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Prescription

Prescription is an order written by a physician, dentist or any other registered medical practitioner to a pharmacist to compound and dispense a specific medication for the patient. The order is accompanied by directions for the pharmacist that what type of preparation is to be prepared and how much is to be prepared. It is also accompanied with the directions for the patient that how much medicament is to be taken, how many times it is to be taken or at what time and how it is to be taken.

The prescription provides a common link of mutual interest between the physician, the pharmacist and the patient. It is the duty of the pharmacist to serve the medication needs of the patient according to the intention of the prescriber. It is not sufficient that the pharmacist should only compound the specific medication but he should make the patient understand about the proper administration of the drug and ensure that the patient sticks to these instructions. At the same time the pharmacist must maintain and respect the confidentiality of both the physician regarding the treatment given as well as that of the patient regarding the nature of his illness and the medication taken by him.

The prescriptions are generally written in the language of the area in which they originate but Latin words are frequently used in the prescription writing because in the olden days the medicines were written in Latin language which was understood all over the world. Still the use of Latin abbreviations in the prescription writing is very common, specially in dosage instructions.

PARTS OF A PRESCRIPTION

A complete prescription should have the following parts :

1. Date
2. Name, age, sex and address of the patient
3. Superscription
4. Inscription
5. Subscription
6. Signatura
7. Signature, address and registration number of prescriber.

1. Date

Date must be written on the prescription by the prescriber at the same time when it is written. The date on the prescription helps a pharmacist to find out the cases where prescription is brought for dispensing long time after its issue. Prescriptions containing narcotic or other habit-forming drugs must bear the date. The prescriptions should be filled within a reasonable time after it is written. If the prescription is brought for filling after two or three days from the date when it was written then the pharmacist must question if the intention of the prescriber and the needs of the patient can still be met.

2. Name, Age, Sex, and Address of the Patient

Name, age, sex, and address of the patient must be written on the prescription. If it is not written then the pharmacist himself should ask the patient about these particulars and put down at the top of the prescription. This avoids the possibility of giving the finished product to a person other than the one it is meant for. Patient's full name must be written instead of surname or the family name.

Age and sex of the patient specially in the case of children helps the pharmacist in checking the medication and the dose. Therefore there will be less danger of its being administered to the wrong member of the family or the hospital ward having similar names. The address of the patient is recorded to help for any reference at a later stage, to contact the patient or to deliver the medication personally.

3. Superscription

The superscription is represented by a symbol Rx which is always written at the beginning of the prescription. In the days of mythology and superstition the symbol was considered as a prayer to Jupiter, the God of healing, for quick recovery of the patient but now this symbol is understood as an abbreviation of the Latin word recipe, meaning "take thou" or "you take".

4. Inscription

This is the main part of the prescription. It contains the names and quantities of the prescribed ingredients. The names of the ingredients are written each on a separate line, followed by the quantity ordered and the last item written is generally the vehicle or diluent. In complex prescriptions containing several ingredients the inscription is divided into three parts (a) the base or the active medicament which is intended to produce the therapeutic effect; (b) the adjuvant which is included either to enhance the action of the medicament or to make the product more palatable; (c) the vehicle which is either used to dissolve the solid substances and/or to increase the volume of the preparation for ease of administration.

Now a days only a few prescriptions are compounded by pharmacists. A majority of prescriptions are written for medications already prepared into dosage forms by industrial manufacturers. The pharmacists are only required to dispense the ready-made dosage form of drugs which has eliminated the compounding of prescriptions.

5. Subscription

This part of the prescription contains prescriber's directions to the pharmacist regarding the dosage form to be prepared and number of doses to be dispensed. Since now-a-days only a few prescriptions are compounded therefore such directions are less frequent.

6. Signatura

It is usually abbreviated as "Sig" on the prescriptions and consists of the directions to be given to the patient regarding the administration of the drug. It usually indicates the quantity of medicament or number or dosage units to be taken, how many times in a day or at what time it should be taken and the manner in which it is to be administered or applied. These instructions must be transferred to the label of the container in which the medicament is to be dispensed and ensure that the patient follows these instructions carefully.

7. Signature, Address and Registration Number of the Prescriber

All other parts of the prescription may be printed or type-written but the prescriber's name must be hand-written and should be signed with ink. This eliminates the danger of dispensing medicament on a spurious order and it authenticates the prescription. The prescriptions containing narcotic or other habit-forming drugs must bear the address and registration number of the prescriber. This identifies the special licence which a prescriber must have to prescribe the narcotic and other habit-forming drugs.

Handling of Prescription

1. Receiving
2. Reading and checking
3. Collecting the materials
4. Weighing
5. Compounding
6. Finishing.

1. Receiving

The prescription should be received from the patient by the pharmacist himself. Under no circumstances an unauthorised person should try to receive or read the prescription.

An Example of a Typical Prescription

General Hospital

Date 21.6.86
Name Sh. Raman Kumar
Age 40 years
Sex Male
Address 817, Sector-20 Chandigarh

Rx (Superscription)

Potassium Bromide	8 gm	(Inscription)
Tincture Nux Vomica	8 ml	
Chloroform Water q.s.	120 ml	

Fiat mistura (Subscription)

Sig. Cochleare magnum ter in die post cibos sumenda. (Signatura)

(Signature of the Prescriber)
S.C. Aggarwal M.D.
Regd. No. 10234

2. Reading and Checking

A brief examination of each prescription should be made immediately upon receiving it from the patient. This will tell the pharmacist about the nature of the dosage form to be prepared and he can estimate the time required for preparing it. If a long time is needed for compounding the prescription then he must tell the patient about the time required for filling the prescription so that he may wait or return after some time. In some cases the patient's name, age and address may not be written on the prescription, in such cases these informations should be enquired from the patient and put down on the prescription.

Careful examination of the prescription should be made only behind the counter, so that if there is any doubt regarding the prescription ingredients or directions or there in any error in writing the prescription, the patient should not come to know about it. If there is any doubt the pharmacist should consult the other pharmacists or the prescriber.

Every prescription should be read and understood completely before compounding it. Every word and abbreviation must be interpreted correctly. He should never guess about the meaning of an illegible or confusing word. It may lead to serious consequences. If there is any doubt he should consult the fellow pharmacists or the prescriber.

As the number of drugs available in the market are increasing, the mistakes, due to the similarity or pronunciation and spellings are also increasing. In such cases a pharmacist has to take a great care specially

when the prescriptions are received orally. Examples of such drugs which look alike or sound alike are given below :

Apresoline	Priscoline
Compocillin	Ampicillin
Daricon	Darvon
Digoxin	Digitoxin
Indocin	Lincocin
Prednisone	Prednisolone
Qinine	Quinidine

Before the start of compounding the prescription, the pharmacist must ensure that what he is going to do and what type of finished product he will obtain.

3. Collecting and Weighing the Materials

Materials to be used in compounding the prescription should be collected on the left hand side of the balance and arranged in the order in which they are to be mixed. The materials which are weighed should be shifted to right hand side of the balance. This gives a mechanical check of ingredients which has been weighed. The label on every stock bottle should be read at least three times :

(a) When taken from the shelf or drawer.
(b) When the contents are removed for weighing or measuring.
(c) When the containers are returned back to its proper place.

4. Compounding

This is the most important phase in handling the prescription. In this case proper drug is dispensed in a suitable form. This can be achieved only if accuracy, cleanliness and proper techniques are observed in the preparation of any medication. Only one prescription should be compounded at one time. If two or more prescriptions are dispensed at the same time, one is likely to make serious mistakes by dispensing wrong drugs. Attention should not be diverted by talking to friends, attending the telephone or engaging in other directions.

Now a days majority of the prescriptions are written for the pre-compounded dosage forms supplied by the pharmaceutical manufacturers which require no compounding or mixing by the pharmacist. When a prescription requiring compounding is received the pharmacist should decide the calculations, special adjuvants and order of mixing then he should proceed further as described above.

5. Finishing

The compounded medicaments should be filled in suitable containers depending on the quantity of the medication to be dispensed and the

method of its use. Various types of containers used in pharmacy are : round vials used for filling the unit dosage forms such as tablets and capsules; oval prescription bottles used for filling liquids of low viscosity; wide mouth bottles used for filling the liquids of high viscosity, large quantities of tablets or capsules and bulk powders; ointment jars and collapsible tubes used for filling the ointments, creams or semisolid dosage forms; dropper bottles used for dispensing the eye drops, ear drops or other liquids to be administered by drops; sifter top containers used for dispensing the powders meant to be applied externally by sprinkling etc. The container should be selected approximately of the same volume as that of the medication to be dispensed.

Most of the containers are available in various sizes, shapes, colours and compositions. They may be made up of glass, plastic or suitable metal. Most of the glass containers are made from colourless or amber coloured glass. The latter being used for dispensing light sensitive medications. Plastic containers and collapsible tubes are also widely used for dispensing various types of dosage forms.

The filled containers are suitably labelled. A good quality of paper and adhesive should be used for labelling the containers. The size of the label should be proportional to the size of the container and should be neatly hand-written or preferably typed. The following information should be written on all labels :

1. Name of the prescription
2. Name of the patient, age and sex
3. Registration number
4. Date of dispensing
5. Directions for its use
6. Expiry date, if any
7. Storage conditions
8. Name and address of the pharmacy.

The label should be placed almost in the centre leaving equal space from the bottom and top of the bottle. On collapsible tubes it should be placed near the top to avoid concealment and wrinkling as the tube is rolled up from the bottom during its use. Special adhesives should be used for fixing the labels on the collapsible tubes.

Some containers like ophthalmic ointment tubes, eye drop and ear drop bottles and other small containers which lack sufficient surface area for attaching the label may be labelled with the serial number and packed in bigger container which is properly labelled. Special directions like "For external use only." and "Shake the bottle before use." must be attached to the bottle as secondary label.

After preparing and labelling, the compounded prescription should be thoroughly examined to ensure accuracy, quality and safety of the

prescription. The checker should first check the written prescription and then the contents of the container for colour, odour or any other indication for the correctness and quality of the medication. If the checker finds that the compounded prescription is correct then he must put his signatures on the prescription. Before the prescription is handed over to the patient the container must be thoroughly polished so as to remove the finger prints.

Latin Terms and Abbreviations Commonly Used in Prescription Writing

Latin term or phrase	*Abbreviation*	*English meaning*
Ad	ad.	to, up to
Ad libitum	ad. lib.	at pleasure, as desired
Admove	admov.	apply
Agita	agit.	shake, stir
Alter	alt.	the other, alternate
Alternis horis	alt. hrs.	alternate hours
Ana	a a.	of each
Ante	a.	before
Ante cibos	a.c.	before meals
Applicandus	applicand	to be applied
Aqua	aq.	water
Aqua bulliens	aq. bull.	boiling water
Aqua destillata	aq. dest.	distilled water
Auris dextra	a.d.	right ear
Auris laeva	a.l.	left ear
Auristillae	auristill	ear drops
Bis in die	b.i.d.	twice a day
Capsula	caps.	capsule
Capiat	cap.	let him take
Capiendus	capiend.	to be taken
Cataplasma	cataplasm	poultice
Charta	chart.	powder, powder paper
Cibos	cibos.	food, meals
Cochleare amplum / magnum / maximum	coch amp. / mag. / max.	one tablespoonful
Cochleare medium / modicum	coch med. / mod.	one desertspoonful
Cochleare minimum / parvum	coch min. / parv.	one teaspoonful
Collunarium	collunar.	a nose wash

Latin term or phrase	*Abbreviation*	*English meaning*
Collutorium	collut.	a mouth wash
Collyrium	collyr.	an eye wash
Congius	cong; c	a gallon
Cum	c	with
Cum duplo	c. dup.	with twice as much
Cum parte aequale	c. pt. aeq.	with an equal quantity
Cyathus	cyath.	a glass
Dentur	dent.	give, let it be given
Dexter	dext.	right
Diebus alternis	dieb. alt.	every other day
Divide	div.	divide
Dolore urgente	dol. urg.	when the pain is severe
Emulsio	emul.	an emulsion
E	—	with
E. lacte	e. lact.	with milk
Ex. aqua	ex. aq.	with water
Ex. modo prescripto	e.m.p.	in the manner prescribed
Fiat, fit, fiant.	ft.	make, let it be made
Granum, grana	gr.	a grain
Gutta, guttae	gtt.	a drop, drops
Hac nocte	hac noct.	to night
Hora	h.	an hour
Hora somni	h.s.	at bed time
In dies	In. d.	daily
Inter cibos	i.c.	during meals
Injectio	Inj.	an injection
Laevo	l.	left
Levis	lev.	light
Linimentum	lin.	a liniment
Liquor	liq.	solution
Mane	m.	morning
Minimum	min.	a minim
Misce	m.	mix, let (it) be mixed
Mistura	mist.	a mixture
Mitte	mitt.	send
Mitte tales	mitt tal.	send such
Modo dicto	m. dict.	as directed, as stated
Modo prescripto	m. pres.	as prescribed
More dicto	m. dict.	in the manner prescribed

Latin term or phrase	*Abbreviation*	*English meaning*
Nebula	nebul.	a spray
Nocte maneque	noct. maneq.	night and morning
Non repetatur	non rep, n.r.	do not repeat
Octarius	o.	a pint
Oculo utro	o.u.	each eye
Oculus dexter	o.d.	right eye
Oculus laevus	o.l.	left eye
Oculus sinister	o.s.	left eye
Omni	omn.	every
Omni hora	omn. hor, o.h.	every hour
Omni quadranta hora	omn. quadr. hor	every quarter of an hour
Omni quarta hora	omn. 4 hrs.	every four hours
Omni secunda hora	omn. 2 hrs.	every two hours
Omni mane	o.m.	every morning
Omni nocte	o.n.	every night
Os, oris	o.s.	mouth
Parti affecti applicandus	p.a.a.	to be applied to the affected part
Per os	p.o.	orally by mouth
Phiala prius agitata	p.p.a.	the bottle, being first shaken (i.e., attach a "Shake the bottle." label)
Post cibos	p.c.	after meals
Pro oculo laevo	p.o.l.	for the left eye
Pro dosi	—	as a dose
Pro re nata	p.r.n.	when necessary, occasionally
Pulvis	pulv	powder
Quantum sufficiat	q.s.	as much as sufficient
Quaque quarta hora	q.q.h.	every fourth hour
Quarter in die	q.i.d.	four times a day
Quotidie	quot.	Daily
Recipe	Rx	take
Secundum artum	s.a.	according to the art
Semis, Semi	ss.	half
Signa, signetur	sig.	write
Si opus sit	s.o.s.	when necessary
Solve	—	dissolve
Solutio	sol.	a solution
Statim	stat.	immediately

Latin term or phrase	*Abbreviation*	*English meaning*
Sumendus	sum.	to be taken
Suppositorium	supp.	a suppository
Tabella, tabletta	tab.	a tablet
Talis, tales	tal.	such
Ter in die	t.i.d.	three times a day
Ter quotidie	—	three times daily
Tussi urgente	tuss. urg.	when the cough is troublesome
Uncia	—	an ounce
Unguentum	ung.	an ointment
Utendus	u. or utend.	to be used
Unus	i	one
Duo	ii	two
Tres	iii	three
Quatuor	iv	four
Quinque	v	five
Sex	vi	six
Septem	vii	seven
Octo	viii	eight
Novem	ix	nine
Decem	x	ten
Undecim	xi	eleven
Duodecim	xii	twelve
Quindecim	xv	fifteen

CALCULATIONS INVOLVED IN DISPENSING

Before discussing the calculations which are involved in dispensing of drugs it is very necessary to have a thorough knowledge regarding weights and measures which are used in calculations. These weights and measures are discussed as follows :

Weight

It is a measure of the gravitational force acting on a body and is directly proportional to its mass. The mass remains constant and never varies because it is based on inertia whereas weight varies slightly with change in latitude, altitude, temperature and pressure. The effect of these factors is not considered unless very accurate weighings are to be done.

Measure

It is the measurement of volume of any substance. Temperature and

pressure exert their effect specially on liquids and gases. The effect of these factors is only taken into consideration when accurate preparations are to be made.

There are two systems of weights and measures (a) the imperial system (b) the metric system, with which the pharmacist must be familiar. The imperial system is an old system based on arbitrary and unrelated units, e.g., grains, drachms, ounces and gallons whereas the metric system or decimal system is based on related and rationally derived units, e.g., milligrams, grams, centimeters, meters, millilitres, litres, etc. Because of its easier calculations, greater accuracy and flexibility and use in other sciences, now a days this is the most widely used system by official agencies.

Adoption of Metric System

In 1948 a committee on weights and measures legislation was appointed by the president of the Board of Trade to review the existing weights and measures legislation and to make recommendations thereof. In 1951 the committee published a report in which it was recommended that the apothecary system (Imperial system) should be abolished and the metric system should be adopted in its place. Therefore steps were taken to abolish the use of imperial system for all dealings in drugs and medicines and its use was declared illegal in pharmacy profession. Since 31st March 1969 pharmacists were required to carry out all dispensing work in metric system.

Accordingly the first changeover to the metric system appeared in the British Pharmacopoeia and British Pharmaceutical Codex published in 1963. The doses of tablets, capsules and injections were given only in metric quantities. Weights and Measures Regulations 1964 described certain equivalents in metric units that whenever strength is prescribed in the imperial units that must be dispensed according to equivalent strength in metric units.

Though the pharmacists are required to use the metric system for dispensing the prescriptions but still a large number of physicians trained to use the imperial system prescribe the drugs in the old system and some hospitals still retain it as the local standard. Some drugs are prescribed in fractional doses (1/200, 1/150, 1/100 gr). The bottles for liquids are still manufactured to contain ounce measurements rather than milliliters.

Due to the above mentioned reasons, it is still necessary to be familiar with both the systems which are described in detail as follows :

(a) Imperial System

Imperial system is divided into two systems :

(i) Avoirdupois system
(ii) Apothecaries system.

Avoirdupois system

According to this system the standard unit for weighing is pound and all other measures of mass are derived from pound. It is represented by lb.

1 lb	= 16 oz (Avoir)	
1 lb	= 7000 grains	
1 oz	= 7000/16	= 437.5 grains

Apothecaries system

It is known as troy system. The standard weight in this system is grain.

20 grain	= 1 scruple
60 grain	= 1 drachm
480 grain	= 1 ounce (Apothe)
8 drachm	= 1 ounce (Apothe)
12 ounces (Apothe)	= 1 pound (Apothe)
5760 grain	= 1 pound (Apothe)

Abbreviations commonly used in weighing

Latin name	*Symbol*	*English name*	*Equal to*
Granum	gr	grain	1 grain
Scrupulus	℈	scruple	20 grains
Drachma	ʒ	drachm	60 grains
Uncia	oz	ounce (Avoir)	437.5 grains
Uncia	℥	ounce (Apothe)	480 grains
Libra	lb	pound (Avoir)	7000 grains
Libra	lb	pound (Apothe)	5760 grains

Measures of Capacity

Standard units for capacity are same in avoirdupois as well as apothecaries system. The standard unit is gallon and all other measures of capacity are derived from gallon.

1 gallon	= 160 fluid ounces	
1/4th of a gallon	= 1 quart	= 40 fl. ounce
1/8th of gallon	= 1 pint	= 20 fl. ounce
1/160th of a gallon	= 1 fl. ounce	
1/8th of one fl. ounce	= 1 fl. drachm	
1/60th of one fl. drachm	= 1 minim	
1 fluid ounce	= 480 minim	
1 fluid drachm	= 480/8	= 60 minim

Abbreviations commonly used in measures of capacity

Latin name	*Symbol*	*English name*	*Equal to*
Minimum	m	minim	1 minim
Fluidrachma	ʒ	fl. drachm	60 minim
Fluidunicia	ʒ	fl. ounce	480 minim
Octarius	O	pint	20 fl. ounces
Congius	C	gallon	160 fl. ounces

Metric System

Standard unit of measures of mass (weight) is kilogram and all other measures of mass are derived from kilogram.

1 Kilogram (kg)	= 1000 gm	
1 Hectogram (hg)	= 100 gm	
1 Decagram (dag)	= 10 gm	
1 Gram (gm)	= 1 gm	
1 Decigram (dg)	= 0.1 gm	= 100 mg
1 Centigram (cg)	= 0.01 gm	= 10 mg
1 Milligram (mg)	= 0.001 gm	= 1 mg
1 Microgram (µg, mcg)	= 1/1000 mg	

Measures of Capacity

Standard unit for measures of capacity (volume) is litre and all other measures of capacity are derived from litre.

1 litre (lt) = 1000 millilitre (ml)

Domestic Measures

1 drop	= 1 minim	= 0.06 ml
1 tea spoonful	= 1 fl. drachm	= 4 ml
1 desert spoonful	= 2 fl. drachm	= 8 ml
1 table spoonful	= 4 fl. drachm	= 15 ml
2 table spoonful	= 1 fl. ounce	= 30 ml
1 wine glassful	= 2 fl. ounce	= 60 ml
1 tea cupful	= 4 fl. ounce	= 120 ml
1 tumblerful	= 8 fl. ounce	= 240 ml

Conversion Factors

1 grain	= 64.8 mg	= 65 mg	(for all practical purposes)
1 drop	= 1 minim	= 0.06 ml	(for all practical purposes)
1 fl. ounce	= 29.57 ml	= 30 ml	(for all practical purposes)
1 gram	= 15.43 gr	= 15 gr	(for all practical purposes)

1 milligram	= 1/65 gr	= 1/65 gr	(for all practical purposes)
1 millilitre	= 16.23 minim	= 15 m	(for all practical purposes)
1 litre	= 33.8 fl. ounce		
1 kilogram	= 2.2 pound		

CALCULATIONS

Calculations based on density

Density in defined as the mass of a substance per unit volume. It has the units of mass over volume.

Specific gravity is the ratio of the weight of a substance in air to that of an equal volume of water. It does not have any units.

In the metric system both density and specific gravity are numerically equal. The density, weight and volume of any substance can be calculated from the following equations :

$$\text{Density} = \frac{\text{weight}}{\text{volume}}$$

$$\text{Weight} = \text{density} \times \text{volume}$$

$$\text{Volume} = \frac{\text{weight}}{\text{density}}$$

If any two variables are given, the third one can be calculated.

1. Calculate the weight of 120 ml of an oil whose density is 0.9624 gm/ml.

$$\text{Weight} = \text{density} \times \text{volume}$$
$$= 0.9624 \text{ gm/ml} \times 120 \text{ ml} = 115.488 \text{ gm.}$$

2. Calculate the volume of 200 gm of glycerin. The density of glycerin is 1.25 gm/ml.

$$\text{Volume} = \frac{\text{weight}}{\text{density}}$$
$$= \frac{200 \text{ gm}}{1.25 \text{ gm/ml}} = 160 \text{ ml.}$$

3. Calculate the weight of 1 litre of alcohol whose density is 0.816 gm/ml.

$$\text{Weight} = \text{density} \times \text{volume}$$
$$= 0.816 \text{ gm/ml} \times 1000 \text{ ml} = 816 \text{ gm.}$$

Conversions from Imperial to metric and metric to Imperial systems

1. How many mg are in one grain.

Since 15.43 gr = 1 gm

$$1 \text{ gr} = \frac{1}{15.43} \text{ gm} = 0.0648 \text{ gm} = 64.8 \text{ mg}$$

$\therefore$ 1 gr = 64.8 mg.

2. How many grams are in 1 ounce (Apothe).

1 ounce (Apothe) = 480 gr

Since 15.43 gr = 1 gm

$$1 \text{ gr} = \frac{1}{15.43}$$

$$480 \text{ gr} = \frac{1}{15.43} \times 480 = 31.11 \text{ gm}$$

$\therefore$ 1 ounce (Apothe) = 31.11 gm.

3. How many grams are in 1 ounce (Avoir).

1 ounce (Avoir) = 437.5 gr

Since 15.43 gr = 1 gm

$$1 \text{ gr} = \frac{1}{15.43} \text{ gm}$$

$$437.5 \text{ gr} = \frac{1}{15.43} \times 437.5 = 28.35 \text{ gm}$$

$\therefore$ 1 ounce (Avoir) = 28.35 gr.

4. How many ml are in 1 fl. oz.

1 fl. oz = 480 m

16.23 m = 1 ml

$$1 \text{ m} = \frac{1}{16.23} \text{ ml}$$

$$480 \text{ m} = \frac{1}{16.23} \times 480 = 29.57 \text{ ml}$$

$\therefore$ 1 fl. oz = 29.57 ml.

5. Convert 3 drachm into mgs.

1 drachm = 60 gr

3 drachm = 60 × 3 = 180 gr

1 gr = 64.8 mg

180 gr = 64.8 × 180 = 11664 mg

$\therefore$ 3 drachm = 11664 mg.

6. Convert 550 mg into grains.

64.8 mg = 1 gr

$$1 \text{ mg} = \frac{1}{64.8} \text{ gr}$$

$$550 \text{ mg} = \frac{1}{64.8} \times 550 = 8.48 \text{ gr.}$$

7. Convert $\frac{1}{100}$ gr into metric weights.

$$1 \text{ gr} = 64.8 \text{ mg}$$

$$\frac{1}{100} \text{ gr} = 64.8 \times \frac{1}{100} = 0.648 \text{ mg.}$$

8. Convert $\frac{1}{6}$ gr into mgs.

$$1 \text{ gr} = 64.8 \text{ mg}$$

$$\frac{1}{6} \text{ gr} = 64.8 \times \frac{1}{6} = 10.8 \text{ mg.}$$

9. Convert 30 m into ml.

$$16.23 \text{ m} = 1 \text{ ml}$$

$$1 \text{ m} = \frac{1}{16.23} \text{ ml}$$

$$30 \text{ m} = \frac{1}{16.23} \times 30 = 1.848 \text{ ml.}$$

10. Convert 2 pt into ml.

$$1 \text{ pt} = 20 \text{ fl. oz}$$

$$2 \text{ pt} = 20 \times 2 = 40 \text{ fl. oz}$$

$$1 \text{ fl. oz} = 29.57 \text{ ml}$$

$$40 \text{ fl. oz} = 29.57 \times 40 = 1182.8 \text{ ml}$$

$$\therefore \quad 2 \text{ pt} = 1182.8 \text{ ml.}$$

Calculations based on Imperial systems

For preparing 1% w/v solns any of the following formulas which are identical in strength can be used :

	I	II	III	IV
Solid	1 gr	4.375 gr	35 gr	1 oz (Avoir)
Solvent to produce	110 m	1 fl. oz	8 fl. oz	100 fl. oz

Formula I should be used when the volume of the solution required is small and the strength of such solution is weak. Formula II, III & IV may be used according to the quantities of the solutions to be prepared.

While using formula I it is important to note that it is not permitted to weigh less than 1 gr of solid on the dispensing balance because of its low sensitivity. Hence, the volume prepared may be much more than the required volume. The excess volume so prepared may be rejected or preserved for further prescriptions to be dispensed.

1. *Rx*

Atropine sulphate	½%
Aqua q.s.	3 ii

Calculations

1 gr of atropine sulphate dissolved in 110 m = 1% W/V soln

1 gr of atropine sulphate dissolved in 220 m = ½% W/V soln.

Dispense 120 m or 2 drachms out of the above soln and reject the remainder.

2. Prepare 1 oz of ⅛% solution of zinc sulphate in equal volumes of normal saline solution and adrenaline solution.

Calculations

Since two solvents, i.e., normal saline solution and adrenaline solution are used out of which adrenaline solution is costlier than normal saline solution therefore dissolve zinc sulphate at double strength in normal saline solutions.

1 gr of zinc sulphate dissolved in 110 m of normal saline solution = 1% W/V soln

1 gr of zinc sulphate dissolved in 440 m of normal saline solution = ¼% W/V soln

Take out 240 m of the above solution and mix it with 240 m of adrenaline solution. The resulting 480 m (1 oz) solution will be ⅛%.

3. Prepare 4 oz of 5% solution of a substance.

Calculations

35 gr dissolved in 8 fl. oz = 1% W/V soln

35×5 gr dissolved in 8 fl. oz = 5% W/V soln

$\frac{35 \times 5}{8}$ gr dissolved in one fl. oz = 5% W/V soln

$\frac{35 \times 5 \times 4}{8} = 87.5$ gr dissolved in 4 fl. oz = 5% W/V soln

Therefore, weigh 87.5 gr of the substance and dissolve in sufficient amount of water to produce 4 fl. oz. The resulting solution will be 5% solution.

4. Send 1 pint of a 1 in 500 solution of potassium permanganate.

Calculations

35 gr of potassium permanganate dissolved in 8 fl. oz = 1% W/V soln

$35 \times \frac{100}{500}$ gr of potassium permanganate dissolved in 8 fl. oz

$= \frac{1}{5}$ % W/V soln (1 in 500)

$\frac{35 \times 100}{500 \times 8}$ gr of potassium permanganate dissolved in one fl. oz

$= \frac{1}{5}$ % W/V soln

$\frac{35 \times 100 \times 20}{500 \times 8} = 17.5$ gr of potassium permanganate dissolved in 20 fl. oz

$= \frac{1}{5}$ % W/V soln

Therefore, weigh 17.5 gr of potassium permanganate and dissolve in sufficient amount of water to produce 1 pint. The resulting solution will be 1 in 500 solution.

5. How many tablets each containing 8.75 gr of mercuric chloride will be required to make one quart of 0.05% solution.

Calculations

35 gr dissolved in 8 fl. oz = 1% W/V soln

35×0.05 gr dissolved in 8 fl. oz = 0.05 % W/V soln

$\frac{35 \times 0.05}{8}$ gr dissolved in one fl. oz = 0.05% W/V soln

$\frac{35 \times 0.05}{8} \times 40 = \frac{35 \times 5 \times 40}{8 \times 100} = 8.75$ gr dissolved in 40 fl. oz

= 0.05% W/V soln

8.75 gr of mercuric chloride contained in 1 tablet

1 gr of mercuric chloride contained in $\frac{1}{8.75}$ tablet

8.75 gr of mercuric chloride will be contained in $\frac{1}{8.75} \times 8.75$

= 1 tablet.

Therefore, each tablet of 8.75 gr of mercuric chloride will make one quart of 0.05% solution.

Solutions dispensed in concentrated form

6. Required 6 oz of a solution so that 2 teaspoonfuls diluted to a pint will make a 1 in 1000 solution.

This problem will be solved in two parts.

(a) Calculate the no. of grains required to make one pint of a 1 in 1000 solution.

(b) Every two teaspoonfuls of the concentrated solution must contain these number of grains. Therefore multiply these number of grains with the number of two teaspoonfuls contained in 6 oz.

(a) 35 gr dissolved in 8 fl. oz = 1 in 100 soln

$\frac{35 \times 100}{1000}$ gr dissolved in 8 fl. oz = 1 in 1000 soln

$\frac{35 \times 100}{1000 \times 8}$ gr dissolved in one fl. oz = 1 in 1000 soln

$\frac{35 \times 100 \times 20}{1000 \times 8} = 8.75$ gr dissolved in 20 fl. oz = 1 in 1000 soln.

Therefore, 8.75 gr of the drug must be contained in every 2 teaspoonfuls of the solution.

(b) 6 oz = $6 \times 8 = 48$ teaspoonfuls

2 teaspoonfuls contain 8.75 gr

1 teaspoonful contains = $\frac{8.75}{2}$ gr

48 teaspoonfuls must contain $\frac{8.75}{2} \times 48 = 210$ gr.

Therefore, dissolve 210 gr of the drug in water and dilute to 6 fl oz.

Sometimes concentrated solutions may be prescribed and the pharmacist is asked to label with directions to prepare weaker percentage solutions.

7. Send 4 oz of a 10% solution of potassium permanganate and label with directions for preparing a quart of a 1 in 400 solution.

Calculations

These types of problems are also calculated in two parts.

(a) Calculate the number of grains required to make 4 oz of a 10% solution.

(b) Calculate the quantity to be diluted to a quart to make a 1 in 400 solution.

(a) 35 gr dissolved 8 fl. oz = 1% W/V soln

35×10 gr dissolved in 8 fl. oz = 10% W/V soln

$\frac{35 \times 10}{8}$ gr dissolved in one fl. oz = 10% W/V soln

$\frac{35 \times 10 \times 4}{8} = 175$ gr dissolved in 4 fl. oz = 10% W/V soln.

Therefore, dissolve 175 gr in water and dilute it to 4 fl. oz.

(b) A 10% solution means 1 in $\frac{100}{10}$ = 1 in 10 soln.

That is, 10 oz of the solution contains 1 oz of the substance

or, 10 oz of this solution diluted to 400 oz will produce 1 in 400 solution

or, $\frac{10 \times 40}{400} = 1$ oz diluted to one quart will produce 1 in 400 solution.

Therefore, label with direction to dilute 1 oz or 2 tablespoonfuls to a quart.

Exercises (A)

Calculate the quantities required to prepare the following :

1. Atropine sulphate 1%. Send 4 drachms.
2. Acriflavine 0.1% in a mixture of equal volume of alcohol and water. Send 2 oz.
3. 8 oz of a 1 in 2000 solution.
4. 1 gallon of a 1 in 1000 solution.
5. 1 pint of a 0.01% solution.
6. 4 oz of a 0.625% solution.
7. 1 quart of a normal saline solution.
8. How many tablets each containing 8.75 gr of corrosive sublimate will be required to make 1 pint of a 0.4% solution.
9. 8 oz of a solution so that 1 tablespoonful to half a gallon makes 1 in 500 solution.
10. 8 oz so that 1 tablespoonful to half a gallon will make a 1 in 2000 solution.
11. 10 oz of a 2.5% solution and label with the directions for preparing a quart of 0.0625% solution.
12. 10 oz of 6% solution and label with the directions for preparing 30 oz of a 0.05% solution.
13. From 20% solution supplied prepare a quart of a 0.0625% solution.
14. From 8% solution supplied prepare 1 pint of a 1 in 1000 solution.

Calculations based on metric system

1. Calculate the formula for 40 gm coal tar and zinc ointment from the official formula given below :

Yellow soft paraffin	600 gm
Zinc oxide, finely sifted	300 gm
Strong coal tar solution	100 gm

Quantities required for 40 gm = $\frac{40}{1000} \times$ official quantities.

2. Calculate the formula for 250 ml of oily lotion of calamine from the formula given below :

Calamine	50 gm
Wool fat	10 gm
Oleic acid	5 ml
Arachis oil	500 ml

Calcium hydroxide solution sufficient to produce 1000 ml

Quantities required for 250 ml = $\frac{250}{1000}$ × quantities given.

3. *Rx*

Hyoscine hydrobromide	0.6 mg

Make powders. Send such 10 powders.

Calculations

To get the required quantities for 10 powders, multiply the given quantity by 10.

4. *Rx*

Heavy magnesium carbonate	8.125 gm
Light magnesium carbonate	8.125 gm
Rhubarb, in powder	6.25 gm
Ginger, in powder	2.5 gm

Make powder. Send 100 gm.

Calculations

To get the required quantities for 100 gm, multiply the given quantities by 4.

Percentage Calculations

(i) *Weight in Volume (W/V) Solutions*

In this the solute is weighed and the solvent is measured. The general formula for 1% W/V solution is :

Solid	1 part by weight
Solvent to produce	100 parts by volume.

1 gm solute dissolved in sufficient amount of water to produce 100 ml or 10 mg in 1 ml of water makes 1% W/V solution.

Unless and until specially specified the solutions in pharmacy are supplied as W/V solutions.

(ii) *Weight in Weight (W/W) Solutions*

In this the solute and the solvent are taken by weight. The general formula for 1% W/W solution is :

Solid	1 part by weight
Solvent to produce	100 parts by weight.

Percentage solutions of solids in liquids are not made W/W unless specially requested.

(iii) *Volume by Volume (V/V) Solutions*

In this solute and the solvent are taken by volume. The general formula for 1% V/V solution is :

Solute	1 part by volume
Solvent to produce	100 parts by volume.

1 ml solute dissolved in sufficient amount of solvent to produce 100 ml.

5. Calculate the quantity of sodium chloride required to prepare 500 ml of a 2% solution.

   Calculations

   1 gm of sodium chloride dissolved in water to produce 100 ml
   = 1% W/V soln.

   1×2 gm of sodium chloride dissolved in water to produce 100 ml
   = 2% W/V soln.

   For 500 ml the quantity of sodium chloride required

   $$= \frac{1 \times 2 \times 500}{100} = 10 \text{ gm.}$$

   Therefore, dissolve 10 gm of sodium chloride in sufficient amount of water to produce 500 ml. The resulting solution will be 2% solution.

6. Calculate the quantity of sodium chloride required for preparing 200 ml of a 0.9% solution.

   Calculations

   1 gm of sodium chloride dissolved in water to produce 100 ml
   = 1% W/V soln.

   1×0.9 gm of sodium chloride dissolved in water to produce 100 ml
   = 0.9% W/V soln.

   For 200 ml the quantity of sodium chloride required

   $$= \frac{1 \times 0.9 \times 200}{100} = 1.8 \text{ gm.}$$

   Therefore, dissolve 1.8 gm of sodium chloride in sufficient amount of water to produce 200 ml. The resulting solution will be 0.9% solution.

7. Prepare 30 ml of 10% solution of methyl salicylate in alcohol.

   Calculations

   For 100 ml solution the quantity of methyl salicylate required
   = 10 ml

For 30 ml solution the quantity of methyl salicylate required

$$= \frac{10 \times 30}{100} = 3 \text{ ml.}$$

Therefore, mix 3 ml of methyl salicylate with sufficient alcohol to produce 30 ml. The resulting solution will be 10% solution.

8. Prepare 50 ml of 0.1% solution of acriflavine in a mixture of equal volume of alcohol and water.

Calculations

Alcohol is relatively expensive but water is inexpensive, therefore, prepare the acriflavine solution at double strength in water and then add alcohol.

Double the strength of 0.1% = 0.2%

1 gm of acriflavine dissolved in 100 ml of water = 1% W/V soln.

1×0.2 gm of acriflavine dissolved in 100 ml of water

= 0.2% W/V soln.

For 50 ml solution the quantity of acriflavine required

$$= \frac{1 \times 0.2 \times 50}{100} = 0.1 \text{ gm} = 100 \text{ mg.}$$

Therefore, dissolve 100 mg of acriflavine in 50 ml water. Out of this, measure 25 ml and mix it with 25 ml alcohol. The resulting solution will be 0.1% solution of acriflavine in a mixture of equal volume of alcohol and water.

9. Prepare 100 ml of a 1 in 4000 solution of potassium permanganate.

Calculations

$$1 \text{ in } 4000 = \frac{100}{4000} \text{ per cent} = 0.025\%$$

1 gm of potassium permanganate dissolved in 100 ml water

= 1% W/V soln.

1×0.025 gm of potassium permanganate dissolved in 100 ml water

= 0.025% W/V soln.

For 100 ml solution the quantity of potassium permanganate required

$$= \frac{1 \times 0.025 \times 100}{100} = 0.025 \text{ gm} = 25 \text{ mg.}$$

Therefore, dissolve 25 mg of potassium permanganate in sufficient water to produce 100 ml. The resulting solution will be 1 in 4000 solution.

10. Send 150 ml of 4% potassium permanganate solution and label with directions for preparing 500 ml of a 1 in 2500 solution.

Calculations

(a) 1 gm of potassium permanganate dissolved in 100 ml water
= 1% W/V soln.

1×4 gm of potassium permanganate dissolved in 100 ml water
= 4% W/V soln.

For 150 ml the quantity of potassium permanganate required

$$= \frac{1 \times 4 \times 150}{100} = 6 \text{ gm.}$$

Therefore, dissolve 6 gm of potassium permanganate in sufficient water to produce 150 ml solution.

(b) Strength of concentrated solution = 4%

Strength of dilute solution = 1 in 2500 $= \frac{100}{2500} = \frac{1}{25} = 0.04\%$

Degree of dilution $= \frac{4}{0.04} = 100$ times.

Quantity of concentrated solution required $= \frac{500}{100} = 5$ ml.

Therefore, dilute 5 ml of concentrated potassium permanganate soln upto 500 ml with water. The resulting solution will be 1 in 2500 solution.

11. From 1 in 400 solution of acriflavine, prepare 100 ml of 1 in 5000 solution.

Calculations

Strength of concentrated acriflavine soln provided

$$= 1 \text{ in } 400 = \frac{100}{400} = \frac{1}{4} = 0.25\%$$

Strength of dilute solution = 1 in 5000 $= \frac{100}{5000} = \frac{1}{50} = 0.02\%$

Degree of dilution $= \frac{0.25}{0.02} = \frac{25}{2}$ times.

Quantity of concentrated solution required $= \frac{100 \times 2}{25} = 8$ ml.

Therefore, dilute 8 ml of concentrated solution of acriflavine upto 100 ml with water. The resulting solution will be 1 in 5000 solution.

Alcohol Dilutions

Dilute alcohols are made from 95% alcohol which contains 95 parts ethyl alcohol and 5 parts water. All other dilutions of alcohol are prepared by mixing the specified parts of alcohol and water.

On mixing alcohol with water, contraction in volume and rise in temperature occurs and mixture becomes turbid. The turbidity is caused

by minute air bubbles evolved from the alcohol on dilution. Because air is less soluble in water than in alcohol, so on addition of water air is partly expelled from the solution. Since there will be contraction in volume and rise in temperature, consequently it is necessary to cool the mixture to about 20°C before adjusting to the final volume.

The general formula for calculating the amount of stronger alcohol required to make a weaker alcohol is as under :

Volume of stronger alcohol to be used

$$= \frac{\text{volume required} \times \text{percentage required}}{\text{percentage used}}$$

12. Prepare 600 ml of 60% alcohol from 95% alcohol.

Calculations

Volume of 95% alcohol to be used = $\frac{600 \times 60}{95}$ = 379 ml.

Therefore, take 379 ml of 95% alcohol, dilute it upto 600 ml with water. The resulting dilution will contain 60% alcohol.

13. Prepare 500 ml of 40% alcohol from 95% alcohol.

Calculations

Volume of 95% alcohol to be used = $\frac{500 \times 40}{95}$ = 210 ml.

Therefore, dilute 210 ml of 95% alcohol upto 500 ml with water. The resulting dilution will contain 40% alcohol.

Weight in Weight (W/W) Solutions

The general formula is as under :

Weight of stronger acid to be used

$$= \frac{\text{weight required} \times \text{percentage required}}{\text{percentage used}}$$

14. Send 200 ml of a solution of acetic acid containing 4% of real acetic acid. The strength of real acetic acid is 33%.

Calculations

Weight of stronger acid to be used = $\frac{200 \times 4}{33}$ = 24.2 gm.

Therefore, weigh 24.2 gm of real acetic acid and dilute it upto 200 ml with water. The resulting solution will contain 4% acetic acid.

15. Send 200 ml of a solution of ammonia containing 4% by weight of ammonia. The strong solution of ammonia contains 32.5% of ammonia W/W.

Calculations

The weight of strong ammonia required = $\frac{200 \times 4}{32.5}$ = 24.615 gm.

Therefore, dilute 24.615 gm of strong solution of ammonia to 200 gm with water. The resulting solution will contain 4% ammonia.

Alligation Method

The calculations for exercises from 12 to 15 may be done by a method known as alligation method. This method is not recommended except as a method of checking because there are chances of errors in writing the figures.

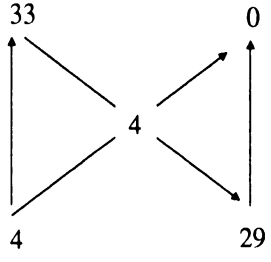
16. Prepare 1000 gm of dilute acetic acid 4% from 33% real acetic acid.

Calculations

The weight of real acetic acid required = $\frac{1000 \times 4}{33}$ = 121.2 gm

The amount of water required = 1000 – 121.2 = 878.8 gm.

By alligation method



Subtract 0 (for water) from 4 = 4

Subtract 4 from 33 = 29

4 parts of real acetic acid and 29 parts of water will constitute 33 parts by weight of dilute acetic acid.

Therefore, the quantity of real acetic acid required

$$= \frac{1000 \times 4}{33} = 121.2 \text{ gm}$$

and the quantity of water required = $\frac{1000 \times 29}{33}$ = 878.8 gm.

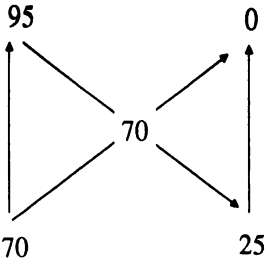
17. Prepare 400 ml of 70% alcohol from 95% alcohol.

Calculations

Volume of 95% alcohol to be used = $\frac{400 \times 70}{95}$ = 294.74 ml

Volume of water to be used = 400 – 294.74 = 105.26 ml.

By alligation method



Subtract 0 (for water) from 70 = 70
Subtract 70 from 95 = 25
70 parts of 95% alcohol and 25 parts of water will constitute the required % alcohol.

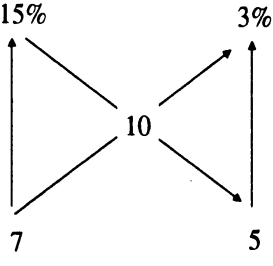
$\therefore$ quantity of 95% alcohol required = $\frac{400 \times 70}{95}$ = 294.74 ml

and the quantity of water required = $\frac{400 \times 25}{95}$ = 105.26 ml.

18. Find out the quantity of 3% ointment which must be added to 100 gm of a 15% ointment to get 10% ointment.

Calculations

By applying alligation rule



i.e., 7 parts of 15% ointment and 5 parts of 3% ointment must be mixed to get 10% ointment. The given strength of 100 gm ointment is 15%. So find out the relative proportion of 3% ointment required.

7 parts of 15% ointment require 5 parts of 3% ointment

1 part of 15% ointment requires $\frac{5}{7}$ parts of 3% ointment

100 parts of 15% ointment require $\frac{5}{7} \times 100$ parts of 3% ointment

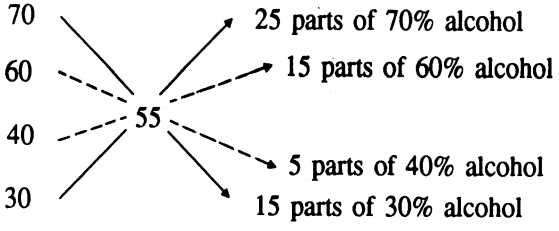
$= \frac{500}{7}$ = 71.43 gm of 3% ointment.

Therefore, 71.43 gm of 3% ointment should be mixed with 100 gm of 15% ointment to get 10% ointment.

19. Find out that how many parts of 70%, 60%, 40% and 30% alcohol should be mixed to get 55% alcohol.

Calculations

By applying alligation rule



Therefore, when 25 parts of 70% alcohol, 15 parts of 60% alcohol, 5 parts of 40% alcohol and 15 parts of 30% alcohol are mixed together, the resulting solution will produce 55% alcohol.

Check :

$(25 \times 70) + (15 \times 60) + (5 \times 40) + (15 \times 30)$

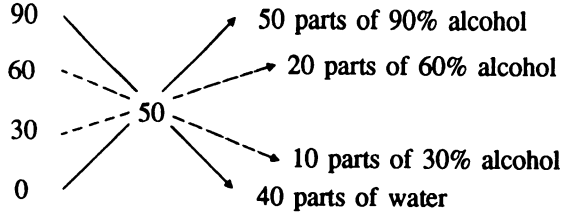
$= 1750 + 900 + 200 + 450 = 3300$

$(25 + 15 + 5 + 15)\ 55 = 60 \times 55 = 3300.$

20. Find out the amount of each of 90%, 60%, 30% and water required to produce 500 ml of 50% alcohol.

Calculations

By applying alligation rule



Therefore, when 50 parts of 90% alcohol, 20 parts of 60% alcohol, 10 parts of 30% alcohol and 40 parts of water are mixed together, the resulting solution will produce 50% alcohol.

Check :

$(50 \times 90) + (20 \times 60) + (10 \times 30) + (40 \times 0)$

$= 4500 + 1200 + 300 + 0 = 6000$

$(50 + 20 + 10 + 40)\ 50 = 120 \times 50 = 6000.$

Exercises (B)

1. Prepare 500 ml of 1 in 5000 solution of potassium permanganate.
2. Send 100 ml of 2% acriflavine solution.
3. Supply 500 ml of normal saline solution.
4. Prepare 300 ml of 45% alcohol from 90% alcohol.
5. Prepare 400 ml of 55% alcohol from 95% alcohol.
6. Send 200 ml of 60% alcohol from 95% alcohol.
7. Supply 500 ml of 20% alcohol from 95% alcohol.
8. From 90% alcohol provided supply 400 ml of 60% alcohol.
9. From 60% alcohol supplied prepare 2 litres of 45% alcohol.
10. Supply 250 ml of solution containing 15% of real acetic acid. The strength of official acetic acid is 33.
11. Prepare 120 ml of solution containing 20% of real acetic acid. The real acetic acid is 33% W/W.
12. Prepare 1000 gm of 6% acetic acid from 33% acetic acid.

Isotonic Solutions

All the ophthalmic and injectable solutions should be isotonic, e.g., ophthalmic solutions should be isotonic with lachrymal secretions (tears) to prevent irritation and pain, similarly, injectable solutions should be isotonic with blood plasma. Solutions having the same osmotic pressure are said to be isotonic. As compared to blood plasma if a solution has lower osmotic pressure it is said to be hypotonic but if it has higher osmotic pressure it is said to be hypertonic.

The solutions which are not isotonic with plasma may be harmful to use. On injecting the hypotonic solutions into blood stream, it may enter the red blood cells in an attempt to produce equilibrium, the cells swell rapidly until they burst leading to haemolysis. As this damage is irreversible, it may lead to serious danger to red blood cells.

When hypertonic solution is injected into the blood stream, the water comes out of the membrane of red blood cells in order to reach equilibrium. The cells shrink leading to crenulation which is only a temporary damage. When the osmotic pressure of two solutions becomes equal, the damaged cells will come to their original position. Hence hypertonic solutions may therefore be administered without permanent damage to the blood cells. They should be injected slowly to ensure rapid dilution into the blood stream and to minimise the crenulation of blood cells.

For the adjustment of tonicity of injectable solutions, substances like sodium chloride and dextrose, etc., are added. About 0.9% solution of sodium chloride is isotonic, 0.45% solution is hypotonic and 5% solution of sodium chloride is hypertonic with plasma.

Proof Spirit

For excise purposes, the strengths of alcoholic preparations are indicated by degrees "over proof" (O.P.) or "under proof" (U.P.). Proof spirit is legally defined as that mixture of alcohol and water which at 51°F weighs 12/13th of an equal volume of water. In India and Britain, this standard is equal to 57.1% V/V or 49.28% W/W of ethyl alcohol. Such a spirit has a sp. gr. of 0.91976 at 15.5°C. Whereas in USA 50% V/V of ethyl alcohol is considered to be 100 proof.

Any alcoholic solution which contains 57.1% V/V alcohol is a proof spirit and is said to be 100 proof. Any strength above proof strength is expressed as over proof (O.P.) and any strength below proof strength is expressed as under proof (U.P.). In India the rates of excise duty are charged in terms of rupees per litre of proof alcohol.

Any % V/V of alcohol can be converted into proof strength and vice versa by using the following method :

Multiply the % strength of alcohol by 1.753 and deduct 100 from the product. If the result is positive it is known as over proof and if the result is negative then it is known as under proof.

The figure 1.753 is obtained as follows :

57.1 volumes of ethyl alcohol = 100 volume of proof spirit

$$1 \text{ volume of ethyl alcohol} = \frac{100}{57.1} = 1.753 \text{ volumes of proof spirit}$$

Example 1. Find the strength of 90% V/V alcohol in terms of proof spirit.

Applying the formula

$$90 \text{ volumes of ethyl alcohol} = 90 \times 1.753 - 100 = 157.77 - 100$$
$$= +57.77 \text{ or } 57.77° \text{ O.P.}$$

Example 2. Calculate the real strength of 40° O.P. and 50° U.P.

Applying the formula

40 over proof means $100 + 40 = 140$

$$\text{Alcohol strength} = \frac{140}{1.753} = 79.86\% \text{ V/V}$$

50 under proof means $100 - 50 = 50$

$$\text{Alcohol strength} = \frac{50}{1.753} = 28.52\% \text{ V/V}$$

Check if strength is 79.86% V/V and 28.52% V/V value of proof will be

(i) $79.86 \times 1.753 - 100 = 139.99 - 100 = +39.99$ or 40° O.P.

(ii) $28.52 \times 1.753 - 100 = 49.99 - 100 = -50.01$ or 50° U.P

Example 3. A sample of brandy is 30 under proof. Calculate its alcoholic strength V/V.

30 under proof means $30 - 100 = 70$

Alcoholic strength $= \frac{70}{1.753} = 39.93$ or 40% V/V.

Example 4. How many proof gallons are contained in 4 gallons of 70% V/V alcohol.

Applying the formula

Value of proof = % strength of alcohol × 1.753 – 100

$= 70 \times 1.753 - 100 = 122.71 - 100$

$= +22.71$ or 22.71° O.P.

That means

100 gallons of 70% V/V alcohol = 100 + 22.71

= 122.71 gallons of proof spirit

1 gallon of 70% V/V alcohol $= \frac{122.71}{100}$ gallons of proof spirit

4 gallons of 70% V/V alcohol $= \frac{122.71}{100} \times 4$ gallons of proof spirit

= 4.90 gallons of proof spirit

Therefore, 4 gallons of 70% V/V alcohol are equivalent to 4.90 gallons of proof spirit.

Exercises (C)

1. Convert the following strength of alcohol into proof spirit :
   (i) 70.74% V/V (ii) 50.16% V/V
   (iii) 25.78% V/V (iv) 79.87% V/V
   (v) 47.31% V/V
2. Convert the following degree of proof spirit into % V/V strength of alcohol :
   (i) 44.6° O.P. (ii) 18.4° O.P.
   (iii) 35.3° O.P. (iv) 75.0° U.P.
   (v) 54.8° U.P.
3. How many proof gallons are represented by 50 wine gallons of 90% V/V alcohol.

Answers

(A)

1. 3 gr of atropine sulphate to be dissolved in sufficient water to produce 330 m.
2. Take 1 gr acriflavine and dissolve it in sufficient water to produce

550 m. Out of this measure out 480 m and mix it with 480 m alcohol. Produce the final volume to 2 oz because there will be little contraction in volume which occurs when alcohol is diluted with water.

3. 1.750.
4. 70.0 gr.
5. 0.875 gr.
6. 10.9375 gr.
7. 157.5 gr.
8. 4 tablets.
9. 70 gr, 1120 gr.
10. 17.5 gr, 280 gr.
11. 109.375 gr, two tablespoonful to be diluted to a quart.
12. 262.5 gr, two teaspoonful to be diluted to 30 oz.
13. ⅛ oz or 60 minims. 14. ¼ oz or 120 minims.

(B)

1. Dissolve 100 mg potassium permanganate in sufficient water to produce 500 ml solution.
2. Dissolve 2 gm acriflavine in sufficient water to produce 100 ml solution.
3. Dissolve 4.5 gm sodium chloride in sufficient water to produce 500 ml solution.
4. 150 ml.
5. 231.578 ml.
6. 126.315 ml.
7. 105.263 ml.
8. 266.666 ml.
9. 1.5 lit.
10. 113.636 gm.
11. 72.72 gm.
12. 181.818 gm.

(C)

1. (i) 24° O.P. (ii) 12.07° U.P. (iii) 54.81° U.P. (iv) 40° O.P. (v) 17.07° U.P.
2. (i) 82.48% V/V (ii) 67.54% V/V (iii) 77.18% V/V (iv) 14.26% V/V (v) 25.78% V/V.
3. 78.88 proof gallons.

Revision Questions

I. Very short answer type questions

Answer the following questions in brief

(i) What is prescription?
(ii) Name various parts of a prescription?
(iii) Why Latin language is used in prescription writing?
(iv) What is the importance of writing the word RJ in prescription writing?

II. Fill in the blanks

(a) Prescription is a ..... order by the prescriber to the .....
(b) The Latin word used for writing the directions to the patient is .....
(c) The signature of the prescriber must be written .....
(d) While collecting and weighing the materials for compounding a prescription the label on every stock bottle must be read at least ..... times.
(e) The prescription must be received and checked by the .....

III. Short answer type questions

1. What is the importance of date in prescription writing?
2. Discuss the importance of name, age and address of the patient in the prescription.
3. Describe in brief the importance of age in the prescription.
4. Give an example of a representative prescription.

IV. Long answer type questions

1. What is 'prescription'? Describe various parts of a prescription.
2. Define the term 'prescription'. Describe different parts and significance of each part of an ethical prescription.
3. Explain the term 'prescription'. Describe the procedure that low a prescription is to be handled by a pharmacist.
4. What is the importance of label to be fixed on a pharmaceutical formulation? Discuss what information is required to be written on label.
5. Translate the following Latin terms into English :
   (i) Ad libitum.
   (ii) Agita
   (iii) Alternis horis
   (iv) a.c.
   (v) Applicandus
   (vi) b.i.d.
   (vii) Cataplasma
   (viii) Cum parte aequale
   (ix) Coch-parvum
   (x) Congius
   (xi) Dol. urg.
   (xii) E. lacte
   (xiii) Ex. Modo prescripto
   (xiv) Guttae
   (xv) Hora somni
   (xvi) Inter cibos

(xvii) Levis
(xviii) m
(xix) Modo dicto
(xx) Nocte maneque
(xxi) o.d.
(xxii) Omni quardanta hora
(xxiii) Nebula
(xxiv) Omni mane
(xxv) p.a.a.
(xxvi) p.p.a.
(xxvii) Post cibos
(xxviii) Pro dosi
(xxix) Pro-re neta
(xxx) q.s.
(xxxi) Secudum artum
(xxxii) Si opus sit (s.o.s.)
(xxxiii) Solve
(xxxiv) Statim
(xxxv) Tales
(xxxvi) Ter quotidie
(xxxvii) Tussi urgente
(xxxviii) Quinque
(xxxix) Decem
(xxxx) Duodecim.

Answers

5. (a) Written, Pharmacist; (b) Sig; (c) By his own hand with ink; (d) Three; (e) Pharmacist