R. K. GROUP OF COLLEGE

BEHIND KALWAR POLICE STATION, KALWAR, JAIPUR (RAJ.)

ZOOLOGY

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ENVIRONMENTAL BIOLOGY.

ANALYSIS OF WATER pH

OBJECT:-

To determine the PH of given water sample

APPARATUS AND GLASSWARE:-

PH meter, water sample pH paper strips, dropper, test tabe, graduated pipettes (1, 5 and 10 ML), reagent battles, test tube stand beakers ek.

PRINCIPIE:-

The term acid/base balance has long been used in relation to the constancy of the hydrogen ion concentration in the body fuids. A pH Lower than 1 indicates thad hydrogen ion concentration is greater than that of water and the solution is an acid. A pH higher than 1 indical a base. The usual range of pH scales is 0 to 14. Three methads can be employed to determine the pH.

pH PAPER STRIP METHOD:-

PROCEDURE :

find out the pH with the help of the colour chart prinkd on the pH paper ship pocket.

B. UNIVERSAL INDICATOR METHOD:-

PROEEOURE :-

1. Taks 10 ml of given water sample in a clean and dried test tube.
2. Add 0.2 ml universal indicator solution and mix.
3. Match the colour of the solution of the test tube with that of the chart printed on the label of the bottle or fellow the instruction of the bottle.

RESOLT:- The matched colour will be the pH of the giver water sampis.

C. pH DETERMINATION BY PH METER:-

PROCEDURE :- This method electronic methods gives as allurate determination of the pH of any solution, several makes of pH meters are available in the market. The instrument wnsists of two electrode. Glass electrods and other calon electrode. glass electrods are nat should be rapeatelly standeridised with solution of know pH are commercially available, for operation the pH meter, see the manual supplied. the Instrument.

RESULT :-

The reading in the pH meter will be the pH of given water sample.

PRECAUTIONS :-

1. Apparatus & Glasswares should be clean and dry.
2. Addition of excess of indicator should be avoided.
3. Reading should be taken carefully.
4. Reagents must be taken clearately.

ALKALINITY OF WATER.

OBJECT :-

To estimate the alkalinity in given water sample. Total alkalinity of water is the capability of neutralising or making ineffective completely the strange acids. Hydroxides (OH^-), carbantes (CO_3^{--}) and bicarbonates (HCO_3^-) contribute to a liquid CO_3^- and HCO_3^- produces alkalinity by combining with water in the following manner.

$$CaCO_3 + H_2O + CO_2 = Ca(HCO)_2 = Ca^{++} + 2HCO_3$$

$$HCO_3^- + HOH \longrightarrow H_2CO_3 + OH^-$$

$$CO_3^{--} + 2H_2O \longrightarrow H_2CO_3 + 2OH^-$$

$$HCO_3^- + H_2O \longrightarrow H_2CO_3 + 3OH^-$$

Alkalinity value provide guidance in applying proper doses of chemicals in water and waste water treatment process, particularly in coagulation, softening and operational control of anaerdic digestion.

APPARATUS AND GLASSWARE :-

Burette, burtle stand measuring cylinder (100ml), beaker, thikation flask, flask dropper, pipette, water sample, reagent bottles etc.

PRINCIPLE :-

Alkalinity can be obtained by neutralizing OH^- CO_3^{--} and HCO_3^- with standard H_2SO_4 Titration to PH 8.3 or de-colowization of phenolpthalein indicator will show complete neutralization of OH^- and 1/2 of CO_3^{--}, while to pH 4.4 or sharp change from yellow to pink of methyl orange indicater will indicate total alkalinity, i,e, OH^-, CO_3^{--} and HCO_3^{--}

INTERFERENCE :-

As indicated in acidity estimation, Borate, siticates and phasphates also produces alkalinity.

REAGENTS :-

1. Standard 0.02N H_2SO_4 :- Prepare 0.1N H_2SO_4 by diluting 3.0 ml conc, H_2SO_4 to 1000 ml. standardize it against standerd Na_2CO_3 (0.1N) Dilute appropriate volume of H_2SO_4 to 100 ml to obtain standerd 0.02 N H_2SO_4

Phenolpthalein indicator :- Dissolve 1g in 500 ml 95% ethyl alcohol. Add 500 ml distilled water. Add dropwise 0.02N NaOH till faint pink colow appears.

Methyl orange Indicator :- Dissolve 0.5g and dil. to 1000 ml with CO_2 free distilled water.

Calculation :-

1. Calculate Total (T) phenolphthalein (P) and Methyl orange (M) alkalinity as follows and express result as mg/l as $CaCO_3$:

Alkalinity, mg/l as $CaCO_3$ = A × 1000/ml sample.

No alkalinity, mg/l as $CaCO_3$ = B × 1000/ml sample.

T alkalinity, mg/l as $CaCO_3$ = (A+B) × 1000/ml sample.

In case of H_2SO_4 is used 0.02N apply the following

Alkalinity mg/l as $CaCO_3$ = $\frac{A \times N \times 50000}{ml\ sample}$

Where N = Normality of H_2SO_4 used

Calculate OH^-, CO_3^{--} and HCO_3^- forms from the of P and T alkalinity as shown below :-

Values of P & T	OH-Alkalinity as $Ca(OH)_2$	CO_3^{--} Alkalinity as $CaCO_3$	HCO_3 Alkalinity as $Ca(HCO_3)_2$
P = 0	0	0	T
$P < \frac{1}{2}T$	0	2P	T-2P
$P = \frac{1}{2}T$	0	2P	0
$P > \frac{1}{2}T$	2P-T	2(T-P)	0
P = T	T	0	0

Here P Means : phenolphtalein Alkalinity
and T denotes : Total Alkalinity.

PROCEDURE :-

1. Take 25 or 50 ml sample in a conical flask and add 2-3 drops of phenolphthalein indicator.

2. If pink colour develops titrate with 0.02N H_2SO_4 till it disappears or pH is 8.3 Note the volume of H_2SO_4 required.

3. Add 2-3 drops methyl orange to the same flask and continue titration till pH comes down to 4.5-4 or orange colour changes to pink. Note the volume of H_2SO_4 added.

4. In case pink colour does not appear after addition of phenolphthalein continue ... procedure point abe

OBSERVATION :-

prepare the observation table as mentioned below

S.No	Water taken (ml)	Burette reading (ml)				
		with phenolphthalein			with phenolphalein	
		Initial	Final	Total (A)	Final	Total (A)

DATE .....

After estimation with phenolphtalein indicator in the sample of the same solution, methyl orange, is added and still the colour remains orange, it indicates phenolphthalein alkalinity is the total alkalinity. It does not mean the Total Alkalinity is Zero (0).

RESULT:

The alkalinity of given water Sample = ____ mgll

Alkalinity of water: ____

PRECAUTIONS:

1. Before titration, the glasswares should be cleaned and rinsed.
2. Addition of excess of indicators must be avoided.
3. Reagents must be taken accurately.
4. Reading Should be taken carefully.
5. Hydrochloric acid (HCl) 0.1N Should be prepared fresh.

DATE .....

ACIDITY Of WATER.

OBJECT:

To estimate the acidity of given Water Sample. Acidity of a liquid is its Capacity to donate H^+ ions. Since, most of the natural Waters and Sewages are buffered by Carbon dioxide - bicarbonate System, the acidity present due to free Co_2 has no Significance from public health point of view. Waters Containing mineral acidity (due to H_2SO_4 and HCl) are unacceptable. Further, acid Water post problem of Corrosion and interfere in Water Softening and Water treatment processes.

PRINCIPLE:

The mineral acids present and Contributing mineral acidity Can be Calculated by titrating or neutralizing Samples to 4.3. ptl. The Co_2 and bicarbonates (carbonic acid) present in the Sample can be neutralized Completly by Continuing the the titration to ptl 8.3.

Faculty Signature .....

interference. Colour and turbidity can be avoided. using potentiometric titrations. Residual Chlorine can be removed by adding thiosulphate.

APPARATUS AND GLASSWARE:

Burette, Burette stand, dropper, measuring cylinder, beaker, titration flask, pipette, water sample, reagents bottles etc.

Reagents:-

1. Standard sodium hydroxide 0.02N: Dissolve 0.8g NaOH and dilute to 1000 ml using CO_2 free distilled water. Store in air-tight, rubber stoppered pyrex/ corning glass bottle to protect from atmospheric CO_2, standardize against 0.02N potassium biphtalate.

2. Phenolphthalein Indicater :- Dissolve 5g in 500 ml 95% ethyl alcohol. Add 500 ml distilled water. Add dropwise 0.02 NaOH till faint pink. Colow appears.

3 Methyl Orange Indicater :- Dissolve 0.5g dilute to 1000 ml CO_2 free distilled water.

Calculation:

(i) Each ml of 0.02 NaOH is = 1mg $CaCO_3$

Therefose, acidity of mineral or due to CO_2 as mg/l CO_2 the used volume (ml) of 0.02 NaOH x 1000 ml sample.

In case of ~~N~~ normality of NaOH is other than 0.02, Cal Cu

(ii) Acidity of mineral or due to CO_2 as mg/l $CaCO_3$:

$$\frac{A \text{ or } B \times N \times 50000}{\text{ml sample}}$$

where:-

A = ml NaOH used for sample to raise pH up to 4.4-

B = ml NaOH used for sample to raise ph for 4.4 - 8.3

N = Normality of NaOH used.

Procedure:-

1. Measure suitable volume of sample (50 or 100 ml) in 250 ml. conical flasle or beaken depending upon the method to be followed.
2. Add 2 drops of methyl orange and titrate with standard 0.02N NaOH till colour changes to faint orange characteristic of ph 4.4 - 4.3.
3. Note down the volume of NaOH used.
4. Add 2-3 drops phenolpthalein indicator and continus titration with NaOH tils faint pink colour appears. indicating pH 8.3.
5. Note down the volume of additional NaOH used.

Observattion:-

Prepare the obsevation table as mentioned below.

S.NO.	Water sample taken (ml)	Burette reading (ml)					
		with methyl orange			with phenolphthalein		
		Initial	Final	Total (A)	Initial	final	Totall (B)

RESULT:-

The acidity of given water sample = _____ mg/l

Acidity of water: _____

Precautions:

1. Glassware should be clean and dry.
2. Reagents must be taken accurately.
3. Avoid any kind of bubbing in the contgents
4. At least 3 readings should be taken to reduce errors.
5. Sodium hydroxide (NaOH) 0.02N should be prepared fresh.

Free CARBON DIOXIDE (CO_2)

OBJECT:-

To estimate free carbon dioxide in a given water sample:

PRINCIPLE:

Free CO_2 can be determined by titrating the sample using a strong alkali (e.g. carbonate free NaOH) to pH 8.3 At this pH, the entire free CO_2 is converted into bicarbonates.

APPARATUS AND GLASSWARE:

Burette, Burette stand, measuring Cylinder (100ml), beaker, titration flask, pipette, dropper, water sample bottles etc.

Reagents:

1. NaOH, 0.05 N: Prepare 1.0 N NaOH by dissolving 40 g of NaOH in CO_2 free distilled water to make 1 litre of solution. Dilute 50 ml of 1.0 N NaOH to 1 litre standardise it with H_2SO_4, HCl or Oxalic acid.

2. Phenolphalein Indicator:- Dissolve 0.5 g of Phenolphtha in 50 ml of 95% ethanol.

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CalcuLATION:-

$$\text{free } CO_2 \text{ ; mg/l} = \frac{Cm\,l \times N) \text{ of NaOH} \times 1000 \times 44}{\text{ml sample}}$$

1mole of CO_2 = 1mole of NaOH

44 gm of CO_2 = 40 gm of NaOH

AS - 1000cc (N) NaOH = 44 gm of solid NaOH

1000cc (N) NaOH = 44gm of CO_2

1000cc $\frac{(N)}{4}$ NaOH = $\frac{44}{44}$ gm of CO_2 = 1gm of CO_2

= 1000 mg of CO_2

1ml $\frac{(N)}{44}$ NaOH = 1mg of CO_2

0.6 ml $\frac{(N)}{44}$ NaOH = 0.6 mg of CO_2

1 :: 50 ml of sample water contains 0.6 mg of CO_2

1000 ml of sample water contains $\frac{0.6 \times 100}{50}$ mg

= 12 mg of CO_2

and add 50 ml of distilled water. Add 0.05 N Co_3 free aOH Solution dropwise until the Solution turns faintly pink.

PROCEDURE :-

1. Take 100 ml of Sample in a Conical flask and add a few drops of Phenolphthalein indicator. If the Colour turns Pink, free w_2 is abbsent. If the Sample remains Colourless, titrate it against 0.05 N NaOH. At the end paint a pink Colour appears.

OBSERVATION :-

Prepare the observation table as meiationed below:

S. No	Water Sample taken ml)	Burette Reading ml		Total	Mean (ml)
		Initial	final		
1.	50	0	0.6	0.6	
2.	50	1	1.6	0.6	0.6
3.	50	2	2.6	0.6	

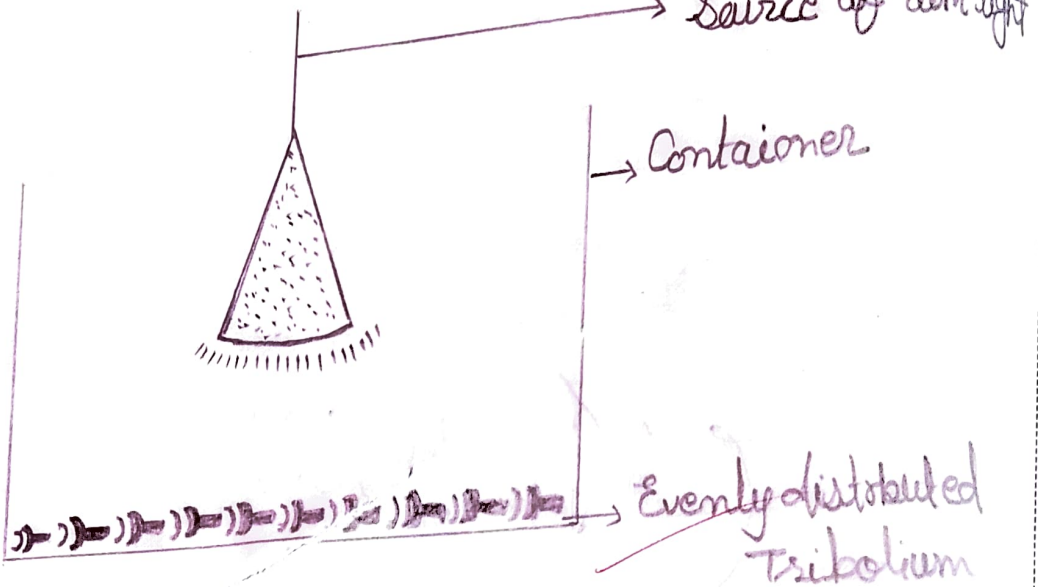
RESULT :- The free Carbondioxide of given water Sample = mg/l free w_2 = So Supplied Sample Containes 12 mg of co_2 /lit or 12 pp m.

PRECAUTIONS :-

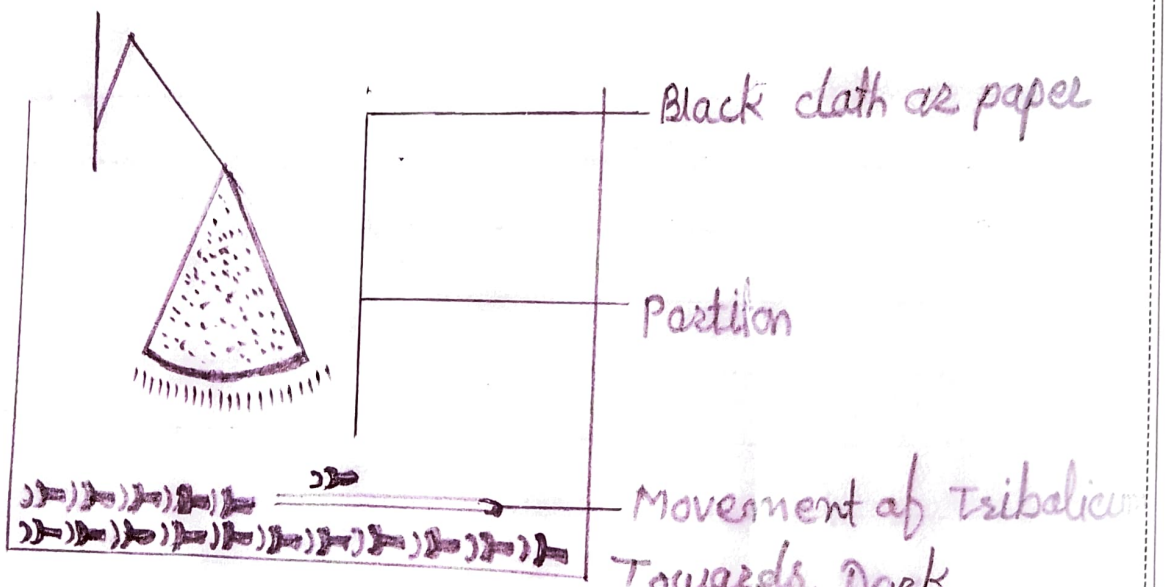
1. Glassware Should be clean d dry.
2. Reagents must be taken accurately.

DATE .....

ETHOLOGY



Movement of Tribolium away from Source of light



RESPONSE OF LIGHT TO TRIBOLIUM

OBJECT:

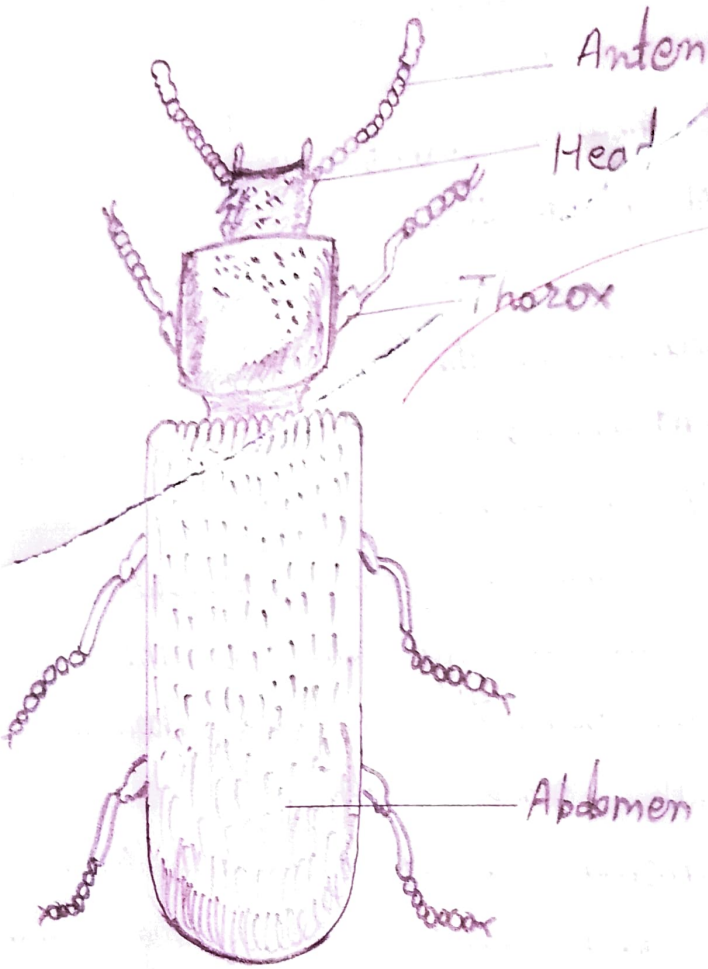
To Study the respons of Light to Tribolium;

MATERTAL REQUIRED:

Small beaker with 20 Tribolium, a rectangular Container, Paint brush, Spirit level, table lamp and black cloth.

METHOD:

1. Release Tribdium in the Centre of the Container.
2. Place the Container Straight and Check acaccuracy with the help of a Spirit level.
3. Keep the Container in very dimlight and note the distribution at an interval of 4hers.
4. Then Keep the Container in total darkness by Covering it with black cloth.
5. finally, uncover half of the container and the table lamp is illuminated at one end again.
6. Note the movement of Tribolium after 24 hrs.



TRIBOLIUM

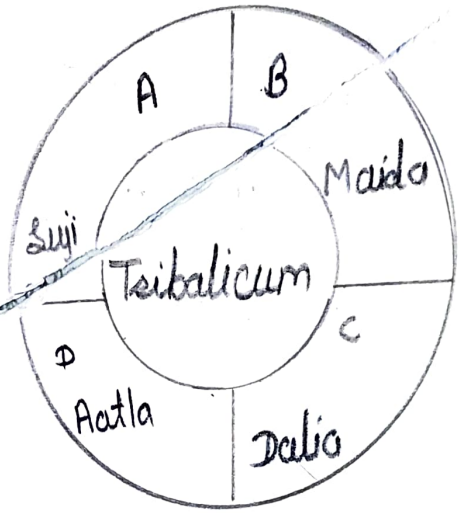
DATE .....

OBSERVATIONS :-

S. No.	Time	Container when kept in light / dark	Distribution of Triboliam :
1.	After 4 hrs	Dim light (diffused)	Evenly distributed
2	After 4 hrs	Holy Container illuminated	Not evenly distributed
3	After 24 hrs	Holy Container dark	More towards dark side.

RESULT :-

From the above observations it can be Concluded that Triboliam are Phatonegative.


A
B
Maida
Suji
Tsibalicum
C
D
Aatla
Dalia

DATE .....

FOOD PREFERENCE OF TRIBOLIUM.

OBJECT:

To Study food Preference of tribolium.

REQUTREMENTS:

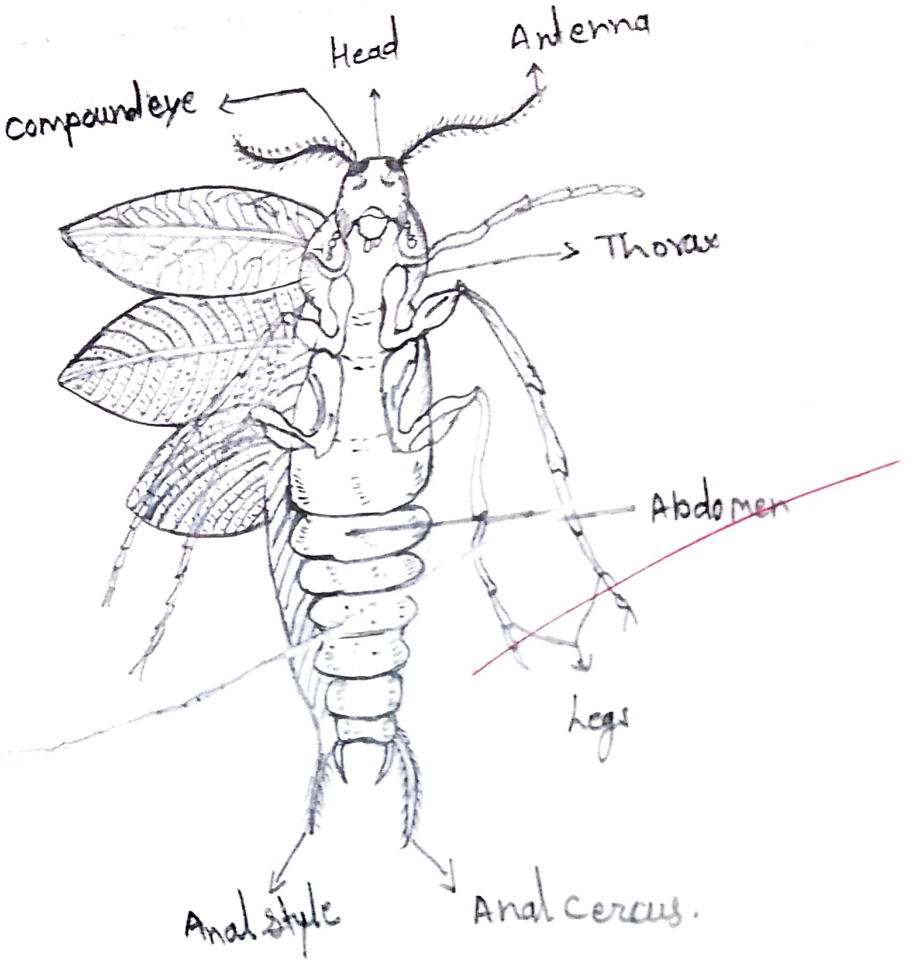
Tribalium insect, Container with 4-5 Paint brush, Semolina, very finely grounded wheat flour; fat, wheat flour.

PROCEDORE:

1. Take a Container having 4s partitions.
2. Put Suji; maida, dalia and wheat flour in each of Partitions A, B, C, & D of the Containers.
3. Very Carefully place Tribolium insect with the help of a Paint brush in the centera of the Container.
4. Cover the Container so that the insects may not come out. Leave the set up for a few hours.
5. Note the number of insects in each Partition.
6. It is obvious that the maximum number of Tribolium found in a Particular food material denotes its Preferance for this food stuff in Comparison to the others.

OBSERVATION:

Total number of Suji Maida & Dali Wheat flour.
Tribalium


Head
Antenna
Compound eye
Thorax
Abdomen
Legs
Anal style
Anal cerci.

A COCKROACH.

ANTENNAL GROOMING IN COCKROACH.

OBJECT:

To study the antennal grooming in Cockroach

PRINCIPLE:

Cockroaches are found in places where there is warmth, dampness and plenty of organic food to devour. These are nactural creatures Durning day time, they ramain inactive and hiding. The antenna of a cockroach are a pair of long, slender, whip-like and many-jointed movables appendages, found on the head. The antennae bear factin and olfactory raceptors and are sensitive to touch and smell. Hence, the animal has to keep these organs neat and clean. The care and cleaning of antenna is known as antennal grooming. The behaviour is a complex and co-ordinated phenomenon and carried out with the help of head and legs.

MATERIALS REQUIRED:

Glass trogh or large sized beaker, vaseline, chloroform or alcohol, Zero number painting brush, cockroach etc.

Teacher's Signature.....

PROCEPURE:

1. Trap a cockroach and cut the wings or make them inactive by applying vaseline on the wings.

2. Transfer the cockroach in a trough or a beaker so that the animal can spread its antennae. Dip the brush in chloroform and apply on the antenna of cockroach.

3. Carefully observe the reaction of cockroach. Cockroach markes a loop of antenna and cleans it with the help of mouth parts and legs.

RESOLT:

Write down the steps of whole cleaning action.

DATE .....

BIOSTATISTICS

HISTOGRAM

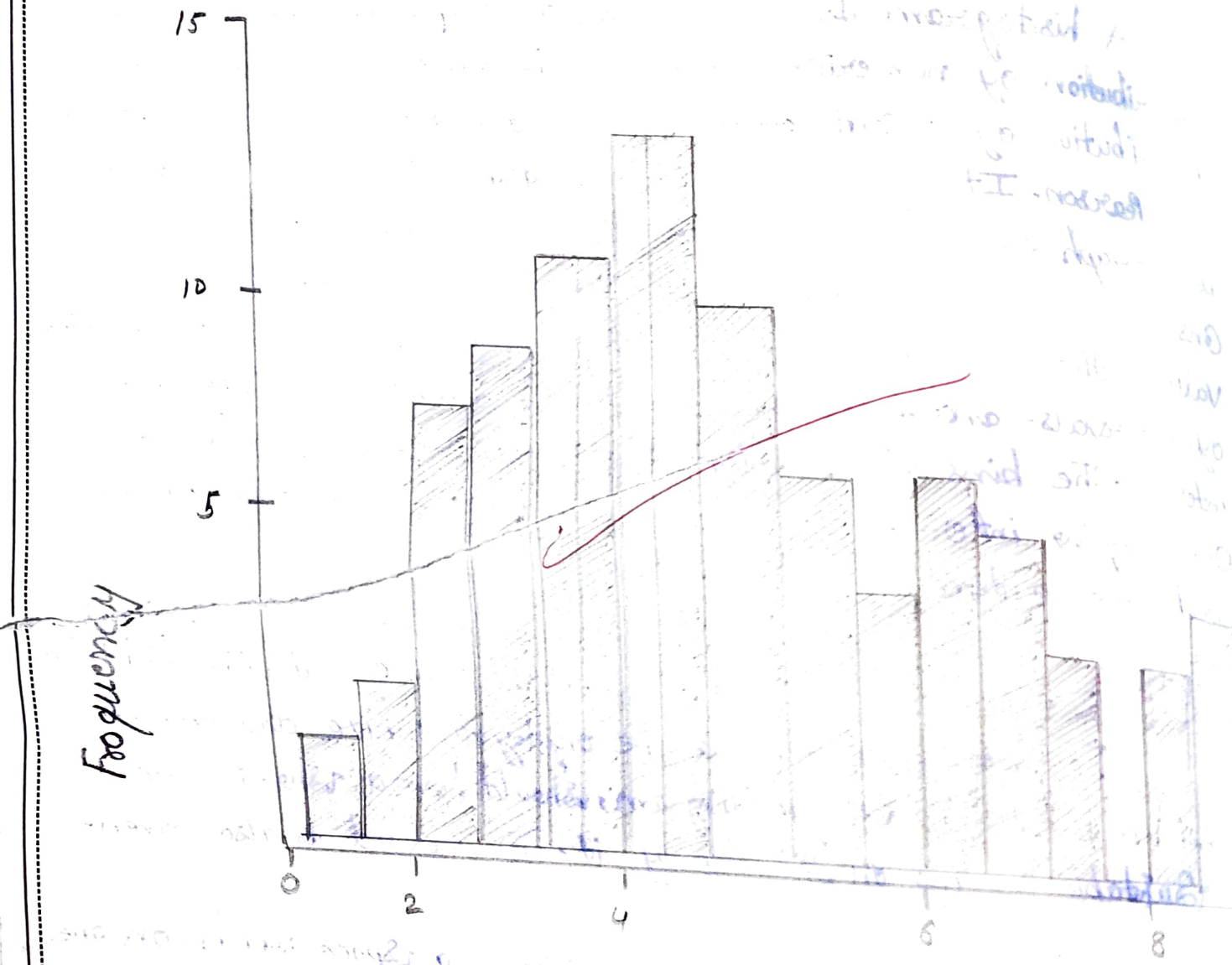
A histogram is an accurate representation of the distribution of numerical data. It is an estimate of the probability distribution of a continuous variables and was first introduced by Karl Pearson. It differs from a bar graph in the sense that a bar graph relates two variables, but histo-gram relates only one. To construct a histogram, the first step is to "bin" the range of values, the first, divide the entire range of values into a series of intervals - and then count how many values fall into each interval. The bins are usually specified as consecutive, non-overlapping intervals of a variable. The bins must be adjacent, and are often of equal size.

RULES FOR DRAWING The DIAGRAM

The following rules should be employed while drawing:

HEADING: Every diagram, should have a short and suitable heading on the top of it. If needed is also given.

SIZE: The diagram should occupy a space which on one hand should be well-fitted on the paper of answer sheets and on the other hand present all the data quite legibly.



Histogram of Arrivals.

SCALE: Bejare drawing a diagram a suitable Scale should be decided for both the axes.

DRAWING: As these are based on the geometric figures.

Index: Sometimes more jacks are Prasented in one diagram

KINDS of HISTOGRAM:

for biostatistical Purposes mainly the following types of diagrams are used:

CONSTROCTION of FREQUENCY DIAGRAM:

frequency diagram can be of the following major types:

1. Line frequency Diagram
2. Histograms
3. frequency curves Polygon
4. frequency Curves
5. Origin Curves or Cumulative frequency Curves.

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BAR DIAGRAM

Bar diagram is also called as bar chart. A common and simple method of graphical representation of data. Bar diagram is a chart that presents grouped date with rectangular bars.

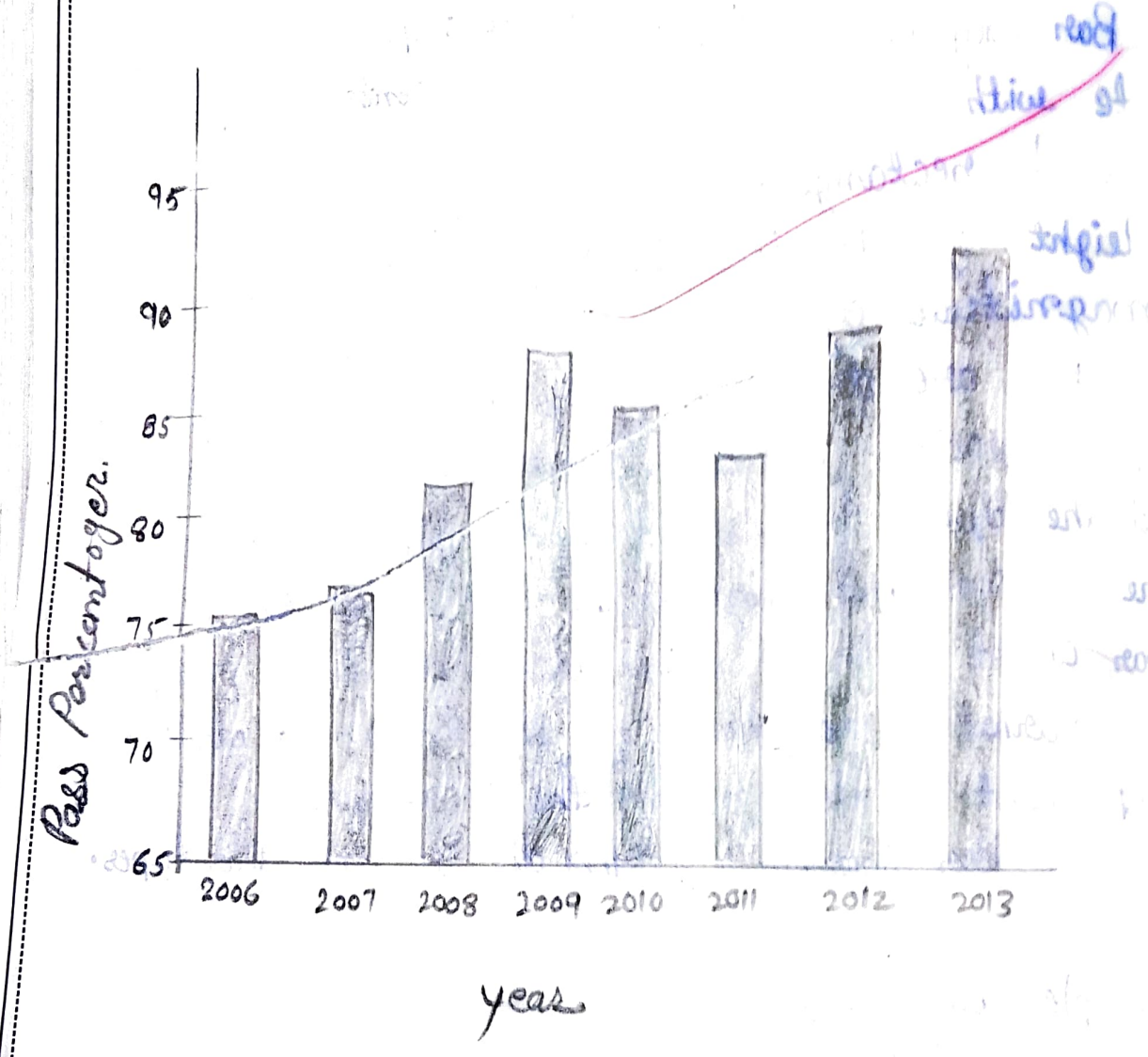
Each rectangular bar represent a class. Height of the ~~iten~~ bar is proportional to the magnitude of the iten in the class.

Bar are drawn vertically or horizontally with equal spacing between them. The width of the bars and the space between them are kept constant. The vertical bar diagram is also called as column bar chart. In a vertical bar diagram, the independent variables are shown on the x-axis, while the dependent variables are shown on the y-axis.

Bar diagram is further divided into four types.

a) Simple bar diagram
b) Multiple bar diagram
c) Subdivided bar diagram
d) Percentage bar diagram

Signature


95
90
85
80
75
70
65
Pass Percentage.
2006
2007
2008
2009
2010
2011
2012
2013
years

a) SIMPLE BAR DIAGRAM:

Items are to be Compared with respect to a single characteristic.

Simple bar diagram may be vertical or horizontal.

Example: Draw a simple bar diagram using the following data.

Year	2006	2007	2008	2009	2010	2011	2012	2013
Pass Percentage (%)	75	79	83	86	85	83	87	89

b) MULTIPLE BAR DIAGRAM:

Contain two or more bars arranged side by side.

Allow comparison of multiple sets of variables comparison.

Different colour or shades are used to distinguish different bars in a single sets.

Example: Draw a bar diagram using the following data showing the Pass Percentage of different subjects in five years.

Teacher's Signature.....

a) SIMPLE BAR DIAGRAM:

Items are to be compared with respect to a single characteristic.

Simple bar diagram may be vertical or horizontal.

Example: Draw a simple bar diagram using the following data.

Year	2006	2007	2008	2009	2010	2011	2012	2013
Pass Percentage (%)	75	79	83	86	85	83	87	89

b) MULTIPLE BAR DIAGRAM:

Contain two or more bars arranged side by side.

Allow comparison of multiple sets of variables comparison.

Different colour or shades are used to distinguish different bars in a single sets.

Example: Draw a bar diagram using the following data showing the Pass Percentage of different subjects in five years.

Teacher's Signature.....

	2011	2012	2013	2014	2015
PHYSICS	79	85	95	100	88
CHEMISTRY	74	80	93	97	70
MATHEMATICS	70	89	81	95	71

c) SUB-DIUTDED BAR DIAGRAM:-

Also called component bar diagram

The individual bar is subdivided into various parts or compartments.

The size of various compartments is proportional to the magnitude of the variable.

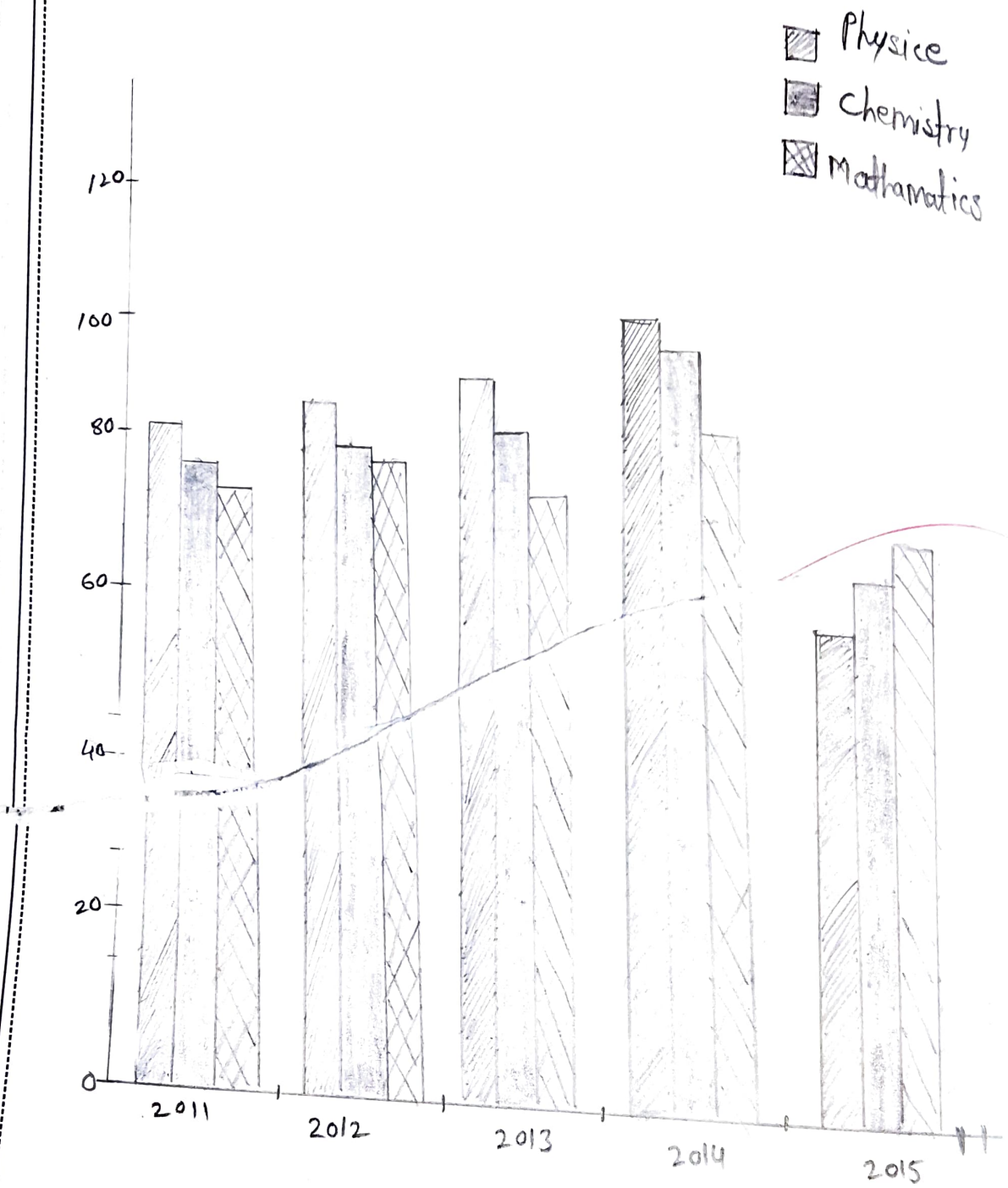
Different colours or shades are used to distinguish the compartments of the bar.

The distance between the bar and the width of the bar is kept constant.

Example:-

Numbers of science graduate students in a college is given below. Draw a subdivided bar diagram using the following data.

Teacher's Signature.....


Physice
Chemistry
Mathematics
120
100
80
60
40
20
0
2011
2012
2013
2014
2015

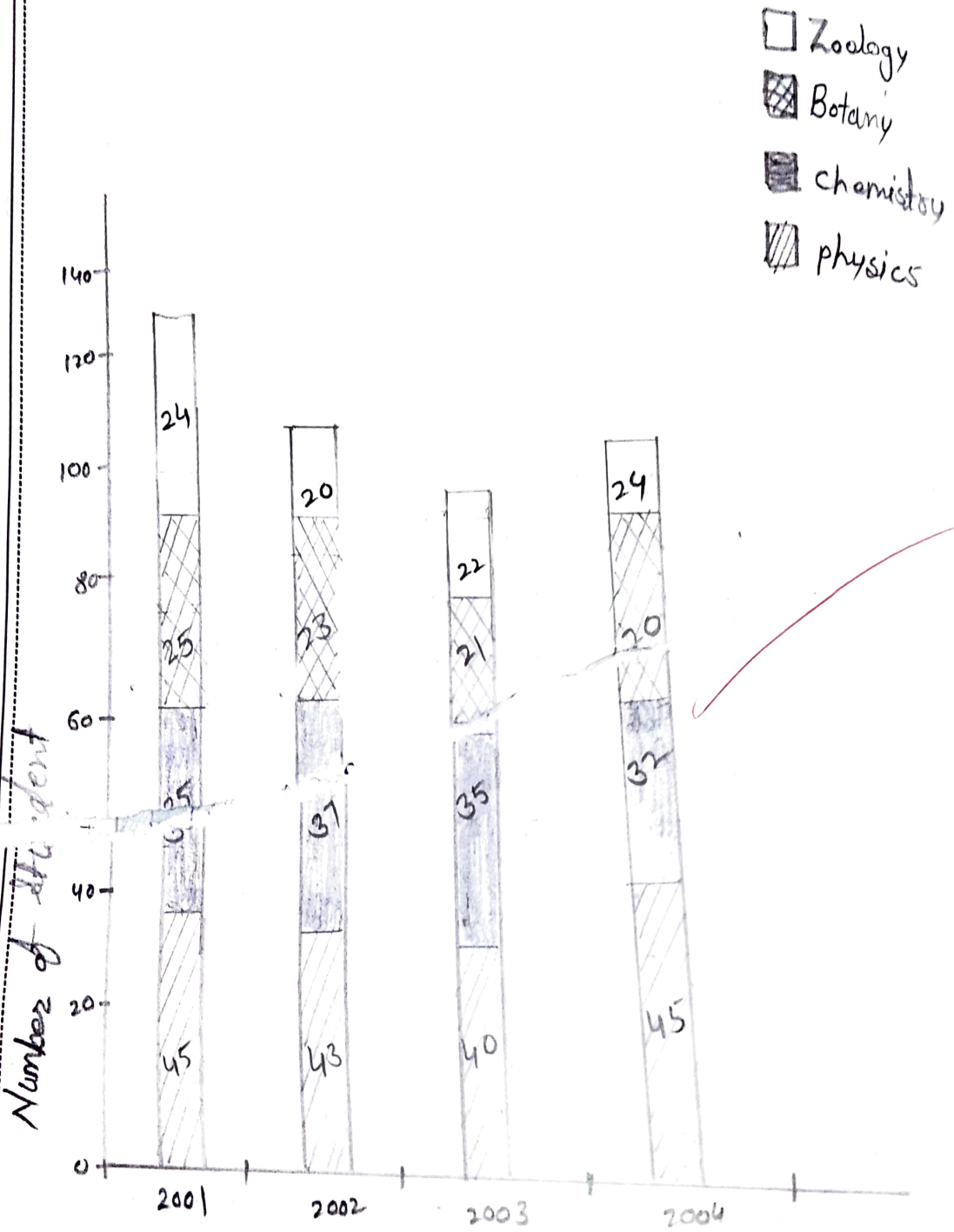
Subject	2001	2002	2003	2004
physics	45	43	40	45
Chemistry	35	37	35	32
Botany	25	23	21	20
Zoology	24	20	22	24

d) PERCENTAGE BAR DIAGRAM:-

Percentage bar diagram is a diagram which exhibits a simple analysis of statical data in terms of percentage. The length of all bars is kept constant (100%.) Each bar consists of several compartments. The size of each compartments of a bar corresponds to the percentage of that componet with respect to the total.

Example:-

Draw a percentage bar digram using the following data.


Zoology
Botany
chemistry
physics
Number of students
140
120
100
80
60
40
20
0
24
25
25
45
20
23
37
43
22
21
35
40
24
20
32
45
2001
2002
2003
2004

DATE .....

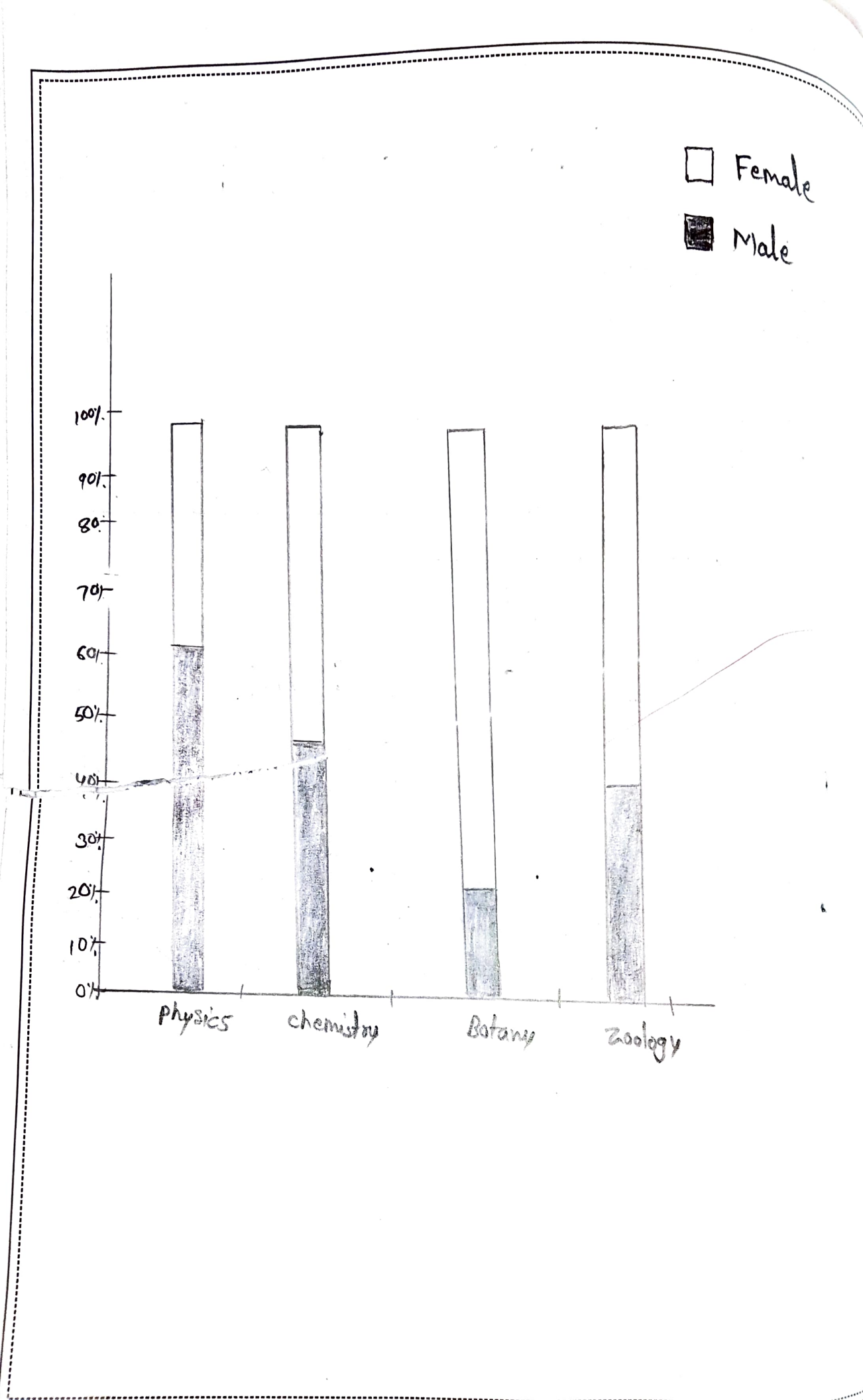
	PHYSICS	CHEMISTRY	BOTANY
Male Students	24	21	01
female students	20	26	25
Total	44	47	32

solution :-

Conversion of absolute values into percentage.

	PHYSICS	CHEMISTRY	BOTANY	ZOOLOGY
male	(24/46) x 100	(21x47) x 1000	(6/32 x 100	(1-c) x 100
Students	= 54.55%	= 44.68%	= 21.87%	= 36.11%
female	(20/44) x 100	(26/47) x 100	(25/32 x 00	(23/36) x 100
students	= 45.55%	= 55.32%	= 78.13%	= 63.89%

Signature.....


Female
Male
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Physics
chemistry
Botany
Zoology

LINE DIAGRAM

The line diagram is the simplest method of graphical representation. In line diagram, the data is represented in the form of straight lines.
Each line in the diagram represents an observation or a class. The height of the line denotes the magnitude of the observation/class. The distance between the line is kept uniform.
Advantages of line diagram: quick and simple method. Comparison became easy.

Example:
A study on the number of accidents in the year 2015 in a particular area is given below. Draw a line graph to represent the data

Months	1	2	3	4	5	6	7	8	9	10	11	12
No. of accidents	21	27	23	34	12	11	9	8	9	8	7	8

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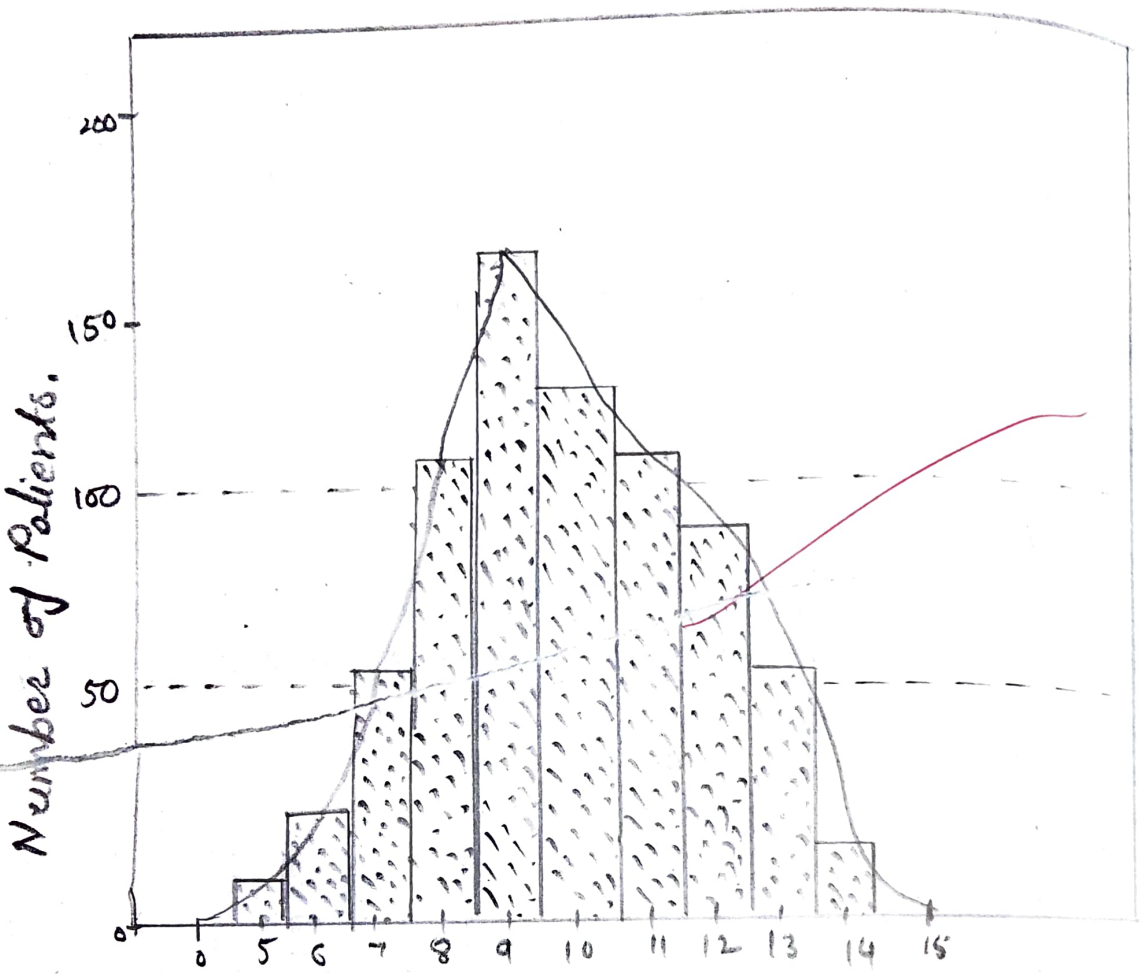
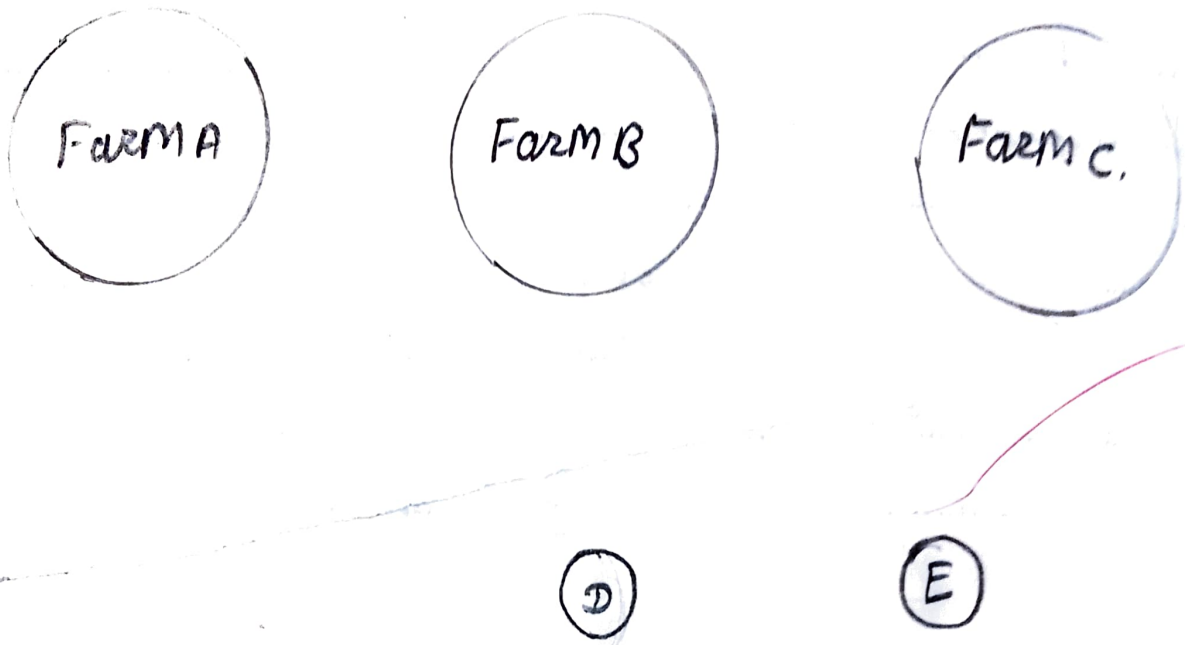

Number of Patients.
200
150
100
50
0
0
5
6
7
8
9
10
11
12
13
14
15
Hemoglobin (gm %)

POLYGONS

The FREQUENCY POLYGON:

The frequency distribution may also be polygon. This graph consisting of straight lines connecting points located above the midpaint of the intervals at heights which correspont to the frequencies. An empty interval is indicted at each end of the distribution, and the graph is brought down to the horizontal axis at the midpaint of these two intervals. When the graph is enclosed in this yashion, the total area endclosed is the same as that of that histogram yor the same data as shown in figure given below. The student should note, however, that the area of that various intervals us not precisely recorded in the frequency polygon, as it is the histogram.


Farm A
Farm B
Farm C.
D
E

DATE .....

PIE CHRIS

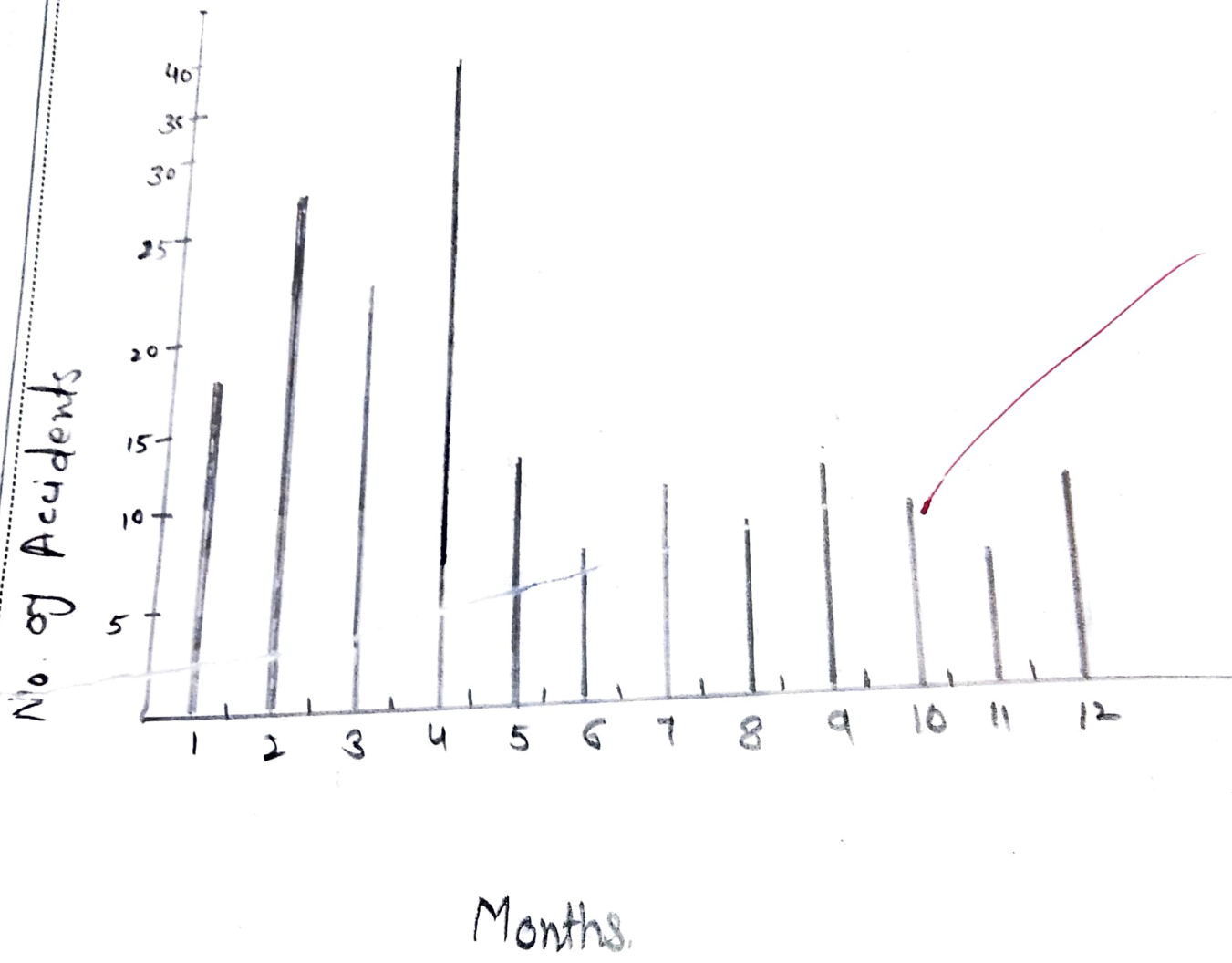
A pie chart is a circular Statistical graphic, which is divided into slices to illustrate numerical proportion. In a pie chart the arc lenght of each slice is proportional to the quantity it represents When there is a wide range of data, a representation of such data in the form of circle is called pie chart. for the construction of pie chart / diagram, square root is calculated. There after the radius calcuated accoreding to their Square roots on the basis of which the Circles are drawn. Such Circles Should be drown only on the Surface and the distance among of ~~two types~~: these Should be equal Pie diagram are of two types:

a) plane or Normal Pie diagrams.
b) Subdivided Pie diagrams.

Example: The annual Productivity (Kg) of five areas is as ~~follo~~ follows:

A = 3600 , B = 1600 C = 900 , D = 100, E =

Draw the five plain pie diagrams and give their Scales also


No. of Accidents
40
35
30
25
20
15
10
5
1
2
3
4
5
6
7
8
9
10
11
12
Months.

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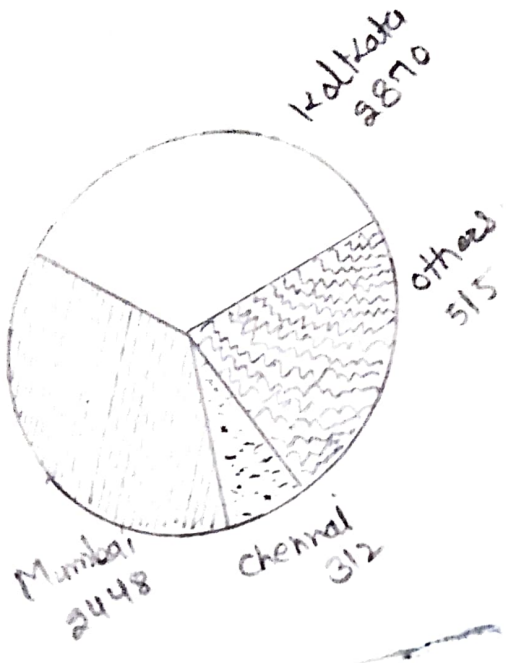
Solution: Computation of the Pie-diagram:
To Compute the Scales for a Pie diagram, first of all area of the Circle should be calculated as shown in the following table.

	A	B	C	D	E
[Kg]	~~3600~~ A	B	C	D	E
Sq	603600	1600	900	100	75
Square root	360	40	30	10	8.66
Size of Squares [Dividing by 20]	3	2	1.5	0.5	0.4

The area of circle would be equal to πr^2 Where pie $\frac{22}{7}$ is or 3.14]. In this figure the one 2cm circle, which be $22/7 \times 9 = 198/7$ Square cm which reveals the 3600 kg. productivity. Therefore, one Square cm would be equivalent to 3600 n ------ 27kg approx).

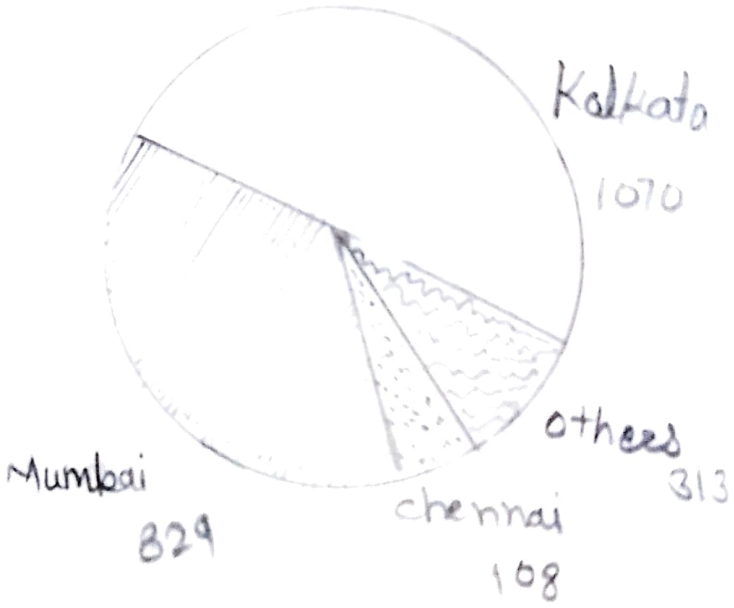
SUB-DIVIDED PIE CHARTS:

When there are several subdivisions of the facts or data, then the circle is further divided. The Centre of a Circle always makes an angle of 360°. Keeping this fact in view, the Sum total of all the values is decided which has an angle, being fraction of 360°. Therefore, this is also called angular ~~diag~~ diagram.



AIDS patients
Numbers.

Fig : Sub-divided pie diagram



1989

In Case two inter-divided pie diagrams are to be drawn then their radius are Calculated in Proportion of the sum total of their Square roots.

Example: following is the data on the occurrence of AIDS Patients in two years. Draw a subdivided pie diagram.

Occurrence of AIDS - Patients

City	1989	1992
Kolkata	10,10	2610
mumbai	829	2443
Chennai	312	312
others	313	515

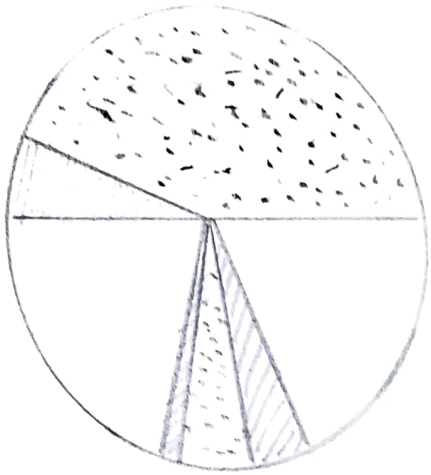
Solution:- The above data requires two pie or circle diagrams to be sketched and these should also be comparable, for both the years, two different circles for different years are placed in proportion of the sum total of their Square roots, the angle should be worked out to sub-divide each circle, as they been depicted in table

Herbivores.

carnivores

Omnivores.

chordates
2490



Non-chordates
1076

Sub: Divided Pie Chart

	1989		1992	
CITY	AIDS Patients	Degrees of Angles	AIDS Patients	Degrees of Angles
KOLKATA	1,070	166	2,670	163
MUMBAI	829	128	2,443	149
CHENNAI	108	17	274	17
OTHER	313	49	515	31
TOTAL	2320	360	5,902	360
Square	4817	-	76.82	-
Radius	2.40	divided by 20	3.84	divided by 20

Scale Measurements: The area of 1989 year reflects an area for the total 2320 patients, Therefore, 1 square centimeter would be equivalent to 2320/18.03 = 128.16 patients

Two-in-one Pie Diagram:
Such a diagram is divided into two halves and each half includes the data which could have also been represented by two separate circle diagram.

Example: Draw a single two-in-one pie diagram to depict the following data.

Animal Types	Herbivores	Carnivores	Omnivores	Total
chor dates	711	1,469	310	2,490
Non-cordates	334	673	69	1,076
Total	1,045	2142	379	3,566

Solution: The total 3566 is taken to be equivalent to 360° and it should be first of all divided Proportionally for the chordates and non-chordates groups.

Chordates will have a degree 2490/3566 x 360 = 250°

Non-chordates will have degree 1076/356x360 = 110

In the same manner 2490, taking 250, the subgroups of chordates will be calculated and taking 110 for the non-chordates all the sub-groups of Non-chordates will be calculated. These have been depicted in the following table.

Animal Types	Herbivores	Carnivores	omnivores	total
Chordates	70	148	32	250
Non-chordates	34	68	8	110
Total	104	216	46	366

The following diagram will truly represent the data:

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STANDARD DEVIATION

The standard deviation or mean error is an absolute measure of dispersion of an individual series or a frequency distribution is the square of deviation of values from their arithmetic mean.

Standard deviation was derived by Profess or root mean square deviation from mean.

Standard deviation is also known as the mean square error or root mean square deviation from mean.

Standard deviation is represented by the small greek letter sigma (σ). While calculating σ Sings are taken into consideration.

Calculation of standard DeviaTIon (S.D.)

I) Calculation of S.D. in Individual Series:

In individul series S.D. is calculated by following two methods :-

A) DIRECT METHOD - Steps involved are as follows :-

i) first of all calculate the arithmetic mean ($\bar{X}$)

ii) Now get the difference of each observations from the arthimetic means.

iii) The square The differences of observations

DATE

for the arithmetic mean.

(iv) After that add the square values to find the sum of the squares.

(v) Divide by the total number of observations.

(vi) formula for S.D. $\sigma = \sqrt{\frac{\Sigma (x-\bar{x})^2}{N}}$ or $\sigma = \sqrt{\frac{\Sigma d^2}{N}}$

Where:

$d = (x - \bar{x})$

x = Individual value or variable value

$\bar{x}$ = Arithmentic mean

N = Number of observations.

Example: Calculate the standard deviation from the following data:

Heights (cms) 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83

Solution:

S.No.	Height in cms (x)	Deviation from the arthemetic Mean $d = (x - \bar{x})$	Square of the Deviation $d^2 = (x - \bar{x})^2$
1	71	71 - 77 = -6	36
2	72	72 - 77 = -5	25
3	73	73 - 77 = -4	16
4	74	74 - 77 = -3	9
5	75	75 - 77 = -2	4
6	76	76 - 77 = -1	1

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7	71	77 - 77 = 0	0
8	78	78 - 77 = +1	1
9	79	79 - 77 = +2	4
10	80	80 - 77 = +3	9
11	81	81 - 77 = +4	16
12	82	82 - 77 = +5	25
13	83	83 - 77 = +6	36
N = 13	$\Sigma X = 1001$		$\Sigma d^2 = 182$

Formula = Mean $(\bar{X}) = \frac{\Sigma X}{N} = \frac{1001}{13} = 77$ cm

standard deviation (S.D.) $= \sigma = \sqrt{\frac{\Sigma d^2}{N}} = \sqrt{\frac{182}{13}}$

$= \sqrt{14}$

$\sigma = 3.74$ cm

B) SHORT CUT METHOD :- steps involved are as-follows:-

i) When the mean of the given data comes out to be a fraction, the standard deviation is found by short cut method.

ii) Firstly, get the assumed mean (A) from given values.

iii) Deviation of the given values may be taken from assumed mean ($d = x - A$) and

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then get the sum of the deviation (Σd)

(iv) Now squares of deviation are obtined and then get the sum of square of deviations (Σd^2)

(v) Σd^2 is the divided by the total number of observations (N)

vi) Formula for S.D -

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

where -

$d = x - A$

x = variable value

A = Assumed meas

N = Total number of observations.

Example :- Find the standard Deviation (S.D) from the given data :-

Marks :- 25, 27, 30, 24, 32, 33, 34, 35, 40, 38.

Solution :-

S.no	Height in CMS (X)	Deviation from Assumed mean (A) $d = (x-A)$ $(A=34)$	Squares of the deviations $d^2 = (x-A)^2$
1.	25	$25 - 34 = 9$	81
2.	27	$27 - 34 = 7$	49
3	30	$30 - 34 = -4$	16

4	24	24-34 = -10	100
5	32	32-34 = -2	4
6	33	33-34 = -1	1
7	34	34-34 = 0	0
8	35	35-34 = +1	1
9	40	40-34 = +6	36
10	38	38-34 = +4	16
N=10		Σd = -33+11 = -22	Σd^2 = 304

Assumed mean = 34

Formula :- standard deviation (S.D)

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

$$\sigma = \sqrt{\frac{304}{10} - \left(\frac{-22}{10}\right)^2}$$

$$= \sqrt{304 - 4.84}$$

$$= \sqrt{25.56}$$

$$\sigma = 5.05$$

II. Calculation of standard deviation (S.D) in Discrete so following methods are uses:-

ii) Dived Method :- Following steps are involved:-

i) First of all calculate the arthmetic mean ($\bar{x}$)

ii) find the deviation from arthmetic mean.

(iii) squares of deviation are also obtained $(d)^2$

iv) Now d^2 are muliplied by their frequencies to

find Σfd^2

formula : $(S.D)\ \sigma = \sqrt{\frac{\Sigma fd^2}{N}}$

where : $d = (x - \bar{x})$

$N = \Sigma f$ (total frequency).

Example : calculate the S.D from the following data

Haemoglobin values (Hb) (grms) (x)	7	8	9	10	11	12	13	14
No of patients (f)	2	3	9	13	16	4	7	8

Hb (grms) (x)	No. of patients (f)	Hb(grms) x No of patients (f) (fx)	Deviation from the Arthemetic mean $d = (x - \bar{x})$	Square the deviation $d^2 = (x - \bar{x})^2$	Square of the deviation Miliply by f $f(d^2)$
7	2	14	7 - 10.90 = -3.9	15.21	30.42
8	3	24	8 - 10.90 = 2.9	8.41	85.23
9	9	81	9 - 10.90 = 1.9	3.61	32.49
10	13	130	10 - 10.90 = 10.1	0.81	10.53
11	16	176	11 - 10.90 = 10.1	0.01	0.16
12	4	48	12 - 10.90 = +1.1	1.21	4.84
13	7	91	13 - 10.90 = +2.1	4.41	30.87
14	8	112	14 - 10.90 = +3.1	9.61	76.88
	$N = \Sigma f$ = 62	Σfn = 676			fd^2 = 211.42

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Arthematic mean $(\bar{x}) = \frac{\Sigma fn}{N} = \frac{676}{62} = 10.90$

Standard deviation $(\sigma) = \sqrt{\frac{\Sigma fd^2}{N}}$

$= \sqrt{\frac{211.42}{62}}$

$\sqrt{3.4}$

$\sigma = 1.84$

B) Short cut method :-

If arithmetic mean has a fractional value then the standard deviation is calculated by short cut method using the following formula :-

$$\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2}$$

where :-

$d = X - A$

$A =$ Assumed mean

$N = \Sigma f$.

Example :- calculate standard deviation for the following data by assumed mean method.

Haemoglobin (Hb)

values (gms) (x)	1	8	9	10	11	12	13	14
No of patient (F)	2	3	9	13	16	4	7	8

solution :-

Hb (gms) (x)	No. of patients (f)	Deviation from Assumed mean d = (x-A)(A=11)	Deviation multiplied by frequency (fd)	fdxd (fd^2)
7	2	7-14 = -4	-8	32
8	3	8-11 = -3	-9	27
9	9	9-11 = -2	-18	36
10	13	10-11 = -1	-13	13
11	16	11-11 = 0	0	0
12	4	12-11 = +1	+4	4
13	7	13-11 = +2	+14	28
14	8	14-11 = +3	+24	72
	N = Σf = 62		Σfd = -48	Σfd² =
			+42 = 6	212

Assumed mean (A) - value has highest frequency

A = 11

Formula: Arthematic Mean $(\bar{x}) = A + \frac{\Sigma fd}{N}$

$= 11 - \frac{6}{62} = 11 - 0.096$

$\bar{x} = 10.90$

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Standard deviation $= \sqrt{\frac{\Sigma f d^2}{N} - \left(\frac{\Sigma f d}{N}\right)^2}$

$= \sqrt{\frac{212}{62} - \left(\frac{-6}{62}\right)^2}$

$= \sqrt{3.41 - (0.096)^2}$

$= \sqrt{3.41 - 0.009}$

$= \sqrt{3.401}$

$= 1.84$

III Calculation of Standard Deviation (S.D) in continuous Series: In this firstly find the mid-value of given classes. Calculation can be simplified if we divide the deviations of the midvalues by class interval. In continous Series S.D is calculated by following method.

A) DIREC METHOD:

Formula: Stand deviation $(\sigma) = \sqrt{\frac{\Sigma f d^2}{N}}$

B) SHORT WTMENTHOD:

$SD: (\sigma) = \sqrt{\frac{\Sigma f d^2}{N} - \left(\frac{\Sigma f d}{N}\right)^2} \times i$

STANDARD ERROR

Standard error is the standard deviation of this statistical distribution. Standard error statics measures how accurate and Precise the sample is as an estimate of Population Parameter. S.E is estimated from the following formulas -

1) Standard error of mean (S.E.X) SE.M

$$S.E.X = \frac{\sigma}{\sqrt{N}}$$

2) Standard error of median (S.E.M) :-

$$S.E.m = 1.2533 S.E.X$$

(or)

$$S.E.M = 1.2533 \frac{\sigma}{\sqrt{N}}$$

3) Standard error of standard

$$S.E.S = 0.7071 \frac{\sigma}{\sqrt{N}}$$

MEAN

Arithmetic mean in the most common and easily understood measure of central tendency we can define mean as the value obtained by dividing the sum of measurements with the data set and is denoted by the symbol $\bar{n}$.

The arithmetic means are computed for three types of series:

i) Individual Data series
ii) Discrete Data series
iii) Continuous Data series

$$M = \bar{X} = \frac{\Sigma X}{N} = \frac{I}{N}$$

$$M = \bar{X} = \frac{\Sigma f_i x_i}{N} = \frac{I}{N}$$

Example :- From the following frequency distribution Calculate Arithmetic mean:

Marks [out of 50)	0-10	10-20	20-30	30-40	40-50
No. of Students	10	12	20	18	10

Solution: Calculation of Arithmetic mean by direct and short-cut methods.

I	II	III	IV	V	VI
				$A = \Sigma mv/y$	
Marks	Mean value x	f	fn	dx $A = 25$	$f dx$
0-10	5	10	50	-20	-2000
10-20	15	12	180	-10	-120
20-30	25	20	500	0	0
30-40	35	18	630	+10	+180
40-50	45	10	450	+20	+200
Total	125	$N = 70$	$\Sigma fn = 1810$		-320 + 380 = +60 $= \Sigma f dx$

mean is 25.86 marks.

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MODE

The mode of a distribution is the value of the point around which the items tend to be most heavily concentrated.

mode is defined as the value of the Variable which occoccs most frequency in a distribution.

The mode in a distribution is that item around which there is a maximum concentration

1) By Inspection
2) By classifying the unclassified values

Example:- Calculate the mode from the following frequency data

weight of tests in mice (mg)	10	11	12	13	14	15	16
number of mice (f):	7	5	8	2	3	10	4

Solution

By Grouping METHOD

weight of tes in mice (x)	number of mice frequency I	II	III	IV	V	VI
10	7 }					
		12	18	2		

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11	5			13	20	15				
12	8	10							13	
13	2			5	15					
14	3	13				17				
15	10			14	11				15	
16	4	5				16				
17	1			7						
18	6	15								
19	9									

Construction of Analysis table

Column	10	11	12	13	14	15	16	17	18	19
I						I			I	I
II									I	I
III						I	I			
IV	I	I	I							
V				I	I	I				
VI					I	I	I			
Total	I	I	I	I	I	4	3	1	1	1

MEDIAN

Median may be defined as the value of that item which divides the series into two equal parts, one half containing values less than it.

If there is an odd number of scores, the values of the median is simply chosen equal to the middle score.

Thus, if n be odd, Median = value of $\left[\frac{n+1}{2}\right]$ th item

If there is an even number of scores, the value of the median will usually be chosen as a point halfway between the two middle scores If it is even then Median = Mean value of $\left[\frac{n}{2}\right]$ th and $\left[\frac{n}{2}+1\right]$ th item.

Example: Calculate Median from the following data:

S.No. of Persons:	1	2	3	4	5	6	7	8
Weight [kg]:	15	35	43	46	48	48	49	50
S.No. of Persons:	9	10	11	12	13	14	15	16
Weight [kg]:	55	56	60	64	71	75	80	85

Solution: The above class will first be written in ascending order:

Sr No.	Marks	S. No.	Marks
1	15	9	55
2	35	10	56
3	43	11	60
14	46	12	64
5	48	13	71
6	48	14	75
7	49	15	80
8	50	16	85

Median = Size of $\left(\frac{N+1}{2}\right)^{th}$ item = Size of $\left(\frac{16+1}{2}\right)^{th}$ item.

$= 8.5th$

$= \frac{\text{Size of } 8th + \text{Size of } 9th}{2}$

$= \frac{50+55}{2}$

$= 52.5kg$

Median weight are 52.5