SAFETY IN THE WORKSHOP

A large number of workshop accidents occur; some of these are in factories and some in schools. These accidents may result in death, in the loss of limb, or in some other permanent injury. Fortunately, in most cases they result only in shock and possibly a visit to the local hospital for a few stitches.

Serious accidents may occur when power-driven machinery is in use, even though belts and moving parts are enclosed as far as possible. An operator who is careful at first may—when he has become familiar with the machine—become careless and take risks. Eventually, he will meet with an accident which he may be tempted to call bad luck. Confidence is necessary, but over-confidence should be avoided at all costs. The machine operator should never take a chance.

The first thing the operator should find out is the quickest way to stop his machine. He would do well to practise stopping his machine until he is satisfied that he can do this in an emergency. Boys should start a machine *only* when the teacher is present and he has given them permission to do so. Boys who do not have permission to use machines should resist the temptation to meddle with them. They should also avoid crowding round the operator of a machine which is in use.

Rags, cotton waste, or loose garments should *never* be allowed near rotating machinery. It is serious enough if the rag becomes caught up in the rotating machinery, but if fingers are also involved, they unfortunately cannot always be disentangled in time to avoid an accident. Loose ties should be tucked well away or even taken off. Aprons should preferably be tied behind.

Ensure that work is securely fixed in a machine before it is started. Always check that chuck keys have been removed before starting lathes or drilling machines. Keep the bed of the lathe clear of tools. When using a drilling machine, hold the work in a drilling vice, hand vice, or mole grips.

The chips or cuttings from a lathe or drill are razor-sharp, and should not be handled. The edge of metal cut with the bench shears is also very sharp and should be handled with care. It is sensible to remove the burrs from any metal with which you may be working, before your fingers become torn or scratched. If sheet metal vice jaws are in use to protect the work make sure that these cannot catch the fingers during filing.

Remember that the operation of a machine is a full-time job. The operator's attention should never wander. He should not walk away leaving the machine running, neither should he allow anyone to interfere with the machine he is using.

All tools, machines, and benches should be cleaned thoroughly after use. During work, the tools should be kept in a neat and tidy manner on the bench. A clean and tidy workshop is usually a safe workshop.

Cultivate the safety-first habit. Remember the machine is stronger than you. If you follow simple and elementary rules and precautions it is unlikely any serious accidents will occur.

Questions

1. Why should rags never be allowed near rotating machinery ?
2. What is the first thing a machine operator should know ?
3. Name three things that you should check before starting a lathe.
4. Give two safety rules you would follow when using a drilling machine.
5. State three ways, in which you could cut your fingers if you were careless.
6. What rule of tidiness would you follow concerning the tools and machines after work ?
7. Complete the following sentence correctly using (*a*) or (*b*). The operator of a machine should (*a*) concentrate on the work he is doing and know how to stop his machine in an emergency, (*b*) watch what other people are doing.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

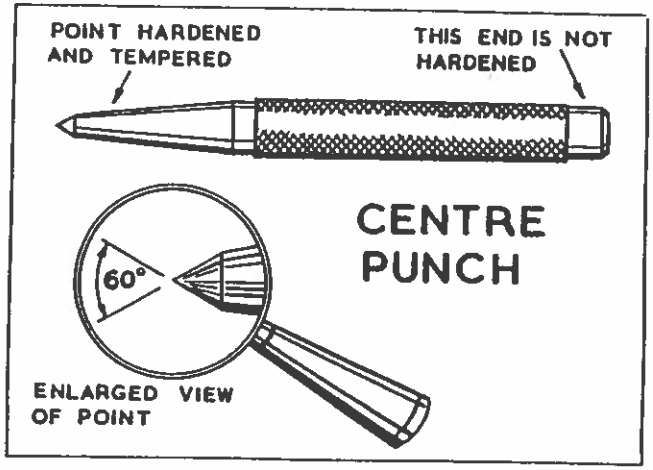
THE CENTRE PUNCH

The centre punch, as the name indicates, is used for marking centres. If the centre is to mark the centre of a hole for drilling, it is made deeply with a heavy hammer blow. If the centre is to mark the centre for an arc or circle, it should be struck lightly, to produce a small centre dot. Centre dot marks are also used for marking outlines and patterns on metal.

When marking the centres for holes the punch should be struck lightly at first, and the mark should then be examined to make sure it is in the correct position. If the mark is inaccurate the punch can be led towards the correct position by inclining it and tapping it over to the correct place.

Centre punches are made of cast steel, hardened and tempered. When round they have a knurled finger-grip, but they are frequently made of octagonal cast steel. Centre dot punches should be ground on the grindstone to an angle of 60° at the point. Heavy-duty centre punches are ground to an angle of 90° at the point.

Centre punches can be made quite well in the school workshop.



Questions

1. Describe three purposes for which a centre punch may be used.
2. Complete the following sentence correctly using (*a*) or (*b*). The centre punch is made (*a*) of cast steel which may be hardened and tempered, (*b*) of mild steel of low-carbon content.
3. How is a centre punch sharpened ?
4. Describe how you would mark the centre of a hole for drilling.
5. How would you correct a slightly inaccurate centre dot ?
6. Reproduce the drawing of a centre punch given above.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

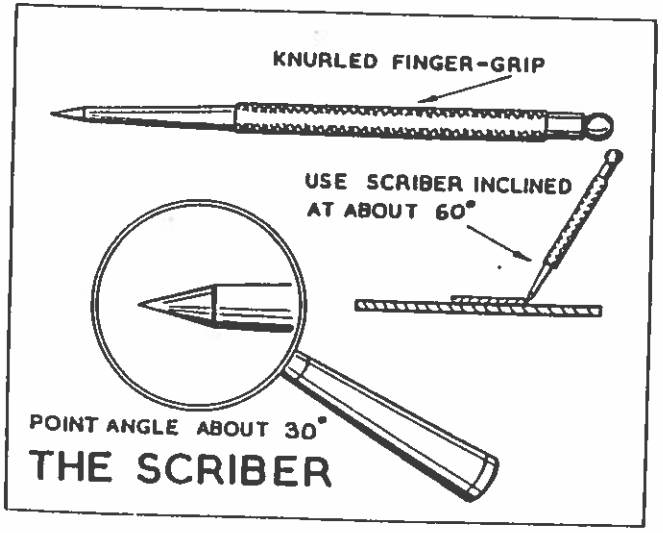
THE SCRIBER

The scriber is used for marking lines on metal. There are various types of scriber, but nearly all have points of cast steel, hardened and tempered.

The points of the scriber must be kept sharp. They are ground on a grindstone to an angle of 30° to 40°. They are rather brittle, and care should be taken to ensure that they are kept in good condition.

Scribers usually have a knurled finger grip. Some have replaceable points.

Scribers can be made quite well in the school workshop.



Questions

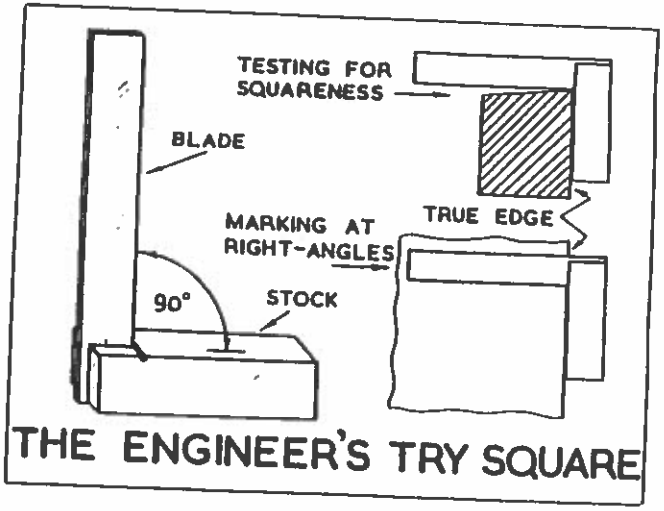
1. What metal are scribers made of ?
2. How is a scriber maintained in good condition ?
3. Complete the following sentence correctly using (*a*), (*b*), or (*c*). The scriber is sharpened (*a*) with a file, (*b*) at an angle of 60°, (*c*) with a grindstone at an angle of 30° to 40°.

THE ENGINEER'S TRY SQUARE

The try square is used for marking lines at right angles to an already trued edge or surface, and for testing edges and surfaces to see whether these are straight and square. When in use the stock is always held firmly against the true edge.

The most important characteristic of the square is that the blade is set in the stock at exactly 90°. Great care must be taken of the square to ensure that it is not damaged in any way; it must not be dropped or thrown.

Squares are obtainable in several sizes, the size being the inside length of the blade. Most squares are *relieved*—that is, a small groove is made in the stock to allow for small burrs on the edge of the metal being tested.



Questions

1. Reproduce the drawing given above.
2. What is the most important thing about the try square ?
3. How is a try square used ?
4. For what purpose might you use a square when filing ?

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

SOME MARKING OUT HINTS

The first step in the production of good, accurate work is accurate marking out. It is impossible to produce good work unless the lines to work to are clear, precise, and in the correct places. A little extra time and care taken with marking out is well worth while.

Frequently, marking out is done from a blueprint. All dimensions should be included on the blueprint although these sometimes take a little looking for. It is not good practice to place the rule or dividers on the blueprint to read off measurements. The blueprint may be to a scale—not full size—in which case the scale will be stated on the blueprint.

The rule used for taking measurements should preferably be made of stainless steel. Non-stainless steel rules tend to blacken with use and the graduations become blurred. However, these may be cleaned with fine emery cloth, and a coat of transparent lacquer applied after cleaning will give them a longer life. Paint or white lead is sometimes rubbed into the graduation lines to make them clear. Wooden rules are not precise enough for metalwork.

Scriber lines, or lines made with the spring dividers, are not easy to see on steel. There are several ways in which they may be made to show clearly.

1. The metal may be wiped over with copper sulphate solution, or dipped into the acid tank used for pickling copper. A copper deposit is left on the surface of the steel, and when this is broken by the scriber the line shows up well.
2. A useful marking out fluid may be made by dissolving gentian violet in methylated spirit and adding shellac or button polish. This is brushed on to the metal, and dries quickly, leaving a blue surface which shows marking out well.
3. If the steel is heated in a clean flame, it will become blue by the formation of oxide on the surface. This also allows marking out to be clearly seen.

If a scriber or a pair of spring dividers is used to mark on tinplate the sharp point will scratch the tin, leaving an unsightly mark which will allow the metal to rust. Scriber marks should be avoided on decorative brass or copperwork as they are very difficult to remove, and they also spoil work in aluminium or other soft metals. You can use a brass scriber for marking out tinplate. However, for work in soft metals a sharp hard pencil is frequently the best method of marking.

Marking out metal that is going to be heated in the forge presents a special problem, and chalk is very useful for this. A chalk line will remain and show even on red-hot metal. When drawing down on the anvil, a chalk mark is often made on the anvil face the required distance from the edge to indicate when enough metal has been drawn down. Centre punch marks will also show clearly on red-hot metal, but these must not be used if they spoil the finish of the work.

Centre punch marks are frequently used to clarify a line when metal has to be machined. They should split the line. When the work has been machined to the line half the centre dot will remain.

Marking out presents many problems that the student will have to solve for himself. One that frequently arises concerns arcs which have to be scribed. Sometimes the centre for an arc may come well clear of the metal being marked. In this case the metal may be clamped to a sheet of black iron, and a centre dot made on the sheet to hold the divider leg.

Questions

1. Name two methods of coating steel so that marking out can be clearly seen.
2. Why is it important to mark out clearly and accurately ?
3. Complete the following sentence correctly using (*a*), (*b*), or (*c*). Chalk is very useful when marking (*a*) decorative copper work, (*b*) metal that is to be made red-hot, (*c*) tinplate work.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

THE COLD CHISEL

Cold chisels are made of octagonal-section cast steel, hardened and tempered at the cutting end. Cold chisels are made in several types. The type in general use is the *flat chisel* shown on page 25. Other types include the *cross-cut*, the *half-round*, and the *diamond-point* chisels.

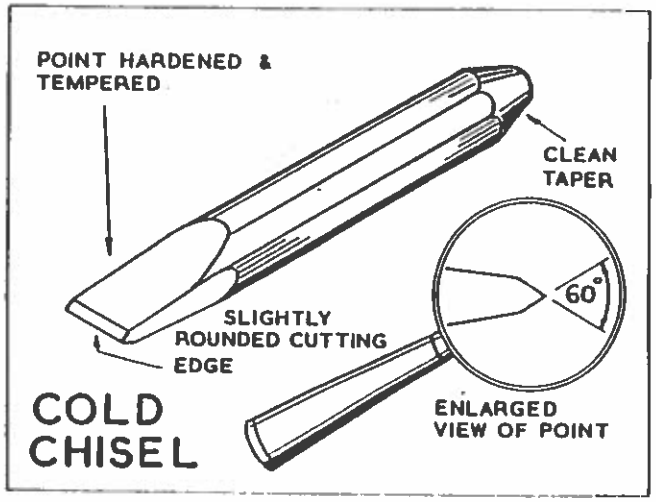
The cold chisel is called 'cold' to distinguish it from the blacksmith's chisel, which is used on red-hot metal. The cold chisel is used on cold metal.

Cold chisels are used mainly for cutting mild steel. It is important that the work being cut rests on a very solid foundation, such as the chipping block. Work may be sheared with the chisel, the work being held in the vice, but work should not be cut on the back of the vice.

The cutting edge of the chisel is ground on a grindstone on both sides, to form an included angle of 60°. This cutting edge is *slightly* rounded.

The cold chisel is not a very precise or accurate tool. Allowance must therefore be left for finishing to the line with a file. Another disadvantage is that it tends to spread the metal being cut, particularly when this is sheet metal.

A cold chisel can be made quite well in the school workshop.



Questions

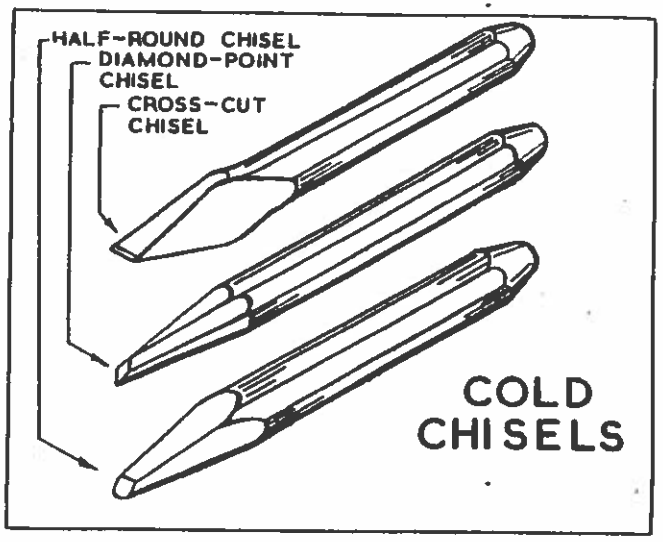
1. What metal is a cold chisel made of ?
2. Why is the chisel termed 'cold' ?
3. Name four types of cold chisel.
4. Complete the following sentence correctly using (*a*) or (*b*). The flat cold chisel is sharpened (*a*) with a file to an angle of about 30°, (*b*) with a grindstone to a point angle of about 60°.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

COLD CHISELS NOT IN COMMON USE

The term 'cold chisel,' usually means the flat cold chisel and the word 'flat' is usually left out. The flat cold chisel is in quite common use. There are, however, other less common types of cold chisel.

The Cross-Cut Chisel: Used for cutting grooves in metal—for example, to form a keyway. The cross-cut chisel is sometimes called a *cape chisel*. It has a narrow cutting edge. The blade is ground in such a way that it is narrower behind the cutting edge. It will not then bind in a groove.



The Diamond-Pointed Chisel: This may be used for cutting V-shaped grooves—for example, for guiding a drill back to the correct position if it has been started out of true. It may also be used to cut out waste metal from the corners of square holes.

The Half-Round Chisel: This is similar to the diamond-point chisel, the difference being in the cutting edge. The half-round chisel has a round cutting edge and is therefore used for cutting round grooves or for trimming fillets.

All cold chisels are made of cast steel, hardened and tempered.

Questions

1. Name three cold chisels that are not in general use.
2. What metal is used to make cold chisels ?
3. Give one use for (*a*) a cross-cut chisel, (*b*) a diamond-pointed chisel.
4. What is the name of the type of cold chisel which is in general use ?
5. Reproduce the drawing of one cold chisel shown

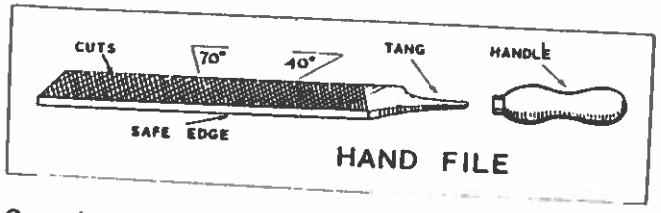
Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

THE HAND FILE

The hand file is widely used. It is parallel for all its length and one edge has no teeth. This edge is called the *safe edge* and it is very useful for working in corners.

Files are made of cast steel, hardened and tempered. The tang, which fits into the handle, is left soft. Hand files may be obtained in several sizes and cuts.

The hand file is easily confused with another type of file, the *flat file*. The flat file has no safe edge and is slightly tapered at the tip.



HAND FILE

Questions

1. Reproduce the drawing of the hand file shown above.
2. What are the characteristics of the hand file ?
3. Complete the following sentence correctly using (*a*), (*b*), or (*c*) : The hand file is made of (*a*) hard metal, (*b*) cast steel, hardened and tempered, (*c*) soft metal.
4. What are the characteristics of the flat file ?

FILES (1)

Files are one of the most important of the metalworking hand tools. They are made in sizes, shapes, and types of cut to suit the work to be done, or the outline to which it is intended to file.

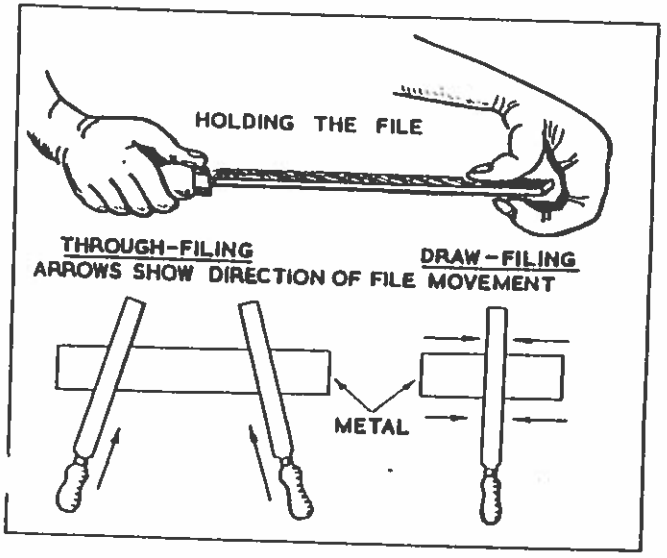
The length of a file is measured along the edge and does not include the tang. The tang is the part which enters the handle. Lengths vary from 75 mm to 500 mm. The sectional form may be flat, half-round, square, round, triangular, or knife edge.

The *cut* of a file refers to the degree of fineness of the teeth. Six types of cut are available: in order of increasing fineness, they are *rough*, *middle*, *bastard*, *second cut*, *smooth*, and *dead smooth*.

The teeth of a file are formed, except in single-cut files, by two separate sets of cuts across the blade. This forms each tooth to a diamond shape.

There are two methods of filing: *through filing* and *draw filing*. In through filing the file is carried forwards along its length in a diagonal direction across the metal and the file should not be allowed to rub on the return stroke. With this method the teeth of the file are cutting to maximum effect. In draw-filing the file is moved forwards and backwards, using the file sideways instead of along its length. With this method the teeth of the file are scraping and a very smooth surface may be produced.

Soft metals clog the teeth of files with small lumps of metal. When this happens the file is said to be *pinned*. These pins must be removed or they will score the metal being filed. Chalk rubbed into the file helps to prevent pinning.



Questions

1. Name the various shapes and cuts obtainable in files.
2. What do you understand by *pinning* ?
3. What is draw filing ?
4. Complete the following sentence correctly using (*a*), (*b*), or (*c*). When we refer to the cut of a file we indicate (*a*) that the file is pinned, (*b*) the degree of fineness of the teeth, (*c*) the size of the file.
5. Why should pins be removed from a file ?

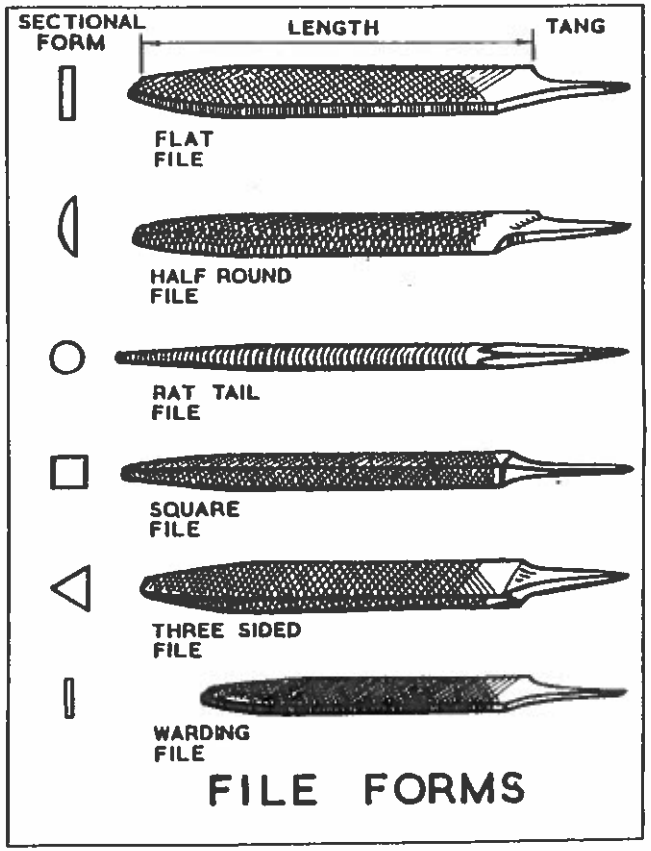
Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

COMMON FILE FORMS

Files are made in many lengths, cuts, and sectional forms. The file is named from its sectional form.

The main sectional forms are illustrated on page and their names and uses listed below.

1. **The Hand File:**
2. **The Flat File:** This file is tapered at the end for about one third of its length. It is double-cut on both faces and single-cut on both edges.
3. **The Half-Round File:** The sectional form of this file is a segment of a circle, not a true half circle. It is tapered both in width and thickness. The flat side is double-cut, and the curved side has rows of cuts at different angles. The half-round file is very useful for filing concave curved surfaces.
4. **The Round File:** This file is used for enlarging holes and slots, and for working very small curves. A common form of round file is the *rat-tailed file*, which tapers to a point. True round files, which are parallel for all their length, are obtainable in some sizes.
5. **The Square File:** This file is double-cut on all sides. Like the round file, it is nearly always tapered. It is used for working in corners and square slots, and for filing round holes square.
6. **The Three-Sided File:** The sectional form of this file is an equilateral triangle. All sides are double-cut and the file tapers slightly at the point. It is used for filing angles that are less than 90°, for sharpening saws, and for working in confined spaces.
7. **The Warding File:** This is a very thin file, with a sectional form just like the flat file. Warding files are made only in small sizes. They are used only when a file of normal thickness cannot be used—for example, when filing a narrow slot.



Questions

1. Reproduce the drawings given above.
2. How would you tell whether a file is a hand file or a flat file ?
3. Name three files which have the same sectional form.
4. Which file would you use for (*a*) filing large concave curves, (*b*) filing very small concave curves ?
5. Complete the following sentence correctly using (*a*) or (*b*). The warding file is a type of file (*a*) that is very small and thin, (*b*) that is used for sharpening saws.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

FILES (2)

It is not easy to produce a flat surface by filing. A true surface is only obtained if the file is correctly used, and plenty of practice is necessary.

The work must be firmly held in the bench vice as low as possible—that is, with as little of the work as possible projecting. This should prevent the work vibrating. The feet should be well spaced apart on the ground in order that the operator may move his whole body forwards with the file, without losing balance. The file must remain horizontal throughout the stroke. If the file is allowed to rock during the stroke, a rounded surface is produced.

The file should be held at the tip between the thumb and fingers with the thumb on top. The handle is held firmly in the other hand.

The teeth of a file are quite easily broken. It is therefore important to look after files. They should not be thrown together in a heap and care should be taken in cleaning if the file becomes pinned. Files should be cleaned with a file card.

The surface of the metal must be tested during filing, to make sure that the filing is being correctly done. A straight edge—such as a steel rule or engineer's square —should be placed on the surface, and checked for accuracy by viewing the area of contact for light. When a large amount of metal has to be filed away, most of the metal should be cut away with a rough- or bastard-cut file, the surface later being smoothed with a second-cut or smooth file. The finished surface may be smoothed by draw filing.

Files should, as far as possible, be used on soft metals when they are new. They should be used on zinc, brass, wrought iron, and mild steel, in that order. When a file has been used on steel it does not cut brass or other soft metal very well.

Questions

1. Describe how you would produce a flat surface by filing.
2. How is the metal held when filing?
3. Describe how you would hold a file and make a stroke.
4. Files should not be thrown together. Why?
5. If you had to cut away a large amount of metal, in what order would you use the types of files?
6. Describe one way in which you might test the surface of the work you are filing to see if it is true.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

DRILLING MACHINES

The majority of school workshops are equipped with one or more power-operated, sensitive drilling machines. These may be either of the *bench type* or the *pillar type*. The pillar type stands on the ground. The bench type has a shorter stem and stands on a bench.

The drawing on page 30 shows the main parts of a typical bench drilling machine. The stem is mounted exactly at right angles to the base. The drilling table may be raised, lowered, or turned to accommodate large or small work, and drills of different length. The drilling table is exactly at right angles to the drill. Care must be taken of the drilling table. The drills must not be allowed to mark or make holes in it.

The electric motor at the top drives a V-belt, which is fully enclosed for safety. The belt may be moved over a range of pulley wheels to give different spindle speeds. The up and down movement of the spindle is by means of a sensitive, spring-return handle. A depth stop is generally fitted which may be set to stop the drill at any required position.

The chuck is three-jaw and self-centring to take parallel shank drills up to 12 mm diameter. It is normally possible to remove the chuck with its arbor (see Section 31, No. 1) when using large, tapered shank drills.

Before using the drilling machine check the spindle speed by looking at the position of the belt: in general, the larger the drill the slower should be the speed of the spindle.

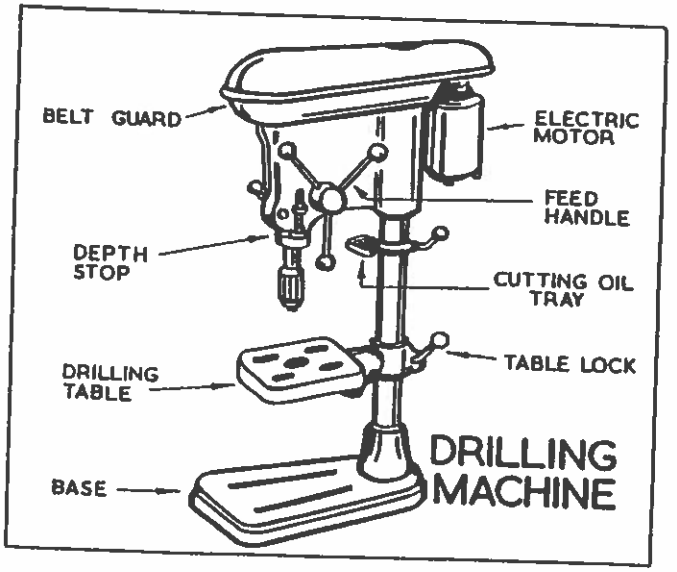
The work being drilled is generally held in a machine vice. It must never be held in the hands. It is possible to bolt this vice to the drilling table, and when using large drills it may be wise to do so.

When fixing a drill in the chuck take care that all three jaws are holding the drill, particularly when using small drills. The jaws should rest on the shank of the drill and not the flutes. The chuck key should be properly engaged before tightening.

Remember to take the chuck key out before starting the machine.

Many workshops have a portable electric drill. These are very useful for light work and for work that cannot be moved to the drilling machine.

After each work period the drilling machine should be thoroughly wiped down and left clean.



Questions

1. State one thing you should check before using the drilling machine.
2. State two things you should check after putting a drill in the chuck of the drilling machine.
3. How is the spindle speed of the drilling machine altered ?
4. Complete the following sentence correctly using (*a*) or (*b*).
   As a general rule the spindle speed of the drill should be ..... the smaller the drill.
   (*a*) slower (*b*) faster
5. What is the difference between a pillar drilling machine, and a bench drilling machine ?

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

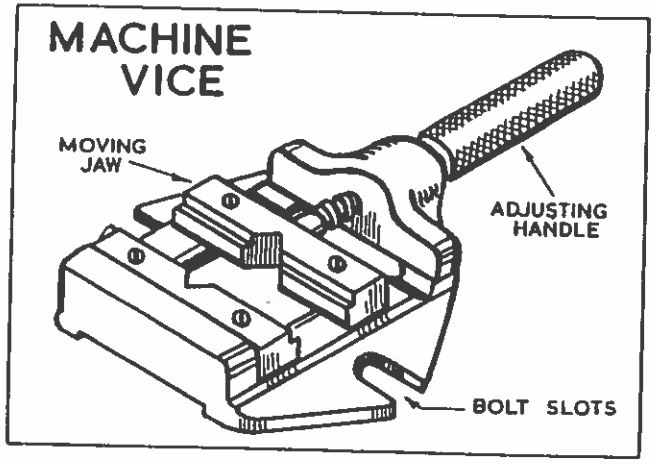
THE MACHINE VICE

When metal is being drilled it must be securely held. Thin sheet is held in a hand vice or with sheet metal *mole grips*; the work is then supported on a wooden block. Thicker metal is held in a *machine vice* which, as it is mainly used for drilling, is frequently called a *drilling vice*.

Very many types of machine vice are available. They are all made to rest on the platform of the drilling machine and may, if necessary, be bolted to it.

The jaws of the vice are made so that they will securely hold round, square, or flat work.

When using the machine vice ensure that the drill does not



pass through the metal and into the vice. This would spoil the vice and probably break the drill.

Questions

1. What is the main purpose for which a machine vice is used ?
2. Reproduce the drawing of a machine vice given
3. Explain one way in which the machine vice could be spoiled.
4. Name two tools used to hold thin sheet which is being drilled.

SOME MORE USEFUL DEFINITIONS

1. **Blank:** A piece of metal prepared for a metalworking operation—for example, a bolt prepared to have the thread cut, or a disc prepared for shaping into a bowl.
2. **Blind Hole:** A hole which does not go right through a piece of metal.
3. **Blueprint:** A drawing, usually fully dimensioned and to scale, showing all the details of the job to be done.
4. **Chromium:** A very hard, non-corrosive, silver-coloured metal used for electroplating. It is also used alloyed in special steels.
5. **Friction:** The resistance to movement between two surfaces that are touching each other. Friction between moving surfaces produces frictional heat and wear.
6. **Oxide:** The chemical compound formed when oxygen combines with another element.
7. **Peripheral Speed:** This is the speed at which the outside of an object travels. The periphery of a bicycle wheel is the tread of the tyre; this obviously moves faster than the hub for each revolution as it has further to go. Peripheral speed must be considered when large and small drills are being interchanged in a machine, or when large-diameter metal is being turned in the lathe.
8. **Sweating:** A method of soft soldering. The two surfaces to be joined are separately coated with solder. They are then brought into contact, and the soldered surfaces are melted together by the application of heat.

Questions

1. Two drilling machines are set to run at 500 r.p.m. One drilling machine has a 6·35 mm drill and the other a 12·7 mm drill. Which drill has the greater peripheral speed?
2. Give an example of the use of a special steel containing chromium.
3. Give an example of possible damage to tools caused by frictional heat.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

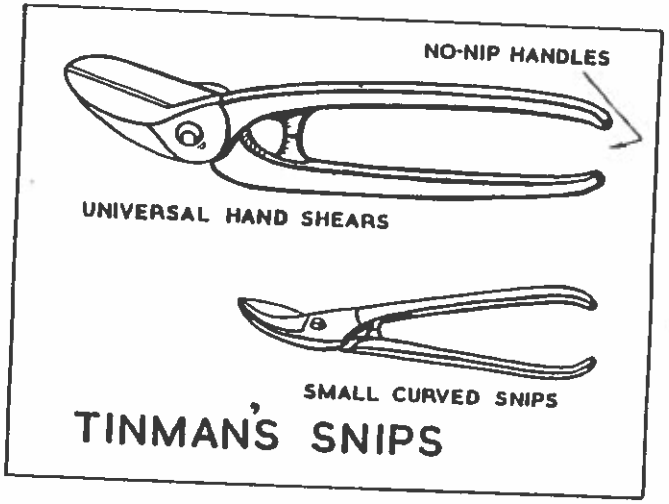
THE TINMAN'S SNIPS

The tinman's snips, or *tin snips* as they are commonly called, are used not only for cutting tinplate but also for cutting all other soft sheet metal up to about 1 mm thick. Above this size sheet metal is usually cut with bench shears.

Snips are obtainable in quite a variety of sizes and types. Probably the most useful are the *universal shears*. These are very strongly made, and the blades are shaped so that they make either straight or curved cuts. The *straight snips* are for making straight cuts and for cutting large external curves. The straight snips are particularly useful in the larger sizes. The *curved snips* are very suitable for cutting small curves. The blades are curved, and they are particularly useful in the small sizes.

Some snips have curved handles which close together completely as the snips are used. With these it is possible to injure the hand when the snips close suddenly at the end of a stroke. Preferably, snips with straight handles should be used.

When using tin snips the cut metal on the left should be raised and the cut metal on the right should be lowered. In this way a long cut through a sheet of metal can be made without cutting the fingers on the sharp edge left on the metal. When making an important cut the snips should not be closed completely, as this leaves a small kink in the metal.



Questions

1. Reproduce the drawing given above.
2. What is the main use for tin snips ?
3. Name three types of tin snips, giving the uses of each.
4. Complete the following sentence correctly, using (*a*) or (*b*). When making a long cut in sheet metal with the tin snips (*a*) the cut metal on the left should be gently raised, (*b*) the cut metal on the right should be gently raised.

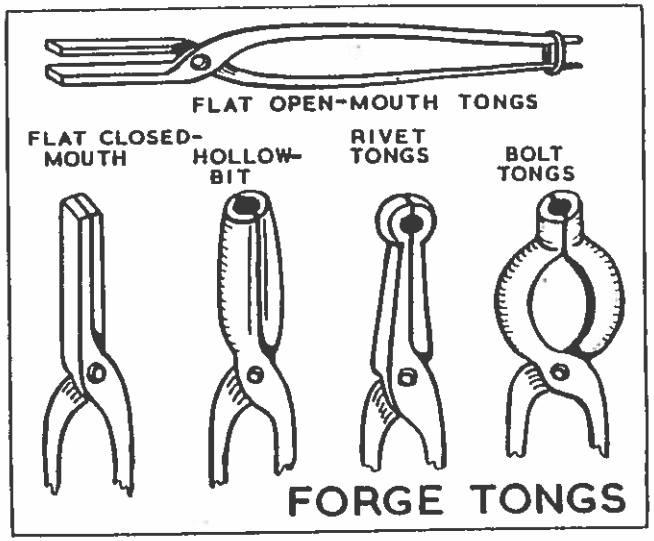
Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

FORGE TONGS

Forge tongs are used for holding hot metal while it is being worked on the anvil. The tongs should not be held in the forge with the metal that is being heated, or they will lose their shape and their correct grip. Whenever possible it is better to do without the tongs. For example, if a ring is to be formed, the ring may be shaped on the end of a fairly long piece of metal and cut off when nearly complete. The piece of metal thus used is called a *handling piece*. Steel is a poor conductor of heat and the work can usually be completed before the handling piece becomes too hot to hold.

Forge tongs are made in several different shapes to suit different bars or rods. *Flat closed-mouth tongs* are for holding thin strip. *Flat open-mouth tongs* are for holding thicker-section flat bars. *Hollow-bit tongs* are for holding round, square, or octagonal sections. These hollow-bit tongs are made in large and small sizes. Other tongs in less general use are the *rivet tongs*, which hold rods at right angles to the tongs; the *bolt tongs*, which are similar to hollow-bit tongs but are shaped to allow for a bolt head; and the *pick-up tongs*, which are used for small or very light work.

A ring is sometimes used on the handles of tongs. This replaces the continuous finger grip that would otherwise be necessary.



Questions

1. Reproduce the drawings of forge tongs given above.
2. Name four types of forge tongs and give the main use for each.
3. What is meant by the term *handling piece*?
4. Complete the following sentence correctly using (*a*) or (*b*). If forge tongs are left in the fire to become very hot (*a*) they lose their correct grip on the metal, (*b*) they become hardened and tempered.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

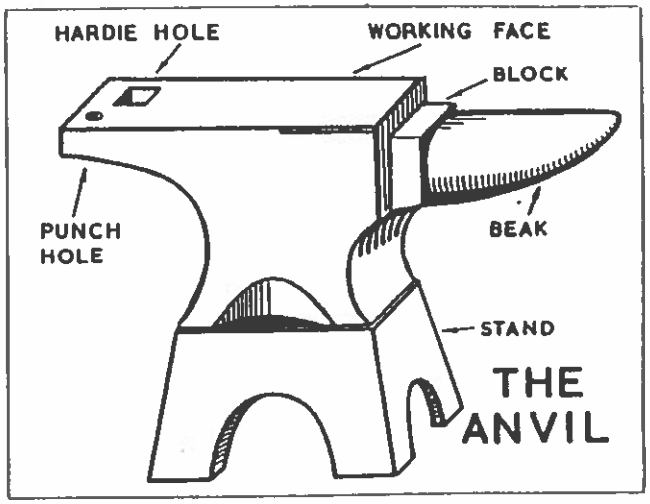
THE ANVIL

The anvil is used for forge work. If you examine it you may think it has an unnecessarily complicated shape, but this has, in fact, been developed to meet the requirements of the blacksmith's trade. The anvil is mounted on a cast iron stand to raise the working face to a convenient height.

The anvil is made of wrought iron or mild steel, with a working face of cast steel welded on. The *block*, which is the ledge between the working face and the beak, is left soft. It is possible to cut on this block without damage either to the chisel or to the working face. The *beak*, which is also soft, is shaped so as to include quite a variety of curves, and is used for shaping curved work such as rings. The *hardie hole* is made to take the shanks of hardies and swages. The *punch hole* is used when driving a punch through hot metal.

When using the anvil the operator should face the side of the anvil with the beak on his left. He can then conveniently use the rounded edge on the far side of the anvil.

The anvil that is usually provided for school use weighs about 50 kg and has a working face 100 mm wide. Blacksmiths prefer the anvil to be mounted on a wooden block. This makes it quieter to use, and gives a little more springiness to the hammer. It is possible to obtain some of these advantages by mounting the stand on a wooden frame.



Questions

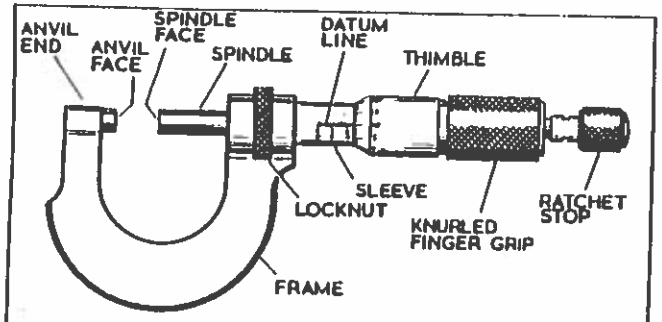
1. Name five parts of the anvil.
2. What is the main purpose for which the beak of the anvil is used ?
3. What metal is the anvil made of ? What metal is the working face made of ?
4. What is the correct position for the operator when using the anvil ?
5. Reproduce the drawing given
6. Complete the following sentence correctly using (*a*), (*b*), or (*c*) The block, which can be used for cutting on, is a part of the anvil (*a*) that is used to form rings and curved surfaces, (*b*) that forms the stand, (*c*) that forms a step between the working face and beak.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....

THE PARTS OF A MICROMETER

The list below gives the names given to the parts of the external micrometer.

1. **The Anvil End.** Measurement into slots is made easier by the thin, tapered frame.
2. **The Anvil and Spindle Faces.** These are perfectly flat and hard.
3. **The Spindle.** This is one piece of special alloy steel having a very accurate thread inside the sleeve. The spindle is hardened.
4. **The Steel Frame.** This part is held when the instrument is in use.
5. **The Locknut.** This locks the spindle at any reading, without altering the setting.
6. **The Sleeve.** This is very accurately divided, and clearly marked.
7. **The Datum Line.** Readings are taken on this line. It is 25 mm long and divided into 25 major divisions. Each major division is sub-divided into two by a line on the other side of the datum line.
8. **The Thimble.** This is accurately divided into 50 equal parts, and clearly marked.
9. **The Ratchet Stop.** The use of this ensures the correct pressure between the spindle and anvil faces.



EXTERNAL MICROMETER

Questions

1. Reproduce the drawing given above.
2. Describe the external micrometer, giving the names of the important parts.

USING THE MICROMETER

The micrometer is used to take very accurate measurements. The rule or the calipers cannot be used to measure a 1/100 mm, but the micrometer can.

Micrometers are of two main types: *external micrometers* measure the outside diameter of work; *internal micrometers* measure the inside diameter of tubes, rings, and so on. The external micrometer is the one that is generally used in the school workshop.

The micrometer consists of a semi-circular frame having a fixed pad at one side (the anvil) and a moveable spindle at the other side. Measurements are taken between these two.

In use, the micrometer is held by the semi-circular frame, opened sufficiently to allow it to pass over the work; it is held perfectly square with the work and closed.

The micrometer should be closed using the ratchet stop. This will give the correct pressure between the spindle and anvil faces. The locknut may be used. However, it should be possible to withdraw the micrometer and take a reading without using the locknut.

The micrometer must be drawn off the work gently and squarely, and the reading made.

It is normal for one micrometer to have a small range of measurement. Thus a micrometer may have a range of measurement 0 to 25 mm or 25 to 50 mm.

Questions

1. Name the two main types of micrometer.
2. Describe how a micrometer is held and closed when taking a reading.
3. What is the normal range of measurement of any one micro meter?
4. Complete the following sentence correctly using (*a*) or (*b*) The micrometer is used to measure to within (*a*) 1/100 mm, (*b*) 1·5 mm.

Name:	Class:	Homework No.:.....	Date:	Parent's signature: .....