

JUNIOR WORKSHOP

WORKBOOK

2

Third Edition

D.Schlyder

B



JUNIOR WORKSHOP B - Workbook 2

Third Edition - D.Schlyder

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ISBN 1 876135 34 4

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Published in Australia by
PCS Publications
Toowoomba 4350

Printed in Australia by
Scanlan Printing
Toowoomba 4350



p.c.s. publications

HEALTH AND SAFETY

1. List six hazardous chemical materials that could be encountered in the school workshop.

a. _____ b. _____ c. _____
d. _____ e. _____ f. _____

2. List three routes by which chemicals can enter the body.

a. _____
b. _____
c. _____

3. List three protective handling strategies that should be followed when using a chemical product that is potentially dangerous.

a. _____
b. _____
c. _____

4. The dangerous goods sign shown on the right would be displayed where a certain type of dangerous goods are stored. Which class of dangerous goods is indicated by this sign.

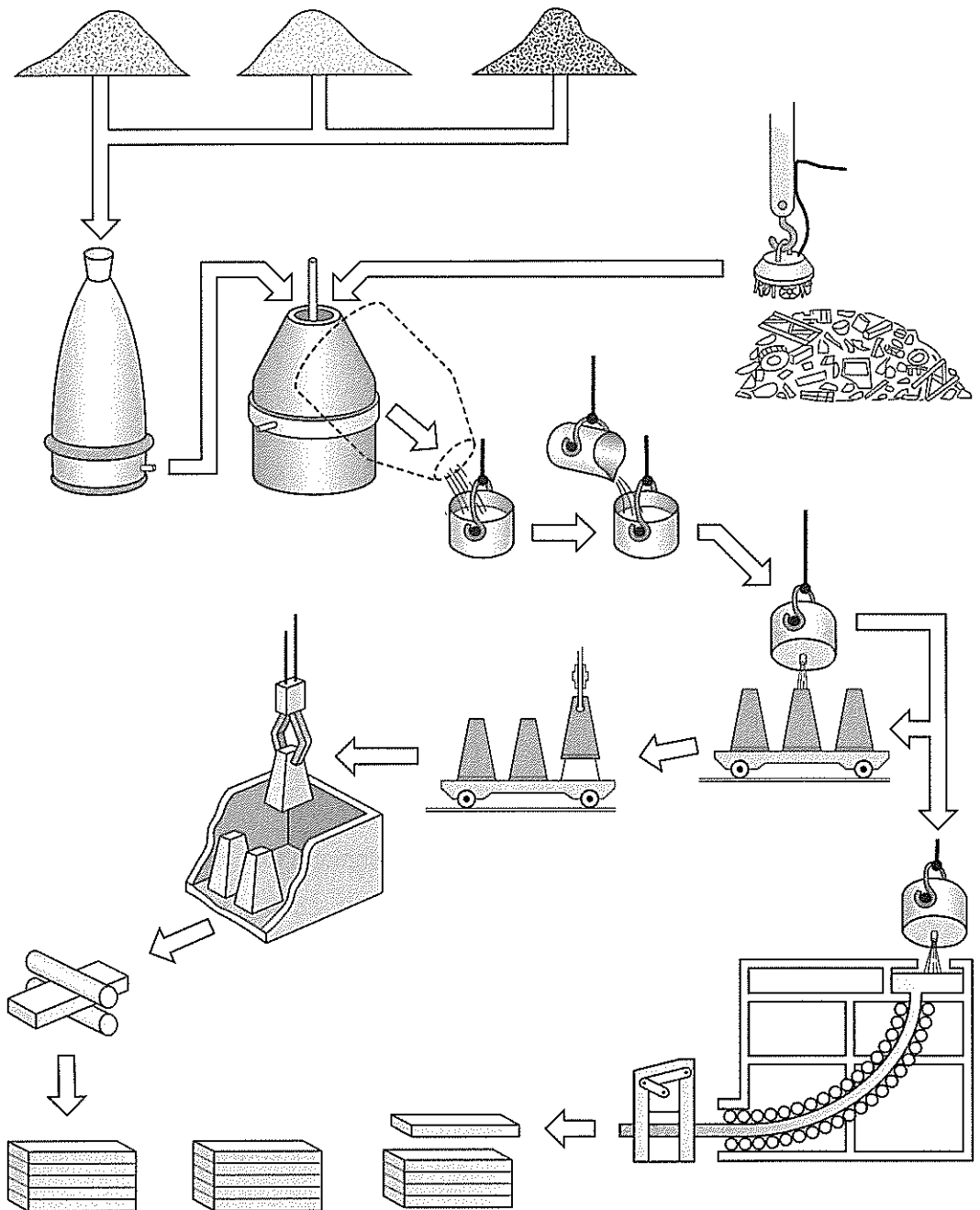


5. Briefly describe the correct manual handling technique for lifting a load.

6. Which parts of the spine are often damaged by using incorrect lifting techniques?

MAKING STEEL

1. The chart below illustrates the steel making process from raw materials to the production of slabs. Neatly print information at each stage of the process, not only naming the stage but briefly describing what occurs at that stage of the production process.



SHEET STEEL PRODUCTS

1. Tinplate is not a sheet steel product.
a. True b. False

2. Explain your answer to question 1 above by stating what tinplate consists of.

3. What does the term 'grain' mean when applied to sheet metal?

4. What is the purpose of the zinc coating on galvabond?

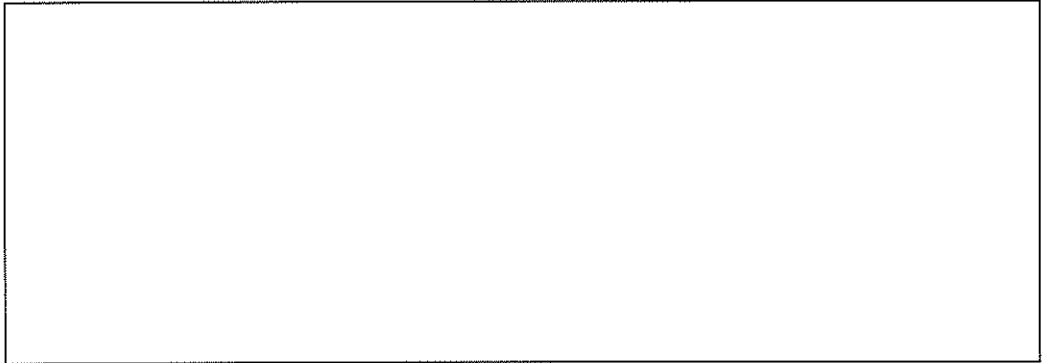
5. Briefly describe how zinc anneal is made.

6. Terneplate is often used to make fuel tanks. It is made by hot dipping sheet steel in terne metal which is an alloy of _____ and _____.
It resists _____ and is very easily _____.

7. In the first stage of sheet steel production heated slabs are descaled. Briefly describe the descaling process.

8. Descaled slabs are forward and reverse rolled _____ or _____ times in the Reversing Roughing Mill. Briefly describe the effects of this process.

9. During the hot rolling process 'grain structure' is deformed but new structure is quickly formed in the hot steel. In the space provided below draw a neat sketch illustrating the changes in grain structure as the metal passes through the reversing roughing mill.



10. Hot bar from the roughing mill passes through sets of rolls in the hot finishing mill reducing the section by up to _____% on each stand.
Normal rolling temperature is about _____ °C.

11. Hot rolled strip has a surface of black _____ or scale. Briefly describe how this scale is removed.

12. When the cold reduction mill is operating at full speed the steel strip exits the mill at about _____ / _____ km/h.

13. Grain structure is deformed during the cold reduction process and heat treatment called _____ is necessary to develop a new structure. This process recrystallises the grain structure to make the steel _____

14. Skin passing or temper rolling improves _____ and _____

15. List two organic coatings sometimes applied to sheet steel in the line process.

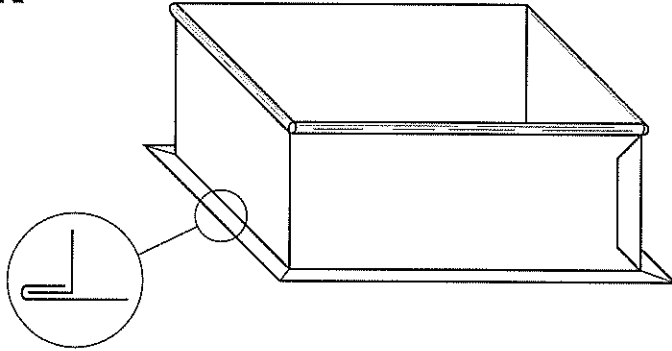
a. _____ b. _____

16. What is 'electro-galvanising' of sheet steel?

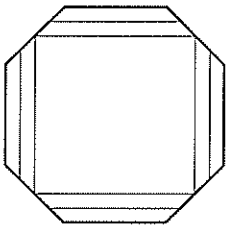
SHEETMETAL WORK

The adjacent drawing shows a sheetmetal box joined on one corner with a folded seam.

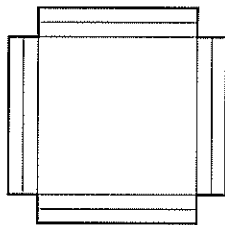
The box has a wired edge and a separate base joined with a peined down seam as shown in the sectional detail.



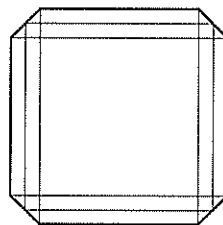
1. Which of the following (drawn to a smaller scale) would be the correct development of the base?



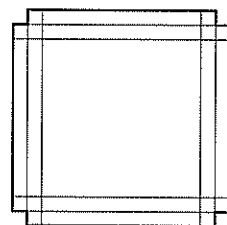
a.



b.

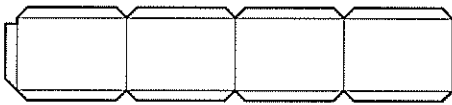


c.



d.

2. Which of the following (drawn to a smaller scale) would be the correct development of the sides of the box?



a.



b.



c.



d.

3. Name a suitable material for the construction of the box given that it would be exposed to excessive moisture.

.....

4. Briefly explain why the sheetmetal you have chosen as your answer to question 3 would not be affected by moisture.

.....

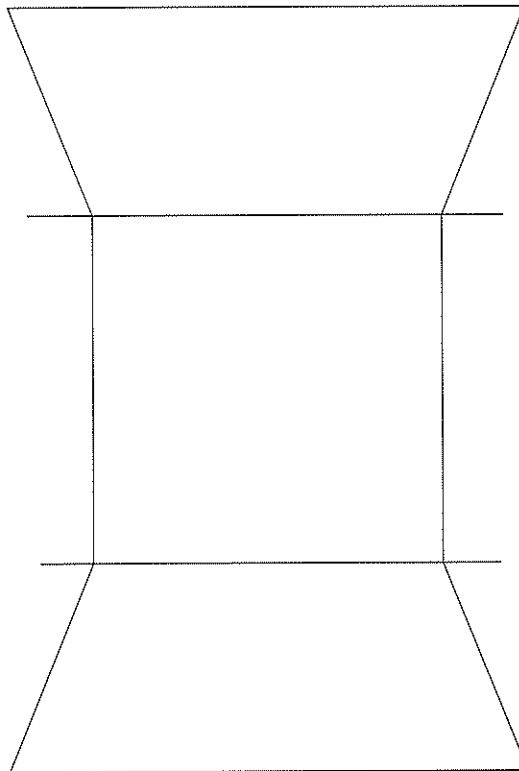
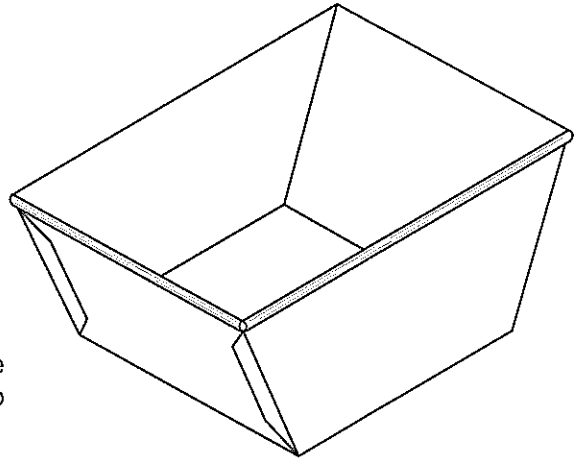
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5. The sketch on the right shows a sheetmetal container with sloping ends. It has wired edges and the corners are joined with 6mm lapped and soldered seams.

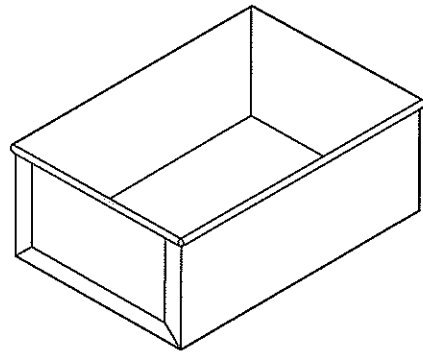
Complete the full size development below by adding the ends and all allowances for the wired edges and lap seams.

N.B. The ends only are sloping; the other two sides are perpendicular to the base.

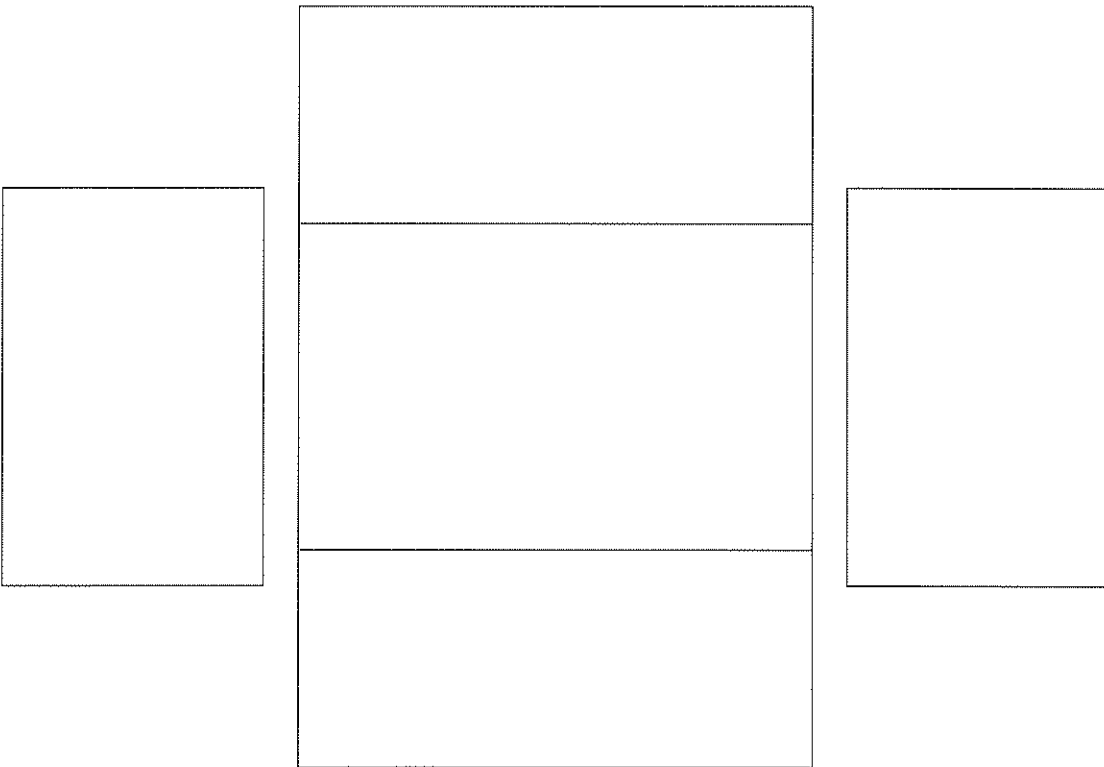


6. Name all the sheetmetal working tools and equipment you would use to mark out, cut and fold up the container shown above.

7. The sketch on the right shows a sheetmetal container with a wired edge and separate ends joined by 5mm folded seams. Complete the full size development below by showing all allowances for seams and edges including notching.

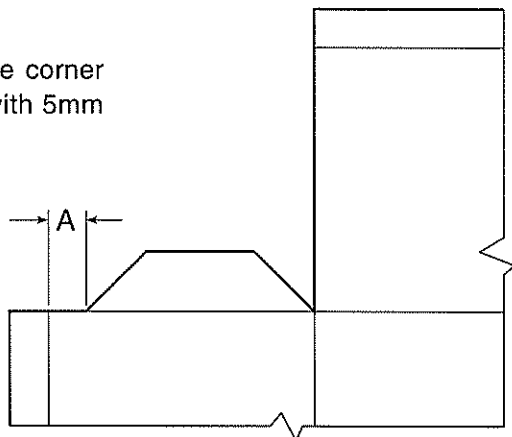


The incomplete development below represents the actual pieces of sheetmetal to be marked out.



8. The diagram on the right represents one corner of the development of a sheetmetal box with 5mm folded edges and 8mm lap seams.

The seams are notched _____ mm as represented by dimension 'A' so that the folded edge does not overlap the _____



SOFT SOLDERING

1. Soft solder is usually an of lead and tin.
2. If the proportion of lead in solder is increased the melting point:
a. decreases. b. increases.
3. All metals will when in contact with the air.
4. List four reasons why a flux is used when soldering.
a.
b.
c.
d.
5. Name a flux that is suitable to use when soldering tinfoil.

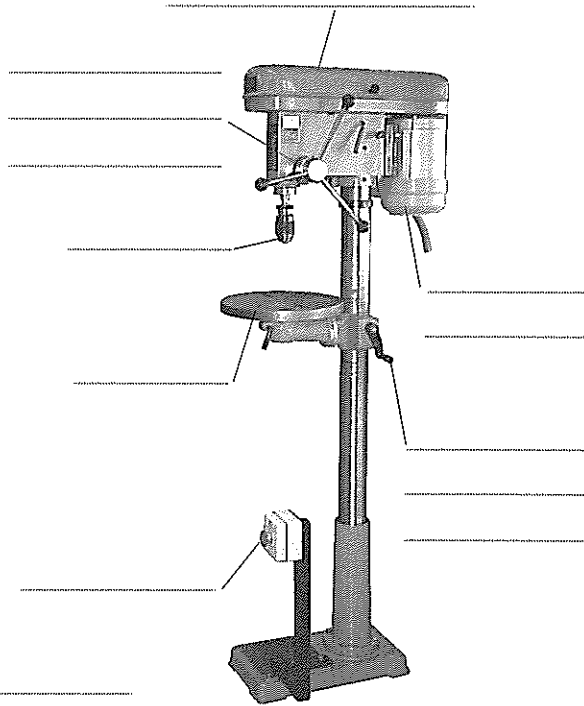
.....
6. What metal is used to make the head of a soldering bit?

.....
7. List two reasons why the metal referred to in question 6 above is used in the head
of a soldering bit.
a.
b.
8. Briefly explain why the head of a soldering bit must be 'tinned'.

.....
.....
.....
9. List the two most important factors in successful soft soldering.
a. b.

THE DRILLING MACHINE

1. The illustration on the right shows a typical floor mounted belt driven drilling machine. Neatly print the names of its parts as indicated.



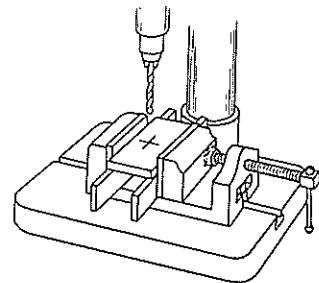
2. The drill speed can be altered by changing the position of the V belt on the cone pulleys. Generally a small drill requires a _____ speed and a large drill a _____ speed.

3. Briefly describe the position of the belt when the slowest speed is engaged.

4. The _____ of the twist drill is the part which is held in the chuck.

5. Briefly describe the 'lands' on a twist drill.

6. Name the tool used for holding work when drilling as shown in the illustration on the right.

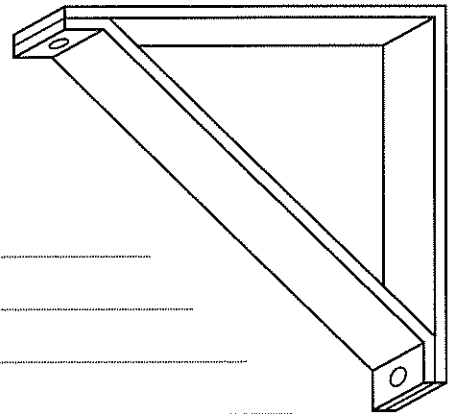


7. List four operating safety precautions you should observe to protect yourself from injury when drilling.

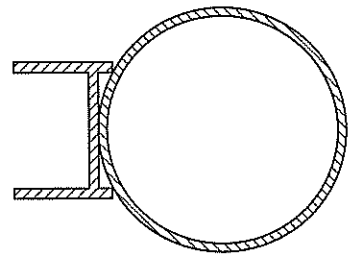
- _____
- _____
- _____
- _____

FABRICATING METHODS

1. The diagram on the right illustrates a shelf bracket made from 25 x 3 black mild steel. Briefly describe the procedure you would follow in joining the angle brace to the bracket with solid rivets. Also explain how you would hold the job securely when drilling the holes required.



2. The diagram on the right shows a metal extrusion which is to be joined to a length of hollow tube. What type of rivets would you use to do the job?



3. Briefly explain the reason for your answer to question 2 above.

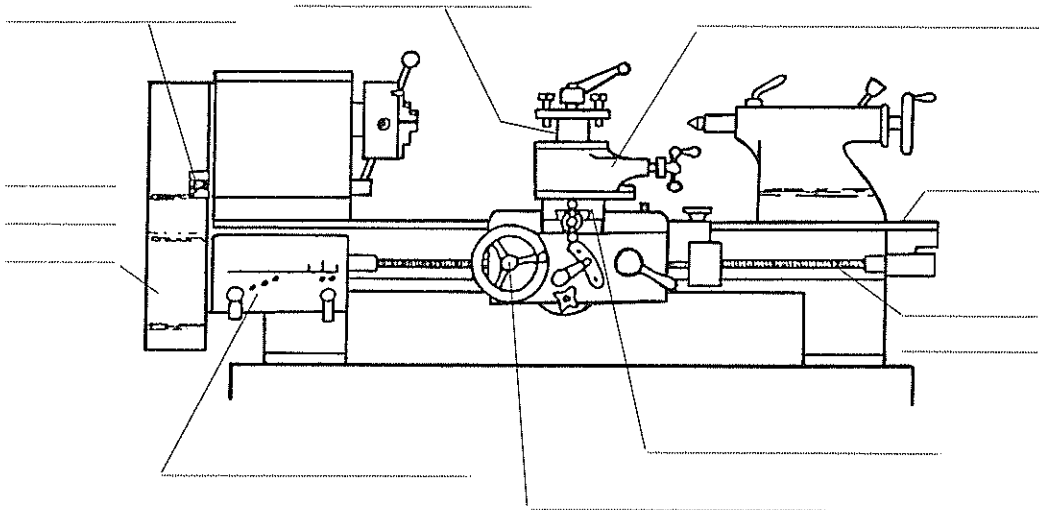
4. Name the hardened screws sometimes used to join sheet metals.

5. What is the main advantage of these screws over rivets as a fixing method?

6. The screws referred to above actually cut their own _____

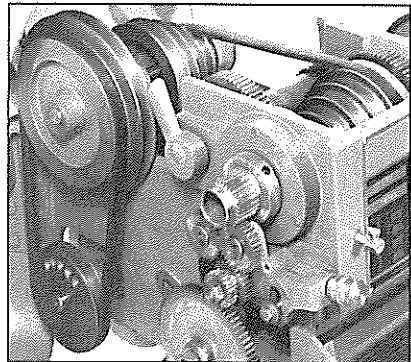
THE METAL LATHE

1. The diagram below illustrates a typical small metal lathe. Neatly print the names of its parts as required.



2. The photograph on the right shows the drive mechanisms of a small belt driven lathe. Draw a pointer to the back gear lever.

Back Gear Lever



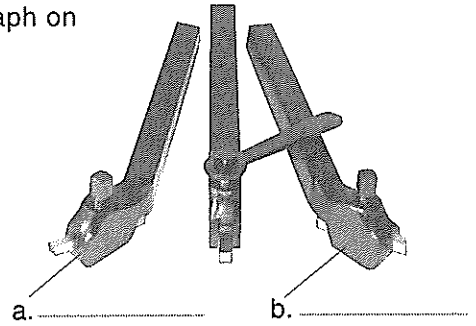
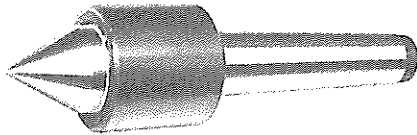
3. What is the purpose of 'back gear' on this type of metal lathe?

4. Name a lathe operation which would require the use of 'back gear'.

5. The _____ slide is mounted on top of the cross slide. It has a swivel base that can move through _____ degrees.

6. Name the tool holders shown in the photograph on the right.

7. Name the metal lathe accessory shown in the photograph below and state the main advantage of this type.



Name. _____ Advantage. _____

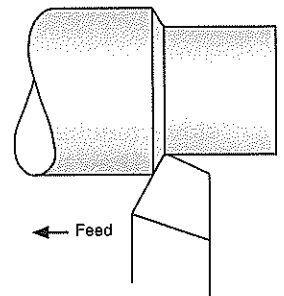
8. A lathe tool that is ground to a special shape so that it can cut from left to right is called a:

a. Left Hand Tool b. Right Hand Tool

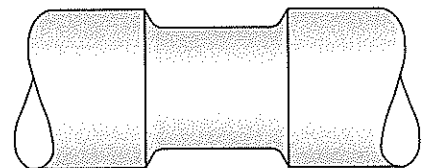
9. Name the type of lathe tool shown in the illustration on the right and briefly describe its use.

Name. _____

Use. _____



10. Draw a neat sketch of the cutting tool required to turn the shape shown in the illustration on the right. Show the tool in the cutting position.



11. What adjustment would need to be made when facing the end of a job in the chuck and a small 'pimple' is left in the centre?

COPPER, ALUMINIUM AND ART METALWORK

1. List six properties of the metal copper.

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____
- f. _____

2. List four uses of the metal copper or products made from copper.

- a. _____
- b. _____
- c. _____
- d. _____

3. Brass is an alloy of:

- a. Copper and Tin.
- b. Copper and Lead.
- c. Copper and Zinc.
- d. Copper and Aluminium.

4. In the mining of copper the ore body rarely yields more than:

- a. 2% copper.
- b. 5% copper.
- c. 10% copper.
- d. 20% copper.

5. Some processing of copper usually occurs at or near the mine site. Briefly explain why this is usually necessary.

6. Copper ore is crushed, screened, mixed with water and then processed in the Ball Mill. Briefly describe the operation of the Ball Mill.

7. Briefly describe the 'Flotation' process used in the production of copper.

8. Briefly describe the operation and purpose of the Roaster which is used in the production of copper.

9. What is the raw material called after the roasting process in the production of copper?

10. Briefly describe the copper smelting process which occurs in the Furnace.

11. Copper Matte is charged into a Converter. Describe the operation and purpose of the Converter.

12. Blister Copper is not a usable form and is about:

a. 50% pure. b. 65% pure. c. 80% pure. d. 99% pure.

13. Blister Copper is usually refined by the process of electrolysis. Briefly describe this process.

14. List four elements used to produce alloys with aluminium.

a. _____ b. _____
c. _____ d. _____

15. List the six properties of aluminium you think are most important.

a. _____

b. _____

c. _____

d. _____

e. _____

f. _____

16. Which of the following is the maximum increase in tensile strength that can be achieved by alloying aluminium?

a. 100%

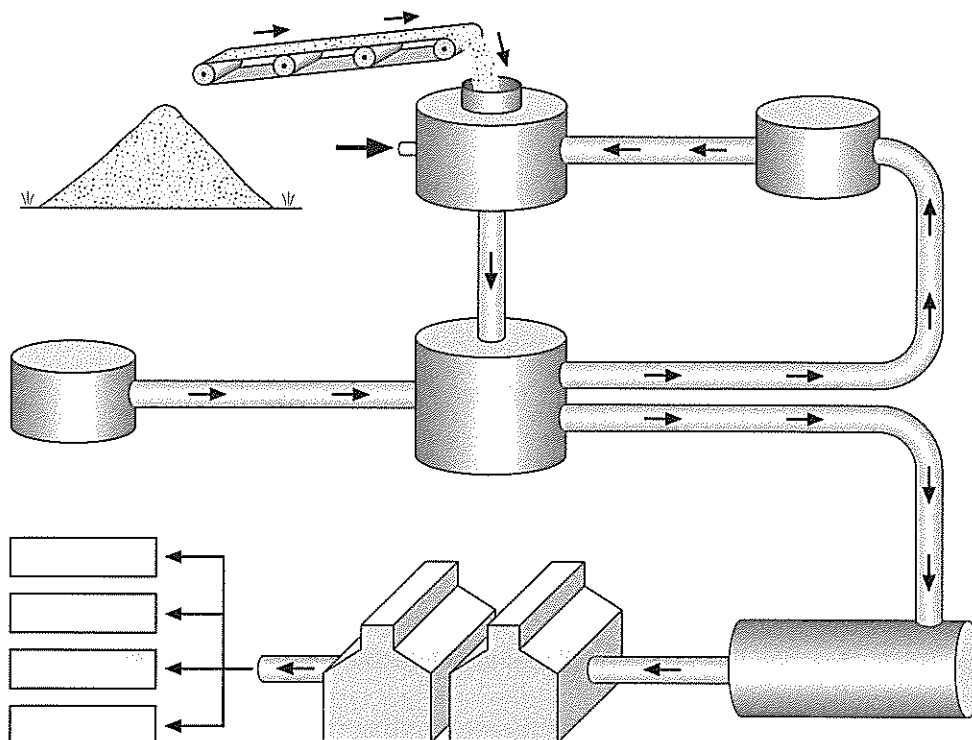
b. 200%

c. 400%

d. 600%

17. Aluminium is produced from a reddish clay-like material called _____ generally mined by the _____ method.

18. The process chart below illustrates the stages in the production of aluminium. Complete the chart by neatly printing explanatory notes at each stage of production.



19. A _____ mallet is used with a _____ block to form bowl shapes in soft art metals such as copper and aluminium.

20. During the process described in question 19 above the metal would tend to work harden. Work hardening is caused by changes in the _____ structure of the metal. Briefly describe how you would anneal (soften) copper sheet after it has become work hardened.

21. Briefly describe the process of 'copper tooling'.

22. A safe and convenient pickling solution can be made by _____

23. Why does a coat of lacquer prevent oxidising or tarnishing of polished metal surfaces?

24. Why is it sometimes necessary to 'pickle' a copper project?

25. Briefly describe the 'fish scaling' method of decorating metal surfaces.

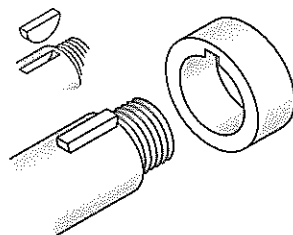
PULLEYS, GEARS, LEVERS & KEYS

1. Keys are used to secure components such as gears and pulleys to a shaft or spindle.
Name two common keys used in engineering applications.

a. _____ b. _____

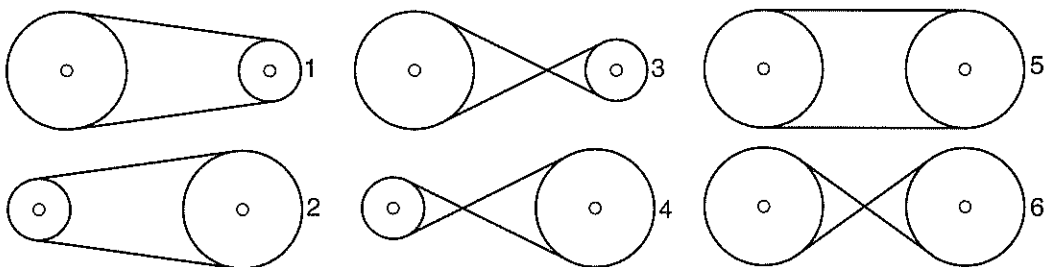
2. Keys are usually made from _____ and are accurately fitted into grooves called _____.

3. The illustration on the right shows a key fitted to a shaft. Why does this type of key provide greater resistance to the thrust of the part (such as a gear) against the shaft?



4. In each of the diagrams below the pulley on the left is the driver and the pulley on the right is driven. Match the number which refers to the speed and direction of rotation of the driven pulley in each diagram, with the statements below.

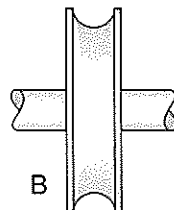
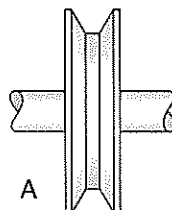
- a. Same direction, same speed. b. Opposite direction, increased speed.
c. Same direction, reduced speed. d. Opposite direction, reduced speed.
e. Same direction, increased speed. f. Opposite direction, same speed.



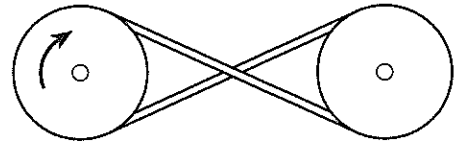
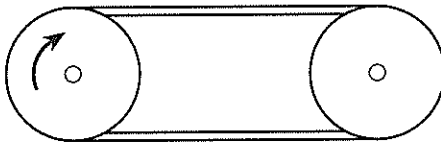
5. Name the pulleys shown in the illustrations on the right.

A. _____

B. _____



6. Indicate with an arrow, the direction of rotation of the driven pulley in each of the diagrams below.



7. Name the pulleys usually used in washing machines and other appliances, in conjunction with circular belts.

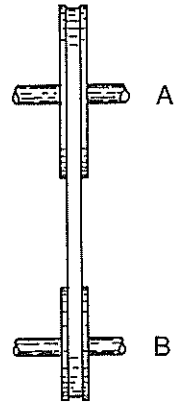
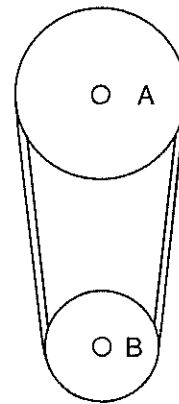
8. The diagrams on the right show two views of pulleys connected by a belt.

Shaft A rotates at 1000 RPM.

Shaft B rotates at 1500 RPM.

Pulley B is 80mm in diameter.

Dia. of pulley A = _____ mm.



9. When would two pulleys and belts be used in preference to a single belt?

10. What is the term given to the sets of pulleys shown in the illustration on the right?

Shaft A rotates at 1200 RPM.

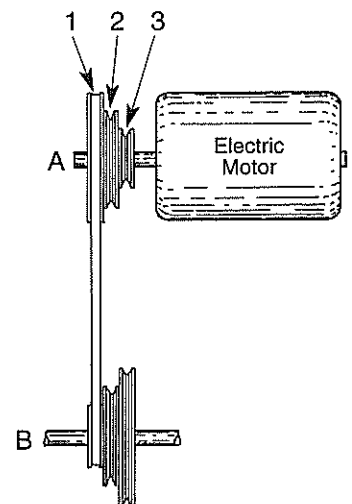
Pulleys are 50mm, 100mm and 150mm in diameter.

Find speed of shaft B when belt is in:

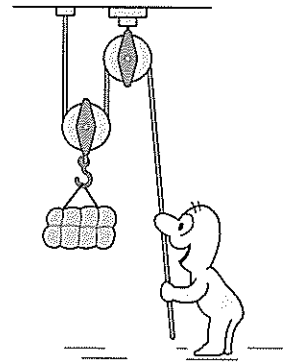
a. Position 1. _____ RPM

b. Position 2. _____ RPM

c. Position 3. _____ RPM



11. Briefly explain why a mechanical advantage is gained when two pulleys are used to lift loads as shown in the illustration on the right.



12. How might a greater mechanical advantage be gained?

13. Name the gear type used in the change gears of a metal lathe.

14. Complete the following sentence.

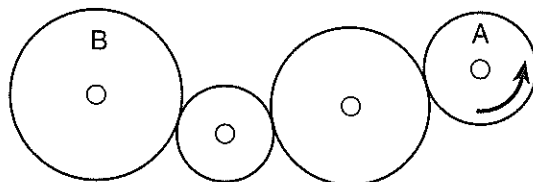
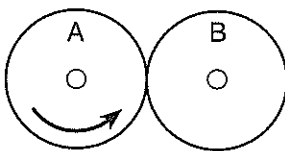
Gears are used to transmit _____ and _____ with _____ drive between two shafts a _____ distance apart.

15. Gears that mesh must have _____ of the same size irrespective of the _____ of the gear wheels.

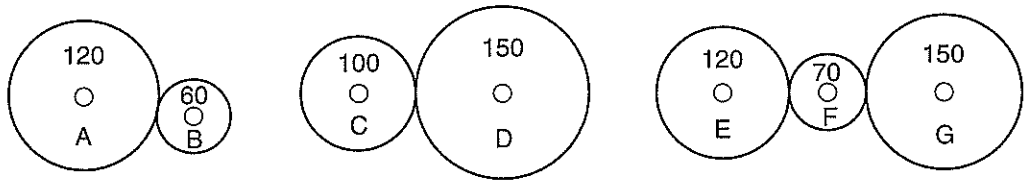
16. The ratio of gear speeds is inversely proportionate to the ratio of the number of teeth in meshing gears.

For example, if the driver gear has twice the number of teeth as the driven gear, the driver gear rotates at _____ the speed of the driven gear.

17. Indicate with an arrow the direction of rotation of gear B in each of the diagrams below.



18. The numbers in the diagrams below represent the number of teeth on the respective gears.



- If gear A rotates at 160 RPM, gear B rotates at _____ RPM.
- If gear C rotates at 300 RPM, gear D rotates at _____ RPM.
- If gear E rotates at 1500 RPM, gear G rotates at _____ RPM.

19. What is the most common mechanical application of the lever principle?

20. Complete the following sentence.

A _____ advantage is usually gained by the use of a lever.

21. A load of 450 kg is moved using a lever and an applied effort of 75 kg.
Complete the calculation below.

$$\text{Mechanical Advantage} = \frac{\text{Load}}{\text{Effort}}$$

= _____

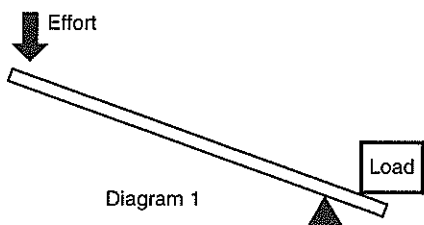
= _____

22. Tinsnips operate according to the principle of the first order lever. Name another tool you use in the workshop that also operates as a first order lever.

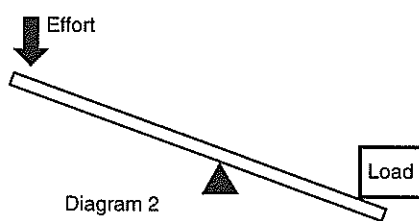
How does the lever principle help in the operation of the tinsnips?

23. In which of the diagrams below would the least effort be required to lift the weight?

a. Diagram 1.



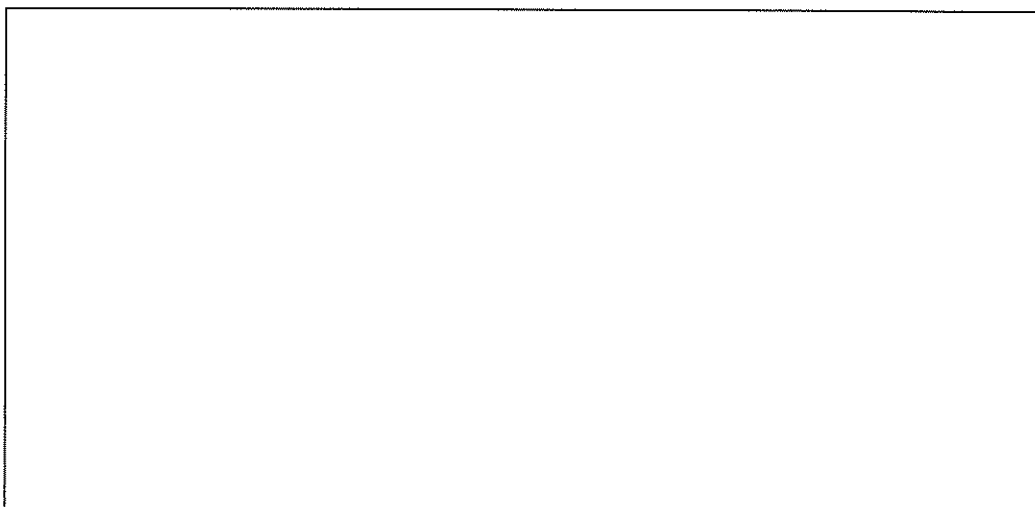
b. Diagram 2.



24. Briefly explain your answer to question 23 above.

25. Briefly explain why bolt cutters can cut through steel bars with very little effort.

26. In the space provided below draw a neat sketch of a pair of tinsnips with the jaws open. Clearly indicate with arrows the direction of the effort applied, the reaction at the fulcrum and the load.

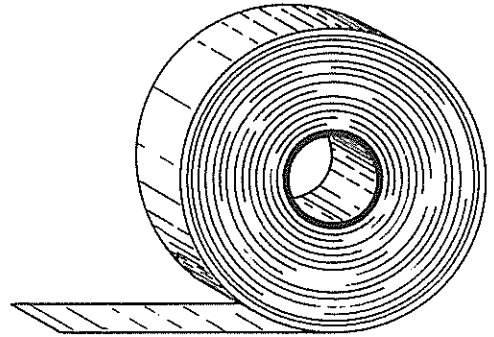


A DESIGN PROBLEM

SITUATION: In your home workshop you often use emery tape which you buy in small rolls. These rolls are sometimes misplaced and sometimes unroll on the work bench. In the interests of good workshop management you decide to improve the situation as suggested in the brief below.

BRIEF: Design and construct a dispenser or holder that can be fixed to the wall of the workshop with screws and is capable of holding a roll of tape as illustrated in the adjacent diagram. A roll of tape is 70mm in diameter, 25mm wide and the hole in the centre is 20mm in diameter.

INVESTIGATION: A search of the workshop reveals several pieces of flat mild steel and several pieces of round mild steel. The sizes are listed below.



Flat Steel: 20 x 3; 25 x 3; 50 x 3. Round Steel: 3,6,12 and 16mm diameter.

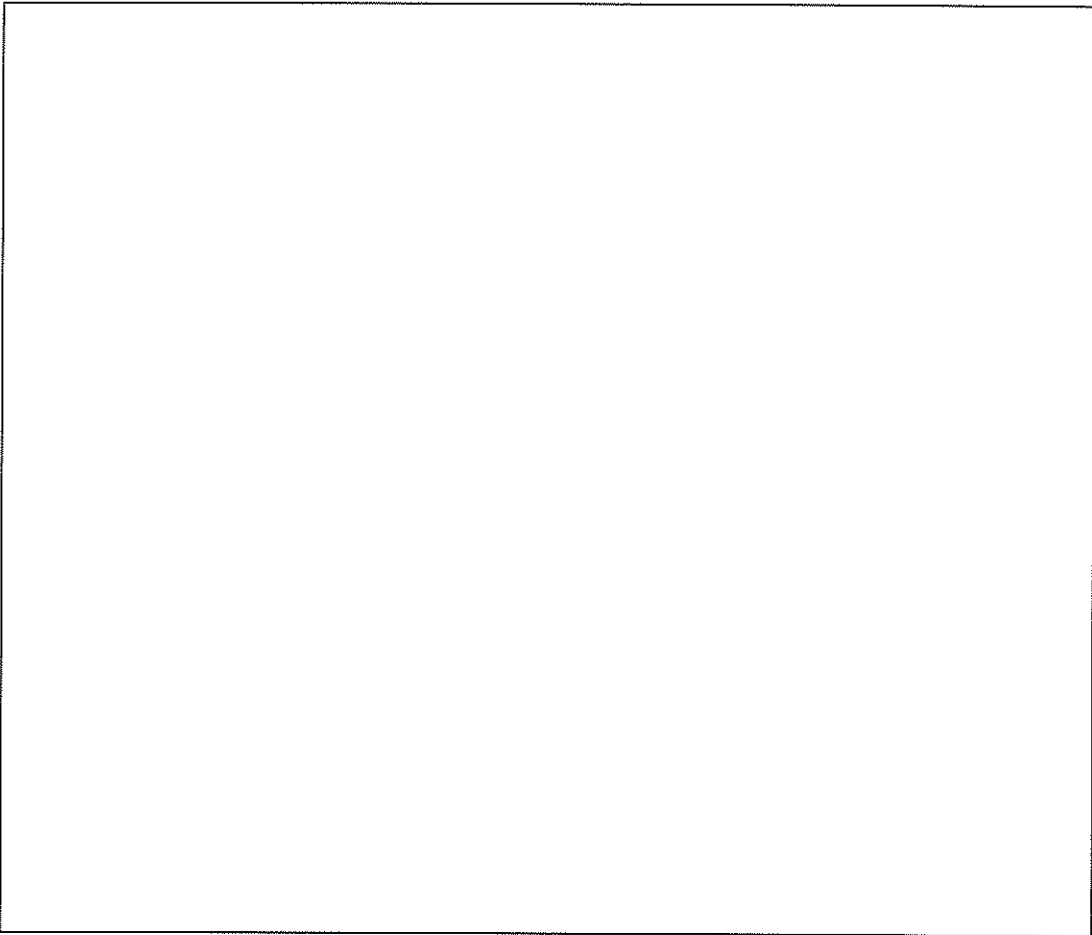
The workshop is equipped with a bench drill, metal lathe and a full range of metalworking tools.

1. List all factors you consider to be important in the design of a dispenser.

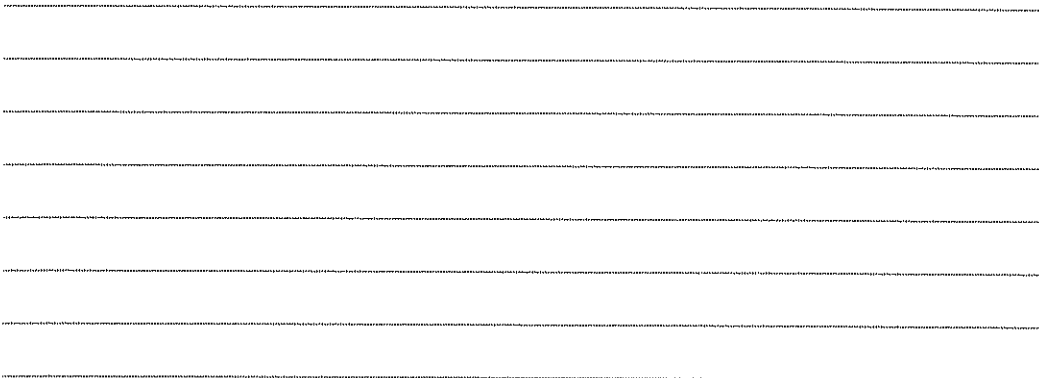
2. In the space provided on the right draw a preliminary pictorial sketch of a possible design.

3. List all materials you would need to construct your project according to the sketch. State number, size and length of all pieces of steel required.

4. In the space provided below neatly and accurately make a workshop drawing which shows details of all component parts of your design including dimensions. Use a suitable scale if the space provided is insufficient for a full size drawing.

A large, empty rectangular box with a thin black border, intended for a workshop drawing. It occupies the central portion of the page below the first question.

5. Briefly describe the procedure you would follow in marking out, cutting, shaping, machining and constructing the dispenser.

A series of ten horizontal lines for writing, providing space for the student to describe the procedure for constructing the dispenser. The lines are evenly spaced and span the width of the page.

ELECTRICITY

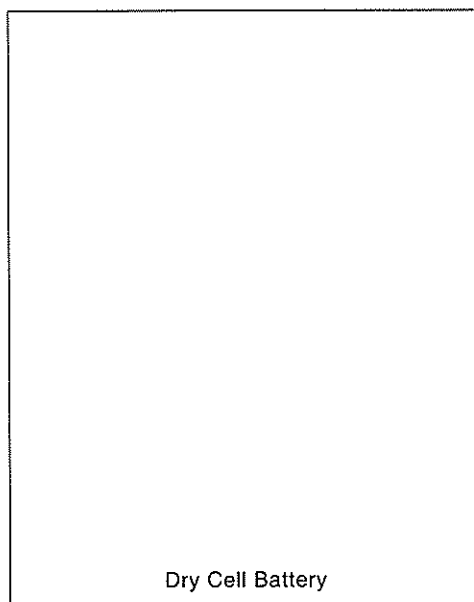
1. Briefly describe an electrical conductor in terms of electron theory.

2. Which of the following is the unit of measurement for Electromotive Force?

a. Proton b. Volt c. Ampere d. Ohm

3. In the space provided on the right draw a neat sectional sketch of a dry cell battery. Name the parts of the battery in your sketch.

Briefly describe how the battery produces electricity (flow of electrons).



4. When a wire is passed close to a magnet the magnetic lines of force cause electrons to flow in the wire.

What happens when the wire is moved in the opposite direction?

5. If a coil of wire is rotated through a magnetic field at high speed a flow of electricity can be produced. List three factors that will affect the strength of the electric current produced.

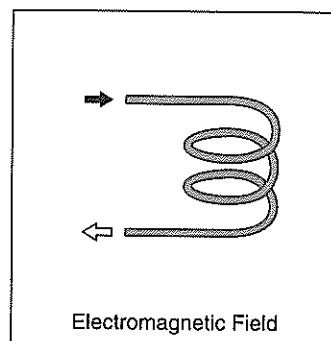
a. _____

b. _____

c. _____

6. The electromagnetic field near a single wire which carries an electric current is too weak for most useful purposes. How can a much stronger electromagnetic field be produced?

7. The diagram on the right illustrates a coil of wire with an electric current passing through it. Complete the diagram by neatly sketching the electromagnetic field around the coil.



8. List two methods of increasing the strength of the electromagnetic field referred to in question 7 above.

a. _____

b. _____

9. In the space provided on the right draw a neat sketch illustrating an electromagnet. Show clearly how the introduction of a soft iron core concentrates the magnetic field when a current is passed through the coil.

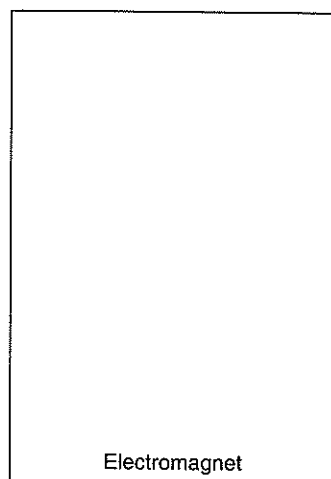
Does the soft iron core remain magnetised when the electric current is switched off?

a. Yes b. No

10. List two appliances whose operation depends on an electromagnet.

a. _____

b. _____



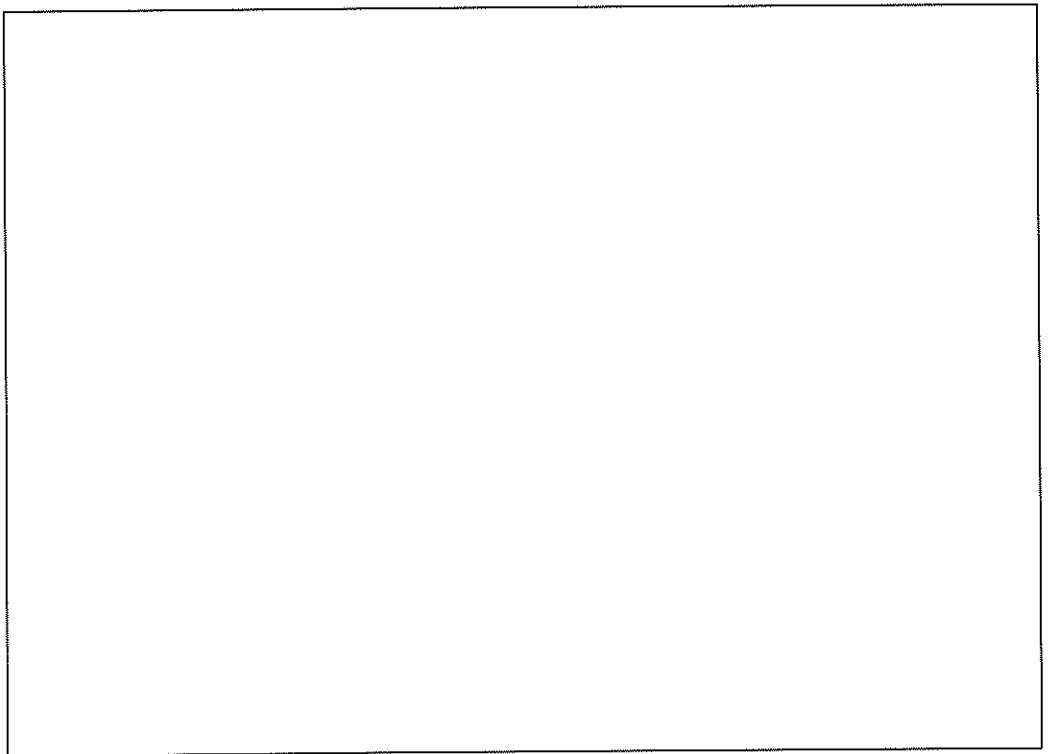
11. Briefly describe the flow of electrons in Direct Current.

12. Briefly describe the flow of electrons in Alternating Current.

- 13.** In the space provided below draw a neat circuit diagram illustrating part of an auto-electrical circuit. Your diagram should include the following:

- 2 head lights
- 2 tail lights
- 1 horn
- 1 fuse for the head lights
- 1 fuse for the tail lights
- 1 fuse for the horn
- 1 switch for all lights
- 1 switch for the horn
- 1 two cell battery

N.B. Make sure you arrange your circuit so that if one bulb blows all the others will remain on.



- 14.** Is the circuit described above a series circuit?

a. Yes b. No

- 15.** Describe one disadvantage of connecting a number of light bulbs in series.

16. List four safety precautions you should always observe when using electrical equipment or appliances.

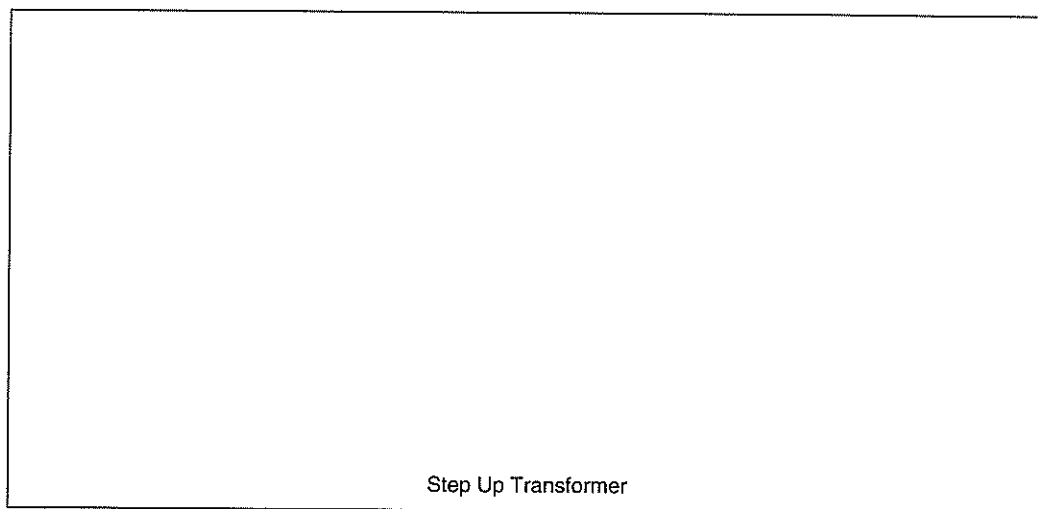
- a. _____
- b. _____
- c. _____
- d. _____

17. What is the purpose of a transformer?

18. The voltage produced in the secondary coil of a transformer will depend on:

- a. _____
- b. _____

19. In the space provided below draw a neat diagram illustrating a 'step-up' transformer with twice the number of turns in the secondary coil as there are in the primary coil.



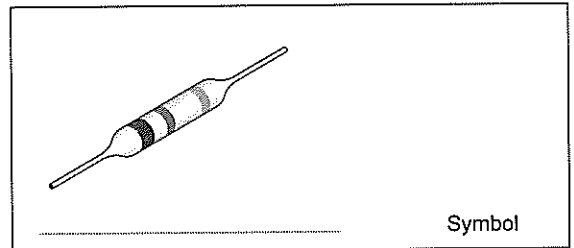
20. If the input voltage of the transformer described in question 19 above is 6 volts the output voltage would be _____ volts.

21. What is the purpose of a rectifier?

22. Complete the following statements which relate to Ohm's Law.

- a. _____ = Current x Resistance
b. _____ = $\frac{\text{Voltage}}{\text{Current}}$
c. _____ = $\frac{\text{Voltage}}{\text{Resistance}}$

23. Name the electronic component shown in the adjacent illustration and neatly draw its symbol.

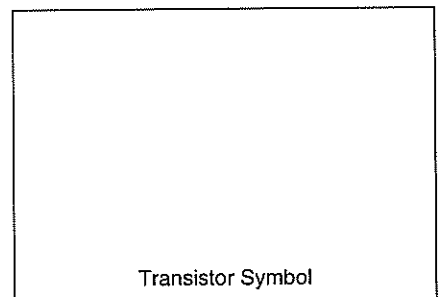


24. What is the common feature of the different types of diodes used in electronic circuitry?

25. What type of diodes glow brightly when connected correctly in a circuit?

26. List the main functions of transistors in electronic circuitry.

27. In the space provided on the right draw the symbol for a transistor showing and naming its three leads.



28. Ignition systems in most cars would include a condenser (or capacitor) in the circuit. Briefly describe the functions of this component.

ISBN 1 876135 34 4

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