. Consider the following statements:

- (A) **Aryabhata** was the first to propose that the Earth rotates on its axis, causing day and night.
- (B) **Brahmagupta** defined the rules for arithmetic operations involving zero and negative numbers.
- (C) **Bhaskara II** founded the **Kerala School** of

Mathematics.

Which of the statements given above are correct?

- (1) (A) Only
- (2) (A) and (B) only
- (3) (B) and (C) only
- (4) All of the above
- (5) Question not attempted

Answer: (2)

Explanation:

(A) ✓	Aryabhata proposed that the earth rotates on its axis (causing day/night) and he provided the scientific explanation for solar and lunar eclipses .
(B) ✓	In Brahmasphutasiddhanta , Brahmagupta gave systematic rules computations involving zero (as a number) and negative numbers.
(C) X	Kerala School was founded by Sangamagrama Madhava , not Bhaskara II .

Additional Information

Aryabhata (c. 476–550 CE)	• Wrote the Aryabhatiya. • He used 'zero' as a placeholder in calculations and precisely calculated the value of Pi as 3.1416.
Bhaskara II (Bhaskaracharya) (c. 1114–1185 CE)	• A 12th-century mathematician who authored the Siddhanta Shiromani (Crown of Treatises), which consists of four parts: Lilavati, Bijaganita, Grahaganita, and Goladhyaya. Faizi translated Bhaskara's Bijaganit during the Mughal period. • He is credited as a pioneer in discovering the principles of differential calculus.
Sangamagrama Madhavan (c. 1340–1425 CE)	• He founded the famous Kerala School of Mathematics. • He introduced the concept of infinity to mathematics and formulated infinite series for trigonometric functions (sine and cosine), laying the groundwork for calculus long



before Newton and Leibniz.

7. Match List I (Scientist) with List II (Epithet/Title) and select the correct answer using the code given below:

List I (Scientist)	List II (Epithet/Title)
A. Acharya Prafulla Chandra Ray	i. Father of Indian Nanotechnology
B. Shanti Swaroop Bhatnagar	ii. Father of the Indian Nuclear Programme
C. C.N.R. Rao	iii. Father of Indian Chemistry
D. Homi J. Bhabha	iv. Father of Research Laboratories in India

Codes:

- (1) A-iii, B-iv, C-i, D-ii
 (2) A-iv, B-iii, C-ii, D-i
 (3) A-iii, B-i, C-iv, D-ii
 (4) A-iv, B-i, C-iii, D-ii
 (5) Question not attempted

Answer: (1)

Explanation:

List I (Scientist)	List II (Epithet/Title)
A. Acharya Prafulla Chandra Ray	iii. Father of Indian Chemistry
B. Shanti Swaroop Bhatnagar	iv. Father of Research Laboratories in India
C. C.N.R. Rao	i. Father of Indian Nanotechnology
D. Homi J. Bhabha	ii. Father of the Indian Nuclear Programme

8. Dr. Daulat Singh Kothari, born in Udaipur, Rajasthan, played a pivotal role in shaping modern India. Which of the following achievements is/are attributed to him?

- (A) He served as the first Scientific Advisor to the Ministry of Defence from 1948 to 1961.
 (B) He chaired the Kothari Commission for modernizing India's education system.

Select the correct answer using the code given below:

- (1) (A) Only
 (2) (B) Only
 (3) Both (A) and (B)
 (4) Neither (A) nor (B)
 (5) Question not attempted

Answer: (3)

Explanation:

(A) ✓	He was India's first Scientific Advisor to the Ministry of Defence and laid the foundation of defence science research.
(B) ✓	He headed the Education Commission (1964-66), popularly known as the Kothari Commission.

Additional Information

Daulat Singh Kothari (1906, Udaipur, Rajasthan)

- ❖ First **Scientific Advisor to the Ministry of Defence** (1948-1961).
- ❖ Chaired the **Kothari Commission (1964-66)** for modernizing India's education system.
- ❖ Key role in establishing the **UGC** and **NCERT**.
- ❖ Internationally recognized for research in **statistical thermodynamics and astrophysics**.

9. With reference to India's nuclear and particle physics initiatives, consider the following statements:

- (A) "Apsara," commissioned in 1956, was India's first nuclear fission reactor.
 (B) India is a contributing member of the international ITER project, which focuses on advanced nuclear fission technology.
 (C) India is actively involved in global particle physics experiments, including contributions to CERN and the establishment of a LIGO observatory.

Which of the statements given above are correct?

- (1) (A) and (B) only
 (2) (B) and (C) only
 (3) (A) and (C) only
 (4) All of the above
 (5) Question not attempted

Answer: (3)

Explanation:

(A) ✓	Apsara (1956) was India's first nuclear research reactor (at Bhabha Atomic Research Centre). It was also the first nuclear reactor in Asia outside the Soviet Union.
(B) ✗	The ITER (International Thermonuclear Experimental Reactor) project is focused on nuclear fusion , not fission.
(C) ✓	India is actively involved in global particle physics experiments, including contributions to CERN (became Associate Member in 2017) and the establishment of a LIGO observatory