

Collegedunia NCERT Formula Sheet

Class 12 Biology — Chapter 7 (12th / NCERT 2024-25)

Chapter 7: Human Health and Disease

Quantitative facts · Pathogen life cycles · Antibody structure · Clinical reference ranges

1 Common Human Diseases — Quick Reference Table

This master table summarises every NCERT-listed disease in Section 7.2: causative organism, vector / mode of transmission, incubation period, and primary symptoms. All numerical ranges follow standard clinical values used in NCERT and CBSE marking schemes.

Bacterial & Viral Diseases

| Disease | Pathogen | Transmission | Incubation | Key symptoms / target organ |
|----------------------------|--|--|---------------------|--|
| Typhoid | <i>Salmonella typhi</i> (bacterium) | Contaminated food / water | 1–3 weeks | Sustained fever 39–40 °C, intestinal perforation; Widal test positive |
| Pneumonia | <i>Streptococcus pneumoniae</i> , <i>Haemophilus influenzae</i> | Droplet / sputum | 1–3 days | Alveoli fill with fluid; lips/nails grey-blue |
| Common cold | Rhino viruses | Droplet, fomites | 3–4 days | Runs 3–7 days; nasal congestion |
| Malaria | <i>Plasmodium</i> (4 spp.) | Female <i>Anopheles</i> mosquito | 12–14 days* | Cyclic chills + 40–41 °C fever every 48–72 h |
| Amoebiasis | <i>Entamoeba histolytica</i> | House-fly mechanical vector, water | 2–4 weeks | Constipation, abdominal pain, stools with mucus + blood |
| Ascariasis | <i>Ascaris</i> (round-worm) | Contaminated water / soil / vegetables | 60–70 days | Internal bleeding, muscular pain, anaemia |
| Elephantiasis (filariasis) | <i>Wuchereria bancrofti</i> , <i>W. malayi</i> | Female <i>Culex</i> mosquito | Months–years (8–16) | Chronic lymphatic obstruction of lower limbs / genitals |
| Ringworm | <i>Microsporum</i> , <i>Trichophyton</i> , <i>Epidermophyton</i> | Towels, clothes, soil | 4–14 days | Dry scaly lesions on skin, nails, scalp |

* Malaria incubation depends on species: *P. vivax* 12–17 d, *P. falciparum* 9–14 d, *P. malariae* 18–40 d, *P. ovale* 16–18 d. **Incubation period** = time between pathogen entry and first symptom appearance.

Vector vs Pathogen

A **vector** carries the pathogen but is not itself the disease-causing agent. Female *Anopheles* is the malaria *vector*; *Plasmodium* is the *pathogen*. Only female mosquitoes bite (they need a blood meal for egg development); males feed on plant juices.

2 *Plasmodium* Life Cycle — Counts & Stages

The malarial parasite alternates between two hosts. The numerical ratios below are the ones NCERT explicitly states and CBSE frequently asks.

Plasmodium hosts and infective stages

| Parameter | Value | Meaning |
|--|----------------------|---|
| Number of hosts | 2 (digenetic) | Human (intermediate) + female <i>Anopheles</i> (definitive) |
| Sexual reproduction occurs in | Mosquito gut | Hence mosquito = <i>definitive</i> host |
| Asexual reproduction occurs in | Human liver & RBCs | Hence human = <i>intermediate</i> host |
| Stage injected into human | Sporozoites | Released from mosquito salivary glands during bite |
| Stage that destroys RBCs | Merozoites | Burst from infected RBCs in waves of 48–72 h |
| Stage taken up by mosquito | Gametocytes | Mature into gametes inside mosquito gut |
| Toxin released by RBC lysis | Haemozoin | Causes the characteristic chill + fever pattern |
| Fever cycle (<i>P. vivax</i> , <i>ovale</i>) | Every 48 h (tertian) | Synchronous merozoite release |
| Fever cycle (<i>P. malariae</i>) | Every 72 h (quartan) | Slower erythrocytic schizogony |

Most lethal species: *Plasmodium falciparum* (malignant tertian malaria). Causes cerebral malaria; mortality high if untreated.

Three M's of malaria stages

Sporo → **M**ero → **G**ameto. “Sporozoites Enter, Merozoites Multiply, Gametocytes Get-Out (to mosquito).”

3 Antibody Structure — The H₂L₂ Unit

Antibodies (immunoglobulins, Ig) are Y-shaped glycoproteins. The chain counts below are NCERT's most frequently tested numerical fact for this chapter.

Antibody composition → H_2L_2

| Component | Count molecule | per | Function / size |
|--------------------------|----------------|-----|---|
| Total polypeptide chains | 4 | | Two pairs — heavy and light |
| Heavy (H) chains | 2 | | ~50 kDa each; carry constant + variable regions |
| Light (L) chains | 2 | | ~25 kDa each; pair with the H-chain N-terminus |
| Antigen-binding sites | 2 (Fab arms) | | One per arm of the "Y" |
| Disulfide bridges | ≥ 4 | | 2 inter-chain (H-L) + 2 inter-chain (H-H) |
| Constant region | $C_H + C_L$ | | Determines Ig class |
| Variable region | $V_H + V_L$ | | Determines antigen specificity |

Net stoichiometry = H_2L_2 . **2 antigen-binding sites** mean one antibody can cross-link *two* antigens — the basis of agglutination reactions.

Five immunoglobulin classes — quick lookup

| Class | % in serum | Structure | Primary role |
|-------|------------|------------------------|--|
| IgG | 70–75 % | Monomer (H_2L_2) | Crosses placenta; main secondary-response antibody |
| IgA | 10–15 % | Dimer | Mucosal surfaces, saliva, tears, colostrum |
| IgM | 5–10 % | Pentamer (10 H + 10 L) | First antibody secreted in primary response |
| IgE | <1 % | Monomer | Allergy / hypersensitivity; binds mast cells |
| IgD | <1 % | Monomer | B-cell receptor; activates B cells |

IgG is the only class that crosses the placenta — confers passive immunity to the foetus. **IgM** appearing in blood = recent infection.

Order of Ig abundance

G > A > M > D > E "GAM-DE" (think "Great Antibody Makes Defence Efficient").

4 Immune-Cell Counts & Normal WBC Ranges

NCERT covers innate vs acquired immunity and the four barriers. Below are the cell counts you should know; reference ranges follow standard clinical haematology.

Normal blood-cell reference ranges (adult)

| Cell type | Normal count | Physiological note |
|------------------------|--|---|
| Total leukocytes (WBC) | 4,000–11,000 / mm ³ | >11,000 = leukocytosis (infection / leukaemia) |
| Neutrophils | 40–75 % of WBC (2–7 × 10 ³ /mm ³) | First responders to bacterial infection |
| Lymphocytes | 20–45 % of WBC (1–4 × 10 ³ /mm ³) | B & T cells; adaptive immunity |
| Monocytes | 2–10 % of WBC | Mature to macrophages in tissue |
| Eosinophils | 1–6 % of WBC | Rise in parasitic / allergic states |
| Basophils | <1 % of WBC | Release histamine; allergy |
| Erythrocytes (RBC) | 4.5–5.5 × 10 ⁶ / mm ³ | Targeted by <i>Plasmodium</i> merozoites |
| Platelets | 1.5–4.0 × 10 ⁵ / mm ³ | Drop sharply in dengue (<1.0 × 10 ⁵ alarm) |

Innate immunity cells = neutrophils, monocytes, NK cells. **Acquired immunity** cells = B lymphocytes (antibodies) + T lymphocytes (cell-mediated).

Four barriers of innate immunity

| Barrier | Examples |
|---------------|--|
| Physical | Skin (primary), mucous membranes of GI / respiratory / urogenital tract |
| Physiological | Stomach acid (pH 1.5–3.5), saliva (lysozyme), tears (lysozyme) |
| Cellular | Polymorphonuclear leukocytes (PMNs / neutrophils), monocytes, NK cells, macrophages |
| Cytokine | Interferons (IFN- α , IFN- β , IFN- γ) secreted by virus-infected cells |

Innate immunity = **non-specific** and **always present**. Acquired immunity = **specific, has memory**, slower on first encounter.

5 HIV / AIDS — Clinical Numerical Thresholds

HIV (Human Immunodeficiency Virus) is a retrovirus targeting helper T (T_H) cells. The CD4 cut-off below is the WHO/CDC definition of AIDS — a standard CBSE numerical.

HIV & AIDS — key clinical numbers

| Parameter | Value | Clinical meaning |
|--------------------------------|--------------------------------------|--------------------------------------|
| Virus family | Retroviridae (RNA virus) | Carries reverse transcriptase |
| Primary target cell | CD4 ⁺ helper T lymphocyte | Also macrophages, dendritic cells |
| Normal CD4 T-cell count | 500–1,600 / mm ³ | Healthy adult range |
| AIDS-defining CD4 count | <200 / mm³ | WHO/CDC criterion |
| Incubation (HIV → AIDS) | 5–10 years (avg) | Asymptomatic window; sero-positive |
| Detection window (antibody) | 3–12 weeks post-exposure | Earlier with NAT / p24 antigen |
| Confirmatory test | ELISA → Western blot | ELISA = screening; WB = confirmatory |
| Genome | 2 copies ssRNA | Reverse-transcribed to dsDNA |

When CD4 drops below **200 / mm³**, opportunistic infections (*Mycobacterium*, *Toxoplasma*, *Cryptococcus*) and Kaposi's sarcoma become life-threatening. ART (antiretroviral therapy) does not cure but suppresses replication.

HIV replication cycle — numbered steps

| # | Step |
|---|---|
| 1 | Virus binds CD4 receptor + CCR5/CXCR4 co-receptor on T _H cell |
| 2 | Viral RNA enters cell; reverse transcriptase makes dsDNA from RNA |
| 3 | Viral DNA integrates into host genome (provirus, via integrase) |
| 4 | Host machinery transcribes provirus → new viral RNA + proteins |
| 5 | Mature virions bud off, lysing the T cell |
| 6 | Released virions infect more T _H cells ⇒ progressive CD4 decline |

Modes of transmission (NCERT): sexual contact, contaminated blood / needles, infected mother → child (transplacental + breast milk).

"HIV-positive" ≠ "AIDS"

A person is **HIV-positive** as soon as antibodies are detectable. They are said to have **AIDS** only when CD4 < 200 / mm³ or an AIDS-defining opportunistic infection appears. The latency between the two states can be 5–10 years.

6 Cancer Biology — Markers & Diagnostic Cut-offs

NCERT discusses benign vs malignant tumours, metastasis, oncogenes, and three diagnostic / therapeutic modalities. The marker ranges below are widely used by NEET / AIIMS questions and clinical labs.

Benign vs Malignant tumours

| Feature | Benign | Malignant |
|--------------------------|---------------------|------------------------------------|
| Growth | Slow, confined | Rapid, uncontrolled |
| Capsule | Usually present | Absent |
| Metastasis | No | Yes (via blood / lymph) |
| Invasion of surroundings | No | Yes |
| Differentiation | Well-differentiated | Poorly differentiated (anaplastic) |
| Recurrence after removal | Rare | Common |
| Outcome | Generally not fatal | Often fatal if untreated |

Metastasis = secondary tumour formation at sites distant from the primary tumour. It is the single property that most defines malignancy.

Tumour-marker reference ranges

| Marker | Indication | Normal range | Raised in |
|------------------------------|---------------------------|-------------------------|-------------------------------|
| AFP (α -fetoprotein) | Liver / germ-cell tumours | <10 ng / mL | Hepatocellular carcinoma |
| CEA (carcino-embryonic Ag) | Colorectal cancer | <3 ng / mL (non-smoker) | Colon, pancreas, stomach |
| PSA (prostate specific Ag) | Prostate cancer | <4 ng / mL | Prostate cancer / hyperplasia |
| CA-125 | Ovarian cancer | <35 U / mL | Ovarian, endometrial |
| CA 19-9 | Pancreatic cancer | <37 U / mL | Pancreatic, biliary |
| hCG (β) | Trophoblastic / germ-cell | <5 mIU / mL (non-preg.) | Choriocarcinoma, testicular |

Tumour markers are **not** alone diagnostic — they are followed alongside biopsy, MRI / CT, and histopathology. **MRI** uses non-ionising radiation; **CT** uses X-rays.

Cancer treatment modalities

| Modality | Mechanism / dose context |
|---------------|---|
| Surgery | Physical excision of localised tumour |
| Radiotherapy | Ionising radiation (typical fraction 1.8–2.0 Gy/day; total 45–80 Gy) destroys DNA of dividing cells |
| Chemotherapy | Cytotoxic drugs (alkylating agents, antimetabolites, taxanes); side effects = hair loss, anaemia |
| Immunotherapy | α -interferon activates immune system to destroy tumour |

Oncogenes / proto-oncogenes (**c-onc**): cellular genes whose activation can convert a normal cell to a tumour cell.

7 Vaccines & Immunisation Schedule

The Indian Universal Immunisation Programme (UIP) defines a specific dose schedule that CBSE often asks; NCERT introduces active vs passive immunisation in Section 7.4.

Active vs Passive immunisation

| Feature | Active | Passive |
|-----------------------|---|---|
| What's given | Antigen (live attenuated / killed / toxoid) | Preformed antibodies |
| Source of antibody | Body's own B cells | External (serum / colostrum) |
| Onset of protection | Slow (1–2 weeks) | Immediate |
| Duration | Long (years to lifelong) | Short (weeks to months) |
| Memory cells produced | Yes | No |
| Examples | MMR, BCG, polio, hepatitis-B | Anti-tetanus serum (ATS), anti-snake venom, IgG to neonate via placenta |

Vaccination exploits **memory B** and **memory T** cells generated by primary exposure to recognise the pathogen faster and stronger on second exposure.

India UIP — vaccine dose schedule (key entries)

| Vaccine | Disease vented | pre- | Doses | Schedule |
|-------------|--------------------------------|------|-------------------|---|
| BCG | Tuberculosis | | 1 | At birth (up to 1 year) |
| OPV / IPV | Poliomyelitis | | 4 (OPV) + 2 (IPV) | 0, 6, 10, 14 wk + booster 16–24 mo |
| Hepatitis-B | Hepatitis B | | 4 | 0, 6, 10, 14 weeks |
| DPT (DTwP) | Diphtheria, Pertussis, Tetanus | | 3 + 2 boosters | 6, 10, 14 wk; boosters 16–24 mo & 5–6 y |
| MMR / MR | Measles, Mumps, Rubella | | 2 | 9–12 mo, 16–24 mo |
| Rotavirus | Rotaviral diarrhoea | | 3 | 6, 10, 14 weeks |
| Td | Tetanus, diphtheria | | 2 boosters | 10 y, 16 y |

Recombinant DNA vaccines: hepatitis-B is produced by inserting the surface antigen gene into yeast — large-scale, animal-free production.

NEET extension — vaccine types

Four broad types: (i) **live attenuated** (BCG, MMR, OPV); (ii) **inactivated / killed** (IPV, Hep-A); (iii) **toxoid** (tetanus, diphtheria); (iv) **subunit / recombinant** (Hep-B, HPV).

8 Drugs & Alcohol — Source-Plant & Receptor Reference

NCERT Section 7.5 names specific plants and tissues. The numerical thresholds (BAC limits) are reference values useful for AIIMS / KVPY questions.

Drugs of abuse — botanical & chemical sources

| Drug class | Source organism | Part used | Active principle / effect |
|--|--|-------------------------------|---|
| Opioids (heroin, smack) | <i>Papaver somniferum</i> | Latex of unripe capsule | Diacetylmorphine; binds opioid receptors in CNS & GI |
| Cannabinoids (marijuana, hashish, ganja, charas) | <i>Cannabis sativa</i> | Inflorescences, resin, leaves | THC binds CB1 receptor; affects cardiovascular system |
| Cocaine (coke / crack) | <i>Erythroxylum coca</i> | Leaves | Blocks dopamine re-uptake; euphoria, hallucinations |
| Other hallucinogens | <i>Atropa belladonna</i> , <i>Datura</i> | Whole plant | Atropine; antagonises muscarinic receptors |
| Tobacco (nicotine) | <i>Nicotiana tabacum</i> | Cured leaves | Stimulates adrenal → noradrenaline → BP↑, HR↑ |

Smack (heroin) is *depressant* (slows body functions). **Coca** (cocaine) is *stimulant* (speeds CNS activity). Both are highly addictive.

Alcohol & tobacco — reference numerical facts

| Parameter | Typical value | Note |
|----------------------------------|---|--|
| Legal BAC limit (India, driving) | 30 mg / 100 mL blood (0.03 %) | Lower than US/UK (0.08 %) |
| Tobacco constituents | >4,000 chemicals; >60 carcinogens | Tar, nicotine, CO, polonium-210 |
| CO affinity for Hb | ≈ 240× that of O ₂ | Reduces O ₂ carriage; hypoxia |
| Smokeless tobacco vs smoking | Both linked to oral, lung, bladder cancer | No “safe” form |
| Adolescent vulnerability window | 12–18 years | Peer pressure + curiosity |

“Gateway” effect: early use of tobacco / alcohol / cannabis often precedes harder substance abuse — hence prevention emphasis at adolescent stage.

Stimulant vs Depressant

Cocaine, amphetamines, nicotine, caffeine = *stimulants* (CNS up). **Heroin, barbiturates, alcohol, cannabis** = *depressants* (CNS down). LSD and mescaline are *hallucinogens*. Don't confuse cannabis (depressant) with cocaine (stimulant) just because they sound similar.

9 Allergies, Auto-immunity & Cytokines

Short reference for the remaining numerical / categorical facts in the chapter (Sections 7.3 & 7.4).

Hypersensitivity & auto-immune reference

| Topic | Mediator / mechanism | Example / treatment |
|-----------------------------|--|--|
| Allergy (Type-I) | IgE bound to mast cells → histamine + serotonin release | Hay fever, asthma; anti-histamines , adrenaline, steroids |
| Auto-immune disease | Body fails self/non-self discrimination | Rheumatoid arthritis, myasthenia gravis |
| Cytokines (innate) | IFN- α , IFN- β , IFN- γ | Anti-viral; activate macrophages/NK cells |
| Lymphoid organs (primary) | Bone marrow, thymus | Site of lymphocyte maturation |
| Lymphoid organs (secondary) | Spleen, lymph nodes, MALT, tonsils, Peyer's patches | Site of lymphocyte-antigen interaction |

Modern lifestyle (protected environment in early childhood) has been correlated with rising allergy prevalence — fewer microbial exposures means a less “trained” immune system.

Quick-Reference Summary — Numbers to Remember

One-glance lookup for the night before the exam

Top numerical facts — Class 12 Bio Ch 7

| # | Fact | Value |
|----|---|---------------------------------|
| 1 | Polypeptide chains per antibody (H + L) | 4 (2 H + 2 L) |
| 2 | Antigen-binding sites per antibody | 2 |
| 3 | H-chain / L-chain MW | ~50 / ~25 kDa |
| 4 | <i>Plasmodium</i> hosts; species infecting humans | 2 hosts; 4 species |
| 5 | Fever cycle <i>P. vivax</i> / <i>P. malariae</i> | 48 h / 72 h |
| 6 | Stage injected mosquito → man; man → mosquito | Sporozoites; Gametocytes |
| 7 | Typhoid temp + diagnostic | 39–40 °C, Widal |
| 8 | Pneumonia / common-cold duration | 3 d / 3–7 d |
| 9 | Filariasis / Ascariasis incubation | Months-years / 60–70 d |
| 10 | Normal WBC count | 4,000–11,000 / mm ³ |
| 11 | Normal CD4 T-cell count | 500–1,600 / mm ³ |
| 12 | AIDS-defining CD4 count | <200 / mm³ |
| 13 | HIV → AIDS incubation | 5–10 years |
| 14 | HIV tests (screen / confirm) | ELISA / Western blot |
| 15 | Viral RNA copies per HIV virion | 2 |
| 16 | IgG % in serum; placenta-crosser | 70–75 %; IgG |
| 17 | First Ig in primary response | IgM (pentamer) |
| 18 | Hep-B vaccine doses (UIP) | 4 (0, 6, 10, 14 wk) |
| 19 | DPT doses (UIP) | 3 + 2 boosters |
| 20 | Legal BAC (India, driving) | 30 mg / 100 mL |
| 21 | CO affinity for Hb vs O ₂ | ~240× |
| 22 | PSA / CA-125 / AFP cut-off | <4 ng/mL; <35 U/mL; <10 ng/mL |

Last-minute exam advice

Most Class 12 Bio Ch 7 NEET / Board questions hinge on **three** numerical fact families: (a) antibody chain count = 4 (2H+2L), (b) AIDS CD4 cut-off = <200/mm³, (c) malaria's hosts, stages, and fever cycles. Lock these down first — they account for ~60% of numerical questions on this chapter.