

# HESI A2 Study Guide

## 220+ High-Yield Terms & Concepts

*for the Evolve Reach Admission Assessment (Elsevier HESI A2)*

Covers all eight academic sections - Anatomy & Physiology, Biology, Chemistry, Grammar, Reading Comprehension, Vocabulary & General Knowledge, Mathematics, and Critical Thinking (plus optional Physics) - with the exam overview, a format reference, a final review, and a test-day strategy. Each concept pairs key facts with a study tip and a practical example.

### How to Use This Guide

The HESI A2 is modular: every nursing program selects the sections you must complete. STEP ONE - check each target school's admissions page and list YOUR required sections, the composite cutoff, and each section minimum before studying. Then work through the sections in this guide in order (Anatomy & Physiology, Biology, Chemistry, Grammar, Reading, Vocabulary & General Knowledge, Math, Critical Thinking, and optional Physics), and finish with the final review, the format reference appendix, and the test-day strategy. Aim 5-10 points above each school's minimum because competition pushes the practical bar higher.

*IMPORTANT DISCLAIMER: This guide is an independent study aid. It is NOT affiliated with, endorsed by, or sponsored by Elsevier Inc. (which publishes the HESI A2), any nursing program, or any testing body. Exam formats, section requirements, cutoffs, and fees are set by each program and change over time - always verify current requirements with your target school and with official Elsevier HESI materials before test day.*

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**Concept total: 243 (advertised 220+)**

*Format notes (verified Sep 2025): Math 50 scored/55 total/50 min; Reading 47/50/60 min; Vocabulary & General Knowledge 50/55/50 min; Grammar 50/55/50 min; Anatomy & Physiology 25/30/25 min; Biology 25/30/25 min; Chemistry 25/30/25 min; Physics 25/50 min (rare). Every section includes ~5 unscored pilot questions - treat every question as scored. Each section scores SEPARATELY 0-100% with no composite; program cutoffs commonly 75-80% (competitive BSN 80-85%, A&P often 80-85%); retake policy is school-set (commonly a 60-day wait); cost ~\$35-\$100 school-set; computerized delivery (testing center or remote proctor), 4-6 hours for a full attempt.*

# Part 1: Exam Overview

2026-current format - 8 scored sections, composite ~75%, retakes, delivery & scoring

## 1. The 8 Scored Sections

The current HESI A2 is built around 8 scored academic sections, and each nursing program selects which you must complete (most require 4-6): Anatomy & Physiology (30 questions / 25 min), Biology (30 / 25), Chemistry (30 / 25), Grammar (50 / 50), Reading Comprehension (50 / 60), Vocabulary & General Knowledge (55 / 50), Mathematics (55 / 60), and Critical Thinking (~26-30 / ~45 min). Physics is optional and only if your program lists it.

*Tip: Write down the EXACT section set and the EXACT question/time counts for each of YOUR schools before you study.*

e.g. A program requiring Math, Reading, Vocab, Grammar, A&P and Critical Thinking means you skip Biology and Chemistry for that application.

## 2. Find YOUR Sections First

Every program publishes its HESI A2 requirements in its admissions materials - which sections, the minimum composite, the section minimums, and the retake policy. Requirements can differ by degree path (ADN vs BSN vs ABSN).

*Tip: Build one checklist per target school: required sections, composite target, per-section minimums, retake wait, and cost.*

e.g. One school may require Critical Thinking for its BSN track but not its ADN track - check both if you apply to either.

## 3. Pilot (Unscored) Questions

A full HESI A2 attempt mixes in roughly 30 pilot (unscored) questions across sections for future exam development. You cannot tell which items are pilots, so treat EVERY question as scored.

*Tip: There is NO guessing penalty on HESI A2 - answer every item, including the pilots.*

e.g. If one Math item feels oddly easy, it may be a pilot; the scored result ignores it but your job is the same: answer it.

## 4. Scoring: Composite ~75%

Score reports show each section 0-100% PLUS a composite result. Passing is set by each nursing program - typically a composite around 75% or higher and/or per-section minimums of 75-85% (A&P is often held to 80-85%). Some schools require both; some only per-section.

*Tip: Treat both numbers as requirements: a composite above the bar is not enough if one section dips under the school's floor.*

e.g. A school asking 'composite 75+, no section below 75' means an 82/84/74 pattern fails - the 74 is under 75.

## 5. Composite vs Section Minimums

Your score report shows the composite result AND each section's percentage. A school can reject you on either, so aim 5-10 points above both the composite cutoff and every section floor.

*Tip: Set a single personal bar: composite 80+ AND every required section at or above the strictest floor you face.*

e.g. If the highest floor among your schools is A&P 80, your A&P prep goal is 85+, not 75.

## 6. Retake Policy: 60 Days (Elsevier Base)

Elsevier requires a 60-day wait between attempts; individual programs may set longer windows (up to 90 days) or cap how many attempts they will consider. Seats are limited. The wait applies even to a near-miss.

*Tip: Read the retake policy BEFORE your first attempt - a 77 versus an 80 floor can cost you an entire application cycle.*

e.g. A program that caps total attempts at 2 means your first sit is not a practice run.

## 7. Delivery: PSI / ProctorU

The exam is computer-based, delivered at PSI testing centers or remotely through ProctorU (remote proctoring is available). A full attempt of all sections takes about 4 hours including breaks (255 scored + 30 pilot questions).

*Tip: Confirm center vs remote at registration; remote requires a quiet room, webcam, government ID, and stable internet.*

e.g. A 4-hour full attempt with a 55-question Math section means pacing matters - rehearse full-length timing once before test day.

## 8. Score Report Within 24 Hours

Your score report PDF is typically available within 24 hours of completing the exam, showing the composite, all section percentages, and percentiles. Many schools require you to send the official report directly from the provider.

*Tip: Plan your application timing around the 24-hour report - you can read your sections and whether a retake is needed within a day.*

e.g. The 24-hour report tells you exactly which section to target if you retake after the required wait.

## 9. Cost & Registration

The exam fee is set by the school or PSI (commonly \$40-\$100), and registration runs through the school's portal or PSI. Test dates fill fast at busy testing centers.

*Tip: Register as soon as the application window opens - seats fill fast and the retake wait is 60 days minimum.*

e.g. A \$60 exam with in-center delivery may book 3-4 weeks out; do not wait until the application deadline.

## 10. Which Sections Matter Most

The highest-yield set for most nursing admissions is Math, Reading, Vocabulary & General Knowledge, Grammar, and Anatomy & Physiology. A&P minimums are commonly the strictest (80-85%), and Critical Thinking is increasingly required.

*Tip: Study the core four + A&P first, then Critical Thinking, then Biology/Chemistry only if your schools require them.*

e.g. A Houston-area ADN candidate typically needs Math, Reading, Vocab, Grammar, A&P and Critical Thinking.

## 11. A&P: Version-Dependent Retake

The Anatomy & Physiology section exists in more than one version; the version you receive at registration and whether a retake re-scores A&P depends on the program and the version assigned. Confirm the policy with your school before relying on a retake to fix an A&P score.

*Tip: Ask admissions directly: 'If I retake, does my A&P score change, and does the version change?' - do not assume.*

e.g. Two applicants at the same school could receive different A&P versions across administrations.

## 12. Computer-Based Test Skills

Everything is on-screen: a calculator for Math, highlight and strikeout tools for Reading, and one-question-at-a-time navigation - on HESI you generally CANNOT return to a previous question after moving on.

*Tip: Decide before you click: treat each question as final, flag nothing, and keep moving. Budget per question using the screen timer.*

e.g. A 55-question Math section at 60 minutes gives you just over a minute per item - pace from question 1.

## 13. Study Priority Strategy

A proven order: (1) Math + Reading + Vocabulary + Grammar, (2) Anatomy & Physiology, (3) Critical Thinking, (4) Biology/Chemistry if required, (5) Physics only if explicitly listed. Rehearse a full-length timing run once.

*Tip: Two weeks out, shift from learning to rapid review - conversions, prefixes/suffixes, labs, and A&P system maps.*

e.g. A 5-section candidate who skips Critical Thinking practice can lose the newest and least-familiar test format on exam day.

## 14. Non-Affiliation Note

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*Tip: Always verify current format, sections, cutoffs, and fees with your target school and the official Elsevier HESI materials.*

e.g. The official HESI A2 Candidate Handbook remains the authoritative source for your registration year.

# Part 2: Anatomy & Physiology

25 scored (30 total) / 25 minutes - most BSN programs require; version-dependent on retake

## 1. Homeostasis

Homeostasis is the body's maintenance of stable internal conditions (temperature, pH, glucose, fluid) via feedback loops: negative feedback reverses change, positive feedback amplifies it.

*Tip: Negative = stabilizer (most systems); positive = amplifier (labor, clotting).*

e.g. Sweating to cool a rising temperature is negative feedback.

## 2. Cell Structure

Cell parts: nucleus (DNA), mitochondria (ATP energy), ribosomes (protein synthesis), ER (transport), Golgi (packaging), lysosomes (digestion), cell membrane (selective barrier).

*Tip: Match the organelle to its one job - mitochondria = energy is the most tested.*

e.g. Muscle cells have many mitochondria for ATP production.

## 3. Cell Transport

Passive transport needs no energy: diffusion (down gradient), osmosis (water), facilitated diffusion (carrier). Active transport uses ATP against the gradient (sodium-potassium pump).

*Tip: Passive = downhill/free; active = uphill/ATP.*

e.g. Oxygen diffuses into red blood cells - passive, no ATP.

## 4. Tissue Types

Four basic tissues: epithelial (covering/lining), connective (bone, blood, fat - support), muscle (skeletal, cardiac, smooth), nervous (signal conduction).

*Tip: Name each tissue by location: skin = epithelial, tendons = connective.*

e.g. Cardiac muscle is found only in the heart.

## 5. Skeletal System

Bones: support, protect, movement (with muscles), mineral storage (calcium), blood cell formation (bone marrow). Axial = skull, spine, ribs; appendicular = limbs + girdles.

*Tip: Red marrow makes blood cells - located in flat bones and long bone ends.*

e.g. The femur is the longest bone; it is part of the appendicular skeleton.

## 6. Muscular System

Three muscle types: skeletal (voluntary, striated), smooth (involuntary, in organs/vessels), cardiac (involuntary, striated, only in heart). Movement = muscle contraction across joints.

*Tip: Skeletal = voluntary/striated; smooth = involuntary/unstriated; cardiac = striated + involuntary.*

e.g. Smooth muscle lines the stomach and blood vessels.

## 7. Nervous System

Central nervous system = brain + spinal cord; peripheral = all other nerves. Neuron = functional unit; synapse = junction; reflex arc = automatic response.

*Tip: CNS = command center; PNS = wiring to the body.*

e.g. Touching a hot pan triggers a spinal reflex without brain input.

## 8. Brain Regions

Cerebrum (thought, voluntary movement), cerebellum (coordination, balance), brainstem (breathing, heart rate, reflexes - medulla controls vital functions).

*Tip: Medulla oblongata = vital centers (breathing, HR) - rote-memorize this.*

e.g. Damage to the cerebellum affects balance and coordination.

## 9. Cardiovascular System

Heart: 4 chambers (2 atria receive, 2 ventricles pump). Blood flows: right side -> lungs (pulmonary), left side -> body (systemic). Valves prevent backflow; SA node = pacemaker.

*Tip: Right = lungs, left = body - memorize the two circuits.*

e.g. The left ventricle pumps oxygenated blood to the whole body.

## 10. Cardiac Cycle & BP

Systole = contraction/peak pressure; diastole = relaxation/low pressure. BP is written systolic/diastolic (120/80). Cardiac output = heart rate x stroke volume.

*Tip: Top number = systole (pressure during pump); bottom = diastole (pressure at rest).*

e.g. Cardiac output rises with faster heart rate or stronger contractions.

## 11. Blood & Blood Cells

Blood: red cells (carry O<sub>2</sub> via hemoglobin), white cells (immune defense), platelets (clotting), plasma (liquid). Hematocrit = % red cells (~45%).

*Tip: RBC = oxygen, WBC = defense, platelets = clot - the three jobs.*

e.g. Hemoglobin binds oxygen; low hemoglobin = anemia.

## 12. Blood Types

ABO system: A, B, AB, O; Rh factor (+ or -). Universal donor = O-; universal recipient = AB+. Type O has no A/B antigens, so no attack.

*Tip: O- donates to anyone; AB+ receives from anyone.*

e.g. A patient with type B blood has anti-A antibodies.

## 13. Respiratory System

Airway: nose -> pharynx -> larynx -> trachea -> bronchi -> lungs -> alveoli (gas exchange site). Diaphragm drives inhalation; surfactant keeps alveoli open.

*Tip: Gas exchange happens ONLY in the alveoli - the rest is a tunnel.*

e.g. Surfactant deficiency (preemies) causes alveolar collapse (RDS).

## 14. Ventilation vs Perfusion

Ventilation = air moving in/out of lungs; perfusion = blood flow to alveoli. Matching (V/Q) matters: areas ventilated must be perfused for gas exchange.

*Tip: Ventilation = air; perfusion = blood - keep the pair straight.*

e.g. A pulmonary embolus blocks perfusion while ventilation continues - V/Q mismatch.

## 15. Digestive System

Pathway: mouth (amylase) -> esophagus -> stomach (acid, pepsin) -> small intestine (digestion/absorption; duodenum, jejunum, ileum) -> large intestine (water) -> rectum. Liver makes bile; pancreas secretes enzymes + insulin.

*Tip: Small intestine = the main absorption zone; stomach = protein + acid start.*

e.g. Bile (from liver, stored in gallbladder) emulsifies fats.

## 16. Renal System

Kidneys filter blood, regulate fluid/electrolytes/pH, secrete hormones (erythropoietin, renin). Nephron = functional unit: glomerulus filters, tubules reabsorb/secret.

*Tip: Nephron = filter (glomerulus) + adjuster (tubules: reabsorb what to keep).*

e.g. Erythropoietin from kidneys stimulates red cell production.

## 17. Endocrine System

Glands + hormones: pituitary (master), thyroid (metabolism), parathyroid (calcium), adrenal (cortisol, epinephrine), pancreas (insulin/glucagon), gonads (sex hormones).

*Tip: Pair each gland with its signature hormone - insulin/pancreas is the most-tested pair.*

e.g. Insulin lowers blood sugar; glucagon raises it.

## 18. Insulin & Blood Sugar

Insulin (beta cells) moves glucose INTO cells, lowering blood glucose. Glucagon (alpha cells) releases stored glucose, raising it. Diabetes = insulin problem (type 1 = deficiency; type 2 = resistance).

*Tip: Insulin = 'opens the door' for glucose; think cells + key.*

e.g. Type 1 diabetics cannot make insulin; type 2 cells resist it.

## 19. Integumentary System

Skin layers: epidermis (outer), dermis (collagen, vessels, nerves, glands), hypodermis (fat). Functions: barrier, temperature regulation (sweat), vitamin D synthesis, sensation.

*Tip: Largest organ = skin; dermis holds the blood vessels and glands.*

e.g. Sweating cools the body; shivering (muscle) warms it.

## 20. Immune System

Innate immunity (skin, WBCs like macrophages, inflammation) vs adaptive immunity (B cells = antibodies, T cells = cell-kill, memory). Vaccines build adaptive memory.

*Tip: B = antibody (humoral); T = cellular. Memory cells = fast second response.*

e.g. A vaccine creates memory B cells so re-exposure is defeated quickly.

## 21. Reproductive System

Male: testes make sperm + testosterone; female: ovaries make ova + estrogen/progesterone; uterus = gestation site; fallopian tubes = fertilization site.

*Tip: Fertilization occurs in the fallopian tube, not the uterus.*

e.g. Ovulation releases an egg into the fallopian tube.

## 22. Lymphatic System

Lymph vessels return fluid (lymph) to blood; lymph nodes filter; spleen filters blood; thymus matures T cells. Blockage = edema (lymphedema).

*Tip: Lymphatics = the body's drainage + filter network.*

e.g. The spleen filters old red cells and mounts immune responses.

## 23. Musculoskeletal: Joints

Synovial joints allow free movement (knee, shoulder). Ligaments connect bone to bone; tendons connect muscle to bone. Bursae reduce friction.

*Tip: Ligament = bone-bone; tendon = muscle-bone - the classic pair.*

e.g. An ankle sprain injures a ligament, not a tendon.

## 24. Fluid & Electrolytes

Key electrolytes: Na<sup>+</sup> (fluid balance), K<sup>+</sup> (heart/nerves), Ca<sup>2+</sup> (muscle/bone), Mg<sup>2+</sup> (nerves). Water moves to balance sodium (where sodium goes, water follows).

*Tip: Sodium and water travel together - hypernatremia = water shifts out of cells.*

e.g. Hyperkalemia (high K) disrupts cardiac rhythm.

## 25. Acid-Base Balance

pH normal 7.35-7.45. PaCO<sub>2</sub> = respiratory driver (high CO<sub>2</sub> = acidosis); HCO<sub>3</sub><sup>-</sup> = metabolic buffer. Respiratory acidosis (CO<sub>2</sub> high), metabolic acidosis (HCO<sub>3</sub><sup>-</sup> low).

*Tip: Look at pH first, then CO<sub>2</sub>/HCO<sub>3</sub> to name the disorder.*

e.g. Hypoventilation raises CO<sub>2</sub> -> respiratory acidosis.

## 26. Vital Signs: Pulse & Respiration

Pulse sites: radial (wrist), carotid, apical (stethoscope over heart), pedal. Respiratory rate adult 12-20; pulse 60-100; O<sub>2</sub> sat 95-100%.

*Tip: Apical pulse is best for infants and irregular rhythms - it is the actual heartbeat.*

e.g. An apical-radial pulse deficit suggests inefficient contraction.

## 27. Anatomical Position & Planes

Anatomical position: standing, palms forward. Planes: sagittal (left/right), frontal (front/back), transverse (top/bottom). Body cavities: thoracic, abdominal, pelvic, cranial.

*Tip: Sagittal = divides L/R like a sagging curtain; frontal = front/back.*

e.g. A transverse (horizontal) section divides superior from inferior.

## 28. Osmosis & Tonicity

Tonicity compares solute: isotonic (no net movement), hypertonic (water leaves cells - cells shrink), hypotonic (water enters cells - cells swell/burst). Normal saline = isotonic.

*Tip: Hyper = shrink; hypo = swell; iso = no change - the mnemonic pair.*

e.g. Infusing hypertonic saline pulls fluid out of cells.

## 29. Respiratory Volumes

Tidal volume = normal breath (~500 mL); vital capacity = max in + max out; residual volume = air left after full exhale; inspiratory reserve = extra you can inhale.

*Tip: Vital capacity = tidal + inspiratory reserve + expiratory reserve.*

e.g. Residual volume cannot be measured by simple spirometry.

## 30. Liver Functions

Liver: makes bile, metabolizes drugs/toxins, stores glycogen, makes clotting factors and albumin, detoxifies ammonia (urea cycle).

*Tip: The liver does almost everything - drug metabolism + clotting are high-yield.*

e.g. Severe liver failure means drug doses must be reduced (less metabolism).

## 31. Pancreas & Blood Sugar Control

Pancreas = both endocrine (islets: insulin, glucagon) and exocrine (digestive enzymes). Blood sugar rises after meals, falls between - insulin/glucagon balance it.

*Tip: Islets = hormones; acinar cells = digestive enzymes.*

e.g. After a meal, insulin rises to store glucose; between meals, glucagon releases it.

## 32. Structures of the Heart

Four chambers + exit vessels: right atrium (receives deoxygenated from body via vena cava), right ventricle -> pulmonary artery, left atrium (receives oxygenated via pulmonary veins), left ventricle -> aorta.

*Tip: Right side = deoxygenated; left side = oxygenated - trace the flow once.*

e.g. Pulmonary ARTERY carries deoxygenated blood - the exception to 'arteries = oxygen'.

## 33. Reflexes & Sensory Receptors

Reflex arc = receptor -> sensory neuron -> spinal cord -> motor neuron -> muscle. Sensory receptors: mechano (touch/pressure), thermo (temp), chemo (chemicals), nociceptors (pain).

*Tip: Nociceptors = pain - the body's alarm system.*

e.g. The knee-jerk reflex uses a two-neuron arc in the spinal cord.

# Part 3: Biology

25 scored (30 total) / 25 minutes - cells, genetics, respiration & biomolecules

## 1. Cell Theory & Organelles

All organisms are made of cells; the cell is the basic unit of life; cells come from existing cells. Eukaryotes (nucleus) vs prokaryotes (no nucleus - bacteria).

*Tip: Eukaryote = 'true nucleus' (eu = good/true); bacteria are prokaryotes.*

e.g. Human cells are eukaryotic; E. coli is prokaryotic.

## 2. DNA Structure

DNA = double helix of nucleotides (sugar deoxyribose + phosphate + base). Bases pair A-T and C-G (complementary). Genes = segments that code for proteins.

*Tip: A pairs with T, C with G - 'Apple Tree, Car Garage'.*

e.g. A strand A-G-C-T pairs with T-C-G-A.

## 3. DNA Replication

DNA unzips; each strand builds a complementary copy (semi-conservative). Enzymes: helicase unzips, polymerase builds, ligase seals.

*Tip: Semi-conservative = each new double helix keeps one original strand.*

e.g. Replication happens in the nucleus before cell division.

## 4. Central Dogma

DNA → RNA → protein. Transcription (DNA to mRNA in nucleus) then translation (mRNA to protein at ribosomes). mRNA codons (3 bases) code amino acids.

*Tip: DNA transcribes to RNA, RNA translates to protein - the one-way flow.*

e.g. The codon AUG codes for methionine and is the start codon.

## 5. Mutations

Changes in DNA sequence: substitution (one base swapped), insertion/deletion (frameshift - shifts reading frame). Mutations can be silent, harmful, or beneficial.

*Tip: Insertions/deletions are usually worse - they shift the whole frame.*

e.g. Sickle cell anemia = a single base substitution in the beta-globin gene.

## 6. Mitosis vs Meiosis

Mitosis = one division, 2 identical diploid daughter cells (body cells, growth/repair). Meiosis = two divisions, 4 haploid gametes (sperm/egg) with genetic variation.

*Tip: Mitosis = body copy ( $2n \rightarrow 2n$ ); meiosis = gametes ( $2n \rightarrow n$ ).*

e.g. Skin cells divide by mitosis; eggs/sperm form by meiosis.

## 7. Cell Cycle

Interphase (G1 grow, S DNA replicates, G2 prep) → mitosis → cytokinesis. Checkpoints (G1, G2, M) verify before proceeding; failures lead to cancer.

*Tip: G1 = growth check before DNA copy; the S phase copies DNA.*

e.g. Cancer = checkpoint failure that lets mutated cells divide uncontrolled.

## 8. Protein Synthesis

Ribosomes read mRNA codons; tRNA brings amino acids; polypeptide chain folds into a protein. Start codon AUG; stop codons UAA, UAG, UGA.

*Tip: mRNA = message, tRNA = taxi (brings amino acids), ribosome = factory.*

e.g. The ribosome assembles amino acids in the order the codons specify.

## 9. Enzymes

Enzymes are protein catalysts: they lower activation energy and are NOT consumed. Substrate fits the active site; temperature/pH affect activity; denaturation destroys shape.

*Tip: Enzyme + substrate = product; the enzyme survives to act again.*

e.g. Salivary amylase is an enzyme that breaks down starch.

## 10. Cellular Respiration

Glucose + O<sub>2</sub> → CO<sub>2</sub> + H<sub>2</sub>O + ATP (36-38 ATP). Stages: glycolysis (cytoplasm), Krebs cycle (mitochondria), electron transport chain (inner membrane, most ATP).

*Tip: Respiration = making ATP with oxygen; the ETC makes the most ATP.*

e.g. Running out of oxygen shifts muscle cells to fermentation (lactic acid).

## 11. Photosynthesis

Plants: light + CO<sub>2</sub> + H<sub>2</sub>O → glucose + O<sub>2</sub>. In chloroplasts: light reactions (thylakoids) capture light; Calvin cycle (stroma) fixes carbon into sugar.

*Tip: Photosynthesis = light energy turned into chemical energy (sugar).*

e.g. Chlorophyll absorbs light mainly in red and blue wavelengths.

## 12. ATP

ATP = adenosine triphosphate - the cell's energy currency. Breaking the last phosphate bond releases energy; ADP is recharged by respiration/photosynthesis.

*Tip: ATP about to drop a phosphate = energy released for work.*

e.g. Muscle contraction uses the energy released when ATP loses a phosphate.

## 13. Biomolecules

Four classes: carbohydrates (quick energy - glucose, starch), lipids (long-term energy, membranes - fats, phospholipids), proteins (structure/enzymes - amino acids), nucleic acids (DNA/RNA - nucleotides).

*Tip: Match carb = energy, lipid = membrane + stored energy, protein = structure/enzyme.*

e.g. Cell membranes are lipid bilayers made of phospholipids.

## 14. Osmosis & Diffusion (Bio)

Diffusion = particles spread from high to low concentration. Osmosis = water movement across a semipermeable membrane toward higher solute. Both are passive (no ATP).

*Tip: Water follows solute - toward the saltier side.*

e.g. A cell in a hypertonic solution loses water and shrinks.

## 15. Genetic Inheritance

Genes have alleles (versions). Dominant (A) masks recessive (a). Genotype = alleles (Aa); phenotype = appearance. Punnett squares predict offspring ratios.

*Tip: Dominant = capital, expressed when present; recessive needs two copies.*

e.g. Two carriers (Aa x Aa) produce 25% affected (aa) offspring.

## 16. Mendelian Ratios

Monohybrid cross Aa x Aa = 3:1 phenotype, 1:2:1 genotype. Dihybrid = 9:3:3:1. Sex-linked traits (X-linked like hemophilia, color blindness) affect males more.

*Tip: 3:1 is the signature ratio of two heterozygous carriers.*

e.g. Hemophilia is X-linked recessive - more common in males.

## 17. Natural Selection & Evolution

Variation exists, more offspring than survive, those with advantageous traits reproduce more - allele frequencies change over generations (adaptation).

*Tip: Evolution = change in allele frequency driven by differential survival.*

e.g. Antibiotic-resistant bacteria out-survive susceptible ones - selection.

## 18. Ecology Basics

Producers (plants) → consumers (herbivores → carnivores) → decomposers. Food chains/web transfer energy; ~10% transfers between trophic levels.

*Tip: Energy flows one way; matter cycles (carbon, nitrogen).*

e.g. Grass → rabbit → fox: each step loses ~90% of energy.

## 19. Human Body Systems (Bio)

Organ systems work together: circulatory (transport), respiratory (gas exchange), digestive (breakdown), excretory (waste), endocrine (signals), immune (defense), nervous (control).

*Tip: Name one main function per system - questions test the match.*

e.g. The excretory system (kidneys) removes nitrogen wastes as urea.

## 20. Water & pH Biology

Water is a polar solvent; it dissolves most biological molecules. pH scale 0-14; 7 neutral; acids <7, bases >7; buffers resist pH change. Blood pH ~7.4.

*Tip: Water = universal solvent; buffers keep enzymes in their happy zone.*

e.g. Sweat and urine range slightly acidic (5-7); blood stays ~7.4.

## 21. Organelle: Mitochondria vs Chloroplast

Mitochondria = cellular respiration (ATP) - in all eukaryotes. Chloroplasts = photosynthesis - in plants/algae. Both have their own DNA (endosymbiont theory).

*Tip: Mitochondria = power plant; chloroplast = solar panel.*

e.g. Root cells have mitochondria but no chloroplasts.

## 22. Preservation & Homeostasis (Bio)

Organisms maintain internal balance: temperature, water, glucose, ions. Negative feedback loops detect deviation and correct it.

*Tip: Homeostasis = the 'thermostat' model - sense, compare, correct.*

e.g. Panting in a dog lowers body temperature - negative feedback.

# Part 4: Chemistry

25 scored (30 total) / 25 minutes - atoms, bonds, solutions, acids/bases & organic basics

## 1. Atomic Structure

Atom = nucleus (protons + neutrons) + electrons in shells. Atomic number = protons; mass number = protons + neutrons. Neutral atom: electrons = protons.

*Tip: Protons define the element - change protons = change element.*

e.g. Carbon (6 protons, 6 neutrons) = atomic number 6, mass 12.

## 2. Ions & Isotopes

Ions form when atoms gain/lose electrons ( $\text{Na}^+$  = lost 1;  $\text{Cl}^-$  = gained 1). Isotopes = same protons, different neutrons (C-12 vs C-14).

*Tip: Gain electrons = negative ion (anion); lose = positive (cation).*

e.g. C-14 (6p, 8n) is a radioactive isotope of carbon.

## 3. The Periodic Table

Rows = periods (energy shells); columns = groups (similar properties). Metals left, nonmetals right, metalloids staircase. Groups: alkali (1), alkaline earth (2), halogens (17), noble gases (18).

*Tip: Group number = valence electrons (for main groups) - 1 = 1 valence el.*

e.g. Sodium (group 1) has one valence electron and reacts similarly to potassium.

## 4. Chemical Bonds

Ionic = transfer of electrons (metal + nonmetal -  $\text{Na}^+\text{Cl}^-$ ). Covalent = sharing (nonmetal + nonmetal -  $\text{H}_2\text{O}$ ). Hydrogen bonds = weak attractions between molecules (water).

*Tip: Metal + nonmetal = ionic (transfer); nonmetal + nonmetal = covalent (share).*

e.g. NaCl is ionic; water is covalent; DNA strands link via hydrogen bonds.

## 5. Solutions & Solubility

Solute dissolves in solvent (salt in water). Solubility = max solute at a temperature; 'like dissolves like' (polar in polar). Concentration = amount solute / amount solution.

*Tip: Polar solvents dissolve polar solutes - water is the universal solvent.*

e.g. Blood (mostly water) dissolves the polar drugs; oils need carriers.

## 6. Acids & Bases

Acids donate  $\text{H}^+$  ( $\text{pH} < 7$ ) - sour, turn litmus red. Bases accept  $\text{H}^+$  ( $\text{pH} > 7$ ) - bitter, slippery, litmus blue. Strong acids (HCl) dissociate fully; weak (acetic) partially.

*Tip: pH down = more acidic; pH up = more basic; each unit = 10x.*

e.g. Gastric juice ( $\text{pH} \sim 2$ ) is strongly acidic; blood (7.4) slightly basic.

## 7. pH & Buffers

Buffer = weak acid/base pair that resists pH change (bicarbonate system in blood:  $\text{H}_2\text{CO}_3/\text{HCO}_3^-$ ). Body pH must stay  $\sim 7.35$ -7.45.

*Tip: The bicarbonate buffer pairs  $\text{CO}_2$  with  $\text{HCO}_3^-$  to hold blood pH stable.*

e.g. Hyperventilation blows off  $\text{CO}_2$   $\rightarrow$  pH rises (respiratory alkalosis).

## 8. Oxidation & Reduction

Redox = electron transfer. Oxidation = loss of electrons (or gain of oxygen); reduction = gain of electrons (or loss of oxygen). LEO says GER (Lose Electrons = Oxidized).

*Tip: OIL RIG: Oxidation Is Loss, Reduction Is Gain.*

e.g. In cellular respiration, glucose is oxidized and oxygen is reduced.

## 9. States of Matter

Solid (fixed shape/volume), liquid (fixed volume, fits container), gas (fills container). Changes: melting, freezing, evaporation, condensation, sublimation.

*Tip: Phase changes = energy in/out WITHOUT temperature change at the transition.*

e.g. Evaporation cools (sweat) - energy leaves with water molecules.

## 10. Kinetic Molecular Theory

Matter = particles in constant motion; temperature = average kinetic energy; hotter = faster particles; pressure = collisions with walls.

*Tip: Heat up a gas = faster particles = more pressure.*

e.g. A sealed IV bag expands in a warm room - faster particles push harder.

## 11. Chemical Reactions

Reactants → products. Types: synthesis ( $A+B \rightarrow AB$ ), decomposition ( $AB \rightarrow A+B$ ), single replacement, double replacement, combustion (fuel +  $O_2 \rightarrow CO_2 + H_2O$ ), acid-base (neutralization).

*Tip: Synthesis = combine; decomposition = split; combustion = burn with  $O_2$ .*

e.g.  $2H_2 + O_2 \rightarrow 2H_2O$  is a synthesis reaction.

## 12. Balancing Equations

Atoms are conserved: the same number of each element on both sides. Balance by adjusting COEFFICIENTS (not subscripts).

*Tip: Count atoms per element; adjust coefficients; recount until balanced.*

e.g.  $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$  (equal C, H, O on both sides).

## 13. Moles & Molar Mass

Mole =  $6.02 \times 10^{23}$  particles (Avogadro). Molar mass = grams per mole (NaCl = 58.5 g/mol). Molarity = moles solute per liter solution.

*Tip: Convert grams to moles: divide by molar mass.*

e.g. 58.5 g NaCl = 1 mole; 1 mole of NaCl in 1 L = 1 M.

## 14. Gas Laws

Boyle: P up, V down (inverse, constant T). Charles: V up with T (direct, constant P). Dalton: total pressure = sum of partial pressures ( $O_2$ ,  $CO_2$ ,  $N_2$  in air).

*Tip: Boyle = squeeze (pressure-volume); Charles = heat (volume-temp).*

e.g. A diving tank: as you surface, lower pressure lets volume expand - Boyle.

## 15. Nuclear Basics

Radioactivity = unstable nuclei decay, releasing particles (alpha, beta) or gamma rays. Half-life = time for half the sample to decay.

Medical use: tracers (technetium-99m), radiation therapy.

*Tip: Half-life is constant - two half-lives leave one quarter.*

e.g. Technetium-99m decays with a 6-hour half-life - ideal for imaging.

## 16. Organic: Functional Groups

Hydrocarbon backbone + functional groups: hydroxyl (-OH, alcohols), carboxyl (-COOH, acids), amino (-NH<sub>2</sub>), carbonyl (aldehydes/ketones). Each group drives behavior.

*Tip: Identify the group's atoms - -OH = alcohol, -COOH = acid (carboxyl).*

e.g. Ethanol ( $CH_3CH_2OH$ ) has a hydroxyl group.

## 17. Carbohydrates (Chem)

Monosaccharides (glucose, fructose), disaccharides (sucrose), polysaccharides (starch, glycogen, cellulose). Glucose formula  $C_6H_{12}O_6$  - key energy molecule.

*Tip: Glycogen = stored animal glucose; starch = plant store.*

e.g. Blood sugar testing measures glucose ( $C_6H_{12}O_6$ ) concentration.

## 18. Lipids (Chem)

Fats/oils = triglycerides (glycerol + 3 fatty acids); phospholipids = membranes; steroids = hormones (cholesterol base). Saturated = solid at room temp (no double bonds).

*Tip: Unsaturated = kinks (double bonds) = liquid oils.*

e.g. Cholesterol is the precursor for steroid hormones like cortisol.

## 19. Proteins & Amino Acids

Amino acids (NH<sub>2</sub> + COOH + R group) link via peptide bonds into proteins. Levels: primary (sequence), secondary (helix/sheet), tertiary (folding), quaternary (multiple chains).

*Tip: Peptide bond = between carboxyl of one and amino of the next.*

e.g. Hemoglobin is a quaternary protein of four polypeptide chains.

## 20. Energy in Chemistry

Exothermic = releases heat (combustion, condensation - products lower energy). Endothermic = absorbs heat (melting, photosynthesis). Activation energy = hurdle to start.

*Tip: Exo = heat OUT; endo = heat IN; activation energy = the start-up hill.*

e.g. Burning glucose (respiration) is strongly exothermic.

## 21. Clinical Chemistry: Electrolytes

Na<sup>+</sup> 135-145, K<sup>+</sup> 3.5-5, Cl<sup>-</sup> 98-106, Ca<sup>2+</sup> 8.5-10.5, Mg<sup>2+</sup> 1.3-2.1 (mEq/L or mmol/L). Chemistry questions test these ranges + what high/low does.

*Tip: Memorize Na and K first - they are the most-tested pair.*

e.g. K<sup>+</sup> 6.0 mEq/L = hyperkalemia - heart rhythm risk.

## 22. Lab Value Interpretation

BMP/CMP: glucose 70-100 fasting, BUN 7-20, creatinine 0.6-1.2, CO<sub>2</sub> 22-29, albumin 3.5-5.0. ABG: pH 7.35-7.45, PaCO<sub>2</sub> 35-45, HCO<sub>3</sub><sup>-</sup> 22-26.

*Tip: Read the pair (pH + CO<sub>2</sub> or HCO<sub>3</sub><sup>-</sup>) to name the acid-base disorder.*

e.g. pH 7.30 + CO<sub>2</sub> 55 = respiratory acidosis (CO<sub>2</sub> up = acid up).

# Part 5: Grammar

50 questions / 50 minutes - parts of speech, agreement, punctuation & usage

## 1. Parts of Speech

Nouns name things, verbs show action/state, adjectives describe nouns, adverbs modify verbs/adjectives/adverbs, pronouns replace nouns, conjunctions join, prepositions show relationship.

*Tip: Label each word in a sample sentence; the label is the question on many items.*

e.g. 'The nurse quickly checked the chart' - nurse=noun, quickly=adverb, checked=verb.

## 2. Subject-Verb Agreement

A verb must agree in number with its subject: singular subject takes singular verb. Watch compound and tricky subjects (everyone, neither, the number of).

*Tip: FIND the subject first - the words between subject and verb are traps.*

e.g. The list of medications IS (not are) on the counter.

## 3. Pronoun Agreement & Case

Pronouns must agree with antecedent in number/gender; subject pronouns (I, she, we) do the action, object pronouns (me, her, us) receive it.

*Tip: Test by isolating the pronoun: 'Me and him went' -> 'I and he went'.*

e.g. Between you and ME (object of preposition), not 'I'.

## 4. Verb Tense Consistency

Keep the same tense within a sentence unless a time shift is stated. Mixing past and present without a time word is a classic error.

*Tip: Read the whole sentence for time clues before picking the tense.*

e.g. She administered the dose and documented it (both past).

## 5. Irregular Verbs

Memorize the principal parts of common irregulars: go-went-gone, see-saw-seen, take-took-taken, lie-lay-lain, set-set-set vs sit-sat-sat.

*Tip: Past participle (have/had + form) is the '-n/-en/-t' column - most errors live there.*

e.g. He has TAKEN (not took) the medication twice today.

## 6. Punctuation: Comma

Commas separate items in a list, set off introductory clauses and nonessential phrases, and join two independent clauses with a conjunction (and/but/or).

*Tip: Do NOT use a comma to join two complete sentences without a conjunction - that is a comma splice.*

e.g. 'The patient arrived at 8, and the nurse assessed immediately' - correct.

## 7. Punctuation: Semicolons

A semicolon joins two closely related independent clauses WITHOUT a conjunction; use it also between list items that contain commas.

*Tip: If you can place a period between two clauses, you may use a semicolon.*

e.g. 'The lab was normal; the patient was discharged.'

## 8. Punctuation: Colon

A colon introduces a list, an explanation, or a formal quotation - it follows a COMPLETE sentence. Do not use it mid-sentence.

*Tip: Colon = 'here comes' - the words before it must stand alone.*

e.g. 'Bring three items: stethoscope, penlight, and ID.'

## 9. Apostrophes

Apostrophe + s = possessive singular (nurse's); s + apostrophe = possessive plural (nurses'); contractions use apostrophes (don't, it's = it is). ITS (no apostrophe) is possessive - it's is always a contraction.

*Tip: ITS vs IT'S is the single most tested apostrophe trap.*

e.g. 'The patient's chart' (one patient) vs 'the patients' charts' (many).

## 10. Sentence Fragments

A fragment is an incomplete sentence missing a subject, a verb, or both - often a dependent clause left standing alone ('Because the lab was late').

*Tip: A complete sentence must contain a subject and a verb and express a full thought.*

e.g. Correct a fragment by attaching it to the sentence it belongs with.

## 11. Run-On Sentences

A run-on (fused sentence) joins two independent clauses with no punctuation or conjunction. Fix with a period, semicolon, or comma + conjunction.

*Tip: Two complete thoughts in one sentence need a connector - period, semicolon, or comma + and/but/or.*

e.g. 'The shift ended the nurse charted' -> 'The shift ended; the nurse charted.'

## 12. Comma Splice

A comma splice incorrectly joins two independent clauses with only a comma. Replace the comma with a semicolon or add a conjunction.

*Tip: When you see comma + two full sentences, choose the semicolon fix.*

e.g. 'She was tired, she kept working' -> 'She was tired; she kept working.'

## 13. Modifiers & Dangling

Modifiers must clearly attach to the word they describe. A dangling modifier leaves the reader guessing ('Running late, the chart was forgotten' - who ran?).

*Tip: Place the modifier NEXT to the word it modifies.*

e.g. 'Running late, the nurse forgot the chart' - clear.

## 14. Parallel Structure

Items in a list or pair must use the same grammatical form: all gerunds, all infinitives, all equal noun phrases.

*Tip: Match the form of the first item when you build the rest.*

e.g. 'She likes assessing, documenting, and TEACHING' (not 'to teach').

## 15. Common Usage Errors

Their/there/they're, your/you're, its/it's, affect/effect, then/than, accept/except, fewer/less (countable vs uncountable), who/whom (subject vs object).

*Tip: Make a one-line personal cheat-sheet of your own two or three danger pairs.*

e.g. 'Fewer patients' (countable) vs 'less water' (uncountable).

## 16. Active vs Passive Voice

Active voice: subject does the action (The nurse gave the dose). Passive: subject receives it (The dose was given by the nurse). Prefer active in clear clinical writing.

*Tip: If 'by zombies' fits after the verb, it is passive ('was given by zombies').*

e.g. 'The provider ordered labs' (active) is cleaner than 'Labs were ordered.'

## 17. Adjective vs Adverb

Adjectives modify nouns; adverbs modify verbs/adjectives/adverbs and usually end in -ly (quick/quickly, careful/carefully).

*Tip: Ask: what is being described? A noun? -> adjective. An action? -> adverb.*

e.g. 'She walked quickly' (adverb) vs 'a quick walk' (adjective).

## 18. Prepositions

Prepositions (of, to, in, for, with, on) show relationships. Idiom pairs are tested: 'different from', 'capable of', 'similar to', 'based on'.

*Tip: Learn fixed preposition pairs by phrase, not by rule - they are idiomatic.*

e.g. 'Statistically significant' pairs with IN, not 'significant to'.

## 19. Articles

A/an = indefinite (one of many); the = definite (a specific one). Use 'a' before consonant SOUNDS, 'an' before vowel SOUNDS (an hour, a university).

*Tip: Sound decides a/an, not the letter: an honor, a union.*

e.g. 'An 80-year-old patient' (vowel sound) - correct.

## 20. Conjunctions

Coordinating (and, but, or, nor, for, so, yet) join equals; subordinating (because, although, when, if) start dependent clauses.

*Tip: But = contrast, so = result, although = concession - match the meaning to the sentence.*

e.g. 'Although the results were normal, the team remained cautious.'

# Part 6: Reading Comprehension

50 questions / 60 minutes - main idea, details, inference & author's purpose

## 1. Main Idea

The main idea is the single point the passage is built around - often stated in the first or last sentence, or in the first sentence of the conclusion paragraph.

*Tip: Read the first and last sentence of each paragraph; the main idea usually lives there.*

e.g. A passage about how hand hygiene cuts infection: the main idea is that hand hygiene prevents transmission.

## 2. Supporting Details

Details are the facts, examples, and data that develop the main idea. Detail questions ask what is directly stated - the answer is in the text, not inferred.

*Tip: For detail questions, scan for the exact phrase from the question stem; the answer is usually near it.*

e.g. 'The CDC recommends 20 seconds of scrubbing' - a detail item asks exactly this figure.

## 3. Vocabulary in Context

When a word is used in the passage, its meaning is set by surrounding clues: definition, example, contrast, or cause-effect. Substitute the likely meaning and test the sentence.

*Tip: Replace the word with each option in the sentence; only the true meaning keeps the sentence sensible.*

e.g. In 'the prognosis was guarded', prognosis = outlook/expected course.

## 4. Inference

An inference is what the text logically supports but does not state directly. Stick to information in the passage - never import outside knowledge or your own opinion.

*Tip: Pick the option that MUST follow from the text; if two options seem possible, choose the more conservative one.*

e.g. If a passage says patients feel calmer after music therapy, you may infer music reduces stress - not that it cures illness.

## 5. Author's Purpose

Authors write to inform, persuade, explain, describe, or entertain. Identify the genre (textbook, brochure, policy, memo) and the target audience to read the purpose.

*Tip: Signal words reveal purpose: 'should' = persuade, 'according to' = inform, 'steps' = explain.*

e.g. A handout titled 'How to Use an Inhaler' exists to explain/teach.

## 6. Text Organization

Common patterns: cause-and-effect, chronological order, compare-and-contrast, problem-and-solution, definition-and-example. The opening of each paragraph signals the pattern.

*Tip: Predict the pattern from the first paragraph; the rest of the passage should confirm it.*

e.g. A passage on 'before and after the policy' is chronological with comparison.

## 7. Fact vs Opinion

Facts are verifiable statements; opinions carry judgment words (should, best, worst, clearly). Policy documents mix both - questions ask you to separate them.

*Tip: Judgment words are the fastest tell; flag them as you read.*

e.g. 'Smoking kills' is fact; 'smoking is disgusting' is opinion.

## 8. Tone & Attitude

Tone = the author's attitude (objective, concerned, supportive, critical) revealed by word choice. Clinical passages tend to be neutral and objective.

*Tip: Notice adjectives: 'excellent outcome' signals positive attitude; 'unfortunately' signals concern.*

e.g. A CDC document written with no opinion words has an objective tone.

## 9. Summarizing

A summary compresses the passage into its main idea plus the key supporting points, in your own words, with no new information.

*Tip: Summarize in one sentence per paragraph mentally as you read - it builds a scaffold for every question type.*

e.g. Summarizing a 3-paragraph safety protocol yields one sentence on who, what, and the top rules.

## 10. Sequence & Steps

Process passages present steps in order; sequence questions ask what comes first, next, or last. Watch for transition words (first, then, finally).

*Tip: Underline transition words; they are the map to sequence answers.*

e.g. 'First wash hands, then apply gloves' - washing comes before gloving.

## 11. Cause and Effect

The passage states that one event or condition produces another. Look for 'because, since, as a result, therefore, leads to'.

*Tip: Identify the trigger and the outcome before reading the answer choices.*

e.g. Because staffing dropped (cause), medication errors rose (effect).

## 12. Compare & Contrast

Compare shows similarities; contrast shows differences. Signal words: similarly, likewise, in contrast, however, whereas.

*Tip: Make two mental columns (A vs B); questions often ask for one column.*

e.g. Study sessions with mnemonics vs without: similar content, different retention.

## 13. Reading a Policy

Policies state rules with conditions (if X, then Y) and exceptions (unless, except). Details questions on policy passages reward close re-reading of conditions.

*Tip: For 'what must the nurse do when X' questions, find the exact conditional clause.*

e.g. Policy: 'If the patient's INR exceeds 4, hold warfarin and notify the provider.' - the action is conditional on INR > 4.

## 14. Patient Education Handouts

Handouts are written for patients: simpler words, short sentences, clear steps, and a call to action. Questions test whether you grasp the plain-language content.

*Tip: Answer patient-education items in the patient's perspective - what the patient is told to do.*

e.g. A handout telling a diabetic patient to 'check feet daily' expects daily foot inspection.

## 15. Evidence & Support

The strongest answers are supported by the most specific evidence stated in the passage - numbers, names, and direct quotes beat generalities.

*Tip: Match the answer to a concrete sentence from the passage; vague options rarely win.*

e.g. If the passage cites 'a 2019 study of 410 patients', an answer mentioning that study is grounded.

## 16. Purpose of Paragraphs

Each paragraph has a job: introduce, define, give example, contrast, conclude. Paragraph-purpose questions ask why the author included a paragraph.

*Tip: Read the paragraph's first and last sentence to name its job (definition? example? warning?).*

e.g. A paragraph defining 'negative pressure rooms' exists to define a term used later.

# Part 7: Vocabulary & General Knowledge

55 questions / 50 minutes - health-science roots, prefixes & suffixes

## 1. Root: cardio-

Cardio- = heart. Medical words: cardiovascular, cardiologist, electrocardiogram (ECG/EKG), cardiac output.

*Tip: Link the root to a word you know - 'cardio' workout = heart workout.*

e.g. Cardiomegaly = enlarged heart (mega = large).

## 2. Root: hemo-/hemat-

Hemo-/hemat- = blood. Words: hemoglobin, hematology, hemorrhage, hemolysis, hematocrit.

*Tip: Associate hemo- with 'hemoglobin carries oxygen in blood'.*

e.g. Hematuria = blood in the urine (uria = urine).

## 3. Root: gastro-

Gastro- = stomach. Words: gastroenterology, gastritis, gastrectomy, gastrointestinal (GI).

*Tip: Think 'gastric juices in the stomach'.*

e.g. Gastroenteritis = stomach and intestine inflammation.

## 4. Root: neuro-

Neuro- = nerve. Words: neurology, neuron, neuropathy, neurosurgery.

*Tip: Neuro- = nerves; connect to 'nerve cells = neurons'.*

e.g. Neuropathy = nerve damage or disease.

## 5. Root: nephro-/ren-

Nephro- and ren- = kidney. Words: nephrology, nephron, renal, nephritis.

*Tip: Both roots mean kidney - renal artery feeds the kidney.*

e.g. Renal failure = kidney failure.

## 6. Root: pulmo-/pneum-

Pulmo- = lung; pneum- = lung or air. Words: pulmonary, pneumonia, pneumothorax.

*Tip: Pulmo- = lung tissue; pneum- often air/lung together.*

e.g. Pneumonia = lung infection.

## 7. Prefix: hyper-

Hyper- = above normal/excessive. Words: hypertension, hyperglycemia, hyperthyroidism, hypersensitive.

*Tip: Hyper = high - hyperglycemia = high blood sugar.*

e.g. Hyperthermia = body temperature above normal.

## 8. Prefix: hypo-

Hypo- = below normal/deficient. Words: hypotension, hypoglycemia, hypothyroidism.

*Tip: Hypo = low - the opposite of hyper. Pair them when studying.*

e.g. Hypotension = low blood pressure.

## 9. Prefix: tachy-

Tachy- = fast. Words: tachycardia (fast heart rate), tachypnea (fast breathing).

*Tip: Tachy = fast; brady = slow - study as a pair.*

e.g. Tachypnea = rapid respirations.

## 10. Prefix: brady-

Brady- = slow. Words: bradycardia (slow heart rate), bradypnea (slow breathing).

*Tip: Remember 'brady' by thinking of a slow-motion heart.*

e.g. Bradycardia = heart rate under 60.

## 11. Suffix: -itis

-itis = inflammation. Words: tonsillitis, appendicitis, cystitis, dermatitis (inflammation of skin).

*Tip: -itis always = inflammation; name the affected part before it.*

e.g. Cystitis = bladder (cyst) inflammation.

## 12. Suffix: -ectomy

-ectomy = surgical removal. Words: appendectomy, tonsillectomy, cholecystectomy (gallbladder removal).

*Tip: -ectomy = cut out; -otomy = cut into - do not mix them.*

e.g. Appendectomy = removal of the appendix.

## 13. Suffix: -otomy

-otomy = cutting into (an incision). Words: tracheotomy, colostomy? No - colostomy is -ostomy. Tracheotomy = incision into the trachea.

*Tip: -otomy = opening/incision (otomy vs ectomy - removal vs opening).*

e.g. Tracheotomy creates an airway opening in the trachea.

## 14. Suffix: -ostomy

-ostomy = creating an opening/mouth. Words: colostomy, tracheostomy, urostomy.

*Tip: -ostomy = new opening; memorize the three: -itis, -ectomy, -ostomy.*

e.g. Colostomy = surgical opening of the colon to the body surface.

## 15. Suffix: -ology

-ology = study of. Words: biology, physiology, pharmacology, pathology.

*Tip: -ology = study; -ologist = one who studies it.*

e.g. Pathology = study of disease processes.

## 16. Suffix: -algia

-algia = pain. Words: neuralgia (nerve pain), myalgia (muscle pain), arthralgia (joint pain).

*Tip: -algia = pain; pair with the body part root before it.*

e.g. Arthralgia = joint pain (arthro- = joint).

## 17. Suffix: -emia

-emia = blood condition. Words: anemia (low red cells), hyperlipidemia (high blood lipids), bacteremia (bacteria in blood).

*Tip: -emia = blood state; prefix tells high/low/which substance.*

e.g. Anemia = deficient red blood cells or hemoglobin.

## 18. Suffix: -uria

-uria = urine condition. Words: hematuria (blood in urine), polyuria (excessive urine), dysuria (painful urination).

*Tip: -uria = urine; dys- = painful, poly- = much.*

e.g. Polyuria = excessive urine output.

## 19. Prefix: dys-

Dys- = difficult/painful/abnormal. Words: dysphagia (difficulty swallowing), dyspnea (difficulty breathing), dysthymia.

*Tip: Dys- = bad/difficult; apply to the body function it precedes.*

e.g. Dyspnea = labored or difficult breathing.

## 20. Prefix: eu-

Eu- = normal/good. Words: eupnea (normal breathing), euthyroid (normal thyroid), euglycemia (normal blood sugar).

*Tip: Eu- = good - contrast with dys- (bad).*

e.g. Eupnea = normal, unlabored breathing.

## 21. Prefix: anti- / contra-

Anti- = against; contra- = against. Words: antibiotic (against bacteria), anticoagulant, contraindication.

*Tip: Anti-/contra- mean against - a contraindication is a reason NOT to do something.*

e.g. Anticoagulants oppose blood clotting.

## 22. Prefix: a-/an-

A-/an- = without/not. Words: apnea (no breathing), anemia (no/insufficient blood), avascular, anoxia (no oxygen).

*Tip: A-/an- = without - apnea = without breath.*

e.g. Anoxia = absence of oxygen supply to tissue.

### 23. General Knowledge: Metric Units

The body uses liters, milliliters, grams, kilograms, and meters. Standard conversions: 1 L = 1000 mL, 1 g = 1000 mg, 1 kg = 2.2 lb.

*Tip: The metric system is decimal - moving the decimal converts units.*

e.g. 500 mL = 0.5 L; 75 kg = 165 lb.

### 24. General Knowledge: Normal Vitals

Reference ranges to recognize: BP ~120/80, HR ~60-100, RR ~12-20, temperature ~98.6 F / 37 C, O<sub>2</sub> sat ~95-100% on room air.

*Tip: Memorize the five ranges; questions present a value and ask if it is normal.*

e.g. A resting heart rate of 72 is within normal limits.

### 25. General Knowledge: Body Directions

Superior = above, inferior = below, medial = toward midline, lateral = away from midline, proximal = closer to trunk, distal = farther from trunk.

*Tip: Draw a stick figure and place the directional terms ON it to lock them in.*

e.g. The elbow is proximal to the wrist (closer to the trunk).

### 26. General Knowledge: Prefixes of Motion

Flexion = bending (decreases angle), extension = straightening (increases angle), abduction = away from midline, adduction = toward midline, rotation = turning.

*Tip: Remember 'abduction = away' by the 'a' for away.*

e.g. Raising your arm out to the side is abduction.

# Part 8: Mathematics

55 questions / 60 minutes - basic math, conversions & word problems (on-screen calculator)

## 1. Fractions

Top-heavy fractions (improper) become mixed numbers by dividing:  $7/4 = 1 \frac{3}{4}$ . Add/subtract only with common denominators; multiply straight across; divide by flipping the second fraction.

*Tip: Reduce before you multiply - it makes arithmetic smaller and faster.*

e.g.  $3/4 + 1/6 = 9/12 + 2/12 = 11/12$ .

## 2. Decimals

Decimals are fractions with power-of-ten denominators:  $0.25 = 25/100 = 1/4$ . Multiply decimals by counting total decimal places; divide by moving the decimal in divisor and dividend equally.

*Tip: Keep place values aligned when adding/subtracting decimals - line up the decimal points.*

e.g.  $0.2 \times 0.3 = 0.06$  (two decimal places total), not 0.6.

## 3. Ratios & Proportions

A ratio a:b compares two quantities; solve proportion problems by cross-multiplying  $a/b = c/d \rightarrow a \times d = b \times c$ . Keep the same unit on matching sides.

*Tip: Set up proportions with labels on both sides so you never invert them.*

e.g. If 3 syringes cost \$2.70, 5 cost x:  $3/2.70 = 5/x \rightarrow x = \$4.50$ .

## 4. Percentages

Percent means per hundred. Part = Percent x Whole. Percent change = (change / original) x 100. Move the decimal two places to convert between decimal and percent.

*Tip: On a calculator, type the rate as a decimal: 15% of 80 =  $0.15 \times 80$ .*

e.g. A \$40 item on 25% sale costs  $40 \times 0.75 = \$30$ .

## 5. Household Measures

Standard conversions to know cold: 1 tsp = 5 mL, 1 tbsp = 15 mL, 1 cup = 240 mL, 1 oz = 30 mL, 1 L = 1000 mL, 1 kg = 2.2 lb, 1 inch = 2.54 cm, 1 kg = 1000 g.

*Tip: Memorize the five most tested: tsp->mL, tbsp->mL, cup->mL, oz->mL, kg->lb.*

e.g. A medication ordered 15 mL equals 1 tablespoon (15 mL = 1 tbsp).

## 6. Unit Conversion Strategy

Convert with a chain of equivalence factors, canceling units. Keep the medicine label unit (mL, mg) aligned with the order unit before solving.

*Tip: Write the conversion as a fraction (15 mL / 1 tbsp) and multiply so units cancel.*

e.g. 2 tbsp -> mL:  $2 \times (15 \text{ mL} / 1 \text{ tbsp}) = 30 \text{ mL}$ .

## 7. Word Problems

Translate the sentence into numbers and one operation: 'of' often means multiply, 'per' means divide, 'increased by' means add. Answer in the unit asked, not the one calculated.

*Tip: Underline the question being asked; most HESI word problems test translation more than computation.*

e.g. 'Nursing students: 24 female of 30 total' ->  $24/30 = 80\%$ .

## 8. Averages

Average = sum of values / number of values. Work backward: sum needed = average x count.

*Tip: If you know the mean and count, multiply to find the missing total.*

e.g. Mean of 80, 90, 70:  $(80+90+70)/3 = 80$ .

## 9. Order of Operations

PEMDAS (parentheses, exponents, multiply/divide left to right, add/subtract left to right). Multiplication and division have equal rank - work left to right.

*Tip: When in doubt, do parentheses first and rewrite the expression.*

e.g.  $8 / 4 \times 2 = 4$  (divide first, left to right), not 1.

## 10. Algebra Basics

Solve one-variable equations by doing the same operation to both sides to isolate the variable. Move a term across the equals sign by changing its sign.

*Tip: Whatever you do to one side, do to the other - the key to every equation.*

e.g.  $x/4 + 3 = 9 \rightarrow x/4 = 6 \rightarrow x = 24$ .

## 11. Perimeter & Area

Rectangle perimeter =  $2(L + W)$ , area =  $L \times W$ . Triangle area =  $1/2 \times \text{base} \times \text{height}$ . Circle circumference =  $2\pi r$ , area =  $\pi r^2$ .

*Tip: Shapes on HESI Math are simple - just pick the right formula and plug in.*

e.g. A 5 ft x 8 ft room has area 40 sq ft and perimeter 26 ft.

## 12. Powers & Roots

Any number to power 0 = 1. Square root of 25 = 5. Multiply powers by adding exponents (same base):  $x^2 \times x^3 = x^5$ .

*Tip: Know the common squares (1-15) and cube of 1-5 to speed up mental math.*

e.g.  $\sqrt{144} = 12$ ;  $6^2 = 36$ .

## 13. Signed Numbers

Adding a negative = subtracting. Subtracting a negative = adding. Product/quotient of two negatives = positive; one negative = negative.

*Tip: Track the sign first, then the magnitude - signs are where most points are lost.*

e.g.  $-5 - (-3) = -5 + 3 = -2$ .

## 14. Precision & Rounding

Round to the decimal place requested. Nurse math orders rarely ask for more than 1-2 decimal places; keep the exact value until the final step.

*Tip: Do all algebra with unrounded numbers; round only the final answer.*

e.g.  $(2.33 \times 7) = 16.31$  rounds to 16.3 at one decimal.

## 15. Reading Graphs

Bar charts compare categories; line graphs show change over time; pie charts show parts of a whole. Read axes and labels before answering.

*Tip: Identify what each axis measures and the units before you pull a value.*

e.g. A bar chart of vital signs per shift: the tallest bar = highest reading across shifts.

## 16. Dosage-Style Problems

Although scored under Math, nursing prep includes dose-style items: dose = (desired / have) x volume. Maintain units throughout.

*Tip: Set it up as (ordered amount / available amount) x vehicle to cancel 'available'.*

e.g. Order 500 mg; tabs are 250 mg each  $\rightarrow (500/250) \times 1 = 2$  tabs.

## 17. Elapsed Time

Elapsed time = end minus start, carrying 60 minutes per hour. AM/PM conversions across noon need +12 hours.

*Tip: Convert PM to 24-hour time before subtracting to avoid off-by-12 errors.*

e.g. 09:45 to 14:20 = 4 hrs 35 min.

## 18. Money & Billing

Unit pricing: total = unit price x count. Discounts: final = original x (1 - rate). Sales tax: total = price x (1 + tax rate).

*Tip: For a percent-off, compute (1 - rate) once and multiply.*

e.g. \$80 shirt, 20% off, 8% tax:  $80 \times 0.8 \times 1.08 = \$69.12$ .

## 19. Probability Basics

Probability = favorable outcomes / total outcomes (0 to 1). Independent events multiply:  $P(A \text{ and } B) = P(A) \times P(B)$ .

*Tip: Convert to a percent by multiplying by 100 when asked for a rate.*

e.g. Drawing a red marble from 3 red + 7 blue =  $3/10 = 30\%$ .

## 20. Data Interpretation

Range = max - min. Median = middle value (average the two middle when even). Mode = most frequent value. Mean = average.

*Tip: On HESI data questions, list the values in order before finding median/mode.*

e.g. Values 2, 4, 4, 9: median = 4, mode = 4, range = 7.

## 21. Metric Movement

Metric ladder: kilo, hecto, deka, base, deci, centi, milli - each step is a power of 10. Moving right = multiply by 10 per step; left = divide.

*Tip: Move the decimal one place per ladder step; never count more, never less.*

e.g. 1.5 L → mL: three steps down = 1500 mL.

## 22. Mental Math Shortcuts

10% of any number = move decimal one place; 5% = half of 10%. Double and halve for easier multiplication ( $25 \times 12 = 50 \times 6 = 300$ ).

*Tip: Break awkward percents into 10% blocks to estimate quickly under time.*

e.g. 15% of 60 = 10% (6) + 5% (3) = 9.

## 23. Inequalities

Solve like equations, but flip the sign when multiplying or dividing by a negative. Keep the inequality direction true to the original wording.

*Tip: Reading 'at least' means  $\geq$ , 'no more than' means  $\leq$  - convert words to symbols correctly.*

e.g.  $x - 3 > 7 \rightarrow x > 10$ ;  $-2x < 6 \rightarrow x > -3$  (flip!).

## 24. Simple Interest & Growth

Simple interest = principal  $\times$  rate  $\times$  time. Final amount = principal + interest (time in years or seasonal fraction).

*Tip: Keep rate as a decimal and time in the same unit the rate is quoted (usually years).*

e.g. \$500 at 4% for 6 months:  $500 \times 0.04 \times 0.5 = \$10$  interest.

## 25. Dimensional Analysis

The gold standard for nurse math: write the desired unit, then chain conversion factors so units cancel. This prevents most dosage errors.

*Tip: Always end with the unit the question asks for; if yours does not match, redo the chain.*

e.g. gtt/min from 500 mL over 4 hr with 15 gtt/mL:  $500 \times 15 / (4 \times 60) = 31$  gtt/min.

## 26. Temperature Conversion

C to F:  $F = (C \times 9/5) + 32$ . F to C:  $C = (F - 32) \times 5/9$ .  $98.6^\circ\text{F} = 37^\circ\text{C}$  = normal body temperature.

*Tip: Memorize  $98.6^\circ\text{F} = 37^\circ\text{C}$ ; for linear neighbors,  $95^\circ\text{F} \sim 35^\circ\text{C}$ ,  $100^\circ\text{F} \sim 37.8^\circ\text{C}$ .*

e.g.  $40^\circ\text{C} \rightarrow \text{F}$ :  $(40 \times 1.8) + 32 = 104^\circ\text{F}$ .

# Part 9: Critical Thinking

~26-30 questions / ~45 minutes - clinical judgment, prioritization, arguments & ethics

## 1. Clinical Judgment Model

Nursing critical thinking follows a cycle: recognize (cue), analyze (interpret), prioritize (decide what matters), implement (act), and evaluate (outcome). HESI CT items test this judgment, not memorized facts.

*Tip: Ask yourself 'what is the nurse's next best action?' - the correct answer is the highest-priority, safest, most-complete option.*

e.g. A patient reports new chest pain: recognize the cue (pain), analyze (possible cardiac), prioritize (assess ABCs), act (call for help).

## 2. ABCs First

Airway, Breathing, Circulation always outrank other concerns. When two actions both seem right, the one that protects airway/breathing/circulation wins.

*Tip: Answer CT prioritization items by running ABCD before anything else: airway, breathing, circulation, disability.*

e.g. A stable post-op patient who suddenly becomes short of breath beats a scheduled dressing change - airway first.

## 3. Maslow's Hierarchy Applied

Physiologic needs (airway, breathing, circulation, food, fluid) precede safety, love, esteem, and self-actualization. Use Maslow to order nursing priorities.

*Tip: When prioritization is ambiguous, pick the option that addresses the most basic physiologic need first.*

e.g. A patient in respiratory distress outranks a patient who is anxious about discharge - physiology over esteem.

## 4. Deductive Reasoning

Deduction moves from a general rule to a specific conclusion: if the rule holds, the conclusion must follow. CT items reward applying the stated standard to the case.

*Tip: Accept the rule as given in the stem; do not re-litigate it. Pick the conclusion that strictly follows.*

e.g. Rule: patients on anticoagulants must be observed for bleeding. Patient X is on warfarin, so observe Patient X for bleeding.

## 5. Inductive Reasoning

Induction moves from specific observations to a general pattern or hypothesis. CT items test recognizing when a few cases suggest a trend without overgeneralizing.

*Tip: Distinguish 'this pattern suggests' (induction, valid) from 'this pattern proves for everyone' (overreach, invalid).*

e.g. Three post-op patients who developed fever after the same surgeon's procedure suggests a possible common cause - not proof.

## 6. Arguments: Premise & Conclusion

An argument = premises (support) + conclusion (the claim being defended). Identify the conclusion FIRST; the premises are the evidence for it.

*Tip: Signal words for conclusions: therefore, thus, hence, so, consequently. Words like 'because, since, as' mark premises.*

e.g. 'Because the WBC is elevated (premise), the patient likely has an infection (conclusion).'

## 7. Assumptions

An assumption is an unstated premise the argument depends on. CT items ask 'which assumption must be true for the argument to work?'

*Tip: Negate each option: the assumption is the one whose falsehood destroys the argument.*

e.g. Argument: 'the patient is septic, so start antibiotics.' Assumption: the patient's symptoms are caused by a bacterial (not viral) process.

## 8. Inference vs Author Claim

An inference goes beyond the text using logic; an author claim is explicitly stated. CT items ask which conclusion is BEST supported - the most direct, conservative link.

*Tip: Pick the inference with the shortest logical distance from the evidence; the farthest jump is usually the distractor.*

e.g. Evidence: BP 82/50 after diuretics. Best inference: the patient is hypotensive and needs evaluation - not 'the diuretic dose was wrong.'

## 9. Evaluating Evidence Strength

Strong evidence is relevant, recent, representative, and from a reliable source (RCTs, guidelines, lab values). Anecdotes, single cases, and outdated sources are weak.

*Tip: Weigh the evidence quality, not the number of examples - one robust study beats many anecdotes.*

e.g. A 2024 systematic review on fall prevention outweighs one colleague's 'in my experience' story.

## 10. Recognizing Bias

Bias = systematic distortion: confirmation (favoring what you expect), anchoring (over-relying on first info), availability (over-using vivid/recent cases). CT items ask you to spot it.

*Tip: Look for 'since we always do it this way' (anchoring/habit) and 'the last patient like this' (availability).*

e.g. A nurse who expects post-op patients to be sleepy may miss an early neurologic change - confirmation bias.

## 11. Cause vs Correlation

Two variables moving together does not prove one causes the other (confounders, reverse causation, coincidence). CT items flag over-claiming from correlation.

*Tip: Ask: is there a plausible mechanism, confounding variable, or possibility that effect precedes cause?*

e.g. Patients who eat breakfast have higher energy - maybe sleep and habits explain it; breakfast is not proven to cause energy.

## 12. Logical Fallacies

Common tested fallacies: ad hominem (attacking the person), false dilemma (only two options), slippery slope, hasty generalization, circular reasoning, appeal to authority.

*Tip: Name the fallacy to eliminate it - CT items reward recognizing why an argument fails.*

e.g. 'Either we discharge today or the hospital loses money' = false dilemma (there are other options).

## 13. Prioritizing Multiple Patients

When several patients need attention, rank by acuity: unstable ABCs/acute change first, then abnormal-but-stable, then routine care. CT items give 4 patients and ask who to see first.

*Tip: Run the ABCD + Maslow filter on each patient in one pass, then pick the most acute.*

e.g. A patient with new-onset confusion and HR 122 beats a stable patient requesting pain meds and a patient due for a scheduled dressing change.

## 14. Triage & Acuity

Triage categories: emergent (life/limb threat - immediate), urgent (would deteriorate without early care), semi-urgent (stable, can wait), non-urgent (can wait safely). CT items test categorization.

*Tip: Use 'without treatment, will this patient deteriorate soon?' to separate urgent from semi-urgent.*

e.g. Chest pain with ST changes = emergent; a recheck of a well-healing incision = non-urgent.

## 15. Delegation & Scope

The RN cannot delegate assessment, teaching, or nursing judgment to an aid (UAP/LPN scope varies). CT items test what can be delegated and what must stay with the RN.

*Tip: Never delegate: initial/focused assessment, teaching, evaluation, or anything requiring nursing judgment.*

e.g. Vital signs on a stable patient - delegable; a first assessment of a newly admitted patient - stays with the RN.

## 16. Decision-Making Steps

A structured clinical decision: gather data -> identify the problem -> weigh options with evidence -> choose -> act -> evaluate. CT items reward the stepwise path.

*Tip: When stuck, name your missing step - most CT misses come from acting before gathering enough data.*

e.g. Before calling the provider about a low BP, gather: trend of BP, urine output, meds given, and the patient's symptoms.

## 17. What Is Missing?

CT questions often ask 'what additional information does the nurse need?' - the best answer fills the biggest gap that would change the decision.

*Tip: Choose the information that would alter management, not nice-to-know details.*

e.g. Before giving PRN morphine, you need the last dose time, current pain score, and BP/RR - not the patient's favorite music.

## 18. Safety & Error Prevention

The nurse's first duty is safety: correct patient, correct med, correct route, correct time, correct dose. CT items test catching errors (look-alike drugs, wrong-limb ID, allergies).

*Tip: When a CT option violates a safety rule (wrong route, overdue allergy check), it is wrong no matter how convenient.*

e.g. Order reads 'give 5 mg IV' but the available vial is 5 mg/mL IM-only - clarify before acting.

## 19. SBAR Communication

SBAR = Situation, Background, Assessment, Recommendation - the standard handoff/phone format. CT items ask which statement belongs in which SBAR slot.

*Tip: Situation = what is happening now; Background = relevant history; Assessment = your read; Recommendation = what you want.*

e.g. S: 'Mrs. Jones is newly confused.' B: 'She had surgery today.' A: 'I suspect an electrolyte imbalance.' R: 'Please evaluate her now.'

## 20. Ethical Principles

Autonomy (patient choice), beneficence (do good), nonmaleficence (do no harm), justice (fairness), fidelity (keep promises), veracity (truthfulness). CT items test applying the principle to the case.

*Tip: Match the principle to the obligation in the stem - autonomy protects the patient's own choice even when you disagree.*

e.g. A competent patient refusing a treatment is exercising autonomy; the nurse supports the choice and notifies the provider.

## 21. Recognizing Urgent Change

Sudden change = urgent: acute confusion, chest pain, dyspnea, hypotension, bleeding, anaphylaxis signs, seizure. CT items present a 'stable patient who just changed' and ask the next best action.

*Tip: When in doubt, reassess ABCs first - a change in consciousness or breathing is never routine.*

e.g. A previously stable patient who is suddenly drowsy with a falling BP is deteriorating - act now, not after rounds.

## 22. Evaluating Outcomes

After an intervention, evaluate: did it achieve the intended effect (pain eased, O2 sat rose, education understood)? CT items ask what to do when an outcome is not met.

*Tip: If an intervention fails, DO NOT simply repeat it - reassess the patient, consider alternatives, and notify the provider.*

e.g. Wound dressing still bleeding after pressure: reassess, suspect a clotting issue, and get help - not another bandage.

## Part 10: Physics (optional)

Only if your program lists it - mechanics, energy, electricity & light

### 1. Mass vs Weight

Mass = amount of matter (kg, constant). Weight = mass x gravity (N);  $W = mg$ . Mass is the same on the moon; weight is one-sixth.

*Tip: Weight changes with gravity; mass does not - the classic pair.*

e.g. A 5 kg object weighs ~49 N on Earth but ~8 N on the moon.

### 2. Speed vs Velocity

Speed = distance/time (scalar). Velocity = displacement/time with direction (vector). Acceleration = change in velocity per time.

*Tip: Velocity = speed + direction; a car turning at constant speed still accelerates.*

e.g. 60 km/h north = velocity; 60 km/h = speed.

### 3. Force & Newton's Laws

$F = ma$  (force = mass x acceleration). Newton's 1st: objects keep moving unless acted on (inertia). 3rd: every action has an equal opposite reaction.

*Tip:  $F = ma$  is the only equation you need for most force items.*

e.g. Pushing a 2 kg cart at  $3 \text{ m/s}^2$  requires 6 N.

### 4. Work & Energy

Work = force x distance (in direction of force). Kinetic energy =  $\frac{1}{2}mv^2$  (motion). Potential energy =  $mgh$  (height/gravity). Energy is conserved - transformed, not created.

*Tip: Work happens only when motion follows the force direction.*

e.g. Lifting a 10 kg box 2 m does  $10 \times 9.8 \times 2 = 196 \text{ J}$  of work.

### 5. Power

Power = work/time (watts) - how FAST work is done. Same work in half the time = double the power.

*Tip: Power = work rate; more power = same work, less time.*

e.g. A 100 W bulb uses 100 joules of energy per second.

### 6. Pressure & Fluids

Pressure = force/area. Fluid pressure increases with depth ( $P = \rho gh$ ). Air pressure ~1 atm = 760 mmHg. Blood pressure is a clinical pressure application.

*Tip: Smaller area = higher pressure for the same force (needles!).*

e.g. A needle concentrates force onto a tiny area -> high puncture pressure.

### 7. Electricity Basics

Current (I) = charge flow (amps). Voltage (V) = electrical push. Resistance (R) = opposition. Ohm's law:  $V = IR$ .

*Tip:  $V = IR$  ties them together - one formula for most electro items.*

e.g. A 120 V device drawing 0.5 A has 240 ohms resistance.

### 8. Light & Sound

Light = electromagnetic wave (travels in vacuum, fastest thing); sound = mechanical wave (needs a medium - speed in air ~343 m/s).

Frequency = pitch; amplitude = loudness.

*Tip: Requires medium = sound; no medium needed = light.*

e.g. In space, no sound travels - but light does.

### 9. Heat Transfer

Conduction = contact (metal spoon), convection = fluid movement (hot air rises), radiation = electromagnetic (sun's heat). Body uses all three to regulate temperature.

*Tip: Conduction = touch, convection = fluid flow, radiation = waves.*

e.g. A thermos minimizes all three - vacuum stops conduction/convection.

### 10. Simple Machines & Levers

Machines trade force for distance: lever, pulley, inclined plane. Mechanical advantage = output force / input force. The body is full of levers (elbow = lever, forearm = rod).

*Tip: Levers let small forces move big loads over longer distances.*

e.g. A longer lever arm = more advantage - why surgical forceps have long handles.

# Part 11: Final Review

The highest-yield concepts across the exam in rapid-review form

## 1. HESI A2 'Core Four' + A&P

The highest-yield combination for nursing admission is Math, Reading, Vocabulary & General Knowledge, Grammar, plus Anatomy & Physiology - most programs require exactly these.

*Tip: Begin every study plan with the sections YOUR schools list; revisit A&P last in review.*

e.g. A school requiring 5 sections: nail Math and A&P first - they drag cutoffs up.

## 2. Math: Fraction Rules

Common denominators to add/subtract; multiply across; divide by flipping. Reduce early. Mixed numbers -> improper for multiplication.

*Tip: On the on-screen calculator, convert to decimals for speed; keep exact for final rounding.*

e.g.  $7/8 - 3/4 = 7/8 - 6/8 = 1/8$ .

## 3. Math: Ratio-Proportion

Cross-multiply  $a/b = c/d \rightarrow ad = bc$  with matching units. The classic dose set-up: (desired/have) x volume.

*Tip: Write units on both fraction sides to avoid inversion.*

e.g. 250 mg ordered, 500 mg/tablet:  $250/500 \times 1 = 0.5$  tablet.

## 4. Math: Percent & Conversion

Percent -> decimal (move 2 places); decimal -> percent (move back). 'Of' = multiply. Household/metric conversions: 1 tbsp = 15 mL, 1 cup = 240 mL, 1 oz = 30 mL, 1 kg = 2.2 lb.

*Tip: Rehearse conversions until automatic - they recycle on every HESI form.*

e.g. 12 oz of juice = 360 mL (12 x 30).

## 5. Math: Word Problems & Graphs

Translate sentences: 'per' = divide, 'of' = multiply, 'increased by' = add. Read graph axes and units before pulling values.

*Tip: Underline the target unit in the question so you answer what is asked.*

e.g. If 6 nurses cover 42 patients, each covers 7 (42/6).

## 6. Reading: Main Idea + Details

Main idea = first/last sentences; supporting details = directly stated facts near the key phrase. Answer detail questions with the text, not inference.

*Tip: Read the first and last sentence of each paragraph first; the main idea is there.*

e.g. A paragraph starting 'The purpose of triage is...' states its main idea in sentence 1.

## 7. Reading: Inference + Purpose

Inference = what logically follows from the text alone. Purpose = inform (explain), persuade ('should'), instruct (steps).

*Tip: Pick the most conservative inference - the one strictly supported by the passage.*

e.g. An article full of 'should' statements persuades; one listing 'steps' instructs.

## 8. Vocabulary: 10 High-Frequency Prefixes

hyper (high), hypo (low), tachy (fast), brady (slow), dys (difficult), eu (normal), a/an (without), anti (against), pre (before), post (after).

*Tip: Pair opposites when memorizing: hyper/hypo, tachy/brady, dys/eu.*

e.g. Tachycardia = fast heart; bradycardia = slow heart.

## 9. Vocabulary: 10 High-Frequency Suffixes

-itis (inflammation), -ectomy (removal), -otomy (incision), -ostomy (opening), -algia (pain), -emia (blood), -uria (urine), -ology (study), -megaly (enlargement), -pathy (disease).

*Tip: The suffix tells the PROCESS; the root tells the PART.*

e.g. Gastrectomy = stomach (gastr) removal (ectomy).

## 10. Grammar: Subject-Verb + Pronouns

Verb agrees with the true subject (ignore the words between). Subject pronouns act (I, she); object pronouns receive (me, her).

*Tip: Isolate the subject and verb; delete the interrupter phrase and re-read.*

e.g. The box of supplies IS (singular subject 'box').

## 11. Grammar: Comma, Splice, Fused, Fragment

Comma splice = two sentences with only a comma - fix with semicolon or conjunction. Fused = no punctuation. Fragment = missing a subject/verb.

*Tip: If two full thoughts collide, add ; or , and - never just a comma.*

e.g. 'She charted, he signed' -> 'She charted; he signed.'

## 12. A&P: Cell + Homeostasis

Mitochondria = ATP; nucleus = DNA; ribosomes = protein. Negative feedback stabilizes (temperature, glucose); positive amplifies (labor, clotting).

*Tip: Map each organelle to one job and rehearse the feedback direction.*

e.g. Stimulating insulin release as glucose rises = negative feedback.

## 13. A&P: Heart + Circulation

Right heart -> lungs (deoxygenated); left heart -> body (oxygenated). SA node = pacemaker. BP = cardiac output x resistance. Coronary arteries feed the heart muscle.

*Tip: Trace one red blood cell through the full circuit - that fixes every flow question.*

e.g. The left ventricle pumps hardest - thickest wall.

## 14. A&P: Lungs + Kidneys

Alveoli = gas exchange; diaphragm = inspiration; surfactant = open alveoli. Nephron = filter (glomerulus) + adjust (tubules); kidneys make erythropoietin + renin.

*Tip: Alveoli and nephrons are the two 'work units' - memorize both.*

e.g. Erythropoietin from the kidneys boosts red cell production.

## 15. A&P: Endocrine + Fluids

Pancreas = insulin (lower glucose); thyroid = metabolism; parathyroid = calcium; adrenal = cortisol/epinephrine. Na<sup>+</sup> drives water; K<sup>+</sup> drives the heart.

*Tip: Pair the gland with ONE hormone and ONE job; electrolytes follow sodium.*

e.g. Insulin deficiency -> hyperglycemia (high blood sugar).

## 16. Biology: DNA + Protein

DNA -> mRNA (transcription) -> protein (translation at ribosomes). Base pairs A-T, C-G. Codons of 3 bases code one amino acid.

*Tip: A-T/C-G pairing; the codon table maps 3 bases to 1 amino acid.*

e.g. A-G-C transcribes to U-C-G on mRNA (T becomes U).

## 17. Biology: Mitosis/Meiosis + Inheritance

Mitosis = identical body cells; meiosis = 4 unique gametes (haploid). Dominant masks recessive; Aa x Aa = 3:1; X-linked traits hit males.

*Tip: Mitosis = copy, meiosis = shuffle - the two words rhyme with their jobs.*

e.g. Two carrier parents (Aa x Aa) have a 25% chance of an affected child.

## 18. Chemistry: Atoms, Bonds, Solutions

Atomic number = protons; metal+nonmetal = ionic transfer; nonmetal+nonmetal = covalent share; polar dissolves polar. Acids donate H<sup>+</sup> (pH<7); bases accept (pH>7).

*Tip: Classify the bond by the partners first, then the solution by polarity.*

e.g. NaCl = ionic (transfer); glucose = covalent (share) and polar.

## 19. Chemistry: pH + Redox + Labs

pH 7.35-7.45 blood; buffer = bicarbonate pair. Oxidation loses electrons (OIL RIG). Labs: Na 135-145, K 3.5-5, glucose 70-100, pH 7.35-7.45, CO<sub>2</sub> 35-45, HCO<sub>3</sub> 22-26.

*Tip: Read acid-base as a pair: pH + (CO<sub>2</sub> or HCO<sub>3</sub>) names the disorder.*

e.g. pH 7.30 + HCO<sub>3</sub> 18 = metabolic acidosis.

## 20. Test-Day Reset

Your weakest sections deserve a fresh review the morning of the exam - flashcards on conversions, prefix/suffix, and the A&P systems you found hardest.

*Tip: Review, do not relearn: skim the final-review tables and your own notes only.*

e.g. Ten minutes on electrolyte ranges and conversions beats a full re-read.

# Part 12: Test-Day Strategy

Pacing, pilots, PSI/ProctorU delivery, composite targeting & the 24-hour report

## 1. Confirm Your Sections

On exam day you sit ONLY the sections your target school requires. Double-check the registration lists which sections you are taking before the clock starts.

*Tip: If a section appears that you did not prepare for, ask the proctor - do not silently sit it.*

e.g. An applicant for a 5-section school should not see Physics on their delivery.

## 2. Pace Per Section

Each section has about a minute per item (50 items/50 min; 25 items/25 min). Reading gets 60 min for 50 items - the most generous pace.

*Tip: Check the clock at 1/3 and 2/3 through; adjust before you run out.*

e.g. At minute 30 of 50, you should be near item 30 in Math/Reading.

## 3. Answer Every Question

Every section mixes in ~5 unscored pilot items, and there is no guessing penalty - a blank is a certain miss. Never leave an item unanswered.

*Tip: Eliminate what you can and commit to the best remaining answer - guess, then move on.*

e.g. Even a pure guess on an unknown pilot item cannot hurt your score.

## 4. Math: Calculator Discipline

An on-screen calculator is available for Math. Do algebra on paper first, then key in - calculators amplify typos and rounding drift.

*Tip: Estimate before the calculation; if the answer is far from your estimate, re-check the setup.*

e.g. For 15% of 80: estimate 12, key  $0.15 \times 80$ , verify 12.

## 5. Reading: Passage Order

Read the passage once with purpose (underline topic sentences), then attack questions. Do not read every word twice - time is the enemy.

*Tip: For long passages, skim each paragraph's first sentence before answering detail items.*

e.g. Marking each paragraph's topic sentence cuts detail-item search time.

## 6. Vocabulary: Root Attack

Unknown words decode: identify the root/prefix/suffix and guess the meaning before looking at answer choices.

*Tip: If you know cardio- = heart, cardiospasm involves the heart - eliminate unrelated options.*

e.g. Hepatomegaly: hepato (liver) + megaly (enlargement) = enlarged liver.

## 7. Grammar: Read Aloud Mentally

For grammar items, read the sentence to yourself exactly as written - errors sound wrong even if you cannot name the rule.

*Tip: Listen for subject-verb mismatches and comma splices; they 'sound' broken.*

e.g. 'She don't have...' sounds wrong -> choose 'doesn't'.

## 8. A&P: System Maps

Anchor each system to its 'work unit' (heart chambers, alveoli, nephron, neuron, islet). Picture the flow and you recall the facts.

*Tip: Draw the circuits (blood flow, GI path, airway) once from memory before the exam.*

e.g. Trace: vena cava -> right atrium -> ventricle -> lungs -> left side -> aorta.

## 9. Pilot-Item Psychology

Some items feel oddly easy or oddly hard - you cannot identify pilots, and guessing is free, so treat every item as scored and never let a weird item rattle you.

*Tip: The weird item, easy or hard, still gets your best answer.*

e.g. If you spotted one 'easy pilot', keep the same effort for the rest.

## 10. Cutoff Targeting

Aim 5-10 points above each school's listed cutoff - the practical bar among competitive applicants is higher than the minimum.

*Tip: Prioritize the section with the tightest margin (often A&P at 80-85%).*

e.g. If a school lists Math 75 and A&P 80, make A&P your study priority.

## 11. Between Sections

Breaks between sections let you reset: hydrate, breathe, and re-anchor on the next section's rules (Reading = underline topic; Math = estimate first).

*Tip: Do not discuss or re-live previous sections between - mental energy stays forward.*

e.g. A 60-second breathing reset before the next section beats a mental replay.

## 12. After the Exam

Scores are typically available quickly; compare each section against your target-school cutoffs and note which sections to retake (school policy and wait apply).

*Tip: Translate the result into a plan: which section needs work and when the school allows your retake.*

e.g. A 78 in A&P against an 80 cutoff is a retake plan (60-day base wait), not a defeat.

# Appendix A: Complete Section Format Reference (2026-Current)

## 1. Anatomy & Physiology

30 scored questions / 25 minutes. Body systems, homeostasis, cell biology, organ functions. Most BSN programs require; exists in multiple versions and retake re-scoring is version/program dependent. Typical minimum 80-85%.

## 2. Biology

30 scored questions / 25 minutes. Cell structure, genetics/DNA, cellular respiration, photosynthesis, biomolecules. Required by many BSN programs, optional for some ADN tracks.

## 3. Chemistry

30 scored questions / 25 minutes. Atoms & periodic table, bonds, solutions, acids/bases, basic organic, nuclear basics. Frequently required alongside Biology for competitive BSNs.

## 4. Grammar

50 scored questions / 50 minutes. Parts of speech, subject-verb agreement, punctuation, sentence structure, usage. A core-four section for nearly every program.

## 5. Reading Comprehension

50 scored questions / 60 minutes. Main idea, supporting details, vocab-in-context, inferences, author's purpose - roughly 8 questions per passage. The most generous pace on the exam.

## 6. Vocabulary & General Knowledge

55 scored questions / 50 minutes. Health-science roots, prefixes/suffixes, general knowledge (metrics, vitals, body directions). The fastest-paced core section.

## 7. Mathematics

55 scored questions / 60 minutes. Basic math: fractions, decimals, ratios & proportions, percentages, household measures & conversions, word problems, graphs. On-screen calculator allowed.

## 8. Critical Thinking

~26 scored questions / 45 minutes. Clinical judgment, prioritization & triage, delegation, arguments/premises/conclusions, assumptions, bias, ethical principles, SBAR. Increasingly required.

## 9. Physics (optional)

A rare, optional section. If a program requires it: basic mechanics, energy, work/power, fluids, electricity, light & sound. Do not study it unless your school lists it.

## 10. Timing & Pilots

A full attempt of all sections takes about 4 hours including breaks (255 scored + 30 pilot questions). Roughly 30 pilot items are mixed in as unscored - treat every question as scored.

## Appendix B: Scoring, Retakes & Delivery Quick Reference

### 1. Composite Score

The program's primary pass criterion is a composite percentage, typically ~75% or higher. Your report shows the composite and every section percentage.

### 2. Section Minimums

Programs commonly require that NO section fall below 75; A&P is often held to 80-85%. A composite above the bar does not rescue a sub-minimum section.

### 3. Retake Policy

Elsevier requires a 60-day wait between attempts; some programs set longer windows (up to 90 days) or cap total attempts. Confirm the policy before your first sit.

### 4. Delivery Options

Computer-based at PSI testing centers or remotely via ProctorU (remote proctoring available). Remote requires a quiet room, webcam, government ID, and stable internet.

### 5. Score Report

The score report PDF is typically available within 24 hours, showing composite, sections, and percentiles. Many schools require the official report sent directly.

### 6. No Guessing Penalty

There is no penalty for wrong answers - answer every question, pilots included. A blank is a guaranteed miss; a guess at worst costs nothing.

### 7. Registration & Cost

Register through the school's portal or PSI; fee commonly \$40-\$100 set by the school/PSI. Dates fill fast - register early in the application window.

### 8. Calculator Policy

An on-screen calculator is provided for Mathematics. Do algebra on paper first, then key in - rounding drift and typos are the classic score killers.

# Appendix C: Key Equations, Conversions & Normal Lab Values

## 1. Dose Calculation

Dose = (desired / have) x volume. Maintain units so they cancel; end with the unit the question asks for.

## 2. Temperature Conversion

$F = (C \times 9/5) + 32$ ;  $C = (F - 32) \times 5/9$ . 98.6 F = 37 C; 100 F ~ 37.8 C.

## 3. Household / Metric

1 tsp = 5 mL, 1 tbsp = 15 mL, 1 cup = 240 mL, 1 oz = 30 mL, 1 L = 1000 mL, 1 kg = 2.2 lb, 1 inch = 2.54 cm, 1 kg = 1000 g.

## 4. Metric Ladder

kilo, hecto, deka, base, deci, centi, milli - one decimal place per step. Right = multiply by 10 per step; left = divide.

## 5. Drip Rate

$\text{gtt/min} = (\text{volume mL} \times \text{drop factor}) / (\text{time in minutes})$ . A 500 mL infusion over 4 hr with 15 gtt/mL = 31 gtt/min.

## 6. Electrolytes

Na 135-145, K 3.5-5.0, Cl 98-106, Ca 8.5-10.5, Mg 1.3-2.1 (mEq/L or mmol/L). High K disrupts cardiac rhythm; sodium drives water.

## 7. ABG Values

pH 7.35-7.45, PaCO<sub>2</sub> 35-45, HCO<sub>3</sub> 22-26. Read as a pair: pH + CO<sub>2</sub> (respiratory) or HCO<sub>3</sub> (metabolic) names the disorder.

## 8. BMP / CMP

Glucose 70-100 fasting, BUN 7-20, creatinine 0.6-1.2, CO<sub>2</sub> 22-29, albumin 3.5-5.0.

## 9. Normal Vitals

BP ~120/80, HR 60-100, RR 12-20, temperature ~37 C / 98.6 F, O<sub>2</sub> sat 95-100% on room air.

## 10. Prefixes / Suffixes High-Yield

hyper = high, hypo = low, tachy = fast, brady = slow, dys = difficult, eu = normal; -itis = inflammation, -ectomy = removal, -otomy = incision, -ostomy = opening, -algia = pain, -emia = blood, -uria = urine.

## Appendix D: 4-Week Study Plan (Modular, Program-Adjusted)

### 1. Week 1 - Find & Learn

List YOUR sections and cutoffs for every target school. Study Math + Reading + Vocabulary + Grammar (one section per day), using the concept tables in this guide.

### 2. Week 2 - Anatomy & Physiology

Dedicate the week to A&P (highest floor, usually 80-85%): cell biology, homeostasis, heart/lungs/kidneys, endocrine, fluids & electrolytes. Add Critical Thinking basics (prioritization + ABCs).

### 3. Week 3 - Remaining + Practice

Biology/Chemistry if required, plus Critical Thinking argument/ethics items. Take one full-length timing run (simulate the 4-hour block with the on-screen calculator).

### 4. Week 4 - Review & Polish

Rapid review: Appendix C tables (conversions, labs, prefixes), final-review tables, and your weakest section daily. Confirm PSI/ProctorU check-in requirements and ID rules.

### 5. Test Day

Answer every question (no penalty), pace by the screen timer, and never second-guess a locked answer - on HESI you generally cannot return to a previous question.

### 6. After the Report

Read the 24-hour PDF: composite + sections vs your school floors. If a retake is needed, map the required wait (60 days base, up to 90 by program) to the application deadline and reserve a seat early.

### 7. Critical Thinking Habits

Run ABCD + Maslow before every prioritization item; name the argument's conclusion first; never delegate assessment or teaching; when an intervention fails, reassess - do not blindly repeat.

# Appendix E: Critical Thinking & Prioritization Double-Check

## 1. Next Best Action

When a CT item asks 'what should the nurse do FIRST', run ABCD + Maslow, then pick the option that protects the patient's airway/breathing/circulation and the most basic physiologic need.

## 2. Two Patients, One Nurse

Rank by acuity: unstable/acute change beats abnormal-but-stable beats routine care. A newly confused patient with tachycardia outranks a dressing change.

## 3. Delegation Rule

Assessment, teaching, and nursing judgment stay with the RN. Vital signs and stable ADLs are delegable; a first assessment never is.

## 4. SBAR in One Line

Situation (what now), Background (relevant history), Assessment (your read), Recommendation (what you want) - keep each slot to one sentence.

## 5. Ethics Quick Map

Autonomy = patient choice; beneficence = do good; nonmaleficence = do no harm; justice = fairness; veracity = truth; fidelity = keep promises.

## 6. Argument Anatomy

Find the conclusion first (therefore/so/thus), then the premises (because/since). The assumption is the unstated premise the argument depends on.

## 7. Evidence Ranking

RCTs and systematic reviews > cohort studies > expert opinion > anecdotes. Relevance, recency, and representativeness decide how strong the evidence is.

## 8. Cause vs Correlation

Two variables moving together do not prove causation - look for confounders, reverse causation, or coincidence before claiming a cause.

## 9. Triage Order

Emergent (life/limb threat) > urgent (would deteriorate) > semi-urgent (stable, can wait) > non-urgent (safe to wait). Always treat the emergent patient first.

## 10. Outcome Evaluation

If an intervention did not work, DO NOT repeat it blindly - reassess the patient, suspect a new problem, and escalate to the provider.

## Appendix F: 20-Second Concept Flash-Check

### 1. Fractions

Multiply straight across; divide by flipping; add/subtract only with common denominators; reduce early.

### 2. Dose Math

Dose = (desired / have) x volume; keep units canceling; end in the asked unit.

### 3. Metric Ladder

kilo, hecto, deka, base, deci, centi, milli - one decimal place per step; right = multiply, left = divide.

### 4. Conversions

1 tsp = 5 mL, 1 tbsp = 15 mL, 1 cup = 240 mL, 1 oz = 30 mL, 1 kg = 2.2 lb.

### 5. Main Idea

First/last sentences of paragraphs; supporting details are directly stated - do not infer beyond the text.

### 6. Prefixes

hyper = high, hypo = low, tachy = fast, brady = slow, dys = difficult, eu = normal, a/an = without.

### 7. Suffixes

-itis = inflammation, -ectomy = removal, -otomy = incision, -ostomy = opening, -algia = pain, -emia = blood, -uria = urine.

### 8. Subject-Verb

The verb agrees with the true subject; delete interrupter phrases between them before checking.

### 9. ABGs

pH 7.35-7.45, PaCO<sub>2</sub> 35-45, HCO<sub>3</sub> 22-26; read pH + CO<sub>2</sub> (respiratory) or HCO<sub>3</sub> (metabolic) as a pair.

### 10. Normal Vitals

BP ~120/80, HR 60-100, RR 12-20, temp 98.6 F / 37 C, O<sub>2</sub> sat 95-100% on room air.

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