

RAILWAY GENERAL SCIENCE HIGH-YIELD MASTER DOSSIER

Physics Laws, Chemical Formulations & Human Physiology for RRB NTPC, Group D & ALP

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1. Physics: Mechanics, Waves, Electricity & Optics

Core principles tested by Railway Recruitment Boards across 2024-2026 shifts:

Concept & Principle	Governing Formula / Definition	Key Railway PYQ Facts
Work, Energy & Power	- Work $W = F \cdot s \cdot \cos \theta$ (Zero if angle = 90° e.g. coolie carrying load) - Kinetic Energy = $\frac{1}{2}mv^2 = p^2 / (2m)$ - Power $P = W / t = V \cdot I$ (1 Horsepower = 746 Watts)	If velocity doubles, Kinetic Energy quadruples. If momentum increases 50%, KE increases by 125%.
Gravitation & Free Fall	$g = GM / R^2$ (g at equator is minimum, poles maximum) - Escape velocity on Earth = 11.2 km/s (Moon = 2.38 km/s) - Variation with depth: $g' = g(1 - d/R)$; at Earth center $g = 0$	Weight becomes zero at the center of the earth. Weight in freely falling elevator = 0.
Wave Motion & Sound	- Speed $v = f \times \lambda$ (Sound travels fastest in Solids > Liquids > Gases) - Audible range: 20 Hz to 20,000 Hz - Infrasonic: < 20 Hz (Whales, Rhinos); Ultrasonic: > 20 kHz (Bats, SONAR)	Sound speed in dry air at 0°C is ~ 332 m/s; increases by 0.61 m/s per 1°C rise in temperature.
Optics & Refraction	- Mirror Formula: $1/f = 1/v + 1/u$ - Lens Formula: $1/f = 1/v - 1/u$; Power $P = 1 / f(\text{in meters})$ Dioptre - Total Internal Reflection (TIR): Optical fiber, Mirage, Sparkling diamond	Concave mirror is used in car headlights and by dentists. Convex mirror is used as rear-view mirror.
Ohm's Law & Circuits	$V = IR$; Resistance $R = \rho(L / A)$ - Series: $R_{eq} = R_1 + R_2$; Parallel: $1/R_{eq} = 1/R_1 + 1/R_2$ - Joule Heating $H = I^2Rt$	Domestic wiring is connected in Parallel so every appliance receives full 220V voltage.

2. Chemistry: Chemical Compounds, pH & Periodic Trends

Compound / Common Name	Chemical Formula & Class	Commercial Use & Railway Focus
Bleaching Powder	CaOCl_2 (Calcium oxychloride)	Disinfectant for water, bleaching agent in textiles. Prepared by passing Cl_2 over dry slaked lime.
Baking Soda	NaHCO_3 (Sodium hydrogen carbonate)	Mild non-corrosive basic salt; antacid component and ingredient in fire extinguishers.
Washing Soda	$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ (Sodium carbonate decahydrate)	Used in glass, soap, and paper industries; permanently removes water hardness.
Plaster of Paris (POP)	$\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ (Calcium sulphate hemihydrate)	Obtained by heating Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) at 373 K. Used for bone fracture casts and statuary.
pH Scale & Litmus	- Blood pH = 7.35 - 7.45 - Acid rain pH < 5.6 - Tooth decay begins when mouth pH < 5.5	Litmus is extracted from Lichens. Blue litmus turns red in acid; red turns blue in base.

3. Biology: Cell Organelles, Human Physiology & Plant Hormones

Biological System / Organelle	Structure & Function	Standard Railway Exam Traps
Cell Organelles	- Mitochondria: 'Powerhouse of Cell' (ATP production, has own DNA) - Ribosomes: Protein factory - Lysosomes: 'Suicidal bags' containing hydrolytic enzymes	Mitochondria and Chloroplasts are semi-autonomous organelles possessing their own DNA and 70S ribosomes.
Circulatory System	- Blood groups: Landsteiner discovered ABO; AB+ Universal recipient, O- Universal donor - Arteries carry oxygenated blood (except Pulmonary Artery) - Normal BP = 120/80 mmHg (Sphygmomanometer)	RBC lifespan ~ 120 days; produced in bone marrow, destroyed in spleen ('graveyard of RBC').
Plant Hormones (Phytohormones)	- Auxin: Apical dominance & cell elongation - Gibberellin: Stem elongation & breaking seed dormancy - Cytokinin: Promotes cell division - Ethylene: Only gaseous hormone; ripens fruit - Absciscic Acid (ABA): Stress hormone; inhibits growth	Ethylene gas is used for artificial ripening. Absciscic acid causes closing of stomata during drought.