JUNIOR WORKSHOP B

ANSWER GUIDE 1

D.Schlyder

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HEALTH AND SAFETY

1. A dirty and untidy work area can be the cause of accidents. List three examples of poor 'housekeeping' in the metal shop.

a. *For example: Untidy or cluttered work benches.*

b. *Materials or oily substances on the floor (trip or slip hazard).*

c. *Combustible materials such as oil soaked rags stored in cupboards.*

2. Briefly describe the potential safety hazard that could be caused by using a cold chisel or centre punch with mushroom heads.

The mushroom heads can break off and become dangerous projectiles when struck with a hammer.

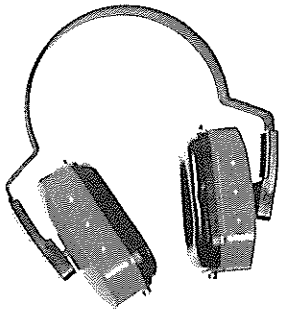
3. List three examples of personal protection that should be observed in the workshop.

a. *For example: Footwear should be strong and in good repair.*

b. *Rings and watches should not be worn.*

c. *Reasonably close fitting clothes should be worn.*

4. Name the personal protection device shown on the right.



Name *Earmuffs*

5. Some workshops can be very noisy. How might long exposure to high levels of noise affect a person who doesn't wear suitable hearing protection?

Long exposure to high levels of noise may result in permanent loss of hearing.

6. What is the meaning of the safety sign illustrated on the right?

Eye protection must be worn.

7. List three fire safety precautions that relate to flammable liquids.

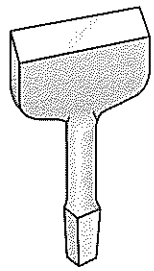
a. *For example: Clean up spillages immediately.*

b. *Remove and wash clothing that is saturated with flammable liquid.*

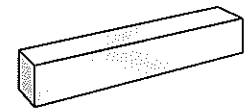
c. *Keep flammable liquids away from sources of heat.*

METALWORK TOOLS AND EQUIPMENT

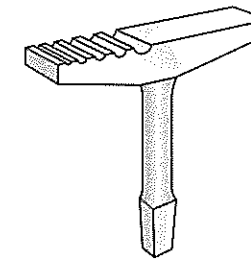
1. Name the sheetmetal working stakes shown in the illustrations below.



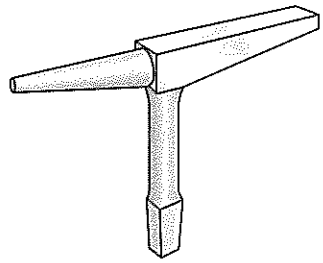
a. *Hatchet stake*



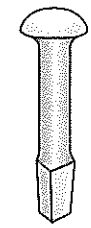
b. *Square mandrel*



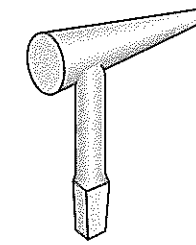
c. *Creasing iron*



d. *Bick (beak) iron*



e. *Dome head stake*



f. *Funnel stake*

2. Name two stakes you could use when turning a folded edge on a piece of tinplate or galvabond.

a. *Bick iron / square mandrel*

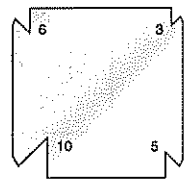
b. *Hatchet stake*

3. Give two reasons why a hammer should not be used to turn a folded edge on a piece of tinplate.

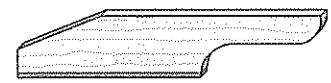
a. *A hammer could dent the material and spoil appearance.*

b. *A hammer could damage the stakes.*

4. Name the sheetmetal working tools shown in the illustrations below.



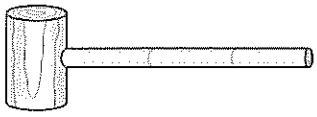
a. *Scratch gauge*



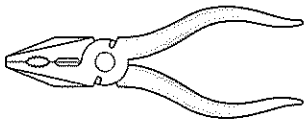
b. *Dresser*

c. *Tinsnips*

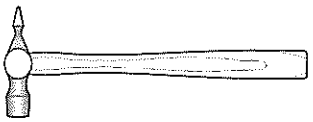
5. Name the sheetmetalworking tools illustrated below.



a. *Tinman's mallet*



b. *Combination pliers*



c. *Cross pein hammer*

6. Which of the following tools would you use to cut a piece of wire for a wired edge?

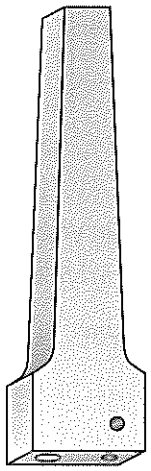
a. Hacksaw
(b.) Combination pliers
c. Tin snips
d. Vice-grip pliers

7. Briefly explain the reason for your choice in question 6 above.

Combination pliers have wire cutters on their edges.

8. Neatly draw a rivet set in the space provided on the right, clearly showing the holes in the face of the tool.

Your sketch could be a pictorial drawing such as an oblique view or it could consist of two orthographic views.



Rivet Set

9. Briefly describe the uses of the two holes in the face of the rivet set.

The deep hole is used to draw the rivet through and the shallow hole is used for doming the tail of the rivet.

10. Name the metalwork tools illustrated below.

a. *Centre punch* b. *Pin punch (solid punch)* c. *Scriber*

11. Which of the tools shown above would be used to punch holes in thin sheetmetal that is to be joined with tinman's rivets?

Pin (solid) punch

12. The diagrams below show a tinplate box positioned on a wooden block ready to punch rivet holes through the seams. Which diagram illustrates the procedure that would give the best result?

a. Diagram A (b.) Diagram B

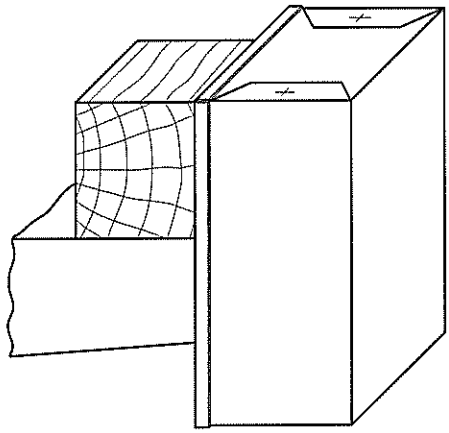


Diagram A

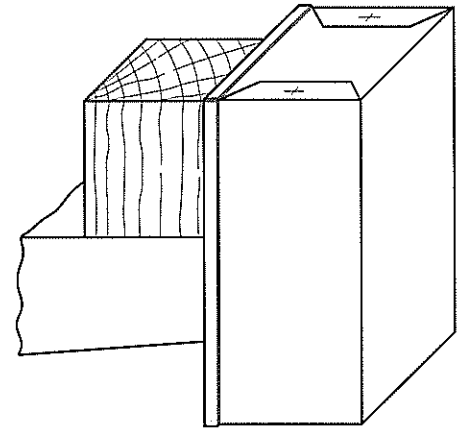


Diagram B

13. Briefly explain your answer to question 12 above.

Waste material from the rivet hole is punched into the end grain of the wooden block giving a cleaner hole in the sheetmetal.

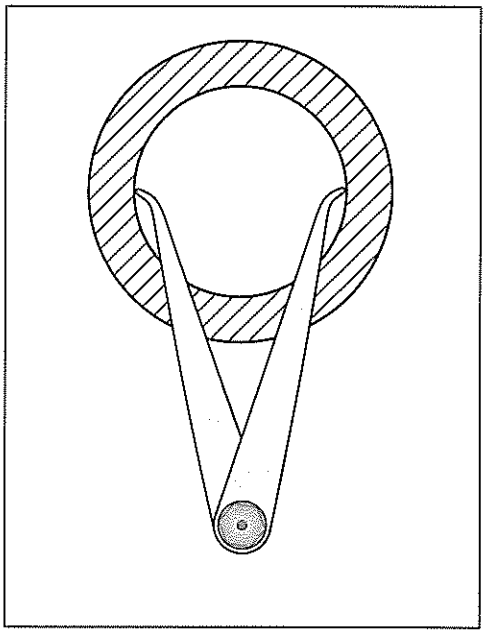
14. Tinman's rivets are usually galvanised. What is the meaning of the term 'galvanised'?

The rivets are coated with the metal zinc.

15. Why are tinman's rivets usually galvanised?

To prevent rusting and corrosion of the rivet.

16. The illustration on the right shows an incomplete section of a hollow steel pipe.



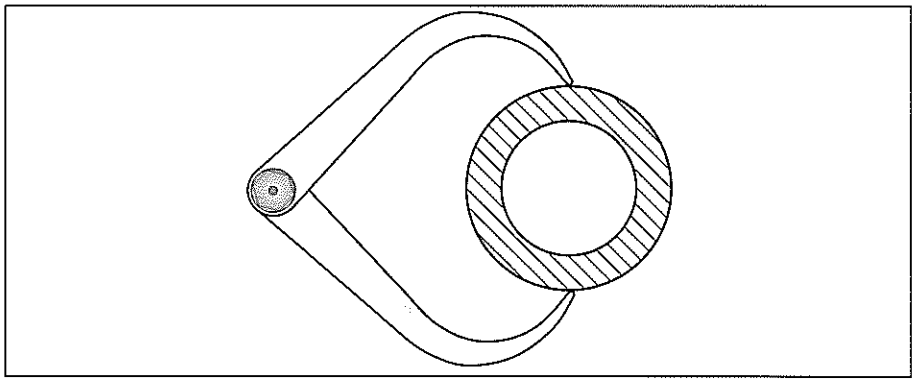
Which of the following tools would you use in conjunction with a steel rule to measure the inside diameter of the pipe?

a. Jenny calipers
b. Inside rule
(c.) Inside calipers
d. Spring dividers

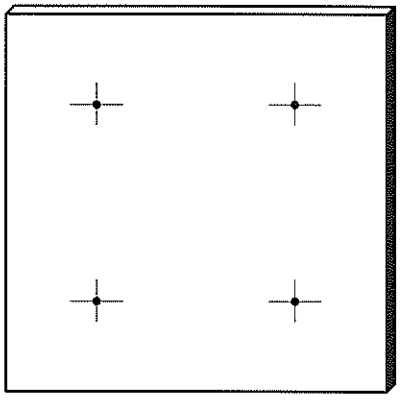
17. Using the diagram on the right, neatly draw the tool you have chosen as your answer to question 16, showing the tool correctly positioned to measure the inside diameter of the pipe.

Also complete the visible part of the section where dotted lines are now shown.

18. The diagram below shows the section of a hollow steel pipe. Complete the sketch illustrating how outside calipers are used to measure diameters.



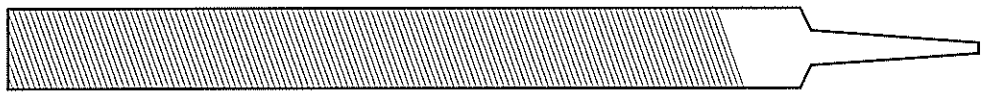
19. The diagram on the right shows a piece of mild steel 50mm x 50mm with the positions of four holes accurately marked ready for drilling.



The holes are to be 5mm in diameter and positioned 12mm from the edges of the piece of steel. List all hand and machine tools you would need to mark out and drill the holes.

Rule, scriber, engineers square (alternatively jenny calipers), centre punch, hammer, 5mm drill bit, drilling machine, face shield.

20. Complete the drawing of the single cut hand file shown below. Neatly sketch in the teeth.

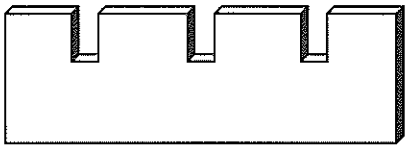


21. List the three most common grades of files commencing with the coarsest.

a. *Bastard* b. *Second cut* c. *Smooth*

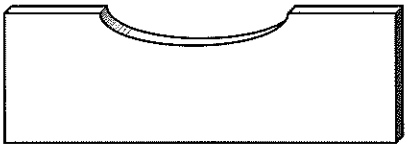
22. Name the file you would use to finish the 4mm slots illustrated in the diagram on the right.

Warding file



23. Name the file you would use to finish the concave shape illustrated in the diagram on the right.

Half round file



24. Diagram A shows a piece of mild steel with edges filed straight and corners square.

List all tools, in the order that they would be used to mark out, cut and file the piece of steel to the shape shown in diagram B.

Edges are to be fine filed to specified sizes and all corners are to be 90°. Tools that are used more than once in the sequence should be listed each time they would be used.

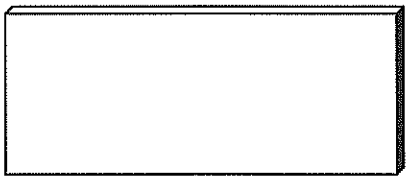


Diagram A

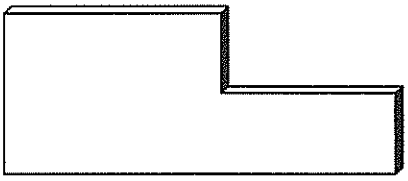


Diagram B

For example: Rule, scriber, engineers square, centre punch, hammer, hacksaw; bastard, second cut and hand smooth files; rule, engineers square, calipers.

25. Name the cutting tool and the tool holder that would be used to thread a short piece of 6mm round mild steel.

Cutting Tool *Button die* Tool Holder *Die stock*

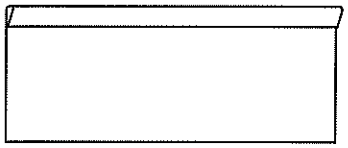
SEAMS AND EDGES

1. List three reasons why sheetmetal projects often require edge treatment.

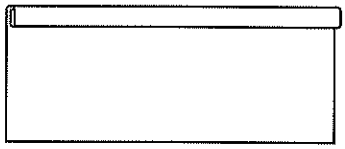
a. *For decorative purposes.* b. *To make edges stronger.*

c. *To make edges safe to handle.*

2. Name the edge treatments shown in the diagrams below.



a. *Folded edge*



b. *Double folded edge*

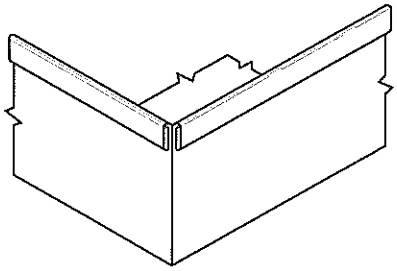
3. The allowance for a wired edge is:

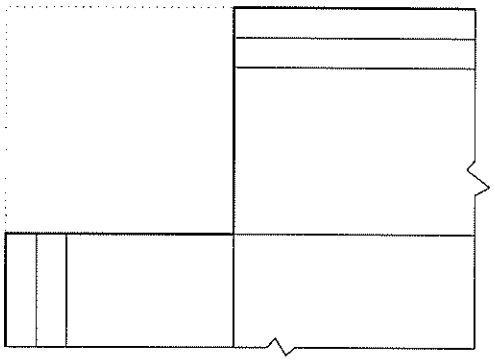
a. 3mm. b. 4mm. (c.) 5mm. d. 6mm.

4. Which of the following seams requires one allowance only?

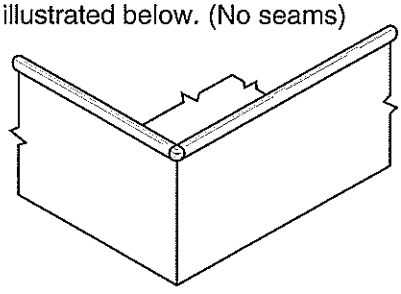
(a.) Lapped b. Grooved c. Folded d. Peined

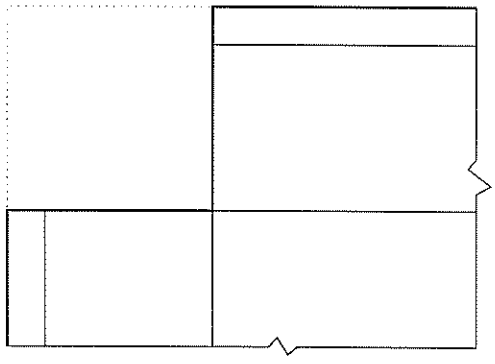
5. Complete the development of one corner of the sheetmetal box with 4mm double folded edges illustrated below. (No seams)





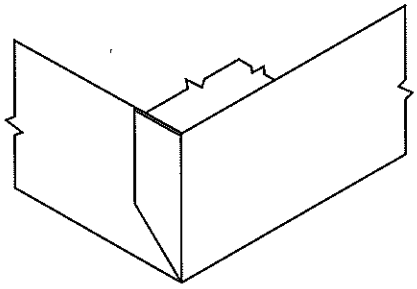
6. Complete the development of one corner of the sheetmetal box with wired edges illustrated below. (No seams)

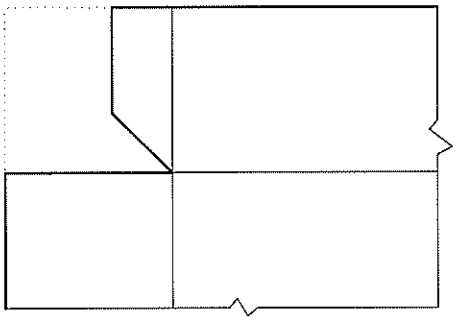




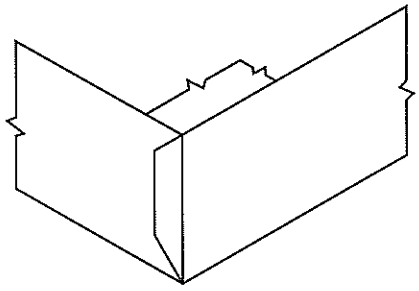
N.B. Notching in the following diagrams is either 90° or 45° as illustrated.

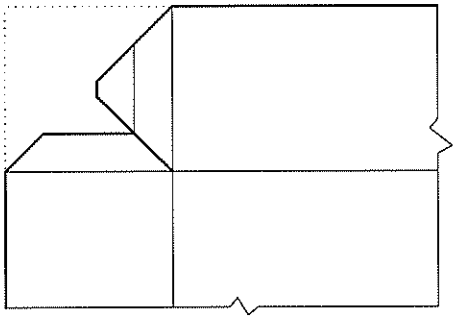
7. Complete the development of one corner of the sheetmetal box with 8mm lap seams illustrated in the diagram below.



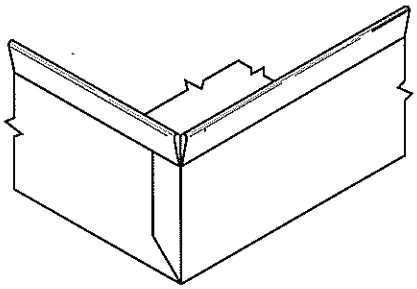


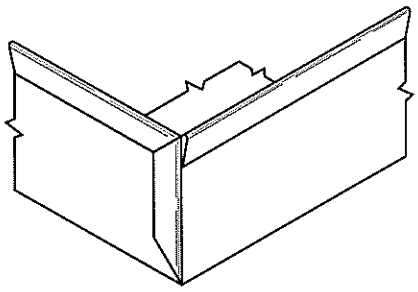
8. Complete the development of one corner of the sheetmetal box with 5mm folded seams illustrated in the diagram below.

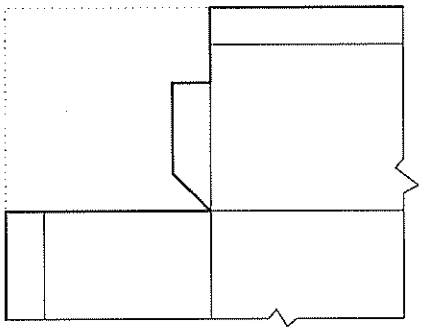


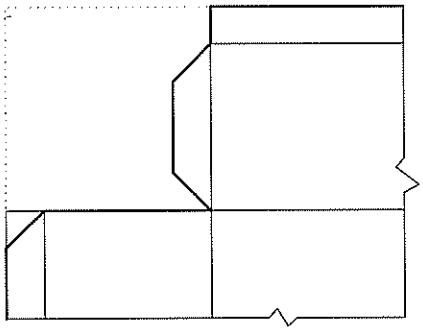


9. Complete the developments of a corner of the sheetmetal boxes shown below. Both boxes have 5mm folded edges and 5mm lap seams which are to be soldered.



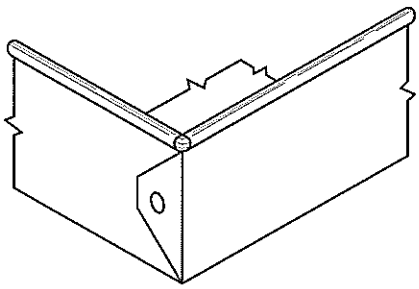


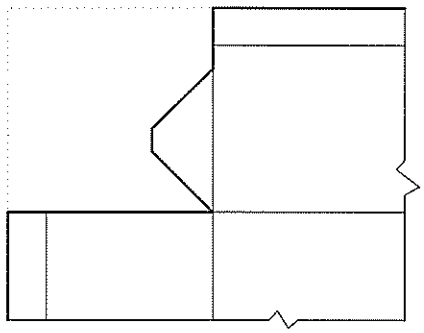




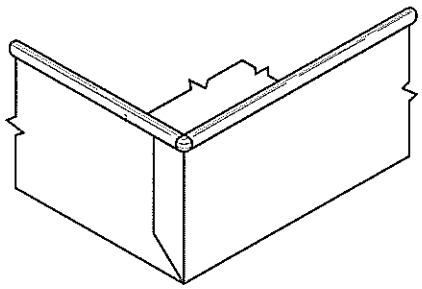
N.B. Notching in the following diagrams is either 90° or 45° as illustrated.

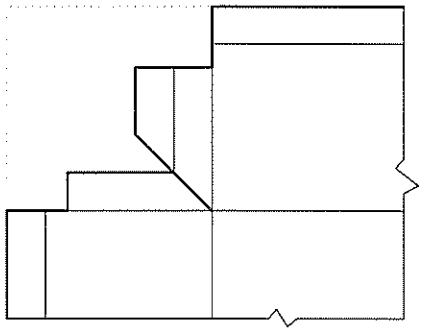
10. Complete the development of one corner of the sheetmetal box with wired edges and 8mm lap seams illustrated below.



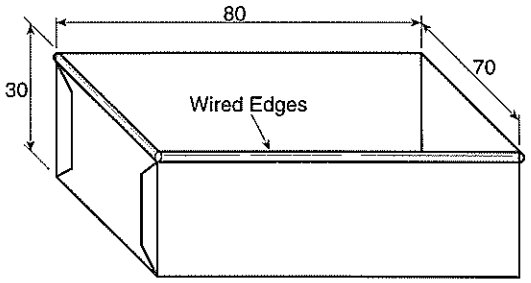


11. Complete the development of one corner of the sheetmetal box with wired edges and 5mm folded seams illustrated below.

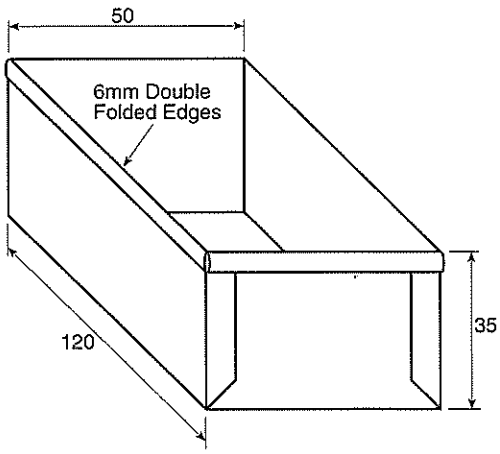




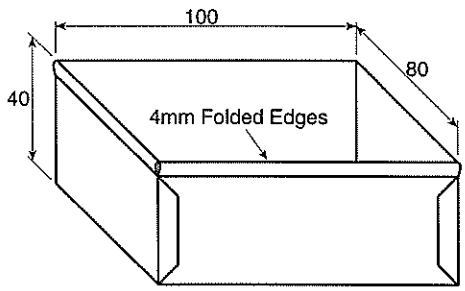
12. Determine the size of the piece of tinplate required to make each of the boxes shown on the right and below.



Material Size *150* x *140*



Material Size *214* x *144*



Material Size *188* x *168*

CLASSIFICATION AND PROPERTIES OF METALS

1. Metals can be broadly classified as pure metals or alloys. Briefly describe an alloy.

An alloy is a mixture of two or more metals.

2. Complete the following statement.

A pure metal contains no impurities or *additives.*

3. Most metals used in industry are in their pure form.

a. True (b.) False

4. Why are other metals added to aluminium in the manufacture of bars, rods, sheets, extrusions and other forms of aluminium used in industry?

Aluminium in its pure form is extremely soft and requires the addition of other metals to form alloys which are more serviceable in industry.

5. Metals can also be classified into ferrous and non-ferrous metals. Briefly explain the difference between these two types.

Ferrous metals are those which contain iron.

Non-ferrous metals are those which have no iron content.

6. Which of the following is a non-ferrous metal?

a. Stainless steel (b.) Gold c. Mild steel d. Cast iron

7. Which of the following is a ferrous metal?

a. Copper b. Aluminium (c.) Tool steel d. Tin

8. The metal zinc can be classified as:

(a.) a non-ferrous metal. b. a ferrous metal.

9. Gold is the most malleable of all metals. Briefly explain what is meant by the term 'malleable'.

Malleability is a characteristic which allows a metal to be rolled or hammered into thin sheets.

10. Name the property of copper which enables it to be readily stretched into wire.

Ductility

11. If a metal has the tendency to break under low stress it is said to be *brittle.*

12. The characteristic 'toughness' in a metal can be thought of as a combination of *strength* and *ductility.*

13. What characteristic of metal can be measured by stretching a test piece on a special machine and recording the stress at which it breaks?

Tensile strength

14. 'Work hardening' of metal is caused by changes in the *crystalline structure* of the metal.

15. Name the method of heat treatment which reverses the effects of work hardening.

Annealing

16. How could you soften a piece of copper sheet that has become work hardened?

Copper can be annealed by heating it to a dull red colour and then quenching it in water.

17. Briefly describe how a piece of tool steel might be hardened.

Tool steel is hardened by heating it to cherry red and quenching it in oil or water.

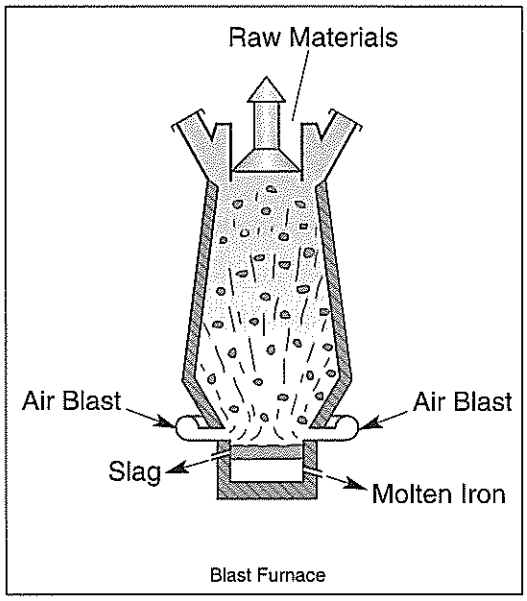
FERROUS METALS

1. Iron ore is also known as:

a. dolomite. b. stalagmite. (c.) haematite. d. satellite.

2. Iron is smelted from iron ore in a blast furnace. In the space provided on the right neatly sketch a blast furnace.

Indicate where the raw materials enter the furnace, where the air blast enters, where the molten iron is tapped from the furnace and where waste material is removed.



Blast Furnace

3. List four raw materials which are charged into the blast furnace.

a. *Iron ore*

b. *Coke*

c. *Limestone*

d. *Iron ore sinter*

4. Which of the raw materials provides the fuel for the blast furnace?

Coke

5. The temperature near the bottom of the blast furnace is about:

a. 190° C. b. 900° C. (c.) 1900° C. d. 9000° C.

6. What is the name of the raw material which acts as a flux in the blast furnace and what is its purpose?

Limestone acts as a flux in the furnace by helping the molten iron to flow.

7. What causes the fierce combustion which provides temperatures high enough to melt the raw materials in the blast furnace?

Air is forced into the bottom of the blast furnace. This causes the coke to burn fiercely.

8. Cast iron has a melting point of:

a. 260° C. (b.) 1260° C. c. 2600° C. d. 12600° C.

9. Cast iron has a high carbon content. Which of the following represents a typical range for carbon content?

a. 1% to 2% (b.) 2% to 5% c. 5% to 8% d. 8% to 12%

10. What is the most common use of cast iron?

In foundry work cast iron is melted down and poured into moulds to form castings which might include products such as machine parts, vices and brake drums.

11. Cast iron is very brittle.

(a.) True b. False

12. Cast iron is:

(a.) very strong in compression but has low tensile strength.
b. very strong in compression and has high tensile strength.
c. weak in compression and has low tensile strength.
d. weak in compression but has high tensile strength.

13. Pig-iron contains several impurities other than carbon. Name four of these impurities.

a. *Silicon* b. *Manganese*

c. *Phosphorus* d. *Sulphur*

14. During the steel making process most of these impurities are removed. What is the other important factor involved in the steel making process?

Addition of the necessary alloying materials to produce the type or grade of steel required.

15. Henry *Bessemer* experimented with purifying large quantities of molten iron in the 1850's.

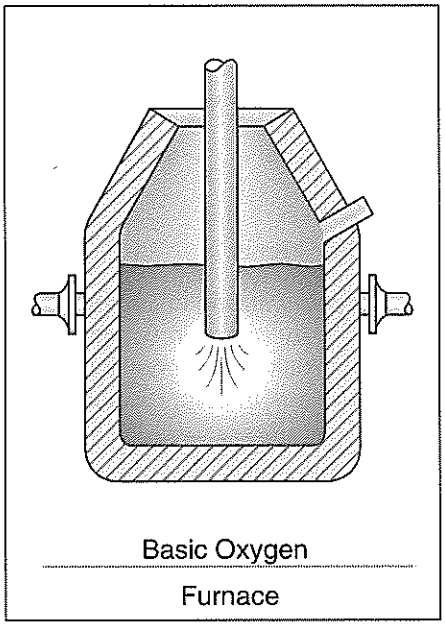
16. In the 1850's a large pear shaped vessel called a *Bessemer Converter* was developed for purifying molten iron.

Briefly describe how it worked.

Air was forced into the bottom of the converter to cause a violent combustion to burn out the impurities. Weighed amounts of ferro-alloys were then added to return the small amounts of carbon, silicon and manganese required.

17. The *Basic Oxygen* process is now used to produce most of the world's supply of steel.

18. In the space provided on the right draw a neat sketch of the furnace used in the modern steel making process and print its name where indicated.



Basic Oxygen Furnace

19. Briefly describe the steel making process after molten iron and scrap are charged into the furnace. Include an explanation of how the required violent combustion occurs.

A jet of pure oxygen is introduced from the top of the furnace to provide the violent combustion required. Trace elements and alloying materials are then added as required.

20. Small quantities of special grades of steel are sometimes produced in an electric furnace. Briefly explain how the necessary heat is produced in the electric furnace.

Electrodes carry a heavy current of electricity which produces heat by striking an arc to the ferrous metals in the furnace.

21. Briefly explain the terms 'teeming' and 'stripping' as applied to the steel making process.

Teeming: Pouring molten steel into ingot moulds.

Stripping: Removing the ingot moulds by overhead crane.

SHEETMETALS

1. Tinplate consists of a thin sheet of metal coated with a very fine layer of tin on both sides. Which of the following is the base metal in tinplate?

a. Cast iron b. Zinc c. Bronze (d.) Mild steel

2. Name the two methods used to produce tinplate.

a. *Hot-dip coating* b. *Electro-plating*

3. Would a plumber be likely to use tinplate to make a rainwater tank?

a. Yes (b.) No

4. Briefly explain the reason for your answer to question 3 above.

The water tank would rust quickly.

5. State one common use for tinplate.

For example: Food and drink cans.

6. Galvabond consists of a thin sheet of mild steel coated mainly with:

(a.) Zinc. b. Lead. c. Tin. d. Aluminium.

7. Would a plumber be likely to use galvabond to make a rainwater tank?

(a.) Yes b. No

8. Briefly explain the reasons for your answer to question 7 above.

The zinc coating would prevent rusting of the mild steel sheet.

9. Describe the process called 'breaking the grain' that is usually necessary when sheet metals are formed into cylindrical shapes.

The metal is rolled first one way and then the other several times to disturb the 'grain' structure.

10. List eight characteristics or properties of the metal copper.

a. *Reddish-brown colour*
b. *Good electrical conductor*
c. *Ductile*
d. *Corrosion resistant*
e. *Malleable*
f. *Soft and easy to work*
g. *Good heat conductor*
h. *Can be highly polished*

11. Name three copper alloys and the metals which combine to make those alloys.

a. *Brass: an alloy of copper and zinc.*
b. *Bronze: an alloy of copper and tin.*
c. *Nickel-silver: an alloy of copper, nickel and zinc.*

12. When copper 'work hardens' it cannot be annealed.

a. True (b.) False

13. List ten characteristics or properties of the metal aluminium.

a. *Silver-grey colour*
b. *Highly reflective*
c. *Light in weight*
d. *Can be highly polished*
e. *Corrosion resistant*
f. *Good heat conductor*
g. *Non-magnetic*
h. *Good electrical conductor*
i. *Non-sparking*
j. *Easy to work*

14. Which property of aluminium is very important in aircraft construction?

Light in weight

15. List four metals or trace elements used to produce aluminium alloys.

a. *Copper*
b. *Manganese*
c. *Zinc*
d. *Magnesium*

16. What is the maximum proportion of added elements in an aluminium alloy?

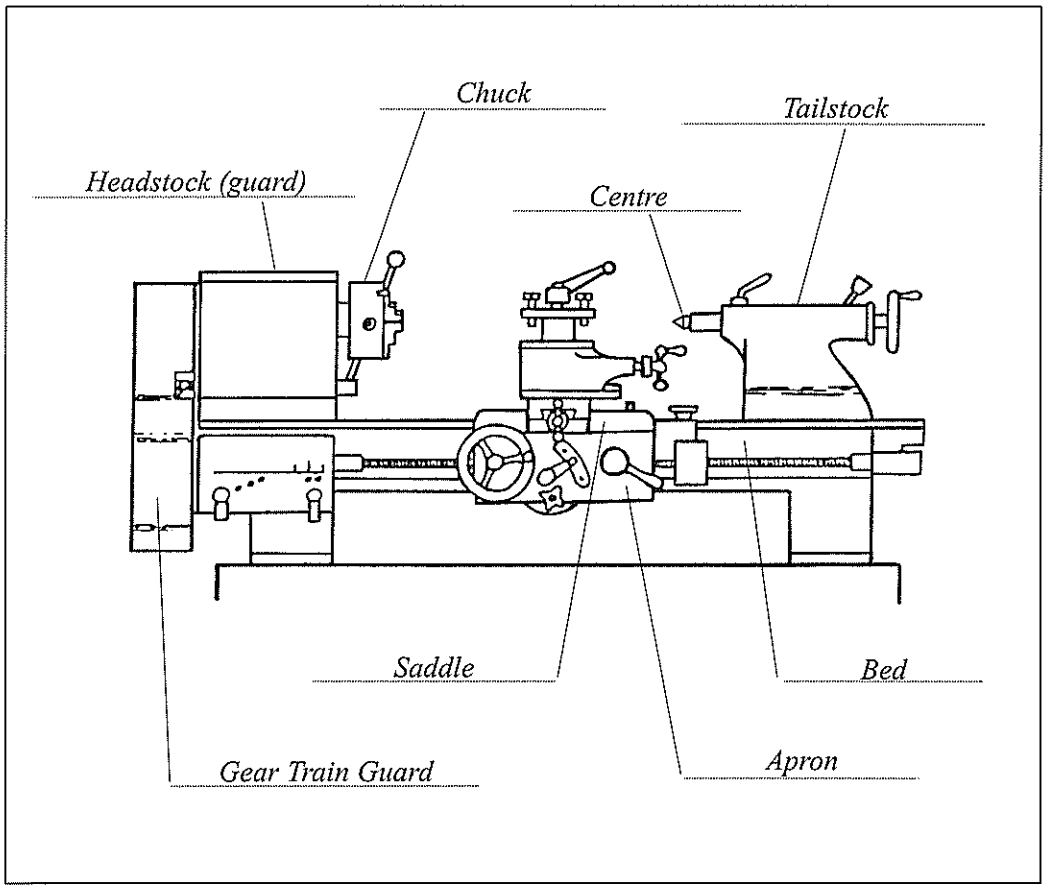
a. 1% b. 5% (c.) 10% d. 20%

17. Alloying aluminium can increase tensile strength by up to:

a. 50%. b. 100%. c. 300%. (d.) 600%.

THE METAL LATHE

1. Name the parts of the metal lathe indicated in the illustration below.



2. The metal lathe is a machine tool in which a piece of material can be held and rotated while it is being shaped by a *cutting tool.*

3. The metal lathe can produce shapes that are *co-axial* with the centre line of the lathe.

4. A metal lathe is driven by an electric motor connected to the headstock spindle. Briefly describe how the spindle speed is changed in a belt driven headstock.

On a belt driven lathe spindle speed is changed by shifting the belt to a different pair of pulleys.

5. What is the most important feature of the three jaw chuck?

The three jaw chuck is self centring. The three jaws move together the same distance from the centre.

6. What is the part of the lathe made up principally by the saddle and the apron?

The carriage

7. Why should the point of a lathe centre be turned or ground accurately to 60°?

Centres are machined to 60° to fit the countersink part of a centre drill.

8. List what you consider to be the three most important personal safety precautions that you should observe *before* commencing to use the lathe.

a. *For example: Wear a face shield to protect the eyes and face.*

b. *Remove or fasten loose clothing which could be caught in moving parts of the lathe.*

c. *Remove rings, watches and other adornments that could be caught in moving parts of the lathe.*

9. List four operating safety precautions that you should observe to avoid injury while using the metal lathe. Do not repeat safety precautions listed in your answer to question 8 above.

a. *For example: Always remove the chuck key from the chuck after use.*

b. *Keep hands away from swarf. Remove swarf with a brush, pliers etc.*

c. *Stop the lathe before making adjustments or measurements.*

d. *Do not leave tools on the saddle or the bed while operating the lathe.*

THE DRILLING MACHINE

1. Name the part of the drilling machine that actually holds the twist drill.

Chuck

2. The drilling machine provides the *rotary* motion and the *pressure* required to cause the *cutting* edges of the twist drill to penetrate the material being drilled.

3. Why are belt driven drilling machines fitted with cone pulleys?

To provide a range of drill speeds from a few hundred to a few thousand revolutions per minute.

4. Speed should be varied according to the size of the twist drill being used. A small drill should be operated at a slow speed.

a. True (b.) False

5. What does the 'HS' which is stamped on good quality twist drills stand for?

High Speed

6. What is the purpose of the 'flutes' which are the spiral grooves around a twist drill?

They provide a channel for the outlet of the waste.

7. List three ways you can ensure that the twist drill does not damage the table of the drilling machine or the machine vice being used.

a. *Set up so the drill passes through the hole in the table.*

b. *Set up so the drill passes between packing strips.*

c. *Use a wood support block under the work.*

8. Why should loose clothing be removed or fastened when you are operating the drilling machine?

Loose clothing could be caught in moving parts of the machine.

9. What would you do if the job you are drilling is seized by the drill and spins around?

Step away immediately and switch the machine off.

Keep hands clear of moving parts.

A DESIGN PROBLEM

SITUATION: You are working on a project in your workshop at home and you find that the cardboard packets you buy your nails in fall apart. When this happens and you have to pick up hundreds of nails off the floor your temper is usually a little short. You decide to make a nail box out of a piece of galvabond left over from a plumbing job you recently completed.

BRIEF: The nail box should have three compartments because you use mainly 15mm, 30mm and 50mm nails. It should be no less than 60mm deep so that each compartment can hold a reasonable quantity of nails. The compartments should be no smaller than 85mm x 65mm for easy access.

INVESTIGATION: Your present financial situation suggests that you should make the nail box out of materials you have on hand. A search of the workshop reveals:

1 piece of galvabond 360mm x 300mm
1 piece of wire 2mm diameter x 630mm
9 tinman's rivets

1. Your workshop is fairly well stocked with sheetmetalworking tools and equipment. You decide to list the tools and equipment you might need to do the job so you can check to see if you have them all.

For example: Rule, scriber, scratch gauge, spring dividers, tinsnips, dresser, combination pliers, pin punch, cross pein hammer, rivet set, bick iron, hatchet stake.

2. List all the types of edge treatment that would be suitable for the box and divisions which form the three compartments.

Wired edge, folded edge, double folded edge.

3. List the types of seams that would be suitable for joining the four corners of the box.

Folded seams, lapped and rivetted seams.

4. List the types of seams and/or joining methods that would be suitable for fixing the divisions into the box.

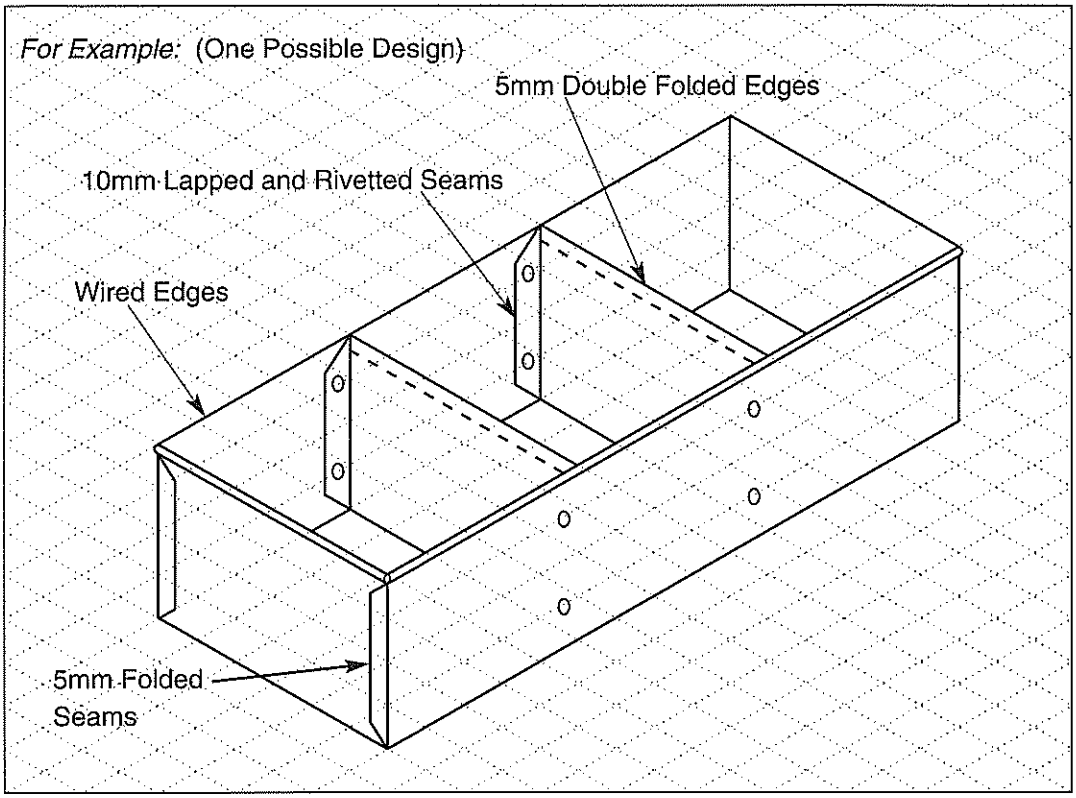
Lapped and rivetted seams.

5. You consider using rivetted seams as a possible joining method for the corners of the box. Would one rivet in the centre of the seam hold the corner together satisfactorily?

a. Yes
b. No
(c.) It would depend on the type of edge treatment used on the box.

6. If you answered 'yes' or 'no' to question 5, give reasons for your answer.
If you chose 'c' as your answer, state which edge treatment you would use.
Wired edge: (A wired edge would hold the top of the box corner together. A folded edge would allow the top of the corner to spread apart.)

7. Using the grid below draw a neat pictorial sketch of your preliminary design. The sketch need not be drawn accurately to scale but should give a good indication of the proportions of the nail box. Clearly indicate the types and size of seams, edges and joining methods used. Do *not* show measurements on the sketch at this stage.



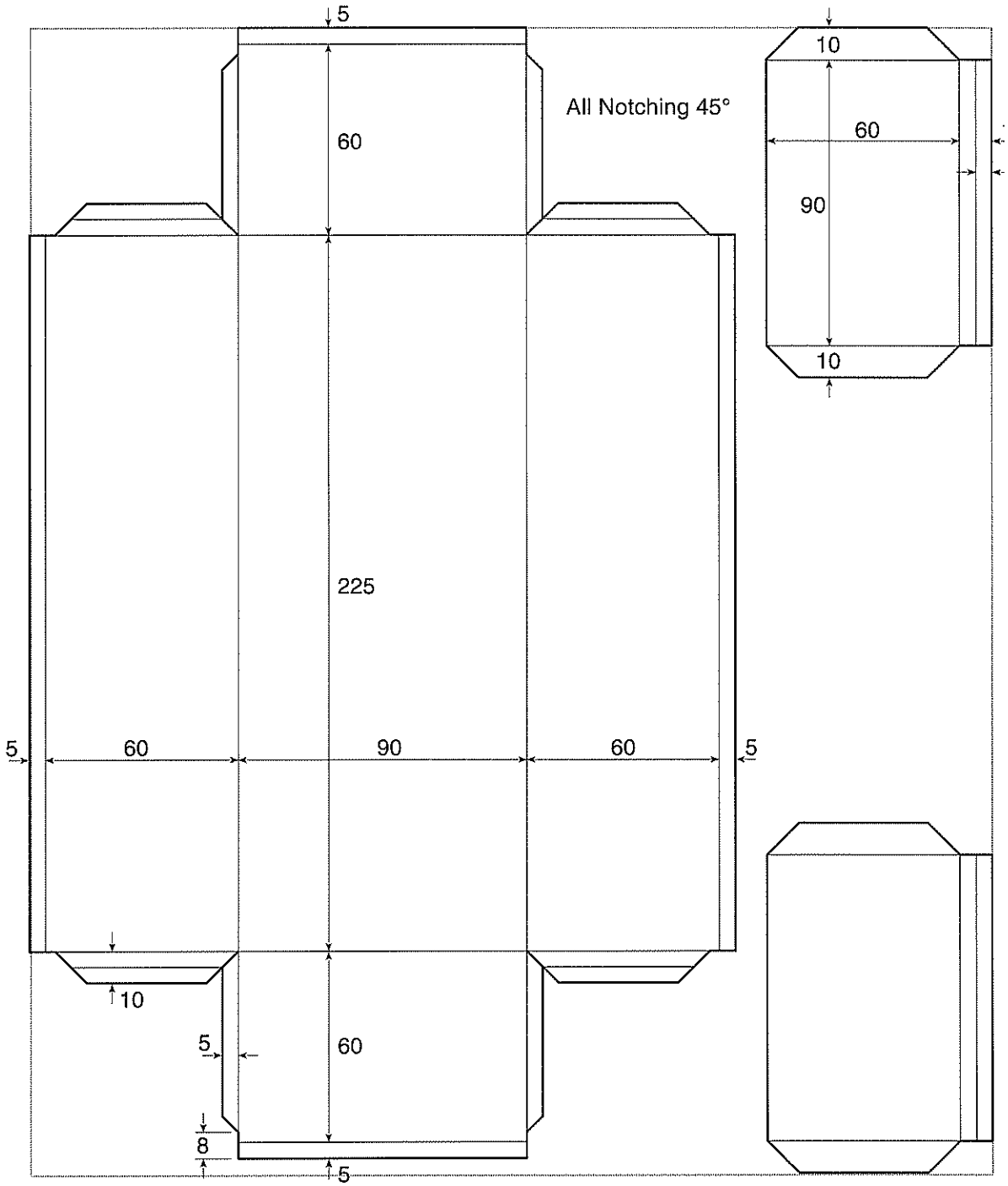
8. From the information given in the *brief* determine tentative overall sizes of the finished box.
Length x Width x Depth
225 x *90* x *60* *(for example)*

9. Calculate the exact material size required to make the box.
355 x *220*

10. Calculate the exact material size required to make the divisions.
110 x *70*

11. The dotted outline below represents the 360mm x 300mm piece of galvabond drawn *half size.* Set out the *half size* development of the box and divisions on the piece of galvabond, showing all edges, seams, folding lines and dimensions.

N.B. If the pieces of material required cannot be cut out of the piece of galvabond represented below, go back to question 8 and re-calculate sizes that will fit.



ART METAL DESIGN

BRIEF: To design a decorative wall plaque.

Theme

The theme of the design is to be 'Flora' and/or 'Fauna' i.e., the image (picture) on the plaque should be based on plants, flowers, animals or birds.

Materials

The back-board of the plaque is to be a piece of veneered particle board.
The picture on the plaque is to be made up of shaped pieces of copper and/or aluminium.
Polishing materials and clear lacquer will be available to finish the copper and aluminium.
The back-board can be either finished with clear gloss polyurethane or matt black enamel.
Metal pieces can be fixed to the back-board with epoxy-resin adhesive.
A vibro-engraver will be available if required.

The rectangle below represents the back-board of your wall-plaque. Sketch the outlines of your design on the back-board and colour or shade the drawing of the finished wall plaque. Use appropriate colours but do *not* use spirit pens.

The individual student's response to this design exercise may depend on imagination and artistic ability. However the main purpose of the exercise is not necessarily related to creativity but to:

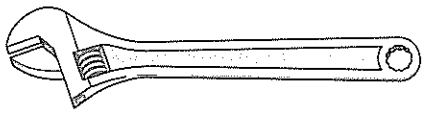
1. *the student's choice and use of materials*

   and

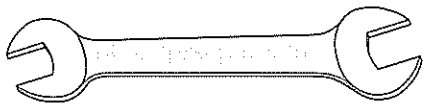
2. *the shapes which combine to form the overall design. It must be feasible for the student to cut, shape and finish the component parts using tools and equipment normally available to students at this level.*

MECHANICS

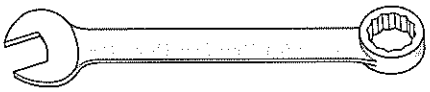
1. Name the spanners shown in the illustrations below.



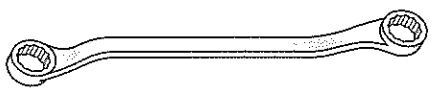
a. *Adjustable spanner (Shifting or Crescent)*



b. *Open end spanner*

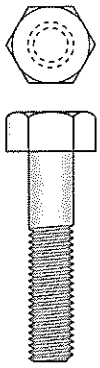


c. *Combination spanner*



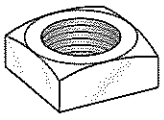
d. *Ring spanner*

2. Name the bolts, nuts, screws and locking devices shown in the illustrations below.

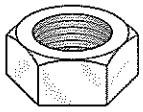


a. *Hexagonal head bolt*

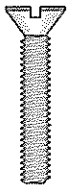
b. *Cup head bolt*



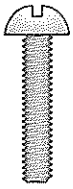
c. *Square nut*



d. *Hexagonal nut*

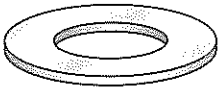


e. *Countersunk metalthread*

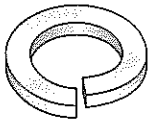


f. *Round head metalthread*

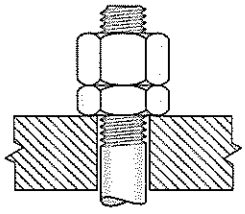
g. *Wing nut*



h. *Flat washer*



i. *Spring washer*



j. *Lock nut*

3. Which of the spanners shown on the previous page would be useful in confined spaces where a full swing is not possible?

Ring spanner

4. A shifting spanner should always be used in preference to a fixed spanner because there is less chance of damaging the nut.

a. True (b.) False

5. What is the purpose of the square section at the base of the head of a cup head bolt?

The square section is driven into the wood to prevent the bolt from turning when the nut is tightened.

6. Name a fixing device that could be used where the reverse side of the part being secured is inaccessible thus preventing a bolt and nut being used.

Engineers stud

7. A tooth lock washer is a device used for locking nuts. Briefly describe how the tooth lock washer actually locks the nut.

The twisted teeth compress and place pressure back on the nut. The edges of the teeth also bite into the nut if it tends to loosen.

8. Name the type of nut that would be used where hand tightening is required.

Wing nut

9. Briefly describe how a self locking nut works.

Nylon or fibre inserts lock the nut when the thread of the bolt cuts its way into the softer material.

10. Name two types of nuts that can be locked with a cotter pin.

a. *Castle nut* b. *Slotted nut*

11. Name the type of nut that would be used in situations where it is necessary to cover the end of the bolt for appearance sake.

Dome (or acorn) nut

ELECTRICITY

1. What is the meaning of the Greek word 'elecktron' from which the English word 'electric' is derived?

Amber

2. What did Benjamin Franklin, in 1752, observe when he was flying a kite in a thunder storm?

He discovered that lightning was an electrical discharge.

3. *Thomas Edison* perfected the incandescent lamp in the year of *1879.*

4. Name the three types of sub-atomic particles which form the structure of an atom.

a. *Electrons* b. *Protons* c. *Neutrons*

5. In electron theory which of the sub-atomic particles is:

a. positively charged? *Proton*

b. negatively charged? *Electron*

c. neutral? *Neutron*

6. If electrons are removed from an atom the remaining structure is said to be *positively* charged.

7. If an atom gains extra electrons the structure is *negatively* charged.

8. Matter which contains a relatively large number of free electrons which can be moved from atom to atom is:

(a.) an electrical conductor.
b. an electrical insulator.
c. positively charged.
d. negatively charged.

9. Which of the following is an electrical conductor?

a. A piece of wood
(b.) A length of steel rod
c. Acrylic sheet
d. A rolled up newspaper

10. Movement of electrons in a conductor is called electric *current.*

11. The unit of measurement for the strength of an electric current is the *ampere.*

12. What is the meaning of the electrical term 'resistance'?

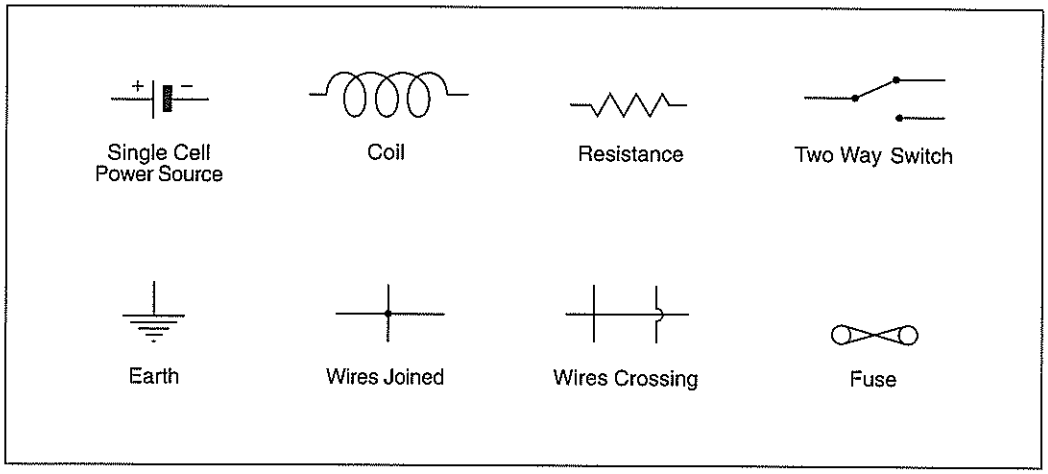
Resistance is the property of interfering with the flow of electrons in an electrical conductor.

13. Poor electrical conductors have little resistance.

a. True (b.) False

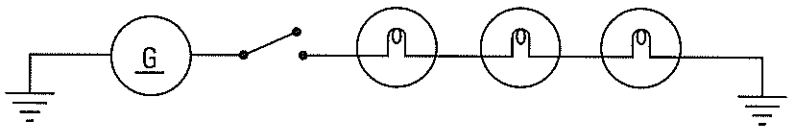
14. The energy which is required to move electrons against the resistance in an electrical conductor is called *electromotive* force or *voltage.*

15. In the space provided below neatly draw and name the following electrical symbols: Single Cell Power Source (battery), Coil, Resistance, Two Way Switch, Earth, Wires Joined, Wires Crossing, Fuse.



16. Does the circuit diagram below represent a parallel circuit or a series circuit?

Series circuit



17. Briefly explain the difference between the conducting paths of series and parallel circuits.

A series circuit has only one conducting path. A parallel circuit may have numerous conducting paths.

18. If four 1.5 volt batteries were connected in parallel the circuit voltage would be

1.5 volts.

19. If two 6 volt batteries were connected in series the circuit voltage would be

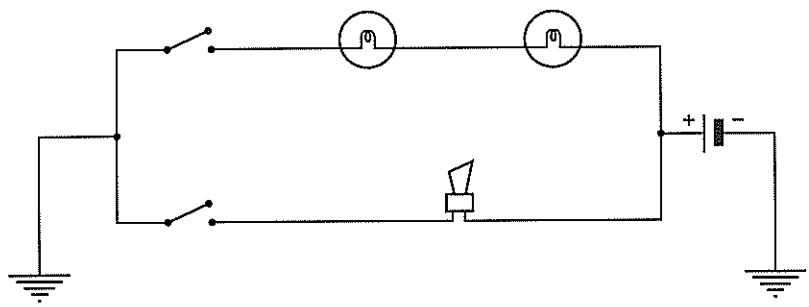
12 volts.

20. If three bulbs and a battery were connected together in a circuit, which of the following statements would be correct?

(a.) A series circuit would have more resistance than a parallel circuit.
b. The bulbs would glow more brightly in a series circuit than a parallel circuit.
c. If one bulb blew in the parallel circuit the others would not light up.
d. The voltage in the circuit would be equal to the sum of the resistance in the three bulbs.

21. In the space provided below draw a circuit diagram containing a single cell battery, 2 globes (light bulbs), 1 horn and 2 switches.

The globes are to be connected to each other in series but the horn is to be connected in parallel with the globes. One switch is for the globes, the other for the horn.



Note: Other arrangements of the battery and switches are possible.

22. Briefly explain an 'open' circuit.

Electrons cannot flow because there is a break in the circuit, (eg. when a switch is in the off position).

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