

## FITTING SHOP

### Introduction:-

The term "bench work" denotes the production of a job by hand on the bench while "fitting" is the proper assembling of two or more parts.

In engineering fields, fitting and bench work play an important role in yielding the desire shape and accuracy. We may finish jobs by using different types of automatic machine, which might be take less time and better results, they still require the hand operations, to be done on them to finish the job by hand. Maximum part of raw materials go into the machine shop and reappears as finished job, ready for assembly.

### Tools and Device in fitting work:-

There are a large number of tools and devices which are commonly used in fitting work. Generally, all the tools may be best classified

as follows:-

- (a) Marking and measuring tools.
- (b) Holding and supporting tools.
- (c) Cutting, filing and scrapping tools.
- (d) Striking tools.
- (e) Drilling, dieing, reaming and tapping tools.
- (f) Miscellaneous tools.

A. Details of marking and measuring tools:-

Engineering Scale:-

It is used for taking linear measurements of any surface. It is made of stainless steel or spring steel, having line graduation engraved at interval of fraction of standard unit of length. It is usually marked in centimeters and then sub-divided in millimeters. Scale of 300mm is mostly used in practice. All the scales are specified according to the length and least count.

Surface Plate:-

It is used for making out work for testing the flatness or true ness of work. It is made of grey cast

Box having a square or rectangular hole. Its top and bottom surfaces are usually machined to keep both in a perfect horizontal plane. Surface that is specified according to the size of the top surface.

### Scriber

This is a piece of hardened steel about 50mm to 300 mm in length and 35 mm in diameter which is pointed out at one or both ends. Scriber, drawing one end in various shape and the other in bent shape it also used along with moxie gauge.

### Punch

It is used for marking out work and locating centre in a permanent manner. They are made of hard drawn steel and may be chiselled in two types such as pick or 1) punch and centre punch. Pick or slot punch is a sharply pointed end. The centre punch has an helmed angle of about 60°.

Tri-square

It is used to check the flatness of mutually normal surfaces or in other words, we can say to check the  $90^\circ$  angle between two adjacent surfaces. In the absence of surface plate, flatness of any surface may also be checked by it. Tri-square has two parts, i.e. blade and stock. Blade is made of steel while the stock of cast-iron. Both the parts are fastened to each other at  $90^\circ$  angle by riveting.

Vernier calipers

Vernier caliper can measure internal dimensions, external dimensions using the picured lower jaws, and depending on the manufacture, depth measurements by the use of a probe that is attached to the movable head and slides along the centre of the body.

Vernier height gauge :-

A vernier height gauge is a height gauge with the additional refinement

of a vernier scale for greater accuracy in reading or setting the jaw.

### Bench-vice's → Holding and supporting tool

It is firmly fixed to the fitter's bench with the help of nuts and bolts and also known as fitter's vice. It consists of cast-iron body with two jaws, a handle of mild steel and a box next of gun metal. Separate jaw plates or cast-steel plates known as jaw-plates are fixed to the jaws by means of set screws. The holding faces of the jaw plates have teeth for gripping the work firmly.

### Chisel:-

for cutting and chipping away pieces of metal, cold type of chisels are used. These are made of high carbon steel usually in rectangular, hexagonal or octagonal cross section. The cutting edge is roughly ground by forging and then sharpened to the correct cutting angles on grindstone or on oil-stone.

Set chisel-

The cutting edge is given a  
short curve so as to prevent  
the work from digging into the  
metal.

Squat chisel-

It is used for cutting grooves  
in large surfaces and edges  
in steps or ledges.

Round nose chisel-

The specific use of this type  
of chisel is in cutting oil grooves  
in bearing, bases and pillars etc.

FILES-

It is the most widely used hand  
tool in filing work. File are  
made by high carbon steel.  
The main function of file are  
to:

1) Remove the extra metal from any  
shape.

2) Finish the final shape of a work-piece  
3) remove the burr from cuts  
4) make a surface smoother and

Date \_\_\_\_\_

Expt. No. \_\_\_\_\_

Page No. \_\_\_\_\_

### Flat chisel:-

Its cutting edge is given a slight curve so as to prevent the corners from digging into the metal.

### Grooving chisel:-

It is used for cutting grooves in large workpieces and keyways in shafts or wheels.

### Shouldered Nose chisel:-

The specific use of this type of chisel is in cutting oil grooves in bearing, bosses and pulleys etc.

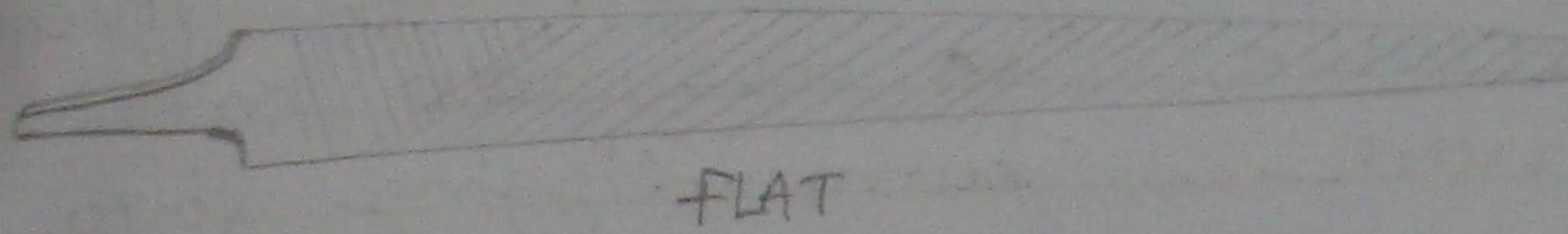
### FILES:-

It is the most widely used hand tools in fitting work, files are made by high carbon steel. The main function of file are to,

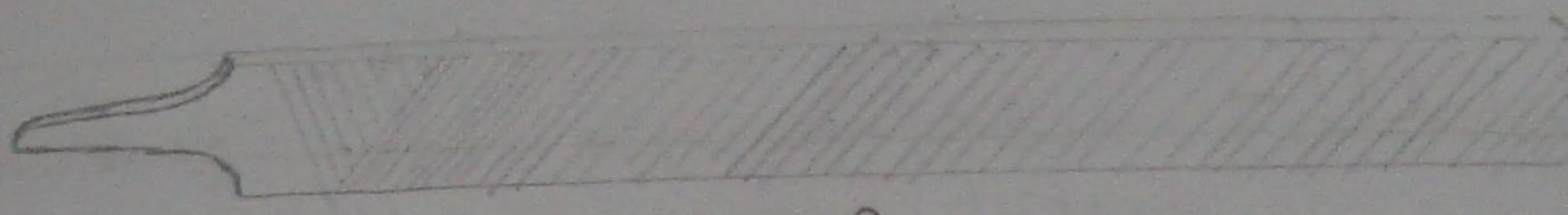
- (a) remove the extra metal from any surface.
- (b) finish the final shape of a work-piece
- (c) remove the burrs from cuts.
- (d) make a surface smooth, and

Teacher's Signature : \_\_\_\_\_

Fig:- - Shapes of file



FLAT



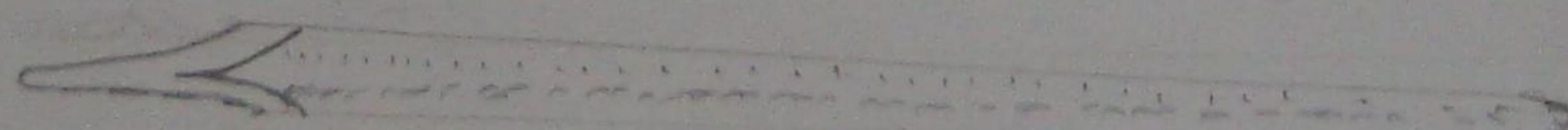
HAND



Square



Pillar



Round



Triangular



Half Round



knife Edge

fit metal parts.

Files are generally classified according to the following factors:-

- (a) effective length i.e. excluding the length of tang.
- (b) shape or cross-section.
- (c) cut of teeth
- (d) grade.

Effective length:-

It is measured from point tip to the nut. files of length between 100mm to 150mm are used for fine work, between 150mm to 250mm for medium sized work and above 250mm for heavy and large sized work.

Shape and cross-section:-

The files are manufactured in different shapes to suit the variety of shapes which they have to work on. The most common type of files as per cross-section are shown in figures.

Expt No. \_\_\_\_\_

Flat file:— This is tapered in width and thicker both, flat file is always double-cut on the faces and single-cut on the edge. It is used for general work only.

Hand file:—

This is tapered in thickness and parallel in its width are always double cut on the faces and single cut on one-edge only i.e. it's one edge does not have feet. Being on edge without feet, this hand file is also known as "safe edge file".

Square file:—

It is square in cross section, double-cut and to opened towards the point used for finishing or enlarging square or rectangular square to rectangular sections as splines and keyways.

Cut of Teeth:—

(i) Single cut:—

The teeth are not cut parallel to each other at  $60^\circ$  to the corner of the file. Single cut are commonly used

in hard metal.

(ii) Double cut -

In a double cut there are two sets of teeth on similar to those of a single cut file and other remaining diagonally across the first teeth and inclined other at an angle of  $75^\circ$  to  $80^\circ$  to the centre line.

GRADE - It is no. of teeth per unit length. As per grade files are classified as

(i) Rough - 8 teeth per cm

(ii) Bistered 8-12 teeth per cm

(iii) Second cut 12-16 teeth/cm

(iv) Smooth 16-24 teeth/cm

Rough are used for soft metal, bistered for shaping work, second cut for hardened metals. The specific use of smooth file is to give a high degree of accuracy with a very high finish.

Hack Saw:-

It is used for cutting off operation or in making a slot on metallic surface. It consist of a

metallic frame, either fixed type or adjustable type, which is fitted with a wooden style.

Two metallic prongs or shears are provided at both the ends of frame screw, known as wing nut. Hack saw blade is held between two prongs by adjusting wing nut.

### Description of Striking Tools:-

Striking tools have 2 wide use in fitting work like chipping, cutting and punching etc. The types of operations need striking on chisel and punch. All the hand hammers used in fitters work are similar in design to the Smith's nail hammers.

### Ball peen Hammer:-

The peen has a shape of ball, which hardened and polished particularly. This type of hammer is used for riveting and chipping projects.

### Cross peen Hammer:-

The peen is across the handle. It is mainly used for bending and hammering in to shoulder etc.

### Straight peen hammer:

It has a peen straight with the handle, parallel and is specifically used for peening or stroaching the metal.

### Chipping:-

It is the operation of removing thick layers of metals from any metallic piece by means of cold chisels and hammers. The work piece is firmly held in a vice and the metal of work piece is removed by striking the chisels on the surface.

### Filing:-

It serves to remove the bur from cuts, clean the face of the cutter and finish the final shape of a work piece.

### Method of filing:-

#### i) Cross filing:-

In this method, the file strokes run alternatively from right

to left. file is held inclined to the axis of job.

### (ii) Straight filing:-

This method of filing is preferred on long and narrow piece of work, whose width is less than that of file. Movement is given only in forward direction.

### (iii) Dovetail filing:-

In this filing method, the hand of file is not held. Both hands are placed together on the blade, the position of file is  $\perp$  to the axis of work. files move of the file  $\perp$  axis of work.

### Hack-swinging:-

Hack-swing operation on a metallic piece is performed by a Hack-saw. Placing the Hack-saw on the work-piece with the right-hand on the handle, the handle and the left-hand on the other end of the Hack-saw formed,

### Job

Aim:- To prepare a L-shape

Tools:-

(i) Hacksaw

(ii) filet

(iii) Bench vice

(iv) Try square & marking tools.

Material:- Mild steel plate.

### Procedure:-

- ii Cut the mild steel work piece of dimension 48 x 48 mm.
- iii File the work piece.
- iv Check right angle using try square at appropriate integral.
- v Paste wet chalk on the piece and mark the dimension using vernier height gauge.
- vi Filing is done at appropriate marking.
- vii Remove small square of dimension (25 x 25) mm using hacksaw.
- viii The left over workpiece is finished by filing.

### Result:-

The work-piece of appropriate dimension is prepared in a work-piece of L-shape.

Date \_\_\_\_\_

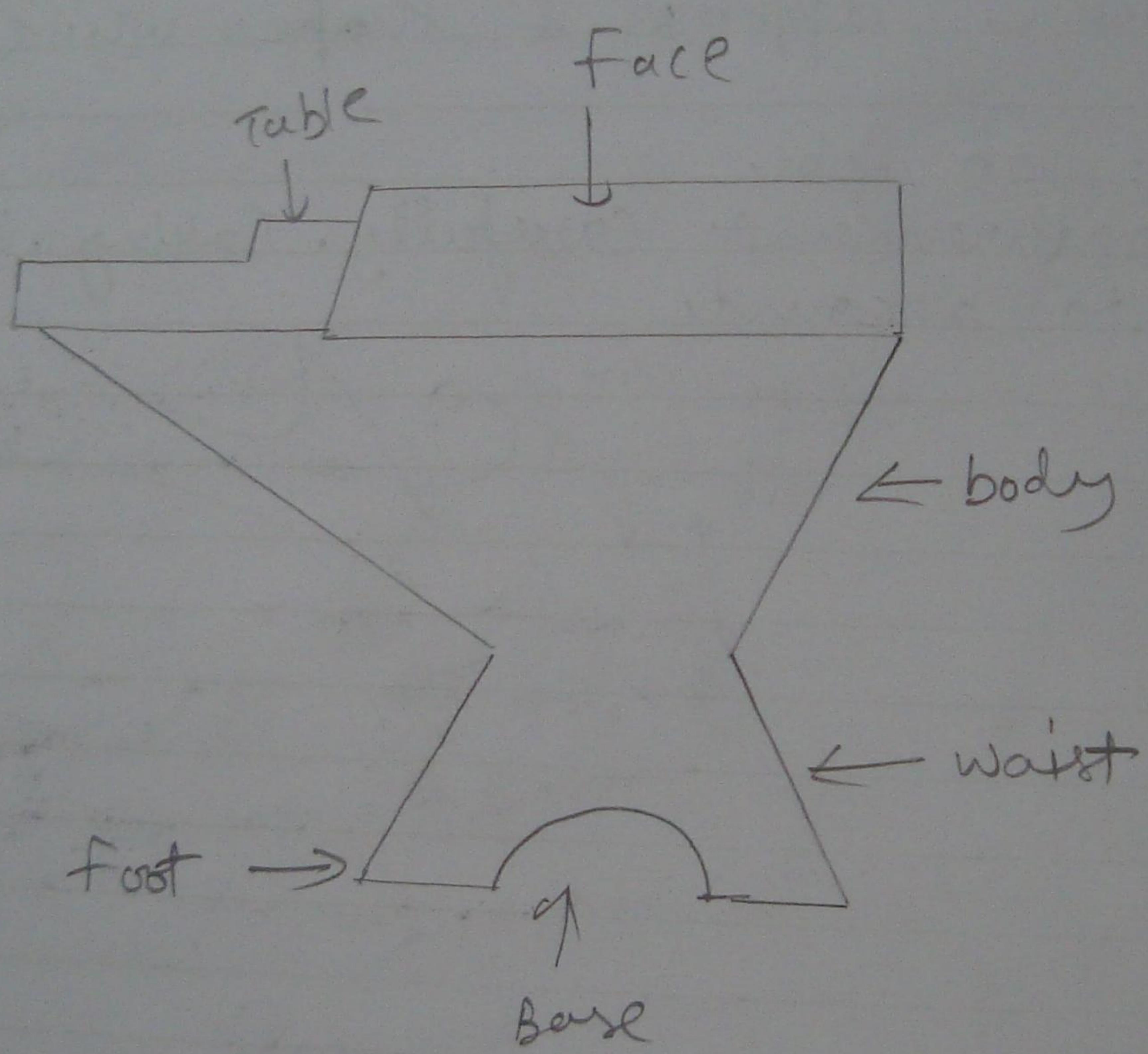
Expt. No. \_\_\_\_\_

Page No. \_\_\_\_\_

Precautions:-

- (i) Always wear apron & mask while working,
- (ii) Concentrate on job.
- (iii) Take measurements carefully. Taking Sart count into account.

C/N



Anvil - tool nomenclature

## Forging

### Introduction

Forging is the manufacturing process in which the metals are processed to get the required size and shape by applying mechanical force or by heating metal and then applying smaller amount of force.

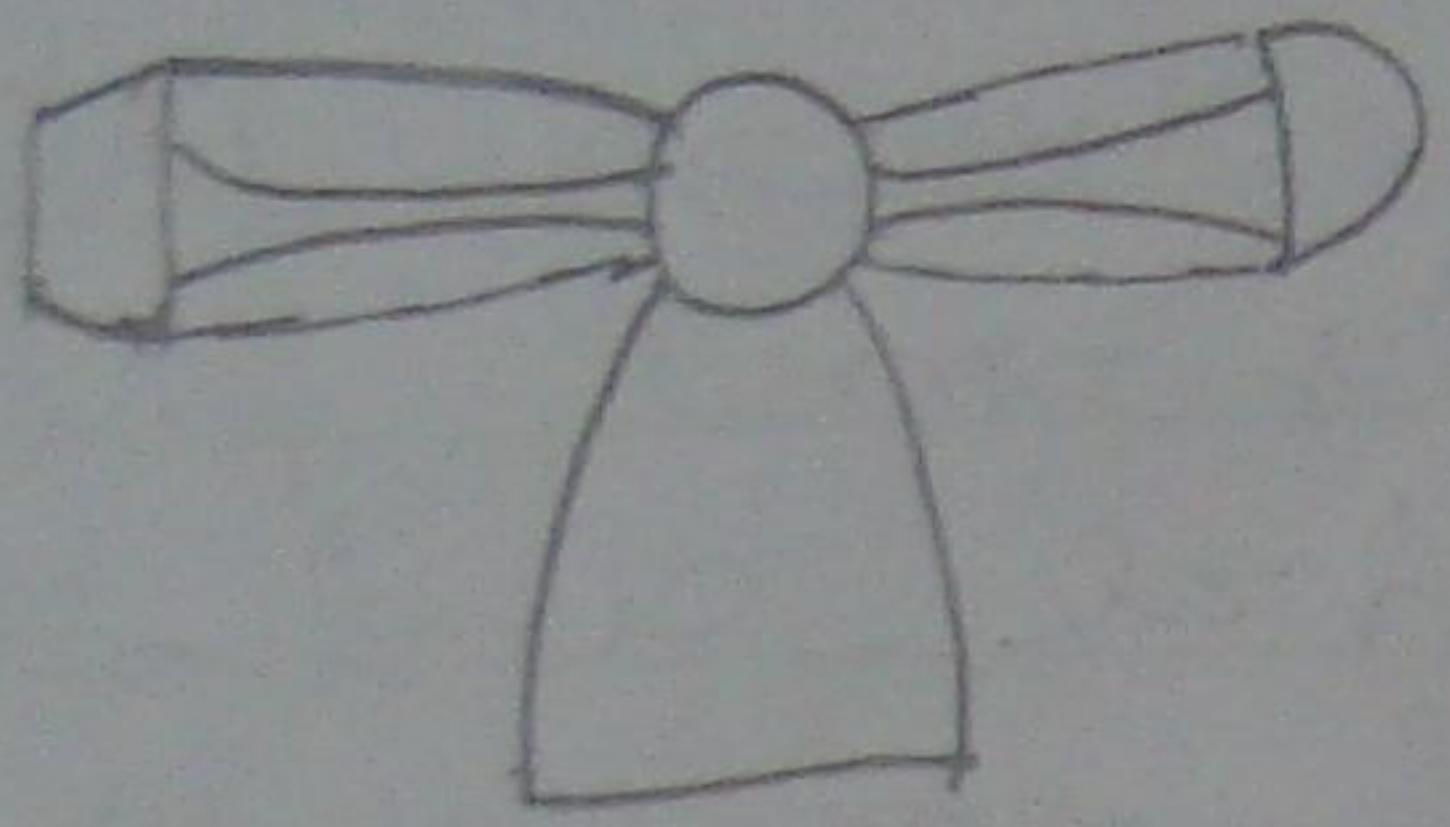
Blacksmithy or hand forging is an ancient trade. It is employed only for relatively small components.

Tools used in smelting shop:-

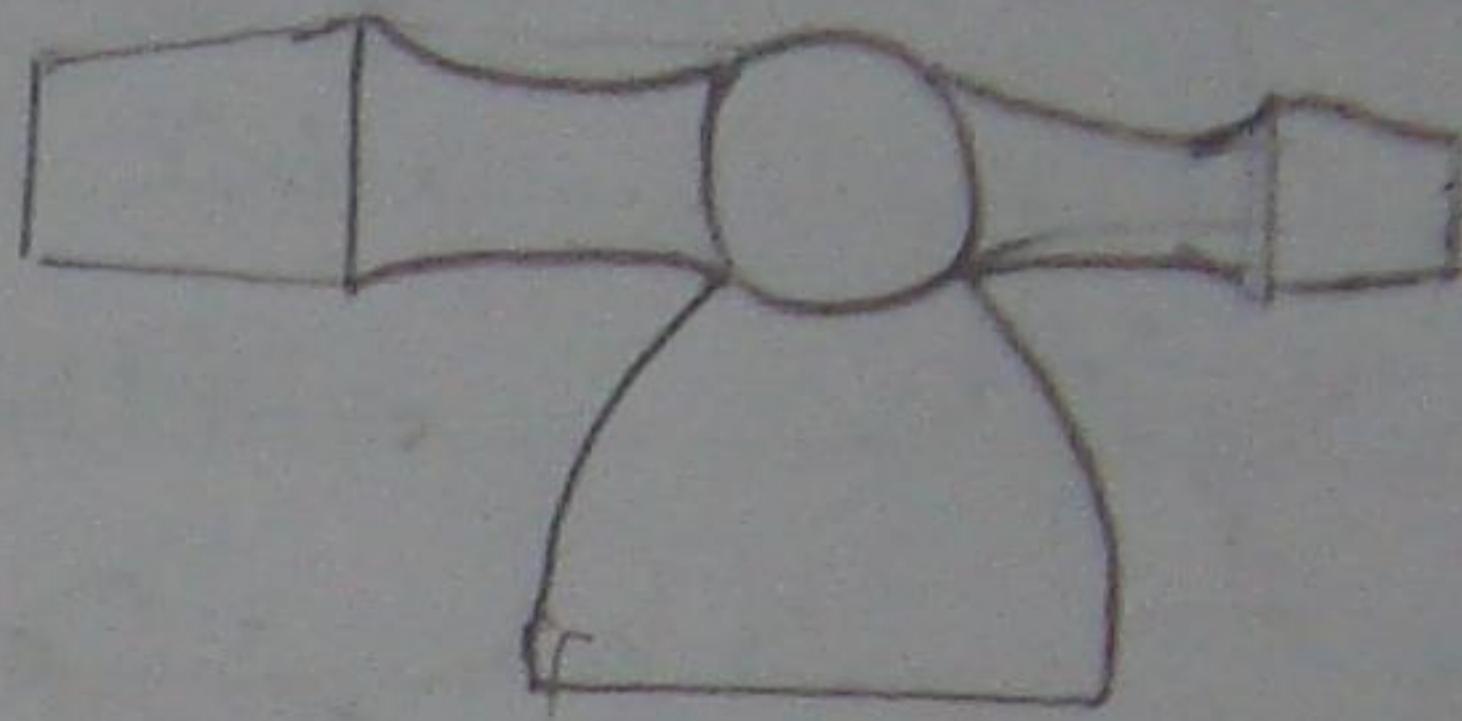
- Supporting tools
- Striking tools
- Holding tools
- Cutting tools
- Finishing and shaping tools.

Supporting Tools:-

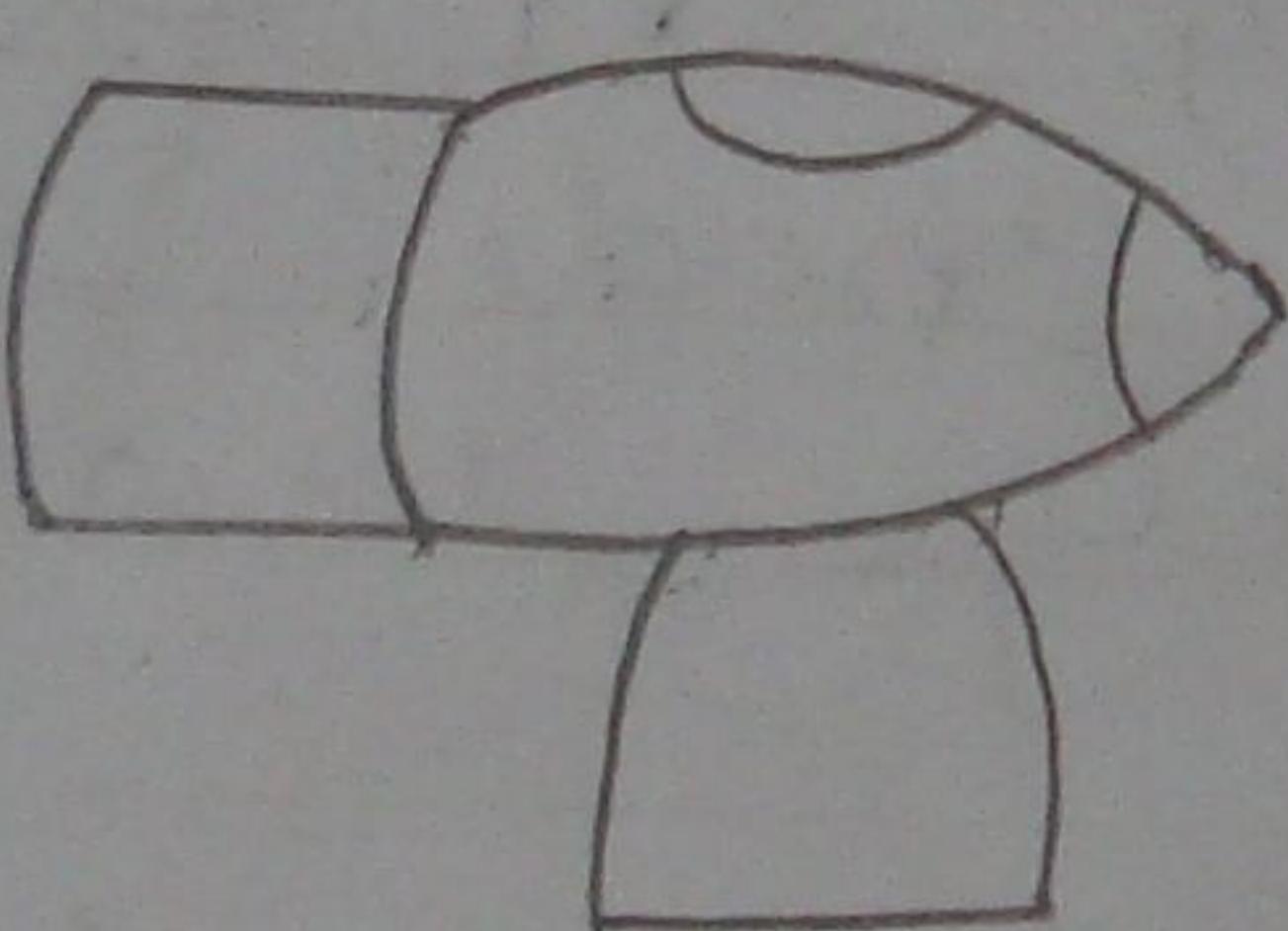
- It is a most important used smelting tool without which we cannot carry any smelting process.
- It is used as a support where hammering is performed. It is made of solid wrought iron or cast steel.



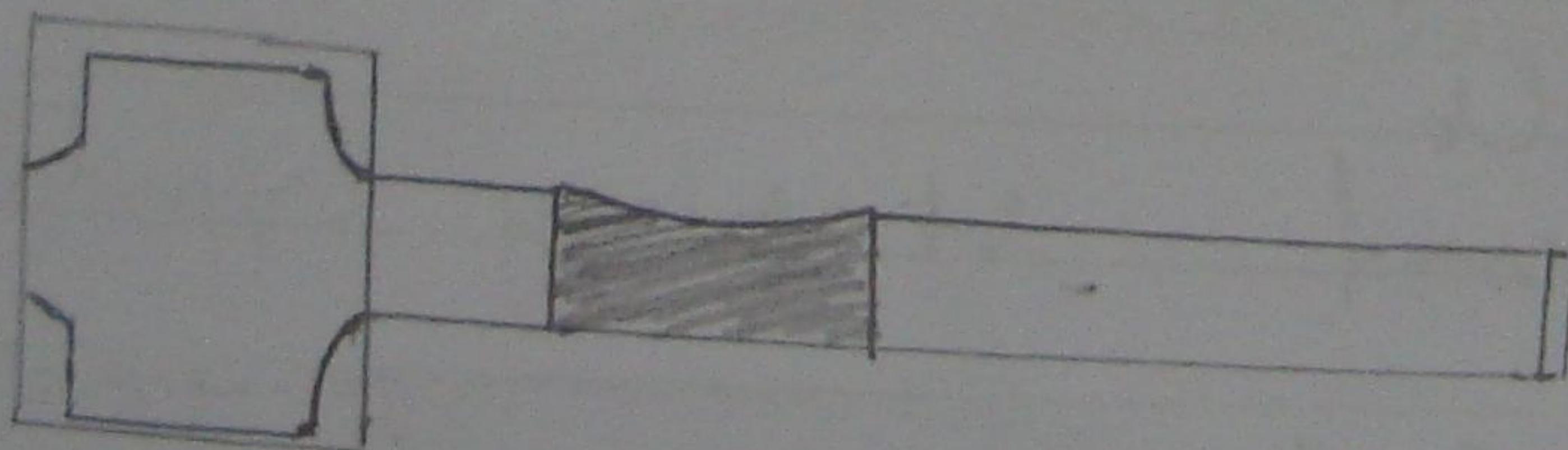
Ball peen Hammer



Straight peen Hammer



Cross peen Hammer



Sledge Hammer

→ The top surface of the anvil has some square and other round shaped parts. This is used when the pieces are inserted in to them to get fitted.

### Striking Tools:-

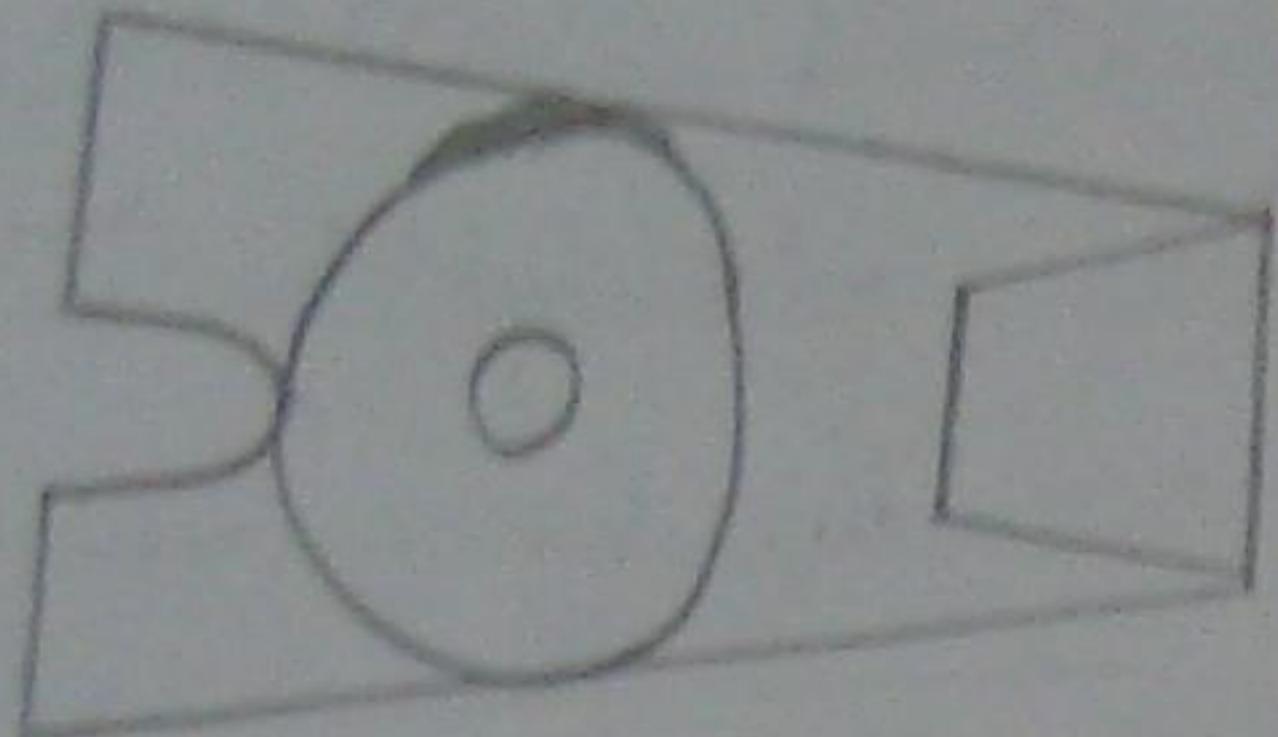
- It is a supporting tool used in a forge shop.
- It is made up of cast iron or cast steel.
- It is used for squaring, heading, bending and forming operations.
- It may be fixed either flat or edge-wise in its position.
- for general appliances width of the anvil block is 0.125m or slightly more.

### Striking tools:-

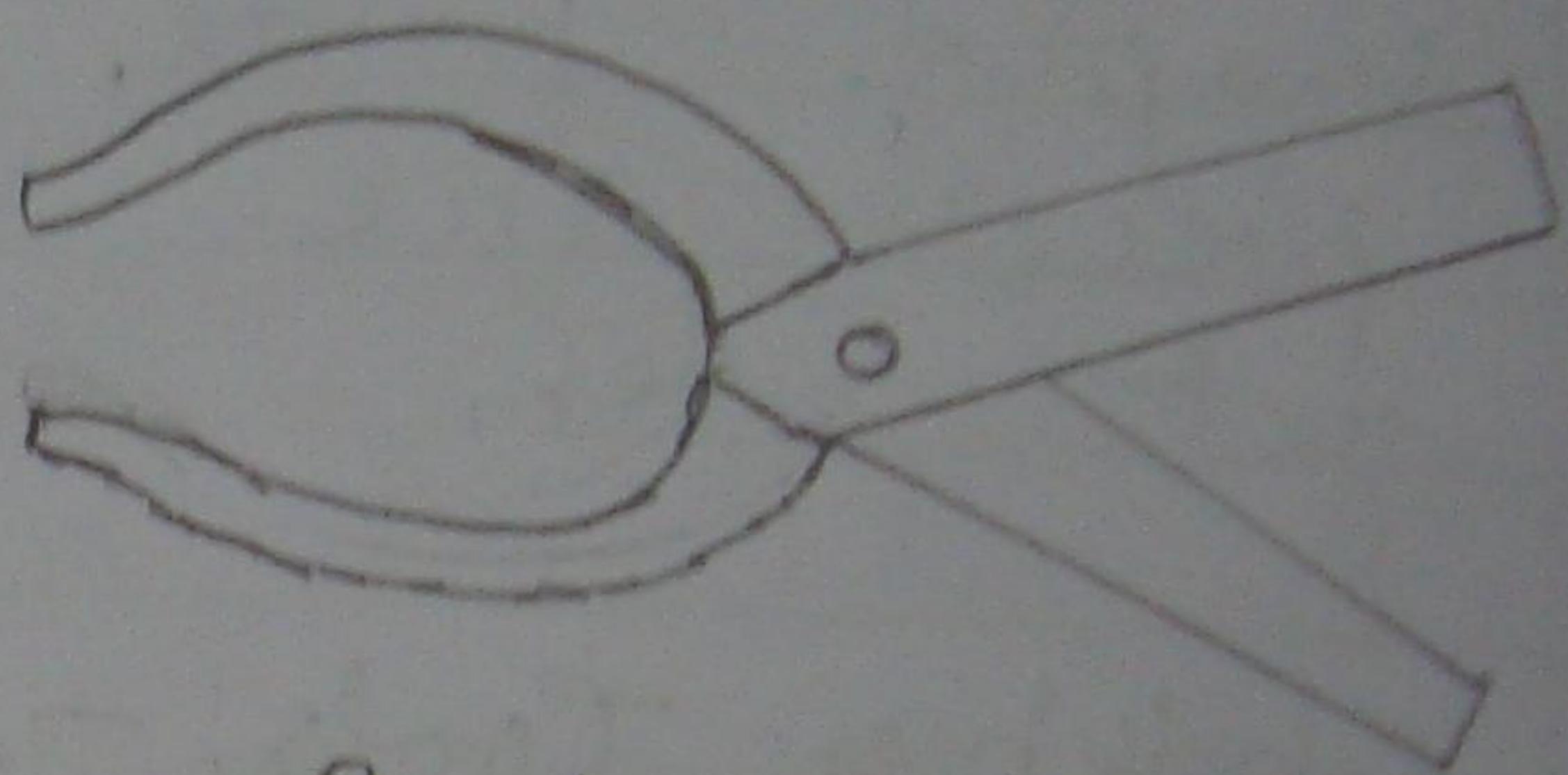
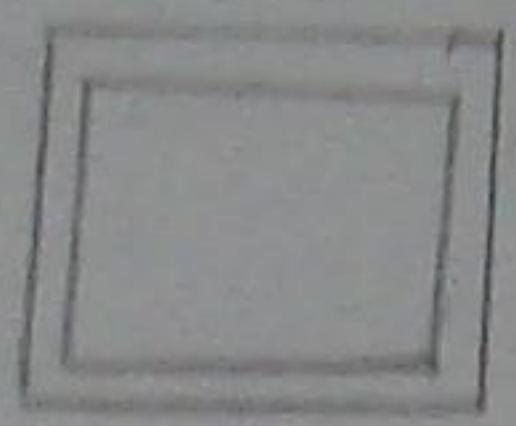
- (i) The hand hammer used by smith
- (ii) the wedge hammer used by the shikar.

### Hand-Hammer:-

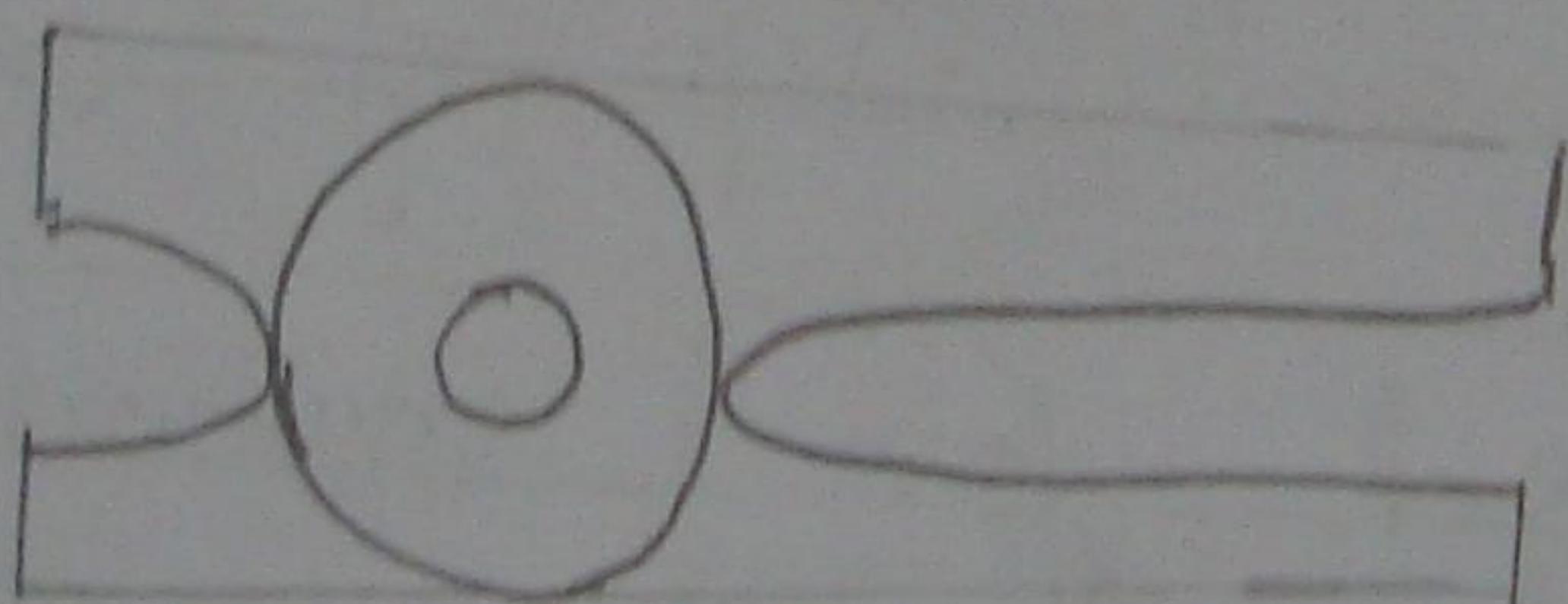
- These hammers are classified as -
- 6.1 Ball peen hammer



flat tong



Crad-tong



straight lip fluted tong

Expt. No. \_\_\_\_\_

(b) straight peen hammer

(c) cross peen hammer

The weight of this hammer varies from 0.5 kg to 2 kg. These hammer are made of cast steel and ends are hardened and tempered.

These hammer used for heavy work.

Sledge hammer:-

It is used for heavy work duty. It has flat ends on both sides. The weight varies from 4.5 to 5.5 kg for ordinary work and around 9 kg for heavy work. The handle being used about one meter long. Handle is made up of either cast iron or wood.

Holding Tools:-

Generally Tonges are used for holding purpose. It is made up of mild steel.

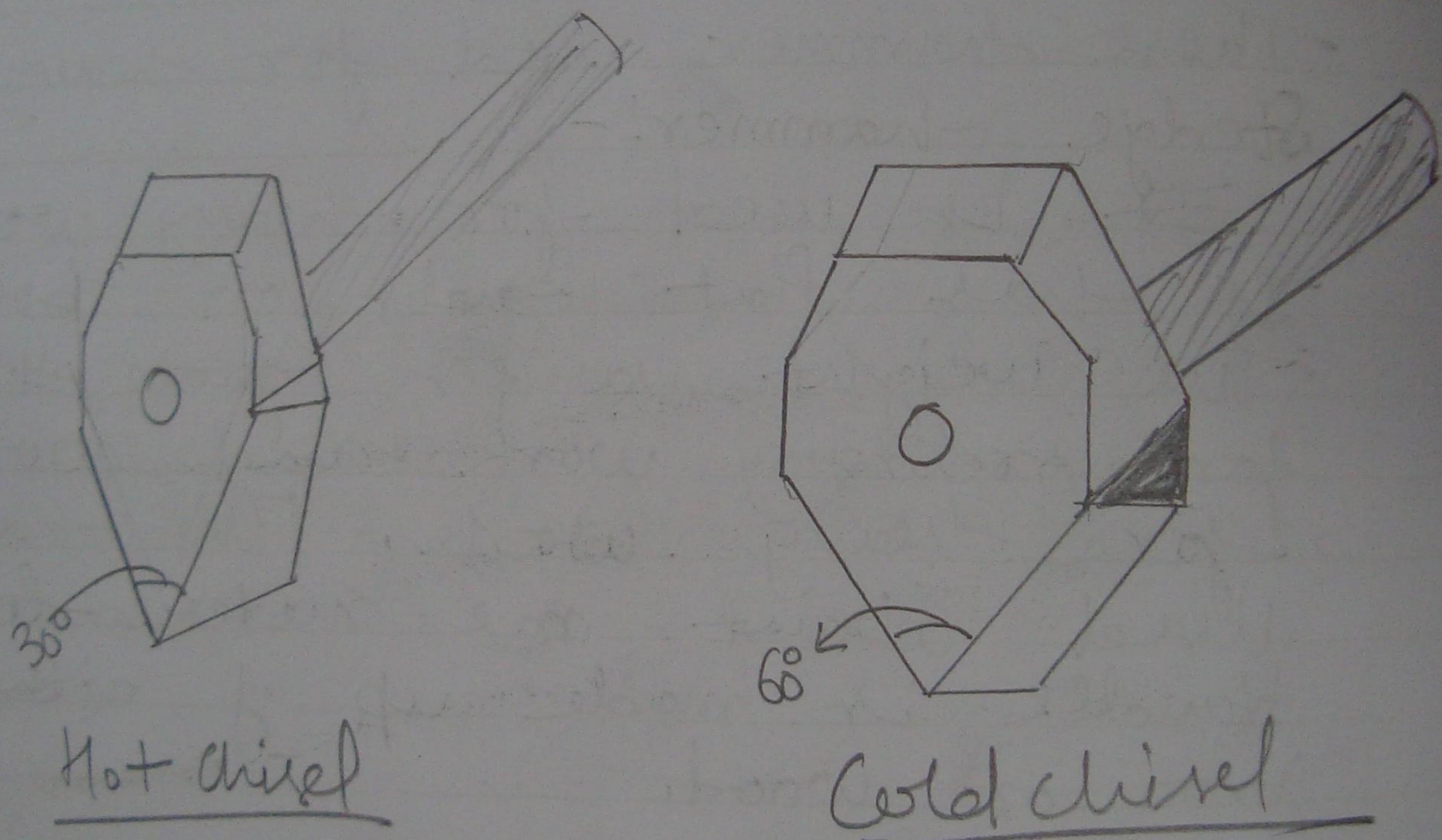
Types of Tonge:-

(i) Flat Tong

(ii) Crad Tong

(iii) King Tong

(iv) straight lip plated tong.



Expt. No. \_\_\_\_\_

## Cutting Tools

It is used for cutting and necking metals prior to breaking. Two types of chisel are normally used

- i) Cold chisel
- ii) Hot chisel

### Cold chisel:-

It is made up of tool steel with a cutting angle of about  $60^\circ$  and its edge is hardened and tempered.

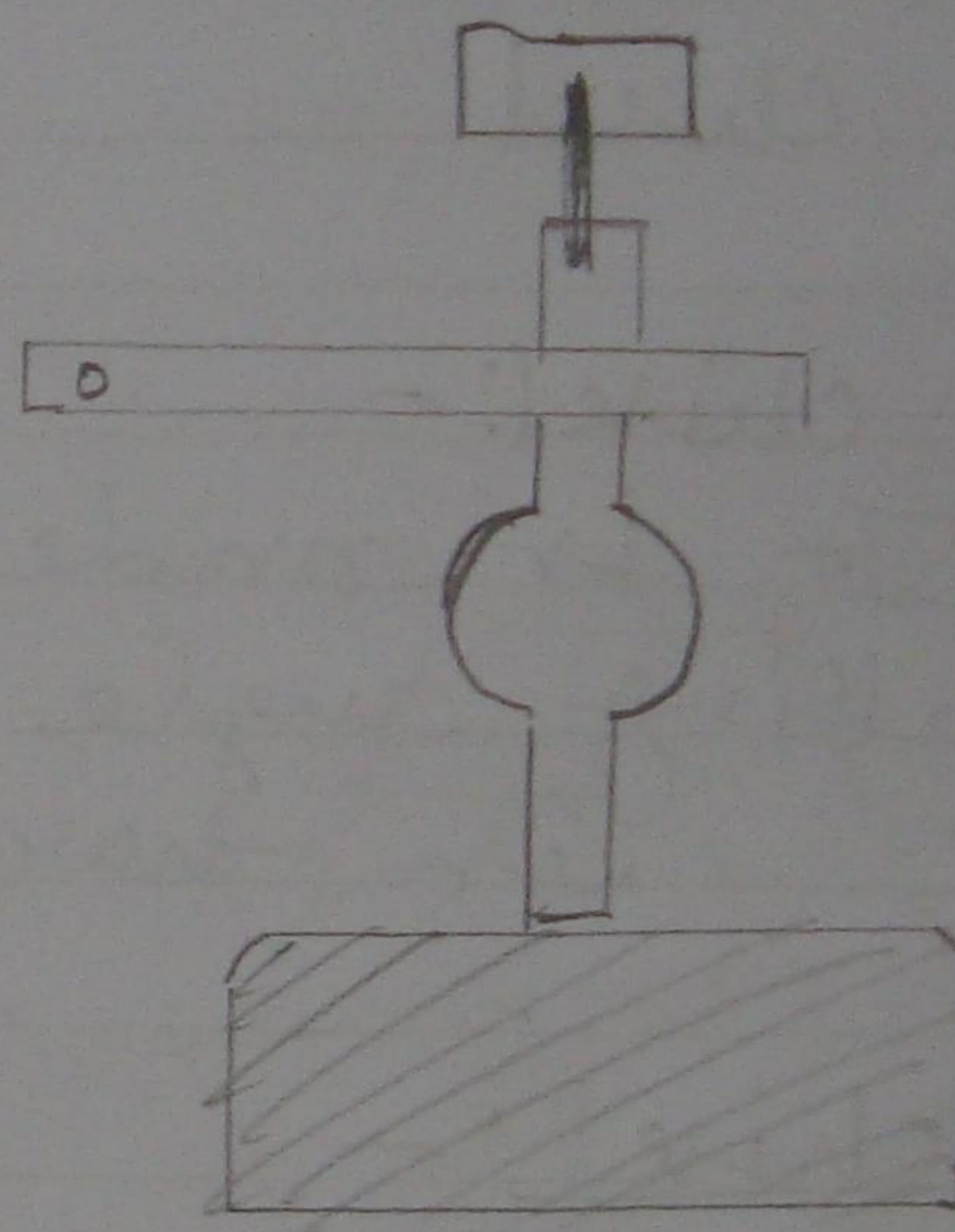
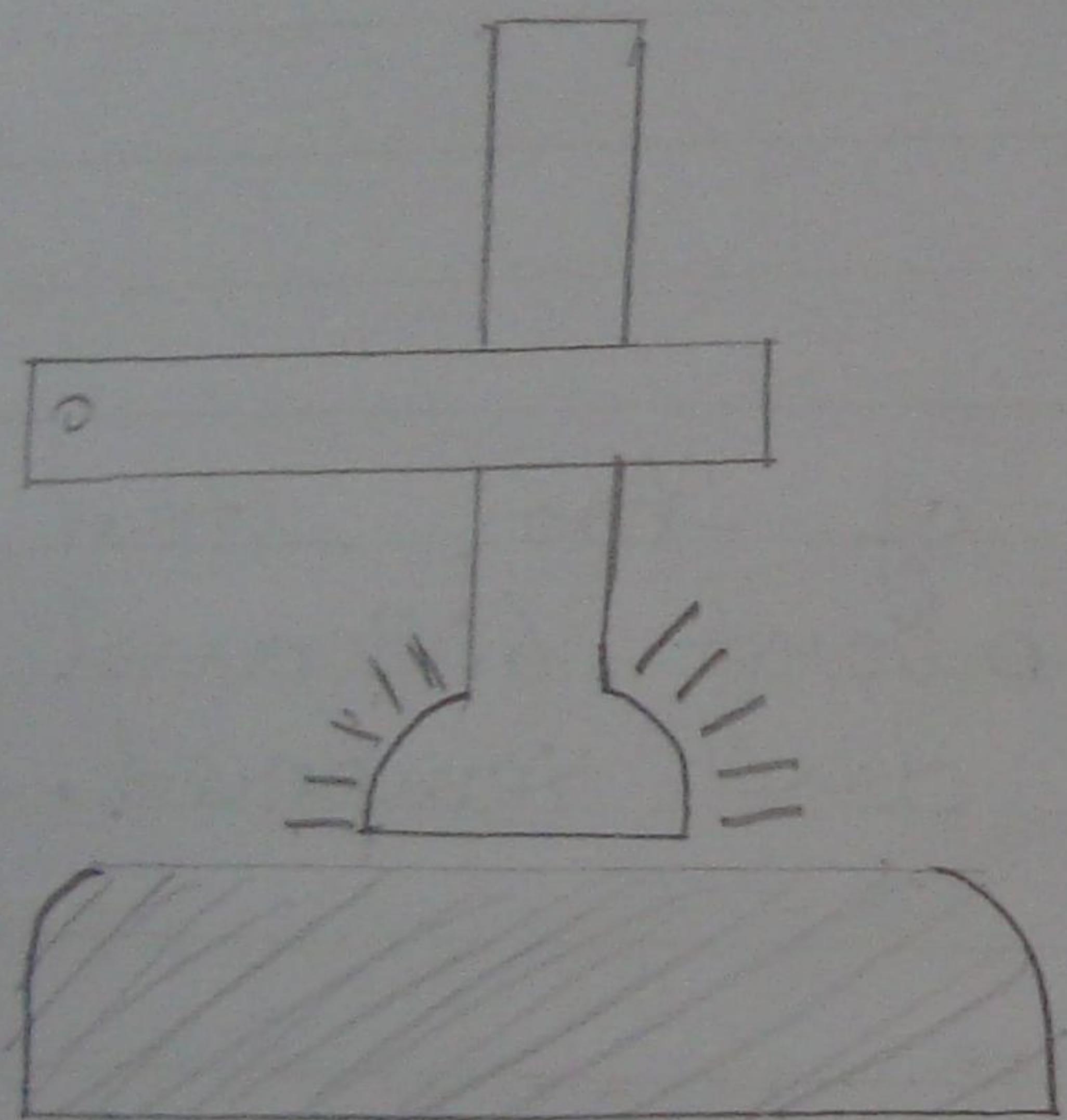
### Hot chisel:-

It is made up of low carbon steel and has a cutting angle of about  $30^\circ$  and its edges does not require hardening.

## finishing & shaping

These tools are used to give the desired forms and shapes

- i) Swages:- Swages are used for work which has to be reduced and finished to round, square or hexagonal forms. It is made up of high carbon steel. The swage may be in separate top and bottom halves.



Upsetting

Expt. No. \_\_\_\_\_

ii) flatters! - The flatters is used after the job has been forged in to shape with a hammer and the hammer marks can be seen on the job surface.

common smith forging operations  
So many operations can be carried out by means of heating the work piece and hammering operations.

The typical smith forging operations are:-

- (i) Upsetting or jumping
- (ii) Setting down
- (iii) Punching and chiseling
- (iv) Bending
- (v) Forge welding
- (vi) cutting
- (vii) fullering
- (viii) Drawing

1. Upsetting or jumping! -

It is one of the process of increasing the thickness of the job and reduced the length by application of hammering operation.

2. Drawing down

It is the operation of increasing the

length of the bar or job by reducing the application of hammering operation.

#### 3. Setting down

It is the process of local thinning down of the work piece by hammering.

#### 4. Punching and Drifting

Punching is the process of making holes on the workpiece. After punching hole can be enlarged by hammering a tapered drift into the hole until the required bore size is reached.

#### 5. Bending

It is one of the main operations to bend the work pieces as we required. It is worked out on the anvil by hammering.

#### 6. Forge welding

It is one of the method of joining the metals or bars by heating and hammering.

#### 7. Cutting off

Cutting off is a form of chiselling operation where by a long piece of stock is cut into several specified lengths.

S. Allusion:-

It is one of the process of spreading the metal along the length of the bar of workpiece by hammering and in which the job is kept blue hot.

Type of forging:-

- (i) Hand forging
- (ii) Machine forging
- (iii) Deep forging

Applications of Smith forging

- It is used to fabricate components like bolts, nut, hook, keys etc.
- It is used to originate agricultural tools and links used in various application.

Advantages of Smith forging:-

- The Smith Forging components have high strength and give great resistance to impact and fatigue loads.
- It improves the grain structure of the metal so that its mechanical properties are also improved.
- Better surface finishing can be easily achieved.

## Disadvantages of Smith forging

- It is very difficult to achieve the accurate dimensions and tolerances, some metals may break while forging.
- There is some limitations to achieve the shape and size of the job.

## SMITH FURNACE:-

The following open hearth furnace is generally used for blacksmith applications.

## Safety precautions for Smithy

1. Work slow and always be aware of your audience.
2. Separate the audience from your forging area as much as possible. Use a rope barrier, display table or something to make a boundary. People tend to move closer and closer as they get involved in watching.
3. Always wear your safety glasses, and if possible have your viewers wear them also.
4. Preferably, keep your audiences in front of you instead of on the sides.

Teacher's Signature : \_\_\_\_\_

Job-1

Qn:- To make a chisel from a square headed rod.

Material:- square headed rod

Tools Required:-

- (i) Block with furnace
- (ii) Tongs
- (iii) other relevant tools
- (iv) Hammer
- (v) Anvil

Sequence of operation:-

- (i) Heating
- (ii) Hammering
- (iii) Forming octagonal shape
- (iv) Tapering one end
- (v) Finishing
- (vi) Checking
- (vii) Cooling

Working Steps:-

- (i) first half length of bar stock was heated.
- (ii) The heated end is put on the anvil by holding the other end by tongs.

- (iii) Hammering was carried out, convert the square bar to an octagonal headed bolt. The same operation was repeated on remaining half of bar length.
- (iv) Now the end of the octagonal bar was heated.
- (v) Forging to flat taper was done by hammering any two opposite faces.
- (vi) The chisel was turned a quarter turn and the narrow sides were hammered to make them parallel.
- (vii) The blows were altered, for coarse on the wider surface then fine or fine off narrow surface. Until the chisel is in desired shape.
- (viii) After the chisel was formed, heat treatment involving annealing and hardening was performed.

Result:-

The desired chisel is obtained.

