

# TNPSC Group I — General Science

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## A. Quick Revision Notes

### Physics — mechanics, heat, light, electricity

Newton's laws: inertia; force = mass times acceleration ( $F = ma$ ); action equals reaction. SI base units: metre, kilogram, second, ampere, kelvin. Work = force times distance; power = work/time (watt); energy in joules — kinetic energy =  $1/2$  times  $m$  times  $v$  squared, potential energy =  $mgh$ . Acceleration due to gravity  $g = 9.8$  m/s squared. Heat transfers by conduction, convection and radiation;  $0$  degrees C =  $273$  K. Light shows reflection and refraction (Snell's law); the visible spectrum is VIBGYOR; light speed is about  $3$  times  $10^8$  m/s. Electricity: Ohm's law  $V = IR$ ; power =  $VI$ ; energy is billed in kilowatt-hours.

### Chemistry — elements, acids & bases, metals

Matter exists as solid, liquid or gas. An atom has protons, neutrons and electrons; the atomic number equals the number of protons. The modern periodic table (Moseley) arranges elements by atomic number into groups and periods; Mendeleev's earlier table used atomic mass. Acids have pH below  $7$ , taste sour and turn blue litmus red (HCl,  $H_2SO_4$ ); bases have pH above  $7$ , feel soapy and turn red litmus blue (NaOH); pH  $7$  is neutral; acid plus base gives salt and water (neutralisation). Metals are lustrous, malleable conductors; alloys include brass (copper + zinc) and steel (iron + carbon).

### Biology — cell, human body, plants

The cell is the basic unit of life; Robert Hooke first observed cells in cork (1665). Cells are prokaryotic or eukaryotic. Organelles: nucleus (control centre), mitochondria (the 'powerhouse', makes ATP), chloroplast (photosynthesis, in plants), ribosomes (protein synthesis). Human systems include digestive, respiratory (lungs), circulatory (a four-chambered heart; blood groups A, B, AB, O and Rh), nervous (brain and neurons) and excretory (kidneys). In plants, photosynthesis converts carbon dioxide and water into glucose and oxygen using chlorophyll and sunlight; transpiration is water loss through leaves.

### Nutrition, health & diseases

Balanced nutrition needs carbohydrates, proteins, fats, vitamins, minerals and water. Vitamin deficiencies: A causes night blindness, B1 beriberi, C scurvy, D rickets, and B12 anaemia. Diseases are communicable — bacterial (tuberculosis, cholera, typhoid), viral (polio, measles, dengue spread by *Aedes* mosquito) and protozoan (malaria by the female *Anopheles* mosquito) — or non-communicable (diabetes, hypertension, heart disease). Immunisation uses vaccines; Edward Jenner developed the smallpox vaccine. Iodised salt prevents goitre. Proteins build and repair tissue; carbohydrates and fats provide energy.

### Environment & biodiversity

An ecosystem has biotic and abiotic parts connected through food chains and webs. Biodiversity is the variety of life; India is a megadiverse country with hotspots in the Western Ghats, the Eastern Himalaya, Indo-Burma and Sundaland. Conservation is in-situ — national parks, wildlife sanctuaries, biosphere reserves, Project Tiger (1973) and Project Elephant — and ex-situ, such as zoos and seed banks. The IUCN Red List grades species as endangered, vulnerable and so on. The Wildlife Protection Act 1972 safeguards species. Nutrients recycle through the carbon and nitrogen cycles.

### Science & technology developments

ISRO was formed in 1969; Vikram Sarabhai is called the father of India's space programme, and Aryabhata was the first Indian satellite (1975). Homi Bhabha is the father of India's nuclear programme; the first reactor was Apsara and nuclear tests were held at Pokhran in 1974 (Smiling Buddha) and 1998. DRDO develops missiles such as Agni and Prithvi; A.P.J. Abdul Kalam is known as the 'Missile Man'. National research bodies include CSIR, ICAR (agriculture), ICMR (medicine) and C-DAC (PARAM supercomputers). The Green Revolution and IT revolution transformed the economy.

### Space & defence technology

ISRO's launch vehicles include the reliable PSLV (the 'workhorse'), the GSLV and the heavy-lift LVM3/GSLV Mk-III. Missions: Chandrayaan-1 (2008) detected water on the Moon; the Mars Orbiter Mission/Mangalyaan (2013) made India the first country to reach Mars orbit on its first attempt; Chandrayaan-3 (2023) soft-landed near the lunar south pole, a world first. Satellite series include INSAT (communication), IRS (remote sensing) and NavIC (regional navigation). Defence systems: DRDO's Agni, Prithvi and BrahMos missiles and the Tejas light combat aircraft.

### Everyday applications of science

A pressure cooker cooks faster because higher pressure raises water's boiling point. A thermos flask uses a vacuum to block conduction and convection. LPG cooking gas is mainly butane and propane. A refrigerator cools by evaporation of a refrigerant. Optical fibres carry signals by total internal reflection. Soaps and detergents clean by emulsifying oil and grease. A fuse wire melts to protect circuits from overload. Iodised salt prevents goitre. Baking soda is sodium bicarbonate. Ripening of fruit is hastened by the gas ethylene. A lightning conductor safely earths lightning.

## B. Practice MCQs (25)

### 1. India's Chandrayaan-3 mission achieved which historic milestone in August 2023?

- (A) Discovery of water ice in permanently shadowed craters
- (B) First Indian astronaut landing on the Moon
- (C) First lunar orbit insertion by an Indian spacecraft
- (D) Soft landing near the Moon's south pole — making India the first country to do so

### 2. What is CRISPR-Cas9 technology primarily used for?

- (A) Measuring cosmic radiation in deep space
- (B) Precise editing of DNA sequences in living organisms
- (C) Manufacturing semiconductor chips at nanoscale
- (D) Developing quantum computing algorithms

### 3. India's three-stage nuclear power programme, conceived by Homi Bhabha, is designed to ultimately use which fuel?

- (A) Plutonium imported from Russia
- (B) Uranium-235 imported from the USA
- (C) Thorium-232, which India has in large reserves
- (D) Hydrogen fusion from ocean water

### 4. The 'Paris Agreement' (2015) on climate change set a global temperature goal of:

- (A) Limiting warming to well below 2°C, pursuing efforts to limit to 1.5°C
- (B) Stabilising temperatures at current 2015 levels
- (C) Limiting warming to 1°C above pre-industrial levels
- (D) Reducing warming by 2°C from current levels by 2100

### 5. Which Indian Space Research Organisation mission successfully performed a Gravity Assist manoeuvre around Mars in 2014?

- (A) GSAT-30
- (B) Aditya-L1
- (C) Chandrayaan-2
- (D) Mars Orbiter Mission (Mangalyaan)

### 6. Biodiversity hotspots are defined as areas having:

- (A) High species diversity and no human disturbance
- (B) UNESCO World Heritage status and high rainfall
- (C) More than 10,000 animal species regardless of plant diversity
- (D) At least 1,500 endemic plant species and having lost over 70% of original habitat

### 7. The Intergovernmental Panel on Climate Change (IPCC) AR6 Synthesis Report (2023) concluded that global warming is:

- (A) Uncertain and still being studied
- (B) Primarily driven by natural solar cycles
- (C) Unequivocally caused by human activities
- (D) Within safe limits and not requiring urgent action

**8. What is the purpose of India's Agni-V ballistic missile?**

- (A) Submarine-launched cruise missile for coastal defence
- (B) Anti-satellite (ASAT) capability
- (C) Surface-to-air interception of enemy aircraft
- (D) Inter-Continental Ballistic Missile with range over 5,000 km

**9. Photosynthesis in C4 plants (like maize and sugarcane) is more efficient than in C3 plants because:**

- (A) C4 plants concentrate CO<sub>2</sub> at the site of the Calvin cycle, suppressing photorespiration
- (B) C4 plants can photosynthesise at night using stored energy
- (C) C4 plants fix nitrogen from the atmosphere along with carbon
- (D) C4 plants have more chlorophyll per leaf area

**10. India's LCA Tejas is significant because it is:**

- (A) A supersonic cruise missile jointly developed with Russia
- (B) India's first geostationary meteorological satellite
- (C) A light combat aircraft developed indigenously by HAL for the Indian Air Force
- (D) India's first indigenous nuclear submarine

**11. The term 'Anthropocene' in geology refers to:**

- (A) The period of prehistoric human evolution from apes to Homo sapiens
- (B) An era of increased meteorite impacts on Earth
- (C) The proposed current geological epoch characterised by dominant human impact on Earth systems
- (D) The geological epoch beginning at the end of the last Ice Age

**12. Antimicrobial Resistance (AMR) is considered a major global health threat because:**

- (A) It makes vaccines ineffective
- (B) Bacteria evolve to resist antibiotics, making common infections untreatable
- (C) It primarily affects only immunocompromised patients
- (D) It is caused by excessive vaccination programmes

**13. Which of the following is a correct statement about mRNA vaccines (as used for COVID-19)?**

- (A) They introduce a fragment of viral protein directly into the bloodstream
- (B) They require live attenuated virus and cannot be produced quickly
- (C) They alter the human DNA in the nucleus
- (D) They deliver genetic instructions for cells to produce a viral protein, triggering immune response

**14. India's first solar mission, Aditya-L1, is positioned at:**

- (A) The Moon's surface after Chandrayaan-3
- (B) The Lagrange Point L1 between Earth and Sun, approximately 1.5 million km from Earth
- (C) Mars orbit to study solar flares
- (D) Low Earth Orbit to observe the Sun

**15. The Western Ghats are considered a biodiversity hotspot primarily because:**

- (A) They are designated as UNESCO World Heritage Sites only for cultural heritage
- (B) They are home to very high levels of endemic species and are under severe human pressure
- (C) They have the highest rainfall in India
- (D) They contain all of India's tiger reserves

**16. What is meant by 'Net Zero' emissions target?**

- (A) Reducing emissions by exactly 50% from 1990 levels
- (B) Balancing emitted GHGs with equivalent removal, so the net addition to the atmosphere is zero
- (C) Producing zero greenhouse gases from any source
- (D) Eliminating all fossil fuel use within national borders

**17. 5G technology differs from 4G primarily in:**

- (A) Using satellite connectivity instead of ground towers
- (B) Providing only voice calls without internet data
- (C) Significantly higher data speeds, lower latency, and massive device connectivity
- (D) Being limited to military and government use

**18. The 'One Health' approach to disease prevention recognises that:**

- (A) Human, animal, and environmental health are deeply interconnected and must be addressed together
- (B) All new diseases originate from laboratory accidents
- (C) Zoonotic diseases can only emerge from domestic livestock
- (D) Human health can be treated in isolation from environmental and animal health

**19. Quantum computing differs from classical computing primarily because:**

- (A) Quantum computers work only at room temperature
- (B) Quantum computers are faster versions of existing silicon chips
- (C) Quantum computers use light instead of electricity
- (D) Quantum bits (qubits) can exist in superposition of 0 and 1 simultaneously, enabling parallel computation

**20. The National Mission for Clean Ganga (NMCG) was launched under which broader programme?**

- (A) Swachh Bharat Mission (2014)
- (B) Jal Jeevan Mission (2019)
- (C) National Water Mission under NAPCC
- (D) Namami Gange Programme (2014)

**21. What type of lens is used to correct the vision defect known as Myopia (nearsightedness)?**

- (A) Convex lens
- (B) Bifocal lens
- (C) Concave lens
- (D) Cylindrical lens

**22. Which of the following physical quantities remains constant for a body moving along a horizontal circular path at a uniform speed?**

- (A) Acceleration
- (B) Velocity
- (C) Kinetic Energy
- (D) Displacement

**23. The total resistance of three resistors of values 2 ohms, 4 ohms, and 6 ohms connected in a parallel configuration will be:**

- (A) Less than 2 ohms
- (B) Greater than 6 ohms
- (C) Exactly 12 ohms
- (D) Between 4 and 6 ohms

**24. Which gas is liberated when an acid reacts with a metal like zinc?**

- (A) Carbon dioxide
- (B) Nitrogen
- (C) Hydrogen
- (D) Oxygen

**25. What is the primary chemical constituent of baking soda?**

- (A) Sodium hydroxide
- (B) Calcium carbonate
- (C) Sodium bicarbonate
- (D) Sodium carbonate

## C. Answer Key & Explanations

1. **(D)** Chandrayaan-3's Vikram lander soft-landed on 23 August 2023 near the lunar south pole — a world first. The Pragyan rover then operated on the surface for ~14 days.
2. **(B)** CRISPR-Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats) is a molecular tool that can precisely cut and edit DNA at specific gene locations.
3. **(C)** Stage 1: PHWRs using natural uranium. Stage 2: Fast Breeder Reactors using Pu-239 to breed U-233 from Th-232. Stage 3: Advanced reactors using Th-232/U-233 fuel.
4. **(A)** Article 2 of the Paris Agreement sets the goal of 'holding the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit it to 1.5°C.'

5. (D) MOM (Mangalyaan), launched November 2013, entered Mars orbit on 24 September 2014 — making India the first country to succeed on its maiden Mars attempt.
6. (D) The hotspot concept (Norman Myers, 1988; Conservation International) requires at least 1,500 endemic vascular plant species AND retention of less than 30% of original vegetation.
7. (C) The IPCC AR6 Synthesis Report (March 2023) concluded with 'unequivocal' scientific certainty that human influence has warmed the atmosphere, ocean, and land.
8. (D) Agni-V is India's ICBM-class surface-to-surface ballistic missile with a range exceeding 5,000 km, capable of reaching all of China.
9. (A) C4 plants use a two-cell mechanism (mesophyll + bundle sheath) to concentrate CO<sub>2</sub>, effectively eliminating photorespiration — the wasteful process that reduces C3 plant efficiency.
10. (C) Tejas (LCA Mark 1) is a delta-winged, fly-by-wire light combat aircraft developed by HAL and ADA — representing a major step in India's aerospace indigenisation.
11. (C) The Anthropocene (proposed but not yet formally ratified) describes the current geological epoch where human activity has become the primary driver of Earth system changes.
12. (B) AMR occurs when bacteria, viruses, fungi, and parasites evolve resistance to medicines. The WHO estimates AMR could cause 10 million deaths annually by 2050 if unchecked.
13. (D) mRNA vaccines (Pfizer-BioNTech, Moderna) deliver lipid-nanoparticle-encapsulated mRNA that instructs ribosomes to produce the SARS-CoV-2 spike protein, training the immune system.
14. (B) Aditya-L1, launched September 2023, reached the L1 Lagrange point in January 2024 — from where it can continuously observe the Sun without eclipses, studying solar wind, corona, and CMEs.
15. (B) The Western Ghats (along with Sri Lanka) form one of the world's 36 biodiversity hotspots — over 5,000 flowering plant species (1,700+ endemic), 450+ bird species, 140 mammal species.
16. (B) Net zero means the amount of GHGs emitted equals the amount removed (through forests, carbon capture, etc.), resulting in no net increase in atmospheric concentrations.
17. (C) 5G operates on new spectrum, delivering peak speeds of 10–20 Gbps (vs. 4G's 100 Mbps), latency below 1 millisecond, and connectivity for millions of IoT devices per km<sup>2</sup>.
18. (A) One Health (WHO/FAO/OIE framework) acknowledges that most emerging infectious diseases (COVID-19, Ebola, Nipah) are zoonotic — originating at the human-animal-environment interface.
19. (D) Qubits exploit quantum superposition and entanglement, allowing quantum computers to explore many solutions simultaneously — exponentially faster for certain problems.
20. (D) NMCG implements the Namami Gange Programme (2014), an integrated conservation mission to rejuvenate the Ganga — addressing sewage treatment, industrial effluents, river surface cleaning, and biodiversity conservation.
21. (C) A concave (diverging) lens is used to correct myopia by diverging the incoming light rays so that the image is focused directly on the retina.
22. (C) In uniform circular motion, speed is constant, meaning kinetic energy remains constant, while velocity and acceleration constantly change due to changes in direction.
23. (A) In a parallel combination, the equivalent resistance is always less than the lowest individual resistance in the circuit.
24. (C) Acids react with active metals to produce a salt and liberate hydrogen gas, which burns with a characteristic pop sound.
25. (C) Baking soda is chemically known as sodium bicarbonate, with the chemical formula NaHCO<sub>3</sub>.