



Notes by PharmacoLearn

General Pharmacy

BP102T — B.Pharm Semester I

Concept Mastery Notes

Deep concepts for GPAT & competitive exams — nothing missed

As per PCI B.Pharm (NEP 2020) syllabus

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Unit I — Introduction to the Profession of Pharmacy

This unit is the story of pharmacy in India and the working language of the profession: where pharmacists came from, what they actually do all day, the official books that decide whether a drug is fit to sell, and how a prescription is built and handled. It is memory-heavy, but almost every mark here is predictable — timelines, definitions, and one model monograph you can reproduce for any drug.

History of the Profession of Pharmacy in India

Indian medicine did not begin with tablets. For centuries, medicines were prepared from plants, minerals and animal products by vaidyas (Ayurveda), hakims (Unani) and Siddha practitioners, who collected, processed and dispensed their own remedies. There was no separate "pharmacist" — the healer was the manufacturer, the quality controller and the dispenser rolled into one.

Modern, Western-style pharmacy arrived with the British, and the profession grew along three parallel tracks — education, industry, and professional organisations. Almost every history question in this subject is really asking you to walk these three tracks in chronological order.

The timeline that matters

Year	Milestone	Why it matters
1899	Acharya P. C. Ray founded the Bengal Chemical and Pharmaceutical Works, Calcutta	Treated as the birth of the Indian pharmaceutical industry — the first serious Indian-owned attempt to manufacture chemicals and drugs instead of importing everything
1901	Alembic Chemical Works set up at Baroda	One of the earliest Indian pharma companies; showed the industry could grow beyond Bengal
1937	First B.Pharm course started at Banaras Hindu University (BHU), Varanasi	The single most-asked date in this topic. Before this, there was no formal degree-level pharmacy education in India
1940	Drugs and Cosmetics Act passed	Brought manufacture, import and sale of drugs under legal control — a response to substandard and adulterated drugs flooding an unregulated market

Year	Milestone	Why it matters
1948	Pharmacy Act passed; Pharmacy Council of India (PCI) constituted	Created the legal definition of a pharmacist and a register of who is allowed to practise. PCI sets education standards for every pharmacy college in the country
1955	First edition of the Indian Pharmacopoeia (IP) published	India got its own official book of drug standards instead of depending on the British Pharmacopoeia

A few later developments worth knowing, because they show the direction the profession moved in: the Indian Pharmacopoeia Commission (IPC) was set up at Ghaziabad as the permanent body behind the IP; NIPER (National Institute of Pharmaceutical Education and Research) was created for higher-level research training; and after independence, Indian industry grew from making simple formulations to becoming one of the world's largest suppliers of generic medicines.

The three tracks, explained

Education. The 1937 BHU course was the seed. The Pharmacy Act (1948) then gave PCI the power to approve courses and inspect colleges, which is why your B.Pharm syllabus looks the same whether you study in Varanasi or Chennai. PCI also maintains the register of pharmacists — registration is what legally separates a pharmacist from a shopkeeper who sells medicines.

Industry. Bengal Chemical (1899) and Alembic (1901) proved Indians could manufacture drugs. The Drugs and Cosmetics Act (1940) then forced that manufacturing to meet standards, and the IP (1955) defined what those standards were. Industry, law and standards grew together — none of them makes sense alone.

Organisations. Know the four names and one line each:

- PCI (Pharmacy Council of India) — statutory body under the Pharmacy Act, 1948; regulates pharmacy education and registers pharmacists.
- AICTE — approves technical institutions, including pharmacy colleges, at the national level.
- IPA (Indian Pharmaceutical Association) — the professional association of pharmacists; represents the profession's interests.
- IDMA and OPPI — industry associations of drug manufacturers (Indian companies and multinational producers in India, respectively).

Trap alert: Students mix up 1937, 1948 and 1955 constantly. Fix them with a story, not rote learning: first the degree (1937, BHU), then the law that recognised pharmacists (1948, PCI), then India's own standards book (1955, IP). Education → profession → standards, in that order.

GPAT angle: "Which Act led to the constitution of PCI?" (Pharmacy Act, 1948) and "Where was the first B.Pharm course started?" (BHU, 1937) are classic one-line GPAT questions. Also remember: the Drugs and Cosmetics Act (1940) controls drugs; the Pharmacy Act (1948) controls pharmacists. Examiners love asking you to keep those two straight.

Scope of the Pharmacy Profession

A registered pharmacist is not a person who hands over a strip of tablets. The syllabus splits the scope into three areas, and questions almost always ask for the role and responsibilities under one head. Learn them as three separate lists — never blend them.

1. Retail / community pharmacy

This is the pharmacy on your street, and it is where most Indians meet the profession. The community pharmacist:

- Dispenses medicines against prescriptions and counsels the patient on dose, timing, duration and storage ("take after food", "finish the full antibiotic course", "keep insulin in the fridge").
- Checks every prescription for errors — wrong dose, wrong drug for the diagnosis, dangerous interactions, illegible handwriting. When something looks off, the pharmacist contacts the prescriber instead of guessing.
- Handles OTC products and gives advice on minor ailments and first aid — the community pharmacist is often the first (and sometimes only) health professional a patient consults.
- Maintains legally required records — prescription files, narcotic and psychotropic drug registers, purchase and sale records. These registers are inspected, so sloppy record-keeping is a legal risk, not just bad practice.
- Promotes rational drug use — in India this especially means discouraging self-medication with antibiotics and explaining why the full course matters (incomplete courses breed resistance).

2. Hospital and clinical pharmacy

The hospital pharmacist works inside the healthcare team, not behind a counter:

- Manages the hospital drug store — procurement, proper storage (cold chain for vaccines and insulin), and distribution to wards and departments.
- Prepares sterile products such as IV admixtures, and handles cytotoxic (anticancer) drugs with special precautions.
- Does clinical pharmacy work — attending ward rounds with doctors, reviewing patients' drug therapy, suggesting dose adjustments in kidney or liver disease, and checking for drug interactions.
- Reports adverse drug reactions (ADRs) under the PvPI (Pharmacovigilance Programme of India) — this is how unsafe drugs get detected after marketing.

- Counsels patients at discharge, especially for chronic diseases like diabetes, hypertension and asthma, where the patient manages the therapy at home for years.

3. Industrial pharmacy, including research and development

- Production — manufacturing tablets, capsules, injections and other dosage forms under GMP (Good Manufacturing Practices).
- Quality control / quality assurance — testing raw materials, in-process samples and finished products against pharmacopoeial standards. QC tests the product; QA builds quality into the whole system.
- Research and development — formulation development (turning a drug molecule into a stable, effective dosage form), analytical method development, and support for clinical trials.
- Regulatory affairs — preparing approval dossiers for CDSCO (India's drug regulator) and for export markets (USFDA, EMA). A brilliant formulation that cannot clear regulation never reaches a patient.
- Marketing and medical promotion — medical representatives who explain products to doctors.

GPAT angle: "PvPI" (Pharmacovigilance Programme of India) and "CDSCO" (Central Drugs Standard Control Organisation) are favourite abbreviation-expansion questions. PvPI = reporting ADRs; CDSCO = approving drugs. One monitors safety after sale, the other permits sale in the first place.

Pharmacopoeias

A pharmacopoeia is an official book that lays down the standards for the identity, purity, strength and quality of drugs. The key word is official: once a drug is included in a pharmacopoeia, those standards become legally enforceable. A manufacturer cannot sell a substandard product and argue about it — the book has already defined what "standard" means.

The pharmacopoeias you must know

Pharmacopoeia	Published by	Used in / notes
IP — Indian Pharmacopoeia	Indian Pharmacopoeia Commission (IPC), Ghaziabad	The legal standard for drugs in India under the Drugs and Cosmetics Act. First edition 1955; the 9th edition (IP 2022) is the widely used recent edition
BP — British Pharmacopoeia	UK (MHRA)	Used across the UK and Commonwealth countries
USP — United States Pharmacopoeia (USP-NF)	US Pharmacopoeial Convention	The legal standard in the USA

Pharmacopoeia	Published by	Used in / notes
BPC — British Pharmaceutical Codex	—	Historical. Last edition 1973; its content was absorbed into the British National Formulary. Know what it was — do not cite it as a current book
International Pharmacopoeia	WHO	Meant for global use, especially in countries with no national pharmacopoeia of their own
NFI — National Formulary of India	IPC, Ghaziabad	Gives prescribing information (doses, formulations, clinical guidance) rather than quality standards

Trap alert: Students write "BPC" as if it were a current pharmacopoeia. It is not — its last edition was 1973. The syllabus still names it, so define it correctly as a historical codex whose material moved into the BNF. Writing "BPC is published regularly" will cost you the mark.

The IP vs NFI distinction is a favourite short question: the IP sets quality standards (what the drug must be — identity, purity, strength), while the NFI gives practical prescribing guidance (how the drug is used — doses, formulations, clinical notes). Both come from the IPC, Ghaziabad. Standards vs guidance — that one line is the whole answer.

Structure and content of the Indian Pharmacopoeia

The IP is published in multiple volumes. Its content is organised as:

- General notices — the rules for reading the whole book (definitions, how to interpret statements like "dissolve" or "freshly prepared").
- Monographs — the core of the IP. One monograph per drug substance or formulation; this is where the actual standards live.
- General chapters — the test methods themselves (limit tests, dissolution testing, sterility testing, microbial limits).
- Appendices — reference standards, reagents, indicators and detailed procedures.
- Recent editions also cover vaccines, sera, biotechnology products and herbal drugs — the IP grew as Indian industry grew into those areas.

Study of one model IP monograph

Every monograph follows the same skeleton. Learn it once, and you can write it for any drug — examiners accept Paracetamol as the worked example. More importantly, understand why each section exists, because that is the IP's quality philosophy in miniature:

- 1 Title — the official name (e.g., Paracetamol). This is the legal identity of the drug.
- 2 Chemical name and structural formula — pins the substance to one exact molecule, so there is no ambiguity about which chemical is meant.

- 3 Description — what it looks like (e.g., white crystalline powder). A wrong colour or texture is the cheapest, fastest sign that something is off.
- 4 Identification — tests that prove the substance is what the label claims (IR spectrum, specific chemical reactions). Identity comes before everything else — there is no point checking the purity of the wrong drug.
- 5 Tests — purity checks: related substances (impurities), heavy metals, loss on drying, sulphated ash. This is where adulteration and manufacturing sloppiness get caught.
- 6 Assay — the quantitative test for strength ("contains not less than 98.0% and not more than 101.0% of paracetamol"). Identity says what it is; assay says how much of it is there.
- 7 Storage — how to keep it (well-closed container, protected from light). A drug that meets every test at the factory can still fail at the pharmacy if stored badly.
- 8 Labelling — what the label must state, so the user gets the right information.
- 9 Category and dose — therapeutic category and the usual dose, linking the standard back to clinical use.

Notice the logic: identity → purity → strength → storage → information. That sequence is not random; it mirrors how quality is actually verified, from the factory gate to the patient's hands.

GPAT angle: Monograph questions in competitive exams often test the order of sections ("which comes first, identification or assay?") or the logic ("why does identification precede the assay?"). If you understand the identity → purity → strength flow, you can answer any sequencing question without memorising.

Introduction to Prescription

A prescription is a written order from a registered medical practitioner to a pharmacist, directing the supply or compounding of medicines for a patient. It is two things at once: a clinical document (it carries the treatment decision) and a legal document (it authorises the pharmacist to supply drugs, including scheduled ones, and it is evidence if anything goes wrong).

Parts / structure of a prescription

There are seven parts. The figure below shows where each one sits on a real prescription; read the figure first, then the descriptions.

A PRESCRIPTION — its seven parts

1	Date: 24/09/2026
2	Name: R. Sharma Age: 34 Sex: M
3	Rx
4	Tab. Paracetamol 500 mg — 20 tabs Cap. Amoxicillin 250 mg — 10 caps
5	<i>M. et ft. pulv. — Dispense as directed</i>
6	Sig: Take ONE tablet twice daily after food with a full glass of water
7	Dr. A. Verma, MBBS Reg. No. 45217 _____

What each part means

- 1. Date**
The prescription must be dated; validity is checked when it is received.
- 2. Patient information**
Name, age, sex, address; weight for children.
- 3. Superscription**
The Rx symbol — Latin recipe, "take thou".
- 4. Inscription**
Names and quantities of the medicaments ordered.
- 5. Subscription**
Directions to the pharmacist (e.g. "make 12 powders").
- 6. Signatura**
Directions to the patient: dose, frequency, route.
- 7. Prescriber details**
Signature, name and registration number — no signature, no validity.

Handling order: receive → read & check → dispense → label → record → counsel.

Seven parts of a prescription and what each one means

- 1** Date — every prescription must be dated. The pharmacist checks it on receipt: an undated or very old prescription may not be honoured, especially for habit-forming drugs.
- 2** Patient information — name, age, sex and address; weight for children (because paediatric doses are calculated from weight, as you will see in Unit II's posology).
- 3** Superscription — the symbol Rx, from the Latin recipe ("take thou"). It is the traditional heading that marks the document as a prescription.
- 4** Inscription — the names and quantities of the medicaments ordered. This is the clinical core of the prescription.
- 5** Subscription — directions to the pharmacist (e.g., "mix and make 12 powders", "dispense"). It tells the pharmacist what to do with the inscription.
- 6** Signatura (often written "Sig.") — directions to the patient: dose, frequency, route ("take one tablet twice daily after food"). This is what gets translated onto the label in the patient's own language.
- 7** Prescriber's signature, name and registration number — without this, the prescription has no legal validity. A missing signature is not a small slip; it invalidates the whole document.

Trap alert: The classic confusion is subscription vs signatura. Fix it with the audience: subscription is the prescriber speaking to the subordinate in the process — the pharmacist; signatura is the signal to the patient (it becomes the label directions). Inscription = what is ordered; subscription = what the pharmacist must do; signatura = what the patient must do.

Handling of prescriptions

Handle every prescription in the same order — this sequence is itself an exam answer:

- 1 Receiving — accept it courteously; check the date, the prescriber's details and signature.
- 2 Reading and checking — read carefully and verify: Is the dose correct for this patient's age? Are there interactions between the drugs ordered? Any incompatibilities? Anything that looks like an error?
- 3 Compounding / dispensing — prepare or select the medicines accurately.
- 4 Labelling — the label must carry the patient's name, directions for use, date and pharmacy details.
- 5 Pricing and recording — enter the prescription in the prescription register (a legal record).
- 6 Delivering and counselling — hand over the medicines with clear verbal instructions, and answer the patient's questions.

One rule overrides everything: if anything is doubtful — an unusually high dose, an illegible drug name, a dangerous interaction — do not guess. Contact the prescriber. That single line earns marks in every prescription-handling answer, because it is the difference between a pharmacist and a dispensing machine.

Latin terminology used in prescriptions

Latin abbreviations survive because they are short, precise and understood internationally — a doctor in any country reads "b.i.d." the same way. Learn these as "expand the following" questions; a wrong expansion on a label is a dosing error, which is why examiners test them so strictly.

Abbreviation	Latin	Meaning
Rx	Recipe	Take thou
a.c.	Ante cibum	Before meals
p.c.	Post cibum	After meals
b.i.d.	Bis in die	Twice daily
t.i.d.	Ter in die	Three times daily
q.i.d.	Quater in die	Four times daily
o.d.	Omne in die	Once daily

Abbreviation	Latin	Meaning
h.s.	Hora somni	At bedtime
s.o.s.	Si opus sit	When required (if needed)
p.r.n.	Pro re nata	When required
stat	Statim	Immediately
q.s.	Quantum sufficiat	A sufficient quantity
aq.	Aqua	Water
mist.	Mistura	Mixture
tab.	Tabella	Tablet
cap.	Capsula	Capsule
ung.	Unguentum	Ointment
lot.	Lotio	Lotion
gtt.	Guttae	Drops
sig.	Signa	Write/label (directions)
m.	Misce	Mix
ft.	Fiat	Let it be made
non rep.	Non repetatur	Do not repeat

Trap alert: s.o.s. and p.r.n. both mean "when required" — students sometimes invent a difference. There is none worth defending in an exam; both indicate the medicine is taken only if needed (e.g., a painkiller). Also, stat means immediately, not "at bedtime" (that is h.s.) — another favourite mix-up.

Very short questions (2 marks)

- 1 In which year and at which university did the first B.Pharm course in India start?
- 2 Expand PCI and state its main function.
- 3 What is a pharmacopoeia?
- 4 Expand Rx and give its Latin origin.
- 5 Distinguish between subscription and signatura in one line each.

Short questions (5 marks)

- 1 Trace the history of pharmacy education in India with important milestones.
- 2 Describe the role and responsibilities of a pharmacist in hospital and clinical pharmacy.
- 3 Differentiate between the Indian Pharmacopoeia and the National Formulary of India.

Long questions (10 marks)

- 1 Describe the structure and content of the Indian Pharmacopoeia. Illustrate the salient features of an IP monograph with a suitable example.
- 2 Define prescription. Describe its various parts and the correct procedure for handling a prescription in a pharmacy.

How to approach these answers

- Very-short Q1: give the year (1937) and the university (BHU, Varanasi) — both halves carry the mark.
- Very-short Q2: expand PCI fully, then one line on its function (regulates pharmacy education and registers pharmacists).
- Very-short Q3: one crisp definition — official book of standards for identity, purity, strength and quality.
- Very-short Q4: Rx = recipe = "take thou"; mention it is the superscription.
- Very-short Q5: subscription = directions to the pharmacist; signatura = directions to the patient.
- Short Q1: write as a timeline table (1899 → 1937 → 1940 → 1948 → 1955) with one line on why each date matters.
- Short Q2: use a clear heading, then 6-8 numbered responsibilities; keep hospital points separate from community or industry points.
- Short Q3: one paragraph of contrast — IP sets quality standards, NFI gives prescribing guidance; note both are published by IPC, Ghaziabad.
- Long Q1: structure — intro (what the IP is), main body under subheads (volumes and components; monograph skeleton numbered 1-9 with the Paracetamol example), close with why the identity → purity → strength order matters.
- Long Q2: structure — definition, the seven parts (numbered, one line each — refer to the labelled figure), then the six handling steps in order, ending with the "never guess, contact the prescriber" rule.

Unit II — Introduction to Pharmaceutical Calculations and Dosage Forms

This unit is the mathematics of pharmacy. It looks intimidating on first reading, but every calculation here follows a fixed method — learn the method, plug in the numbers, show your steps, and the marks are yours. Examiners award method marks generously, so never write just the final answer: write the formula, the substitution, and then the result. Alongside the maths, this unit teaches the language of dosage forms — routes, classification, APIs and excipients.

Metric system of weights and measures

Pharmacy uses the metric system almost exclusively: grams for weight, litres for volume, metres for length. Fluency in conversion is assumed in every numerical, so fix these:

- 1 kg = 1000 g; 1 g = 1000 mg; 1 mg = 1000 micrograms (mcg or μg)
- 1 L = 1000 mL; 1 mL = 1 cm³
- Household measures you will still meet on prescriptions and labels: 1 teaspoon $\approx$ 5 mL, 1 tablespoon $\approx$ 15 mL, 1 drop $\approx$ 0.05 mL (so 20 drops $\approx$ 1 mL)

Scientific notation keeps very large or small quantities readable: 0.00025 g = 2.5×10^{-4} g; 2500 mg = 2.5×10^3 mg. The golden rule of every calculation in this unit: convert everything to the same unit before you start. Most lost marks come from mixing mg with g, not from the formula.

Alligation

Alligation is the method for mixing two preparations of different strengths to obtain a preparation of an intermediate strength. The classic question: "How much of 70% alcohol and 20% alcohol must be mixed to get 500 mL of 40% alcohol?"

Why the cross method works

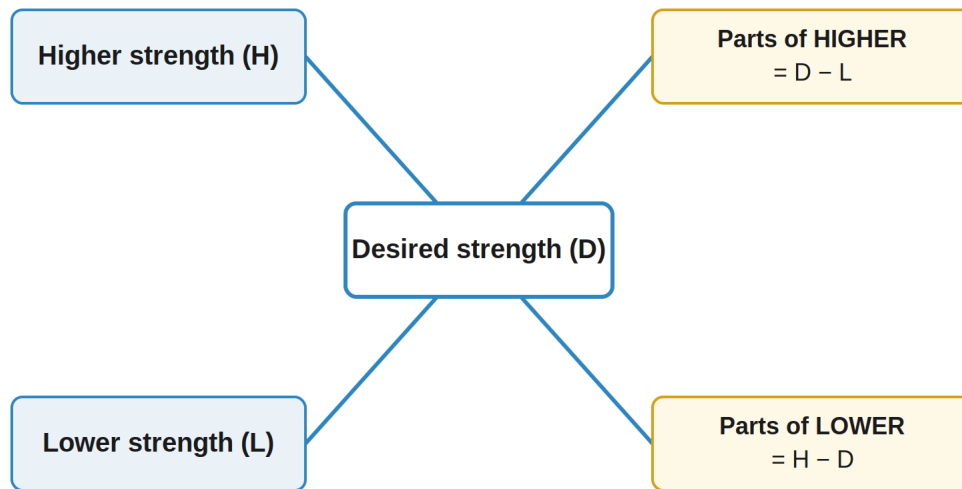
Alligation alternate looks like a trick, but it is just a weighted average drawn as a cross. Suppose you mix a parts of the higher strength (H) with b parts of the lower strength (L) to get the desired strength (D). The total amount of active ingredient must balance:

$$aH + bL = (a + b)D$$

Rearranging: $a(H - D) = b(D - L)$, so $a : b = (D - L) : (H - D)$.

That is all the cross does — it reads off those two differences. Parts of the higher-strength ingredient = $D - L$; parts of the lower-strength ingredient = $H - D$; total parts = $H - L$. Notice the pairing: the higher strength pairs with the difference measured from the lower end ($D - L$), and vice versa. Understanding this kills the most common error, which is swapping the two.

Alligation Method — The Cross Diagram



Worked example

Mix 80% and 20% to get 50%:

Parts of 80% = $50 - 20 = 30$

Parts of 20% = $80 - 50 = 30 \rightarrow$ ratio $30 : 30 = 1 : 1$

Tip: the cross layout earns method marks even if the arithmetic slips.

Alligation alternate: the cross method for mixing two strengths

Worked example 1

Prepare 500 mL of 40% v/v alcohol from 70% and 20% alcohol.

- Parts of 70% alcohol = $D - L = 40 - 20 = 20$ parts
- Parts of 20% alcohol = $H - D = 70 - 40 = 30$ parts
- Total parts = $20 + 30 = 50$ parts
- Volume per part = $500 \text{ mL} \div 50 = 10 \text{ mL}$
- 70% alcohol needed = $20 \times 10 = 200 \text{ mL}$
- 20% alcohol needed = $30 \times 10 = 300 \text{ mL}$
- Check: $(200 \times 0.70) + (300 \times 0.20) = 140 + 60 = 200 \text{ mL alcohol in } 500 \text{ mL} = 40\%$. Correct.

Worked example 2 (with a solid diluent)

Prepare 250 g of 1:400 zinc oxide powder using 1:100 stock powder and lactose (0% drug).

First convert ratio strengths to percentages: $1:400 = (1 \div 400) \times 100 = 0.25\%$; $1:100 = 1\%$. Treat lactose as 0%.

- Parts of 1% stock = $0.25 - 0 = 0.25$ parts
- Parts of lactose = $1 - 0.25 = 0.75$ parts

- Total = 1 part → per-part weight = 250 g
- Stock powder = $0.25 \times 250 = 62.5$ g; lactose = $0.75 \times 250 = 187.5$ g

Trap alert: The parts from the cross are relative, not absolute — students often write "20 mL and 30 mL" and stop. The cross gives you a ratio (20:30); you must scale it to the required total quantity. Always do the "per part" step. Also remember: the desired strength D must lie between H and L. If it doesn't, the question is unanswerable — and sometimes that is exactly the trap.

GPAT angle: Alligation numericals are near-guaranteed in competitive exams. Draw the cross even when you can do it mentally — in a theory paper the diagram itself carries method marks, and it makes a swapped-difference error visible before you commit to it.

Proof spirit

Alcohol strength in pharmacy is measured against a reference called proof spirit: a mixture containing 57.1% v/v ethanol (at 15.56 °C, i.e. 60 °F). Proof spirit itself is defined as 100° proof. Strengths are then expressed relative to it:

- Over proof (O.P.) — stronger than proof spirit. 25° O.P. means 25 degrees above proof spirit, i.e. 125° proof.
- Under proof (U.P.) — weaker than proof spirit. 25° U.P. means 25 degrees below, i.e. 75° proof.

Conversions (learn both directions):

- % v/v ethanol = (proof strength ÷ 100) × 57.1
- Proof strength = (% v/v ÷ 57.1) × 100

Worked example

A tincture is labelled 70° proof. What is its % v/v ethanol content?

$$\% \text{ v/v} = (70 \div 100) \times 57.1 = 0.70 \times 57.1 = 39.97 \approx 40\% \text{ v/v.}$$

Reverse: a spirit containing 45.68% v/v ethanol = $(45.68 \div 57.1) \times 100 = 80^\circ$ proof, i.e. 20° U.P.

Trap alert: Proof strength is not % v/v. 100° proof is only 57.1% v/v — students who treat "70° proof" as "70% v/v" lose the numerical completely. The degree sign (°) is your warning: degrees proof and percent are different scales anchored at 57.1% v/v.

Isotonic solutions

A solution is isotonic with body fluids (blood plasma, tears) when it exerts the same osmotic pressure as those fluids. The reference point you must memorise: 0.9% w/v sodium chloride is isotonic with blood and tears.

Why does this matter? Put red blood cells in a hypotonic solution (lower osmotic pressure) and water rushes into the cells — they swell and burst (haemolysis). Put them in a hypertonic solution and water is drawn out — the cells shrink (crenation). For injections this can be dangerous; for eye drops, any departure from isotonicity causes stinging, irritation and tissue damage. That is why tonicity adjustment is a manufacturing step, not an afterthought.

Two standard methods adjust tonicity:

1. Sodium chloride equivalent (E value) method

The E value (sodium chloride equivalent) of a drug is the amount of NaCl that produces the same osmotic effect as 1 g of the drug. The method:

- 1 Calculate how much NaCl the drug present is "worth": $E \times (\text{grams of drug per 100 mL})$.
- 2 Subtract from 0.9 (the NaCl needed for 100 mL of isotonic solution).
- 3 Add that much NaCl to make up the difference.

Worked example: Make 100 mL of a 2% w/v solution of a drug isotonic. E value of the drug = 0.18.

- Drug present = 2 g per 100 mL.
- NaCl equivalent of the drug = $0.18 \times 2 = 0.36$ g.
- NaCl still needed = $0.9 - 0.36 = 0.54$ g per 100 mL.
- So: dissolve 2 g drug + 0.54 g NaCl, make up to 100 mL with water for injection.

2. Freezing point depression method

Blood plasma (and tears) freeze at -0.52 °C. Any solution that also freezes at -0.52 °C is isotonic with blood. The method: measure (or calculate from tables) the freezing point depression caused by the drug, then add enough NaCl — whose 1% solution depresses the freezing point by 0.58 °C — to bring the total depression to 0.52 °C.

Worked example: A 1% w/v solution of a drug depresses the freezing point by 0.10 °C. How much NaCl is needed per 100 mL to make the solution isotonic?

- Depression still needed = $0.52 - 0.10 = 0.42$ °C.
- 1% NaCl gives 0.58 °C depression, so NaCl needed = $(0.42 \div 0.58) \times 1\% = 0.724\%$ w/v, i.e. 0.724 g per 100 mL.

Trap alert: The E value is defined per 1 g of drug — students multiply by the wrong quantity (e.g., by the volume instead of the drug weight). Always do it as: $E \times (\text{grams of drug in 100 mL})$. And in the freezing point method, the target is always 0.52 °C (the depression for plasma); the most common slip is subtracting from 0.58 instead.

GPAT angle: "Define isotonic solution. Describe the methods of adjusting tonicity" is a standard 5–10 mark question. Open with the 0.9% NaCl reference, then give both methods with one line of principle each — and note that eye drops and parenteral products are the two dosage forms where isotonicity is non-negotiable.

Dilute solutions — percentage and ratio strengths

Four ways of expressing concentration, and you must convert between them without hesitation:

- % w/w = grams of solute per 100 g of solution (used for ointments and creams — e.g., 5% w/w).
- % w/v = grams of solute per 100 mL of solution (most liquid preparations — e.g., 0.9% w/v NaCl).
- % v/v = mL of solute per 100 mL of solution (liquid-in-liquid — e.g., alcohol).
- Ratio strength = 1:1000 means 1 g in 1000 mL. Convert with: $\% = (1 \div \text{ratio}) \times 100$. So 1:1000 = 0.1% w/v; 1:400 = 0.25% w/v.

Worked example

How many grams of potassium permanganate are needed to make 500 mL of a 1:5000 solution?

- $1:5000 = (1 \div 5000) \times 100 = 0.02\% \text{ w/v} = 0.02 \text{ g per } 100 \text{ mL}$.
- For 500 mL: $0.02 \times 5 = 0.1 \text{ g}$.

Trap alert: Ratio strength 1:1000 is 0.1%, not 1% — the missing zero is the single most common percentage error in this unit. When in doubt, expand the ratio literally: 1 g in 1000 mL.

Geometric dilution

When a tiny quantity of a potent drug must be mixed uniformly into a large quantity of powder, dumping it all in at once guarantees lumps of pure drug in the final mix — dangerous when the drug is potent. Geometric dilution solves this: triturate the drug with an approximately equal volume of diluent, then add diluent equal to the mixture and triturate again, doubling each time until all the diluent is incorporated.

Why doubling works: at every step the drug is only ever diluted about two-fold, so no step asks a small amount of drug to distribute through a huge mass at once. The mixture stays uniform at every stage. This is the standard way of blending potent powders (a few mg of drug in grams of lactose) in a mortar, and the same doubling principle is used when incorporating a small amount of drug into an ointment base by trituration (Unit V).

GPAT angle: "What is geometric dilution and where is it used?" — answer: stepwise doubling of the diluent for uniform mixing of small quantities of potent drugs with large quantities of powder (and the same idea for ointments). Examiners accept a three-line description if the doubling logic is stated.

Posology

Posology (from Greek posos, "how much", and logos, "study") is the branch of pharmacy concerned with the determination of doses — how much of a drug a particular patient should receive. The adult dose is the reference point; children's doses are calculated from it because children are not simply small adults — their metabolism, body water and organ maturity differ.

Factors affecting the dose (beyond age and weight): sex, body surface area, route of administration, disease state (kidney/liver impairment), genetic differences, drug interactions, tolerance and the severity of the condition. In exams, the formulas below are what get tested — but naming one or two of these factors shows you understand that formulas are approximations, not truth.

Dose calculation formulas

Formula	Based on	Equation (child dose = ... × adult dose)
Young's formula	Age in years (children)	$\text{Age} \div (\text{Age} + 12)$
Dilling's formula	Age in years	$\text{Age} \div 20$
Clark's formula	Body weight	$\text{Weight (lb)} \div 150, \text{ or } \text{Weight (kg)} \div 70$
Fried's rule	Age in months (infants)	$\text{Age (months)} \div 150$
Body surface area	BSA in m ²	$\text{BSA} \div 1.73$

The body surface area method is considered the most accurate for children, because BSA correlates better with metabolic rate and organ function than age or weight alone. BSA is calculated by the Mosteller formula:

$$\text{BSA (m}^2\text{)} = \sqrt{[\text{height (cm)} \times \text{weight (kg)} \div 3600]}$$

Worked examples (show every step)

1. Young's formula. Adult dose 500 mg; child aged 6 years.

$$\text{Child dose} = [6 \div (6 + 12)] \times 500 = (6 \div 18) \times 500 = 0.333 \times 500 = 166.7 \text{ mg.}$$

2. Clark's formula. Adult dose 250 mg; child weighing 20 kg.

$$\text{Child dose} = (20 \div 70) \times 250 = 0.2857 \times 250 = 71.4 \text{ mg.}$$

3. Fried's rule. Adult dose 300 mg; infant aged 10 months.

$$\text{Infant dose} = (10 \div 150) \times 300 = 0.0667 \times 300 = 20 \text{ mg.}$$

4. BSA method. Adult dose 400 mg; child with BSA 0.8 m².

Child dose = $(0.8 \div 1.73) \times 400 = 0.4624 \times 400 = 185$ mg.

Trap alert: Three formula traps in one unit: (i) Clark's uses 150 for pounds but 70 for kilograms — using 150 with kg inflates the dose more than two-fold; (ii) Fried's rule takes age in months, not years — a 1-year-old is 12 months here; (iii) Young's has (Age + 12) in the denominator, not just 12. Write the formula by name before substituting — examiners give marks for naming the right formula even if the arithmetic slips.

Introduction to dosage forms — routes of administration and classification

A dosage form is the physical form in which a drug is presented for administration — tablet, syrup, injection, ointment. The dosage form and the route of administration together decide how fast the drug acts, how much reaches the blood, and where it goes.

Routes of administration

Route	Examples	Key points
Oral	Tablets, capsules, syrups	Most convenient; but slow onset, and the drug faces first-pass metabolism in the liver, which destroys part of the dose before it reaches the circulation
Sublingual / buccal	Nitroglycerin (sorbitrate) tablets under the tongue	Rapid absorption through the rich blood supply of the mouth; bypasses first-pass metabolism — why it works in seconds for angina
Parenteral	IV, IM, SC, intradermal, intrathecal injections	IV is the fastest route of all (drug directly into blood); used when oral is impossible (vomiting, unconsciousness) or rapid action is needed. Must be sterile
Rectal	Suppositories, enemas	Useful in vomiting/unconscious patients and children; partly avoids first-pass metabolism
Topical	Ointments, creams, lotions	Local action on skin; limited systemic absorption (which is usually the point)
Inhalation	Aerosols, nebulisers	Drug delivered directly to the lungs — ideal for asthma (e.g., salbutamol)

Route	Examples	Key points
Nasal, ophthalmic, otic	Nasal drops, eye drops, ear drops	Local action; eye drops must be sterile and isotonic
Transdermal	Medicated patches	Drug absorbed through skin over hours for sustained systemic effect

The speed ranking worth memorising: IV > IM > sublingual > oral. And the reason oral is slowest is not just dissolution — it is absorption through the gut wall plus first-pass loss in the liver.

Classification of dosage forms

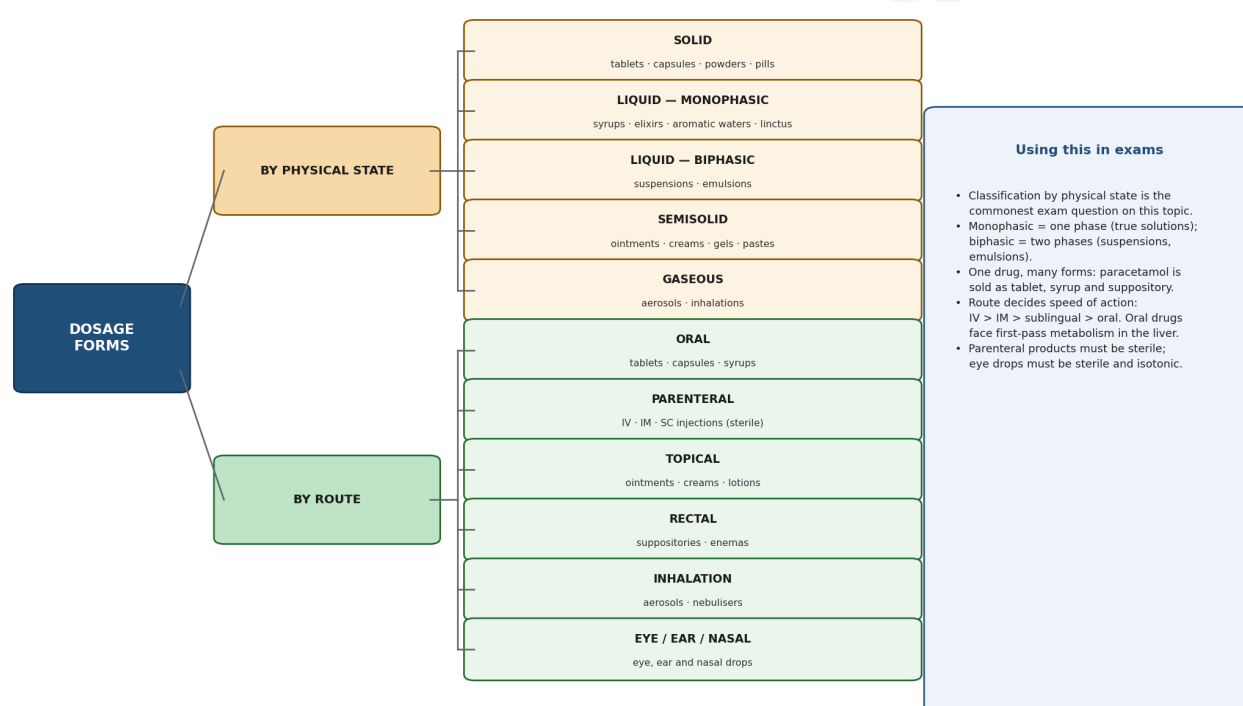


Figure: Dosage forms classified by physical state and by route of administration

Dosage forms classified by physical state and by route of administration

The commonest exam classification is by physical state (shown in the figure above): solids, liquids (monophasic and biphasic), semisolids and gases. Dosage forms are also classified by route (oral, parenteral, topical, rectal, inhalation...) and by release pattern (immediate-release, sustained-release, controlled-release, delayed/enteric-coated). A single product can sit in all three classifications at once — a sustained-release tablet is a solid, oral, sustained-release dosage form. Examiners sometimes ask you to classify one product three ways, and that is the trick: the classifications are not alternatives, they are different axes.

Active Pharmaceutical Ingredients and Excipients

- API (Active Pharmaceutical Ingredient) — the substance in the formulation that produces the therapeutic effect (paracetamol in a Crocin tablet; amoxicillin in a Moxikind capsule). Everything else in the formulation exists to serve the API.
- Excipient — any substance other than the API included in the formulation to help manufacture it, keep it stable, or make it acceptable to the patient. Examples: lactose and starch as diluents, starch paste as a binder, colourants, flavouring agents, preservatives.

Ideal characteristics of excipients: chemically inert (no reaction with the drug), non-toxic, stable under processing and storage, compatible with the API and the packaging, and economical (they are used in bulk). An excipient that reacts with the drug or degrades on the shelf defeats its own purpose.

Why excipients matter — this is the "importance" part examiners ask for: without excipients, a potent drug present in milligrams could not be made into a tablet that holds together, flows through a machine and breaks up in the gut; a bitter drug could not be made into a syrup a child will swallow; a suspension would settle into an unusable cake. Excipients decide whether a good drug molecule becomes a usable medicine. They are pharmacologically inactive, but pharmaceutically indispensable.

GPAT angle: "Define API and excipient. What are the ideal characteristics of excipients?" is a favourite 5-mark short note in both university and competitive exams. Structure it exactly as above: two definitions, five characteristics, one paragraph on importance with two concrete examples.

Very short questions (2 marks)

- 1 Define posology.
- 2 State the E value concept in one line.
- 3 What is proof spirit?
- 4 Convert 1:1000 ratio strength to percentage.
- 5 Expand API and give one example each of an API and an excipient.

Short questions (5 marks)

- 1 Define and explain alligation with a worked example. Draw the alligation cross.
- 2 Define an isotonic solution. Describe the sodium chloride equivalent method of adjusting tonicity with a worked example.
- 3 Define posology. Write Young's, Clark's and Fried's formulas and state what each is based on.

Long questions (10 marks)

- 1 A child aged 4 years weighs 16 kg and has a BSA of 0.7 m². The adult dose of a drug is 250 mg. Calculate the child's dose by (a) Young's formula, (b) Clark's formula, and (c) the BSA method. Comment on which result is considered most reliable and why.

- 2 Classify dosage forms by physical state and by route of administration with examples. Add a note on APIs and the ideal characteristics of excipients.

How to approach these answers

- Very-short Q1: one definition — posology is the study of dose determination (mention the Greek roots for a bonus impression).
- Very-short Q2: E value = NaCl producing the same osmotic effect as 1 g of the drug.
- Very-short Q3: proof spirit = 57.1% v/v ethanol = 100° proof (both numbers carry marks).
- Very-short Q4: 1:1000 = 0.1% — show the one-line conversion.
- Very-short Q5: API = therapeutic effect (e.g., paracetamol); excipient = other ingredients (e.g., lactose).
- Short Q1: open with the definition, draw the cross, then solve a 70%/20% → 40% example step by step including the per-part scaling.
- Short Q2: define isotonic (0.9% NaCl reference), explain the E-value principle, then a full worked example with the subtraction step shown.
- Short Q3: define posology, then a three-row table of the formulas with their bases; add one line that BSA is the most accurate.
- Long Q1: structure — write each formula, substitute, solve (three sub-parts), then a concluding paragraph on why the BSA method is preferred (best correlation with metabolic rate).
- Long Q2: structure — intro (what a dosage form is), classification by physical state (use the tree figure), classification by route (table), then API/excipient definitions with ideal characteristics; close with why excipients matter.

Unit III — Solid Dosage Forms

Solid dosage forms are the backbone of pharmacy — tablets and capsules account for the majority of medicines dispensed anywhere in the world. This unit covers powders, tablets and capsules: what each type is for, why it behaves the way it does, and how it is made. "Advantages and disadvantages" questions are near-certain here, so learn every list as a paired list — each advantage should make you able to state the matching disadvantage.

Powders

Powders are solid dosage forms containing one or more drugs in a dry, finely divided state. They are among the oldest dosage forms in existence and survive because some jobs suit nothing else: doses too large to fit in a tablet, drugs for dusting onto skin, and drugs too unstable to keep in solution.

Classification (learn with one example each)

- Bulk powders — dispensed in bulk; the patient measures each dose (e.g., antacid powder). Cheap, but dose accuracy depends on the patient.
- Divided powders — individually wrapped single doses (e.g., ORS sachets). Accurate, but more packaging.
- Dusting powders — applied externally to skin, and must be very finely sifted so the particles don't irritate. Two kinds: medical dusting powders contain a medicament (e.g., zinc oxide–starch antiseptic powder); surgical dusting powders are sterile and used on wounds.
- Effervescent powders — contain sodium bicarbonate plus an organic acid (citric/tartaric acid). On contact with water they release CO_2 , producing a fizzy solution (e.g., ENO). The effervescence masks unpleasant taste and the dissolved, slightly acidic drink is absorbed quickly.
- Efflorescent powders — contain drugs that lose their water of crystallisation on exposure to air and turn damp and sticky. They are gently dried before mixing and packed in well-closed containers. (Think of it as the mirror image of hygroscopic powders — one loses water to the air, the other takes up water from it.)
- Hygroscopic powders — absorb moisture from the air and cake. They need airtight packing, sometimes with a desiccant sachet.
- Eutectic mixtures — the most conceptually interesting type. Two solids that liquefy when mixed because the mixture's melting point falls below room temperature. The classic pair is menthol + camphor (menthol + thymol behaves the same way). Each solid is pure and stable alone; together, they depress each other's melting point — the same freezing-point-depression principle you met in Unit II, working in reverse. They are handled by triturating each component separately with an inert absorbent (light magnesium oxide or lactose) before combining, which soaks up the liquefied mixture — or by dispensing the components separately.

Trap alert: Examiners deliberately pair effervescent (fizzes in water — releases CO_2) with efflorescent (goes damp in air — loses water of crystallisation). The names differ by two letters and the behaviours are opposites. Write the mechanism, not just the word: fizz vs damp.

Advantages and disadvantages of powders

Advantages: suitable for large doses that would make impossibly big tablets; rapid dissolution and therefore fast absorption; simple and cheap to compound; useful externally as dusting powders.

Disadvantages: bitter or unpleasant drugs taste terrible; hygroscopic drugs cake on storage; bulky and inconvenient to carry; dose measurement by the patient (bulk powders) can be inaccurate.

Excipients and preparation

Diluents such as lactose and starch bulk up small drug quantities so they can be weighed and mixed accurately. Preparation is by trituration (grinding in a mortar) or simple mixing, then sifting and packing — with geometric dilution (Unit II) used whenever a potent drug is present in tiny amounts.

Tablets

A tablet is a solid dosage form containing a drug, with or without excipients, prepared by compression (or, historically, moulding) into a flat or biconvex disc. It is the commonest dosage form in the world because it is accurate, stable, portable and cheap to mass-produce.

Types of tablets (with examples and rationale)

- Compressed tablets — the ordinary tablet (e.g., paracetamol/Crocin).
- Sugar-coated tablets — a sugar coat masks bitter taste and protects the core (older vitamin tablets).
- Film-coated tablets — a thin polymer coat for taste-masking, stability and elegance.
- Enteric-coated tablets — the coat resists stomach acid and dissolves in the intestine. Two reasons to do this: the drug irritates the stomach (e.g., diclofenac), or stomach acid destroys the drug (e.g., omeprazole, erythromycin). Enteric coating protects the stomach from the drug and the drug from the stomach — both directions matter.
- Chewable tablets — chewed before swallowing; for children and for antacids (e.g., Digene), where chewing increases surface area and starts the action in the mouth.
- Sublingual / buccal tablets — dissolve under the tongue or in the cheek for rapid absorption into the bloodstream, bypassing first-pass metabolism (e.g., sorbitrate/nitroglycerin for angina — seconds matter here).
- Effervescent tablets — dissolve in water with effervescence before drinking (e.g., vitamin C tablets); useful for large doses and patients who can't swallow tablets.
- Dispersible tablets — disperse quickly in water before administration.
- Sustained-release (SR) / controlled-release (CR) tablets — release the drug slowly over hours (e.g., metformin SR), so the patient takes fewer doses and blood levels stay steadier.
- Moulded tablets (tablet triturates) — made by moulding a moist powder mass, not compression. Small, rapidly dissolving tablets historically used for potent drugs (e.g., nitroglycerin). Largely obsolete in industry, but examiners still ask for the definition — the trap is calling them compressed.
- Pills — small spherical masses made by rolling, not compression. This is the traditional dosage form that tablets replaced. Know the definition; you will rarely see real pills in modern practice.

GPAT angle: "Which coating is used for drugs destroyed by gastric acid?" (enteric coating) and "Name a tablet that bypasses first-pass metabolism" (sublingual nitroglycerin) are standard one-mark questions. Also remember: moulded tablets = moulding, every other tablet = compression.

Advantages and disadvantages

Advantages: accurate unit dosing; convenient, portable and stable; coatings allow taste-masking and targeted release; economical for mass production; tamper-evident.

Disadvantages: slower onset than liquids; difficult for children and elderly patients to swallow; unsuitable for drugs unstable under compression pressure or for very large doses; once swallowed, the dose cannot be withdrawn.

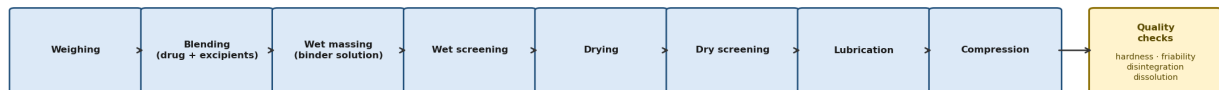
Excipients used in tablets

Excipient	Function	Example
Diluent	Bulks up the tablet when the drug quantity is small	Lactose, starch, microcrystalline cellulose
Binder	Holds the granules/tablet together	Starch paste, PVP, gelatin
Disintegrant	Breaks the tablet apart in the gut so the drug can dissolve	Starch, croscarmellose sodium, sodium starch glycolate
Lubricant	Reduces friction between tablet and die wall during compression/ejection	Magnesium stearate, talc, stearic acid
Glidant	Improves powder flow into the die	Colloidal silicon dioxide, talc
Colourant / flavourant	Identification and patient acceptability	Approved dyes, flavours

Notice the built-in tension formulators live with: the binder must hold the tablet together, while the disintegrant must break it apart. Too much binder → the tablet never disintegrates; too much disintegrant → it crumbles in the bottle. Tablet formulation is the art of balancing these opposing forces.

Methods of preparation

WET GRANULATION — the commonest route; a binder solution granulates the powder



DRY GRANULATION — for drugs harmed by moisture or heat; no liquid binder



DIRECT COMPRESSION — fewest steps; needs free-flowing, directly compressible excipients



Figure: The three routes of tablet manufacture — all end in compression and the same quality checks

The three routes of tablet manufacture, from powder to quality checks

There are three routes from powder to tablet (see the figure):

- 1 Wet granulation — the commonest method. Drug + excipients are blended, moistened with a binder solution (wet massing), screened into wet granules, dried, dry-screened, lubricated and compressed. Use it when the powder doesn't flow or compress well on its own.
- 2 Dry granulation — for drugs harmed by moisture or heat. The powder blend is compressed into large tablets (slugs), which are milled into granules, then lubricated and compressed into final tablets. No liquid binder, no drying step.
- 3 Direct compression — the blend is compressed directly: fewest steps, cheapest. But it demands free-flowing, directly compressible excipients — most drugs don't qualify, which is why granulation exists at all.

Quality checks on tablets (why each one exists)

- Weight variation — each tablet must contain the same drug quantity; weighing tablets is the fast proxy for content uniformity.
- Hardness — the tablet must be hard enough to survive handling and transport.
- Friability — the tablet must not crumble or chip when tumbled (the Roche friabilator test); hardness and friability together prove mechanical strength.
- Disintegration — the tablet must break apart in the gut within the specified time; a tablet that never disintegrates never releases its drug.
- Dissolution — the drug must actually dissolve at the required rate; this is the test closest to predicting absorption in the body.

Capsules

A capsule is a solid dosage form in which the drug is enclosed in a gelatin shell. The shell is tasteless and dissolves in the gut, releasing its contents.

Types of capsules

- Hard gelatin capsules — two-piece (body + cap), filled with powders or granules (e.g., amoxicillin, omeprazole capsules). This is the familiar capsule.
- Soft gelatin capsules — one-piece sealed shell, filled with liquids or semi-solids (e.g., vitamin E/Evion, cod liver oil). The sealed shell protects oils from air and makes them easy to swallow.

Capsule sizes

Hard gelatin capsules come in sizes 000, 00, 0, 1, 2, 3, 4, 5 — 000 is the largest and 5 the smallest, and size 0 is the most commonly used. Memory hook: more zeros = bigger capsule.

Trap alert: Students write "size 5 is the largest" because $5 > 0$. It is exactly backwards: 000 > 00 > 0 > 1 > 2 > 3 > 4 > 5. The zeros count upward as the capsule gets bigger, then the plain numbers count downward as it gets smaller.

Advantages and disadvantages

Advantages: the tasteless shell masks bitter drugs; elegant appearance; fast disintegration (no compression pressure to overcome); soft capsules can carry oils and liquids that tablets cannot; accurate unit dosing.

Disadvantages: unsuitable for very hygroscopic drugs (gelatin absorbs moisture and the shell softens); unsuitable for very large doses; gelatin is animal-derived, which matters to vegetarian patients and some religious groups; more expensive than tablets.

Excipients and preparation

Diluents (lactose) bulk up the fill; lubricants and glidants help the powder flow into the shells. Hard capsules are filled on capsule-filling machines (hand-operated for small batches, fully automatic in industry); soft gelatin capsules are made by the rotary die process, which forms, fills and seals the shell in one continuous operation.

GPAT angle: Capsule questions in competitive exams cluster around three facts: hard = two-piece/powders vs soft = one-piece/liquids; the size order (000 largest, 0 commonest); and the rotary die process for soft gelatin capsules. That trio covers nearly every capsule question asked.

Very short questions (2 marks)

- 1 Define a eutectic mixture with one example.
- 2 Which is the largest hard gelatin capsule size, and which is most commonly used?

- 3 What are moulded tablets?
- 4 Name two disintegrants used in tablets.
- 5 Distinguish between medical and surgical dusting powders.

Short questions (5 marks)

- 1 Classify powders with one example of each type.
- 2 Describe the three methods of tablet manufacture. When is dry granulation preferred?
- 3 Compare hard and soft gelatin capsules under suitable headings.

Long questions (10 marks)

- 1 Define tablet. Describe the various types of tablets with examples, and give the advantages and disadvantages of tablets as a dosage form.
- 2 Classify the excipients used in tablet formulation with examples, and describe the quality control tests performed on tablets, explaining the purpose of each test.

How to approach these answers

- Very-short Q1: definition (two solids liquefy on mixing due to melting-point depression) + the menthol-camphor example.
- Very-short Q2: 000 is largest, 0 is commonest — state both; the order is the mark.
- Very-short Q3: tablets made by moulding moist powder (not compression), e.g., nitroglycerin; note they are largely obsolete.
- Very-short Q4: any two — starch, croscarmellose sodium, sodium starch glycolate.
- Very-short Q5: medical = contains medicament; surgical = sterile, for wounds.
- Short Q1: list the seven powder types with one example each; add one line on effervescent vs efflorescent since examiners pair them.
- Short Q2: describe wet, dry and direct routes in order; dry granulation is for moisture/heat-sensitive drugs — state the reason, not just the name.
- Short Q3: compare under headings — shell (two-piece vs one-piece), fill (powders vs liquids), example, preparation method.
- Long Q1: structure — definition, types with examples and rationale (group coated/modified-release/special types), then paired advantages and disadvantages; close with one line on why tablets dominate.
- Long Q2: structure — intro, excipient table (six rows: diluent, binder, disintegrant, lubricant, glidant, colourant), then the five QC tests each with its purpose; conclude with the binder-vs-disintegrant balancing idea.

Unit IV — Monophasic and Biphasic Liquids

Liquid dosage forms are either monophasic (one clear phase — true solutions) or biphasic (two phases — suspensions and emulsions). This is the longest unit in BP102T, and the way to master it is to learn each preparation as definition → example → one key preparation point. The examples are what make your answers read like a pharmacy student's, not a textbook index.

Monophasic liquids for internal use

Four preparations, all taken by mouth. Fix this group first — everything else in the monophasic list is external or for body cavities.

Aromatic waters — clear, aqueous solutions of volatile oils or aromatic substances, used mainly as pleasantly flavoured vehicles (e.g., chloroform water, peppermint water, rose water, camphor water). Prepared by shaking the aromatic substance with purified water and filtering. They must be stored in well-closed containers, protected from light — volatile constituents escape through loose closures and degrade in light, so a badly stored aromatic water loses both odour and value.

Syrups — concentrated aqueous solutions of sucrose (or other sugars). Simple syrup IP contains 66.7% w/w sucrose, and that concentration is itself the preservative: the high osmotic pressure of the sugar solution stops microbial growth, which is why simple syrup keeps without added preservatives. Used as sweet vehicles for bitter drugs (cough syrups are the familiar example). Prepared by dissolving sucrose in purified water with heat, or by agitation without heat when heat-sensitive ingredients are added afterwards.

Elixirs — clear, sweetened hydroalcoholic liquids (they contain alcohol, typically 5–40%) used as vehicles for drugs (e.g., phenobarbitone elixir). The alcohol does two jobs: it keeps both water-soluble and alcohol-soluble ingredients in one clear solution, and it acts as a preservative. The trade-off: the alcohol content limits their use in children and in patients who must avoid alcohol — a point worth one line in any answer.

Linctus — viscous, sweet liquid preparations taken in small doses for their soothing action on the throat in cough (e.g., codeine linctus, pholcodine linctus). They are sipped slowly and not diluted with water — the whole point is prolonged contact between the drug and the throat mucosa, and diluting would wash it away.

GPAT angle: "Simple syrup IP contains what percentage of sucrose?" (66.7% w/w) is a classic one-marker. The follow-up reasoning — why no preservative is needed (osmotic pressure) — turns it into a 2-mark answer and shows you understand formulation, not just numbers.

Monophasic liquids for external use and body cavities

- Liniments — liquid or semi-liquid preparations rubbed onto the skin with friction; they may be alcoholic or oily (e.g., turpentine liniment). Labelled "for external use only" and "shake well before use".

- Lotions — aqueous preparations dabbed onto the skin without friction, for a soothing or cooling effect (e.g., calamine lotion).
- Throat paints — viscous liquids applied to the throat with a brush (traditional iodine-based throat paints).
- Applications — an older term for liquids or semi-liquids applied to the skin; the syllabus lists it as a historical category, so know the name and move on.
- Gargles — aqueous solutions used to treat the throat — gargled and spat out (e.g., Betadine gargle is the modern familiar example).
- Mouthwashes — used to cleanse and deodorise the mouth (e.g., chlorhexidine mouthwash).
- Enemas — liquids administered rectally, either for evacuation of the bowel or for retention of a medicament.
- Eye drops — sterile aqueous or oily solutions instilled into the eye; they must be sterile, isotonic and buffered (this ties straight back to Unit II's isotonicity — the eye is the dosage form where all three requirements meet).
- Ear drops — instilled into the ear (e.g., wax-softening drops).
- Nasal drops — instilled into the nose (e.g., decongestant drops).
- Tinctures — alcoholic or hydroalcoholic extracts of crude drugs (e.g., tincture of iodine, compound tincture of benzoin). Prepared by maceration or percolation — the alcohol extracts the active constituents from the crude drug.

Trap alert: Liniment is rubbed, lotion is dabbed — students swap these constantly. Anchor it: liniment goes with movement (friction); lotion is dabbed lowly and gently. And gargle = throat, mouthwash = mouth — different sites, different formulations, another deliberate exam pairing.

Memory hook for the whole section: internal = waters, syrups, elixirs, linctus (four). Everything else in the syllabus list is external or for body cavities. If a question says "classify monophasic liquids", that split is your answer's skeleton.

Official preparations — excipients and methods

Official means listed in the pharmacopoeia — prepared exactly to the book's formula. The excipients behind these liquids:

- Vehicles — purified water, alcohol, glycerin (the bulk liquid carrying everything else).
- Sweeteners — sucrose, sorbitol (taste and, in syrups, preservation).
- Preservatives — benzoates, parabens (where the formulation doesn't preserve itself, unlike simple syrup).
- Flavours and colours — patient acceptability and identification.

General methods of preparation: solution (dissolve with stirring, with or without heat), maceration and percolation (soaking or slow extraction for tinctures and extracts of crude drugs), and filtration/clarification to get the clear, elegant liquid the patient expects.

Suspensions — biphasic liquids

A suspension is a biphasic liquid dosage form in which finely divided solid particles are dispersed in a liquid vehicle (usually water). "Shake well before use" exists because of physics: the drug particles are denser than the vehicle, so they settle on standing, and shaking re-disperses them.

Why particles settle — and how formulators fight it

Settling follows Stokes' law: the settling velocity increases with particle size and with the density difference between particle and vehicle, and decreases as the vehicle's viscosity rises. That one law explains the whole formulation strategy:

- Reduce particle size (fine milling) → slower settling.
- Increase vehicle viscosity with suspending agents → slower settling.
- But viscosity can't go too far, or the suspension won't pour — another balancing act, like the binder-disintegrant tension in tablets.

Flocculated vs deflocculated suspensions

This is the conceptual heart of the topic. In a flocculated suspension, particles carry little surface charge, so they attract each other into loose, fluffy aggregates called flocs. In a deflocculated suspension, particles carry a significant charge of the same sign, repel each other, and remain as individual fine particles.

	Flocculated	Deflocculated
Particle state	Loose aggregates (flocs)	Individual, separate particles
Settling rate	Fast (flocs are large)	Slow (fine particles)
Sediment character	Fluffy, loose	Dense, tightly packed
Redispersion	Easy — gentle shaking re-disperses	Difficult — forms a hard cake (caking)
Verdict	Preferred	Avoided

Read that table carefully, because it is counterintuitive: the suspension that settles faster is the better one. Fast settling of fluffy flocs is harmless because shaking restores uniformity in seconds; slow settling of individual particles is dangerous because the sediment packs into a cake that no amount of shaking will break up — and the patient then gets an under-dose from the top of the bottle and an overdose from the bottom. Caking is the failure mode; flocculation is the prevention.

Advantages and disadvantages

Advantages: suitable for drugs that are insoluble or unstable in solution; masks bitter taste better than solutions (the drug isn't dissolved on the tongue); higher drug loading is possible; prolonged action is achievable with the right formulation.

Disadvantages: physical instability (settling, and caking if deflocculated); dose uniformity depends entirely on the patient shaking well; bulky to store and transport.

Formulation excipients

- Suspending / viscosity agents — tragacanth, bentonite, sodium CMC, methylcellulose; they thicken the vehicle and slow settling (Stokes' law in action).
- Wetting agents — surfactants that let hydrophobic drug particles be wetted by water instead of floating in clumps.
- Flocculating agents — electrolytes added in controlled amounts to reduce surface charge and create flocs deliberately.
- Sweeteners, flavours and preservatives for acceptability and stability.

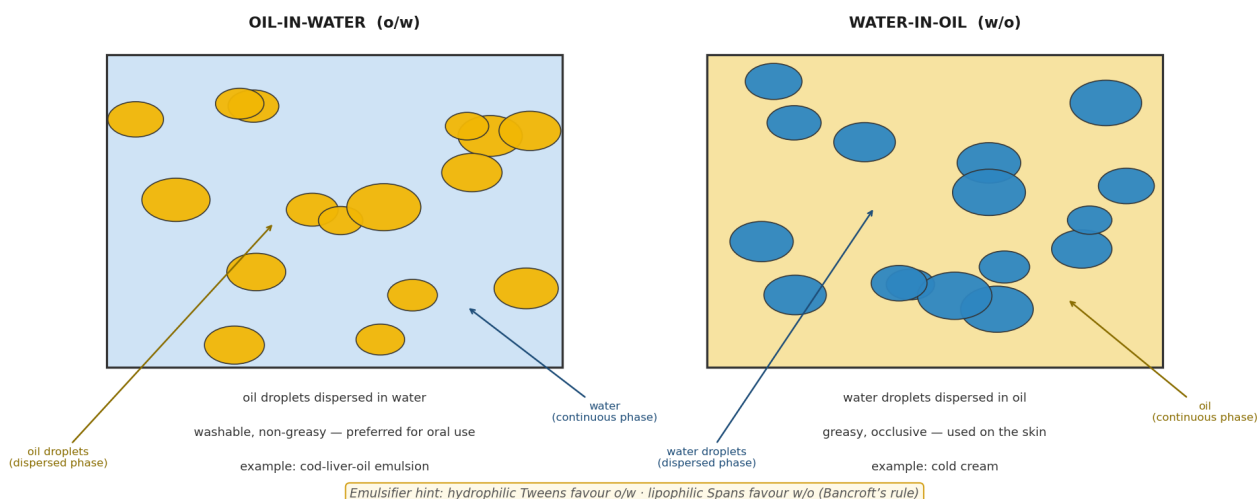
General method of preparation

Triturate the drug with the wetting agent → add the suspending agent (often as a mucilage) → incorporate the vehicle gradually with stirring → make up to volume → pack with a "shake well before use" label. The order matters: the drug must be wetted before it meets the bulk vehicle, or it will never disperse properly.

Trap alert: Students write "deflocculated suspensions are better because they settle slowly." Exactly wrong. Slow settling with caking is the worst outcome in suspension formulation. The exam-ready line: flocculated = fast settling, easy redispersion, no caking (good); deflocculated = slow settling, hard cake, difficult redispersion (bad).

Emulsions — biphasic liquids

An emulsion is a biphasic liquid in which one liquid is dispersed as fine droplets in another immiscible liquid, stabilised by an emulsifying agent. Milk is the everyday example — fat droplets in water, stabilised by milk proteins.



Tests for identifying the emulsion type

Test	o/w emulsion	w/o emulsion
Dilution test	mixes freely with water	mixes freely with oil, not water
Dye test (water-soluble dye)	colours uniformly	colour appears as spots
Conductivity test	conducts electricity	does not conduct
Fluorescence test (UV light)	spotty fluorescence	uniform fluorescence

Oil-in-water vs water-in-oil emulsions, with the four identification tests

Types

- Oil-in-water (o/w) — oil droplets dispersed in water (e.g., vanishing-cream-type bases; oral emulsions like cod-liver-oil emulsion). Washable, non-greasy, preferred for internal use.
- Water-in-oil (w/o) — water droplets dispersed in oil (e.g., cold-cream type). Greasy and occlusive, used externally.

Which type forms is decided by the emulsifier, not by the ratio of oil to water: Bancroft's rule states that the phase in which the emulsifier is more soluble becomes the continuous phase. Hydrophilic emulsifiers (the Tweens) dissolve better in water → o/w emulsions; lipophilic emulsifiers (the Spans) dissolve better in oil → w/o emulsions. This is also expressed through HLB (hydrophilic-lipophilic balance) values: high HLB → o/w, low HLB → w/o.

Why emulsions break — the physics of instability

Oil and water want to separate; the emulsifier only holds them together temporarily. The failure modes:

- Creaming — droplets rise (or sink) to form a concentrated layer, but don't merge. Reversible on shaking; governed by Stokes' law, like suspension settling.
- Cracking (breaking) — droplets coalesce (merge) and the two phases separate completely. Irreversible — the emulsion is destroyed.
- Phase inversion — an o/w emulsion flips to w/o (or reverse), usually from adding too much electrolyte or the wrong emulsifier.

Good formulation — right emulsifier, right HLB, small uniform droplets, adequate viscosity — slows all three.

Emulsifying agents

- Natural — acacia, tragacanth, gelatin, egg yolk.
- Synthetic surfactants — Tweens (hydrophilic → o/w) and Spans (lipophilic → w/o).
- Finely divided solids — bentonite and similar clays, which sit at the oil-water interface and physically block coalescence.

Tests for identification of emulsion type

Learn all four — this is a classic "write short notes" question, and the figure above summarises it:

- 1 Dilution test — an o/w emulsion dilutes freely with water; a w/o emulsion does not (it dilutes with oil). Like mixes with like.
- 2 Dye test — a water-soluble dye colours the continuous phase: uniform colour = o/w (water is continuous), spotted colour = w/o. An oil-soluble dye gives the reverse pattern.
- 3 Conductivity test — o/w conducts electricity (water, the continuous phase, carries the current); w/o does not.
- 4 Fluorescence test — under UV light, o/w shows spotty fluorescence while w/o shows uniform fluorescence, because oils fluoresce and water doesn't.

Each test is really the same question asked four ways: which liquid is continuous? If you remember that, you can reconstruct any test you forget.

Formulation excipients and preparation

Excipients: emulsifying agents (above), preservatives, antioxidants (oils go rancid), and flavours/sweeteners for oral emulsions.

General methods of preparation:

- Dry gum (continental) method — acacia is triturated with the oil first, then water is added all at once with vigorous trituration to form the primary emulsion. The classic ratio is oil : water : gum = 4 : 2 : 1.
- Wet gum (English) method — acacia is first made into a mucilage with water, then the oil is added gradually with trituration.
- Bottle method — for volatile or low-viscosity oils; the ingredients are simply shaken in a bottle.

Trap alert: In the dry gum method the gum goes with the oil first (dry = no water yet); in the wet gum method the gum goes with the water first. Students swap these two constantly. The names tell you: dry gum = gum stays dry until the water hits it all at once.

GPAT angle: The four identification tests are asked as a set in both university and competitive exams — often as "how would you distinguish an o/w from a w/o emulsion?" Lead with the dilution test (simplest), then dye, conductivity and fluorescence, one line of principle each. And memorise the 4:2:1 primary-emulsion ratio for the dry gum method; ratio questions appear regularly.

Very short questions (2 marks)

- 1 What is the sucrose concentration of simple syrup IP, and why does it need no preservative?
- 2 Distinguish between a liniment and a lotion.
- 3 What is a tincture? Name the two methods used to prepare it.
- 4 Define an emulsion and name its two types with one example each.
- 5 State the oil : water : gum ratio of the primary emulsion in the dry gum method.

Short questions (5 marks)

- 1 Classify monophasic liquid dosage forms for internal use, with one example and one preparation point for each.
- 2 Compare flocculated and deflocculated suspensions under suitable headings. Which type is preferred and why?
- 3 Describe the four tests used to identify the type of an emulsion, giving the principle of each.

Long questions (10 marks)

- 1 Define suspension. Explain the formulation excipients used in suspensions and the general method of preparation. Why is a flocculated suspension preferred over a deflocculated one?
- 2 Define emulsion. Describe the types of emulsions, the emulsifying agents used, and the general methods of preparation. Add a note on the physical instability of emulsions.

How to approach these answers

- Very-short Q1: 66.7% w/w sucrose; the high osmotic pressure prevents microbial growth.
- Very-short Q2: liniment = rubbed with friction; lotion = dabbed without friction — one line each with an example.
- Very-short Q3: alcoholic/hydroalcoholic extract of a crude drug; maceration and percolation.
- Very-short Q4: one liquid dispersed as droplets in another immiscible liquid; o/w (cod-liver-oil emulsion) and w/o (cold cream).
- Very-short Q5: 4:2:1 — oil : water : gum.
- Short Q1: four preparations (aromatic waters, syrups, elixirs, linctus) — definition + example + one preparation point each.

- Short Q2: reproduce the comparison table (particle state, settling, sediment, redispersion), then the caking argument in two lines.
- Short Q3: four tests, each as name + principle + result for o/w vs w/o; frame them as "which phase is continuous?"
- Long Q1: structure — definition, Stokes' law in one line, excipients grouped by function, preparation steps in order, then the flocculated-vs-deflocculated argument with the caking failure mode.
- Long Q2: structure — definition, types (o/w vs w/o with Bancroft's rule), emulsifying agents (three groups), three preparation methods, and instability (creaming, cracking, phase inversion) with one line on each.

Unit V — Semisolid Dosage Forms

Semisolids sit between solids and liquids: they stay where you put them on the skin or mucosa, but they spread under pressure. This unit covers ointments, pastes, creams and gels, then suppositories and pessaries. The two highest-yield topics in the whole subject live here: the four ointment bases and displacement value. Both are asked almost every year — learn them cold.

Definitions and classification

Semisolid dosage forms are preparations of such consistency that they adhere to the skin or mucous membrane on application, without being fluid enough to flow.

- Ointments — greasy, medicated semisolids carrying the drug in a base (e.g., sulphur ointment). The classic vehicle for delivering drugs through or onto the skin.
- Pastes — stiffer than ointments because they contain a high proportion of insoluble powder (20-50%). The powder makes them less greasy, more protective and better at staying exactly where applied (e.g., zinc oxide paste). Think of a paste as an ointment thickened with powder until it barely spreads.
- Creams — semisolid emulsions: o/w creams (vanishing creams — washable, non-greasy, cosmetically elegant) and w/o creams (cold creams — greasy, emollient, protective). A cream is what you get when Unit IV's emulsion science meets skin application.
- Gels (jellies) — transparent or translucent semisolids in which the liquid phase is thickened by a gelling agent (e.g., carbopol-based diclofenac gel — the Volini-type products). Non-greasy and easy to wash off, which patients prefer.

Advantages and disadvantages

Advantages: direct local action at the site of application; avoid first-pass metabolism (the drug doesn't go through the gut and liver first); easy to apply and remove; good for skin diseases where the skin itself is the target.

Disadvantages: greasy and messy (ointments especially); inaccurate dosing — nobody measures exactly 1 g of ointment; poor acceptability on weeping or hairy areas; stability

problems such as rancidity of fatty bases on storage.

Ointment bases and other excipients

The base is not a passive carrier — it decides how the ointment behaves: how greasy it feels, whether it washes off, whether it hydrates the skin, and how fast the drug is released. There are four types. Learn this table exactly as it is; it is one of the most repeated questions in BP102T.

Base type	Character	Example	Key point
Oleaginous (hydrocarbon)	Greasy, anhydrous, occlusive	White soft paraffin, hard paraffin, liquid paraffin	Form a water-proof film on skin; don't absorb water; difficult to wash off; protect and soften dry skin
Absorption	Anhydrous bases that absorb water to form w/o emulsions	Wool fat (lanolin), beeswax	Can take up aqueous drug solutions that oleaginous bases would reject
Emulsion (water-removable)	o/w or w/o emulsion bases	Hydrous wool fat	Washable with water; the o/w type is cosmetically preferred (non-greasy)
Water-soluble	Greaseless, washable	Macrogols (PEG ointment)	Release water-soluble drugs well; no rancidity since there are no fats to oxidise

Why does the base choice change drug delivery? An occlusive oleaginous base traps moisture under it, hydrating the skin — and hydrated skin absorbs drugs better. So for a drug that must penetrate, an occlusive base can be therapeutically superior to a washable one, even though the patient prefers the washable one. Efficacy vs acceptability: the formulator chooses based on which matters more for that product.

Other excipients: preservatives (parabens — needed wherever water is present), antioxidants (to prevent rancidity in fatty bases), humectants (glycerin — keeps the preparation from drying out), stiffening agents (waxes), and of course the medicament itself.

General methods of preparation

- 1 Trituration method — for ointments containing insoluble powders. Finely powder the drug, triturate it with a small portion of the base on an ointment slab, then geometrically dilute with the rest of the base (the Unit II doubling principle again — it guarantees the drug is uniformly distributed instead of sitting in lumps).
- 2 Fusion method — for waxy bases. Melt the base ingredients together in decreasing order of melting point (highest first), add the drug (dissolved or suspended), and stir while cooling. Why decreasing order? So the high-melting waxes are fully molten before the low-melting ones join — otherwise you'd overheat and degrade the low-melting

components. Stirring while cooling prevents grittiness (large crystals forming as the mass solidifies).

Pastes, creams and gels follow the same two ideas: pastes are made by the trituration route (their high powder content is worked into the base geometrically), creams are made by emulsification — forming the o/w or w/o emulsion with the chosen emulsifying agent, exactly as in Unit IV — and gels are made by dispersing the gelling agent in the liquid phase (often with a humectant like glycerin) until a clear, uniform gel forms.

GPAT angle: "Classify ointment bases with examples" is the single most repeated question from this unit — reproduce the four-row table. The two most common follow-ups: "which base is water-removable?" (emulsion base) and "which base shows no rancidity?" (water-soluble/macrogol base, because rancidity is oxidation of fats).

Suppositories and pessaries

A suppository is a solid dosage form for rectal administration that melts, softens or dissolves at body temperature to release the drug. Pessaries are the vaginal equivalent (larger, usually ovoid); urethral suppositories are called bougies (thin, pencil-shaped).

Types: rectal suppositories (torpedo/cone-shaped, about 1–2 g), vaginal pessaries (larger, ovoid — the vagina accommodates a bigger, slower-dissolving form), urethral bougies (thin and pencil-shaped for the narrow urethra). Shape follows anatomy — another "why" worth one line in an answer.

Advantages and disadvantages

Advantages: usable when the patient can't take oral medicines — vomiting, unconsciousness, or children who can't swallow; useful for local rectal action (piles, constipation — e.g., glycerin suppositories); partly bypasses first-pass metabolism (the lower rectum drains into the systemic circulation, not the portal vein, so part of the dose avoids the liver).

Disadvantages: low patient acceptability; absorption can be incomplete and irregular; storage problems in hot climates (fatty bases melt on the shelf — a real problem in Indian summers).

Properties of an ideal suppository base

- Melts at body temperature (or dissolves in body fluids) and releases the drug promptly — a base that melts at 45 °C is useless in a 37 °C rectum.
- Non-toxic, non-irritant and stable on storage.
- Compatible with the drug (no reaction that inactivates it).
- Contracts slightly on cooling, so the suppository releases cleanly from the mould.
- Good emulsifying and water-absorbing capacity where the formulation needs it.

Types of suppository bases

- Oleaginous bases — cocoa butter (theobroma oil) is the classic: it melts at body temperature ($\sim 34\text{--}35\text{ }^{\circ}\text{C}$), which is exactly the property needed. Its weaknesses: it goes rancid on storage, and it shows polymorphism (it can crystallise in forms with different melting points — a manufacturing headache), and it softens too easily in hot climates.
- Water-soluble / water-miscible bases — glycono-gelatin (dissolves slowly in body fluids; suited to vaginal pessaries where slow action is wanted) and macrogols (PEG bases) — stable in heat, no rancidity, but hygroscopic (they absorb moisture and must be well packed).

Trap alert: Cocoa butter melts at $\sim 34\text{ }^{\circ}\text{C}$ — just below body temperature, which is precisely why it works. Students sometimes write "melts at body temperature" vaguely; the number shows you know the base. And remember its two weaknesses (rancidity + polymorphism/heat sensitivity), because "why not always use cocoa butter?" is the natural follow-up question.

Displacement value

Here is the numerical heart of the unit. Suppositories are made in moulds of fixed volume. When you put drug into the mould, the drug occupies space — so less base fits in. If you ignore this, each suppository ends up with the right drug dose but the wrong total weight (or you overflow the mould).

The displacement value of a drug is the quantity of drug that displaces one part (1 g) of the base. It lets you calculate exactly how much base to use:

Base required = (mould capacity $\times$ number of suppositories) — (total drug $\div$ displacement value)

Worked example 1

Prepare 10 suppositories, each containing 0.5 g of drug. Mould capacity (for the base alone) is 2 g per suppository. Displacement value of the drug = 1.5.

- Total base capacity = $2\text{ g} \times 10 = 20\text{ g}$.
- Total drug = $0.5\text{ g} \times 10 = 5\text{ g}$.
- Base displaced by the drug = $5 \div 1.5 = 3.33\text{ g}$.
- Base required = $20 - 3.33 = 16.67\text{ g}$.
- So: melt 16.67 g of base, incorporate 5 g of drug, pour into 10 moulds — each mould then holds exactly 2 g total (0.5 g drug + 1.67 g base).

Worked example 2

Prepare 6 pessaries, each containing 0.3 g of drug. Mould capacity 4 g; displacement value = 2.

- Total capacity = $4 \times 6 = 24\text{ g}$.
- Total drug = $0.3 \times 6 = 1.8\text{ g}$.
- Base displaced = $1.8 \div 2 = 0.9\text{ g}$.

- Base required = $24 - 0.9 = 23.1$ g.

Trap alert: Two classic displacement-value errors: (i) forgetting to multiply by the number of suppositories — the formula needs totals, not per-suppository figures, in both terms; (ii) dividing the wrong way — it is $\text{drug} \div \text{displacement value}$ (this gives the base displaced), not $\text{displacement value} \div \text{drug}$. Check your answer by sanity: the base required must be less than the total mould capacity. If your answer is bigger than the capacity, you've gone wrong.

General method of preparation

Fusion (moulding) method — melt the base → incorporate the drug (dissolved, or suspended with stirring so it doesn't settle) → pour into cooled, lubricated moulds → allow to set → trim the excess → pack. (The older alternative is cold compression / hand-rolling, where the mass is shaped without heat.) Lubricating the mould matters because of the ideal-base property above: even a good base needs help releasing cleanly.

GPAT angle: "Define displacement value" is a 2-mark favourite; the numerical is a 5-mark favourite. Memorise the definition word-for-word ("the quantity of drug that displaces one part of the base") and the formula. In competitive exams the numbers are usually chosen to divide cleanly — if yours don't, recheck which term you divided.

Very short questions (2 marks)

- 1 Define a suppository and a pessary.
- 2 What is displacement value?
- 3 Name the four types of ointment bases with one example each.
- 4 Why is the fusion method carried out in decreasing order of melting point?
- 5 At what temperature does cocoa butter melt, and why is this significant?

Short questions (5 marks)

- 1 Classify semisolid dosage forms with examples. Give the advantages and disadvantages of semisolids.
- 2 Describe the properties of an ideal suppository base and the types of suppository bases with examples.
- 3 Describe the trituration and fusion methods of preparing ointments.

Long questions (10 marks)

- 1 Classify ointment bases with examples. Explain how the choice of base affects drug release and patient acceptability, and describe the general methods of preparing ointments.

- 2 Define displacement value. Derive its use with a worked numerical: prepare 12 suppositories, each containing 0.4 g of drug, in 2 g moulds, given the displacement value of the drug is 1.2. Also describe the general method of preparing suppositories.

How to approach these answers

- Very-short Q1: suppository = rectal solid melting at body temperature; pessary = vaginal equivalent.
- Very-short Q2: the quantity of drug displacing 1 g of base — memorise it word-for-word.
- Very-short Q3: oleaginous (soft paraffin), absorption (wool fat), emulsion (hydrous wool fat), water-soluble (macrogol) — four pairs.
- Very-short Q4: so high-melting waxes melt fully without overheating and degrading the low-melting ones.
- Very-short Q5: $\sim 34\text{--}35^\circ\text{C}$ — just below body temperature, so it melts on administration.
- Short Q1: four classes with examples, then paired advantages and disadvantages.
- Short Q2: list the ideal-base properties first, then the two base types with examples and one weakness of cocoa butter.
- Short Q3: trituration for insoluble powders (with geometric dilution); fusion for waxy bases (decreasing melting-point order, stir while cooling).
- Long Q1: structure — intro (what a base decides), the four-row table, a paragraph on occlusive hydration vs washability, then the two preparation methods.
- Long Q2: structure — definition, the formula, the numerical solved step by step (totals first: capacity 24 g, drug 4.8 g, displaced 4 g, base 20 g), then the fusion/moulding steps in order; close with the sanity check (base < total capacity).