JUNIOR WORKSHOP

B

WORKBOOK

1

Third Edition

D.Schlyder

JUNIOR WORKSHOP B - Workbook 1

Third Edition - 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. _____

   b. _____

   c. _____

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

   _____

   _____

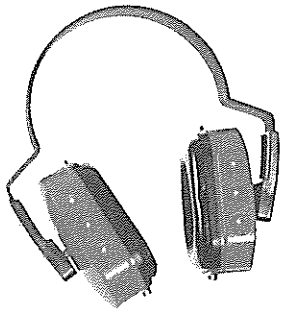
3. List three examples of personal protection that should be observed in the workshop.

   a. _____

   b. _____

   c. _____

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



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?

   _____

   _____

   _____

Name _____

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

   _____

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

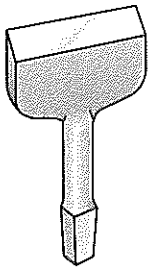
   a. _____

   b. _____

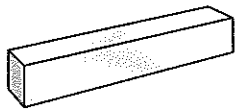
   c. _____

METALWORK TOOLS AND EQUIPMENT

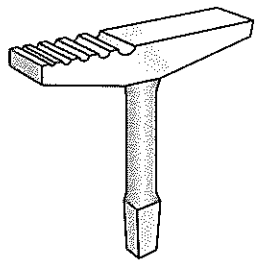
1. Name the sheetmetal working stakes shown in the illustrations below.



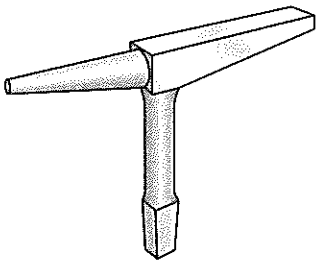
a. _____



b. _____



c. _____



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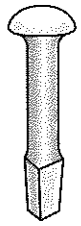
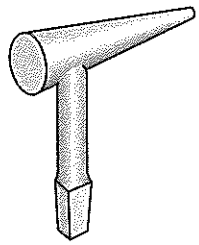


e. _____



f. _____

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

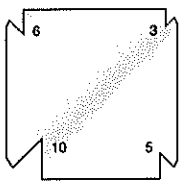
a. _____ b. _____

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

a. _____

b. _____

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

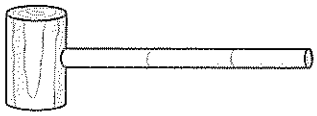


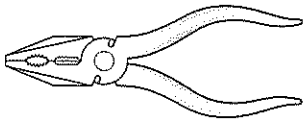
a. _____

b. _____

c. _____

5. Name the sheetmetalworking tools illustrated below.





a. _____ b. _____ c. _____

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.

_____

_____

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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

10. Name the metalwork tools illustrated below.

a. _____ b. _____ c. _____

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?

_____

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

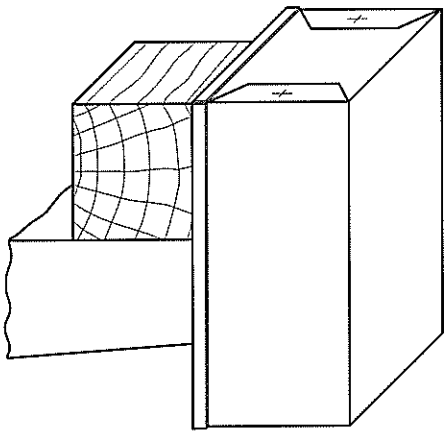


Diagram A

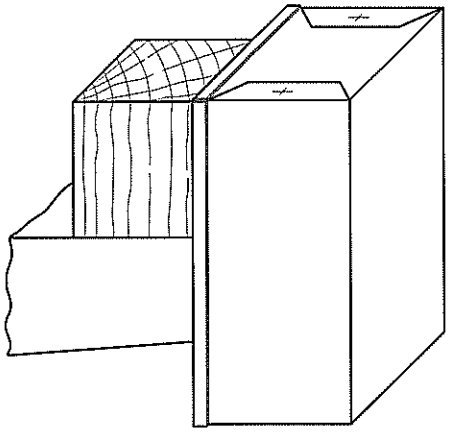


Diagram B

13. Briefly explain your answer to question 12 above.

_____

_____

_____

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

_____

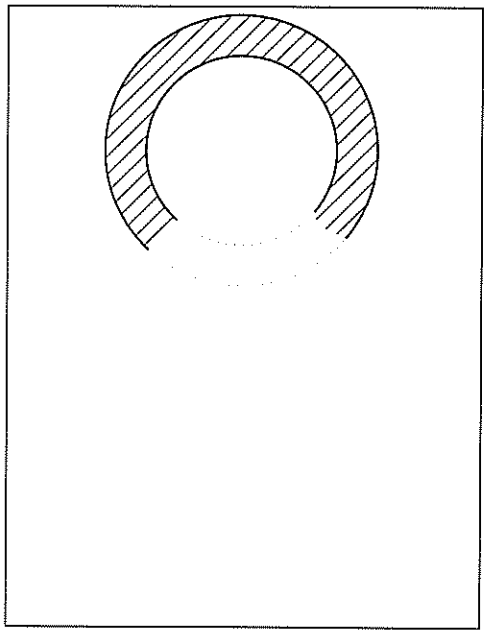
15. Why are tinman's rivets usually galvanised?

_____

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?

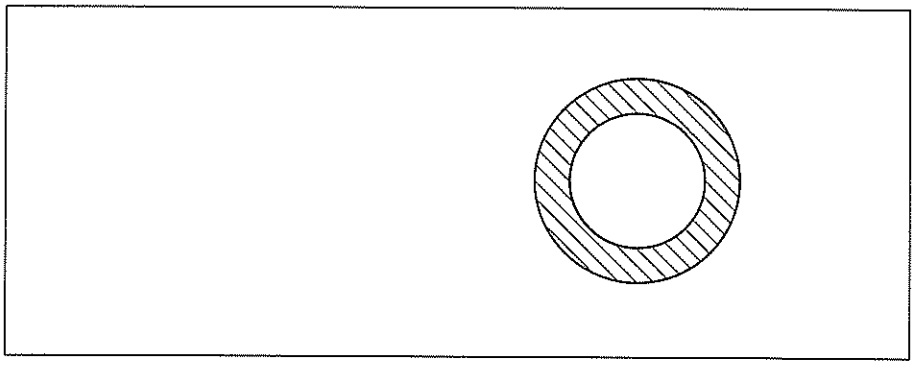
a. Jenny calipers
b. Inside rule
c. Inside calipers
d. Spring dividers



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.

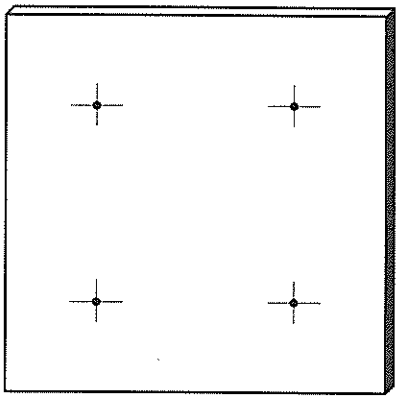
Also complete the visible part of the section where dotted lines are now shown.

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.



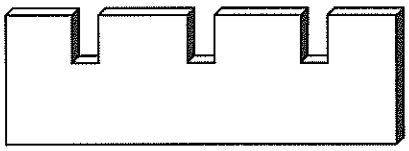
20. Complete the drawing of the single cut hand file shown below. Neatly sketch in the teeth.

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

a. _____ b. _____ c. _____

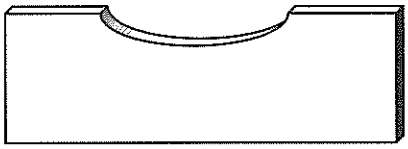
22. Name the file you would use to finish the 4mm slots illustrated in the diagram on the right.

_____



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

_____



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.

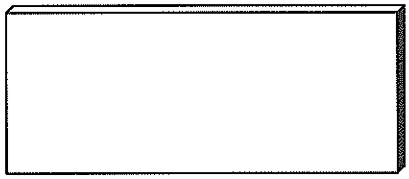


Diagram A

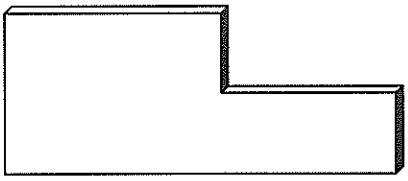


Diagram B

_____

_____

_____

_____

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 _____ Tool Holder _____

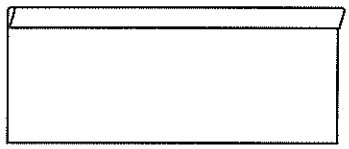
SEAMS AND EDGES

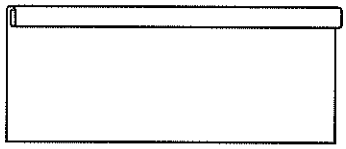
1. List three reasons why sheetmetal projects often require edge treatment.

a. _____ b. _____

c. _____

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





a. _____ b. _____

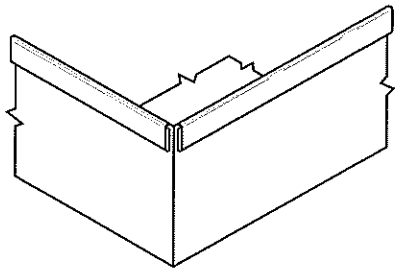
3. The allowance for a wired edge is:

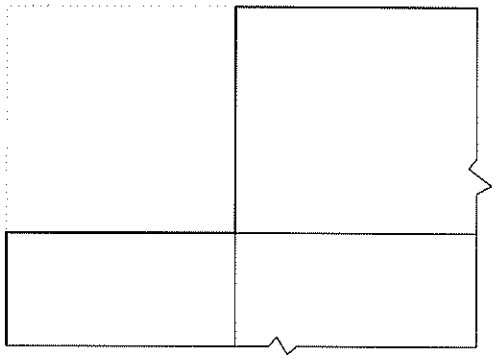
a. 3mm. b. 4mm. c. 5mm. d. 6mm.

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

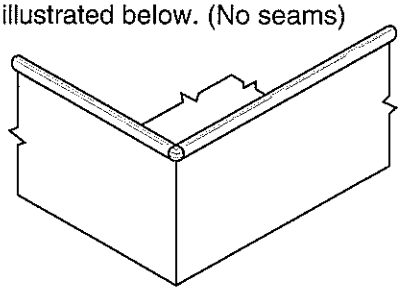
a. Lapped b. Grooved c. Folded d. Peined

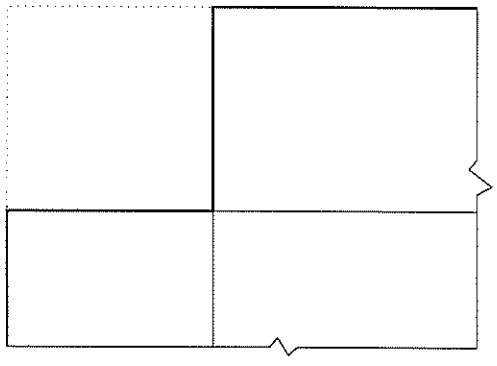
5. Complete the development of one corner of the sheetmetal box with 4mm double folded edges illustrated below. (No seams)





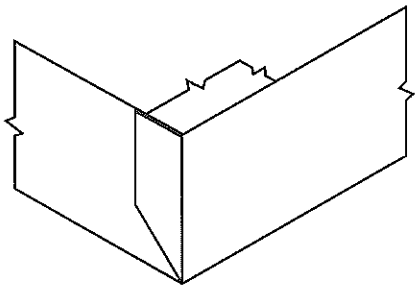
6. Complete the development of one corner of the sheetmetal box with wired edges illustrated below. (No seams)

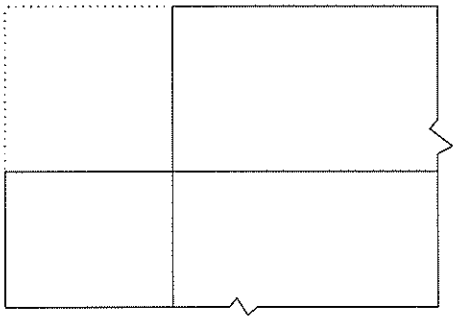




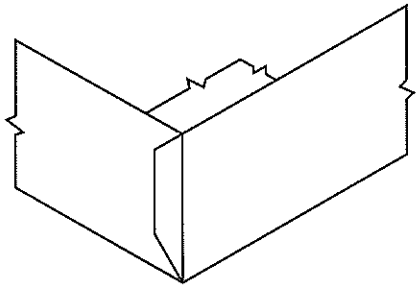
N.B. Notching in the following diagrams is either 90° or 45° as illustrated.

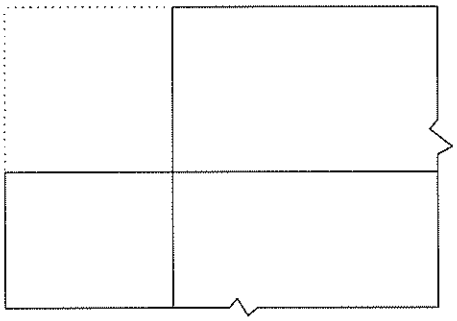
7. Complete the development of one corner of the sheetmetal box with 8mm lap seams illustrated in the diagram below.



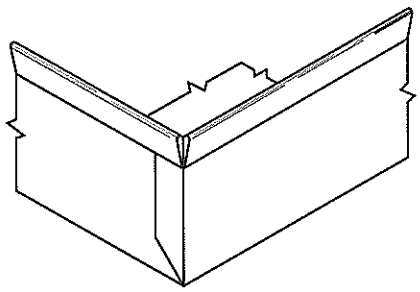


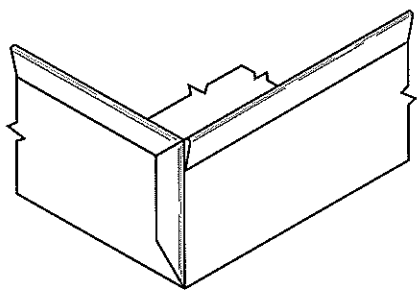
8. Complete the development of one corner of the sheetmetal box with 5mm folded seams illustrated in the diagram below.

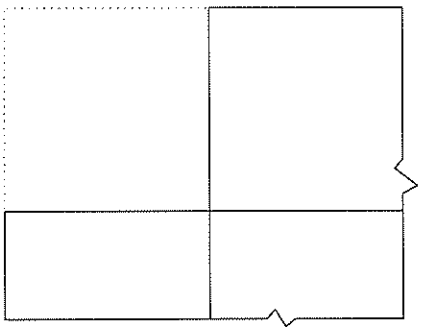


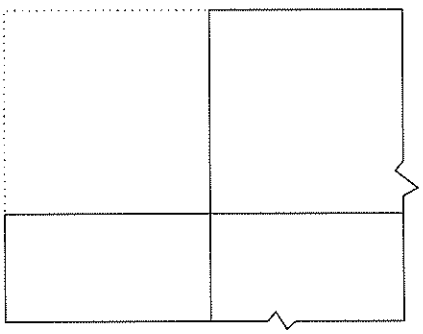


9. Complete the developments of a corner of the sheetmetal boxes shown below. Both boxes have 5mm folded edges and 5mm lap seams which are to be soldered.



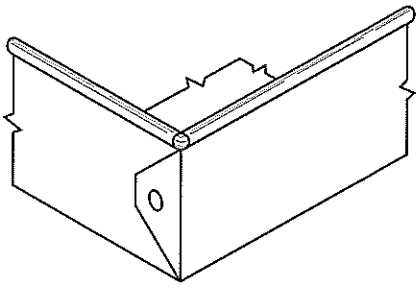


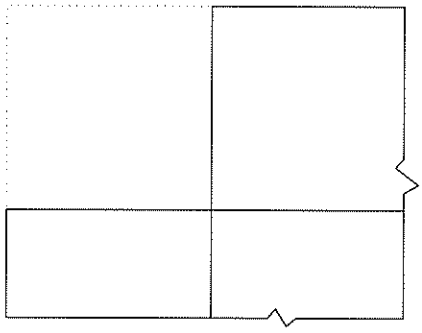




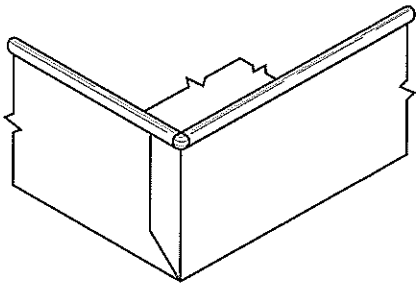
N.B. Notching in the following diagrams is either 90° or 45° as illustrated.

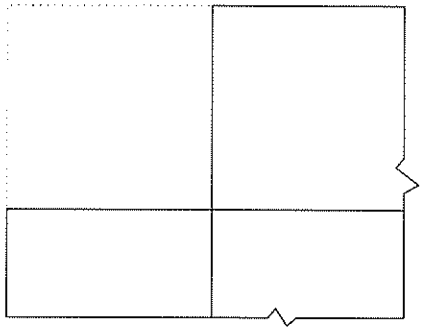
10. Complete the development of one corner of the sheetmetal box with wired edges and 8mm lap seams illustrated below.



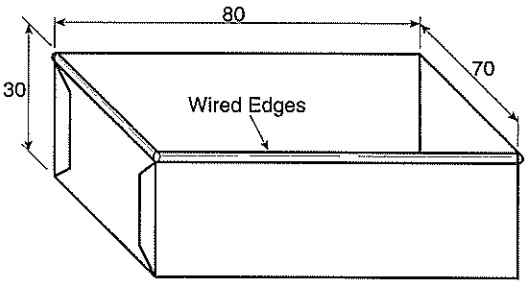


11. Complete the development of one corner of the sheetmetal box with wired edges and 5mm folded seams illustrated below.

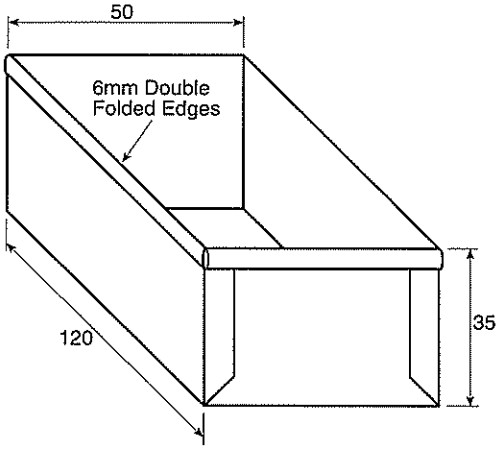




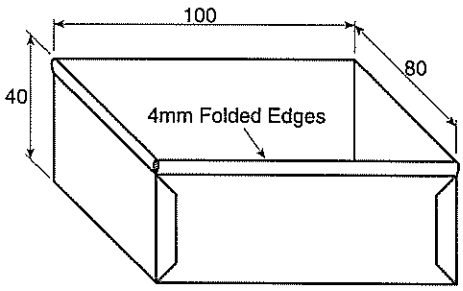
12. Determine the size of the piece of tinplate required to make each of the boxes shown on the right and below.



Material Size _____ x _____



Material Size _____ x _____



Material Size _____ x _____

CLASSIFICATION AND PROPERTIES OF METALS

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

2. Complete the following statement.

A pure metal contains no impurities or _____

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?

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

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'.

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

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

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

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?

14. 'Work hardening' of metal is caused by changes in the _____ _____ of the metal.

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

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

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

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. _____

b. _____

c. _____

d. _____

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

_____

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?

_____

_____

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

_____

_____

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?

_____

_____

_____

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. _____ b. _____

c. _____ d. _____

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

_____

_____

_____

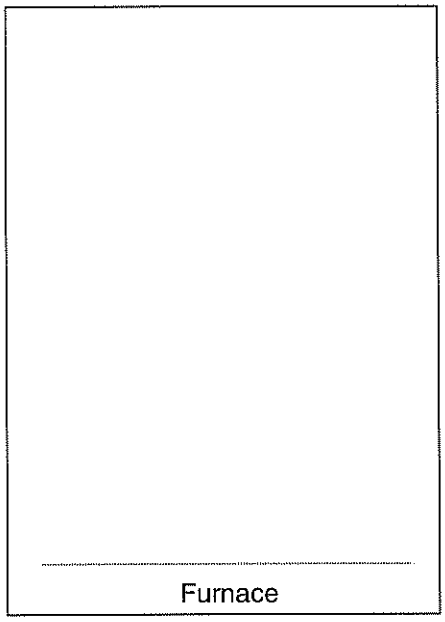
15. Henry_____ experimented with purifying large quantities of molten iron in the 1850's.

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

Briefly describe how it worked.

17. The _____ 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.



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.

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.

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

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. _____ b. _____

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.

_____

5. State one common use for tinplate.

_____

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.

_____

_____

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

_____

_____

_____

_____

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

a. _____ b. _____

c. _____ d. _____

e. _____ f. _____

g. _____ h. _____

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

a. _____

b. _____

c. _____

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

a. True b. False

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

a. _____ b. _____

c. _____ d. _____

e. _____ f. _____

g. _____ h. _____

i. _____ j. _____

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

_____

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

a. _____ b. _____

c. _____ d. _____

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

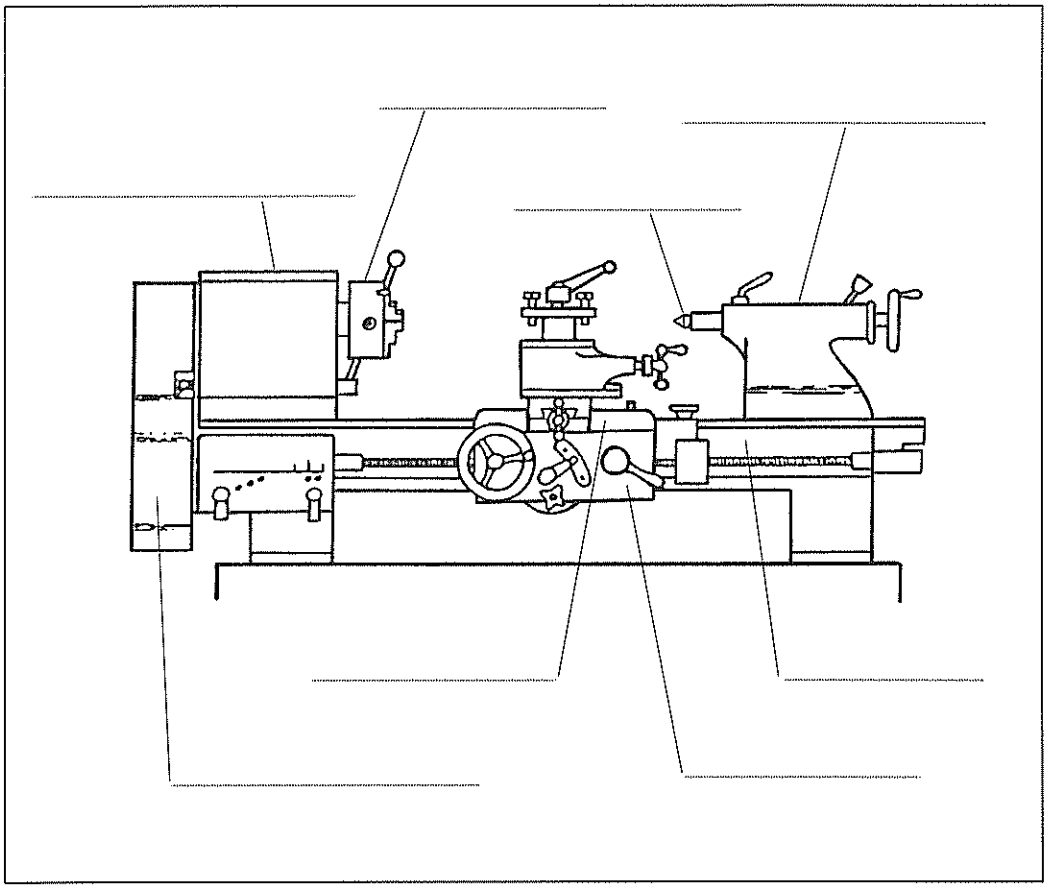
a. 1% b. 5% c. 10% d. 20%

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 _____

3. The metal lathe can produce shapes that are _____ 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.

_____

_____

_____

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

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

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

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.

b.

c.

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.

b.

c.

d.

THE DRILLING MACHINE

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

_____

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

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

_____

_____

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?

_____

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

_____

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. _____

b. _____

c. _____

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

_____

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

_____

_____

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.

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

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

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

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.

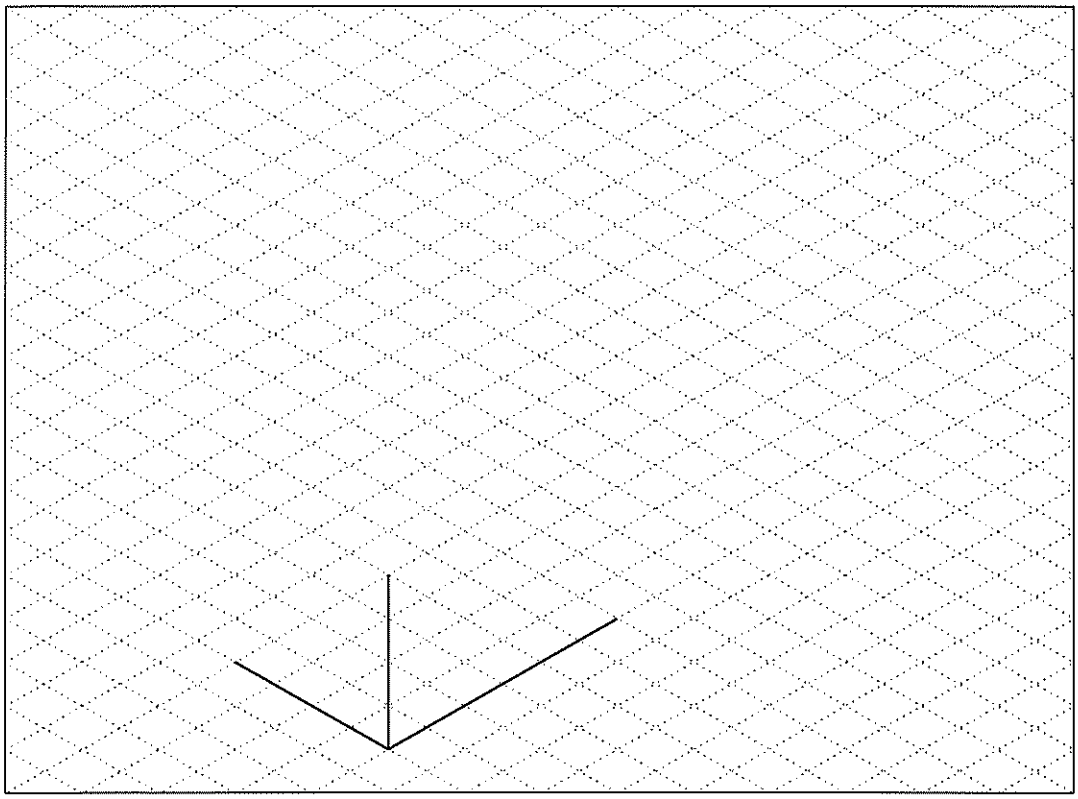
6. If you answered 'yes' or 'no' to question 5, give reasons for your answer.
If you chose 'c' as your answer, state which edge treatment you would use.

.....

.....

.....

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

..... x ..... x .....

9. Calculate the exact material size required to make the box.

..... x .....

10. Calculate the exact material size required to make the divisions.

..... x .....

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.

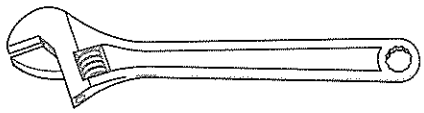
Materials

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.

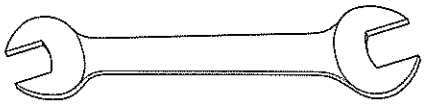
The rectangle below represents the back-board of your wall-plaque. Sketch the outlines of your design on the back-board and colour or shade the drawing of the finished wall plaque. Use appropriate colours but do *not* use spirit pens.

MECHANICS

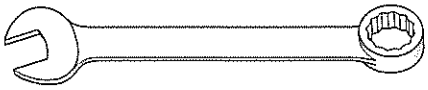
1. Name the spanners shown in the illustrations below.



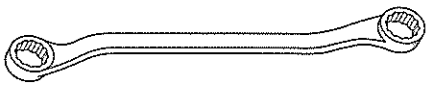
a. _____



b. _____

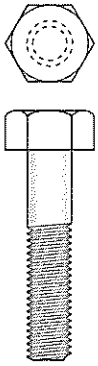


c. _____



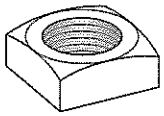
d. _____

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

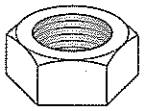


a. _____

b. _____



c. _____



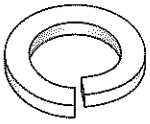
d. _____

e. _____

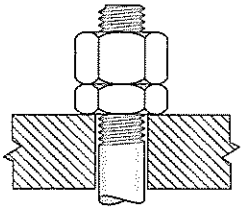
f. _____

g. _____

h. _____



i. _____



j. _____

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

_____

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?

_____

_____

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.

_____

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

_____

_____

_____

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

_____

9. Briefly describe how a self locking nut works.

_____

_____

_____

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

a. _____ b. _____

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.

_____

ELECTRICITY

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

   _____

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

   _____

   _____

3. _____ perfected the incandescent lamp in the year of _____

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

   a. _____ b. _____ c. _____

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

   a. positively charged? _____

   b. negatively charged? _____

   c. neutral? _____

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

7. If an atom gains extra electrons the structure is _____ 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 _____

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

_____

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

_____

_____

13. Poor electrical conductors have little resistance.

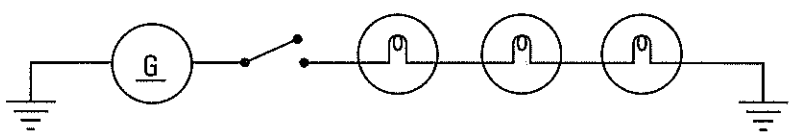
a. True b. False

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

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?

_____



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

_____

_____

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

.....volts.

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

.....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.

22. Briefly explain an 'open' circuit.

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