Western Cape Government

Western Cape Education Department
Directorate: Curriculum FET

AGRICULTURAL TECHNOLOGY

REVISION BOOK TERM 2

Grade 10

This revision program has been developed to assist you in reviewing important content and skills taught during the second term. The aim is to prepare you to understand the core concepts. It also aims to provide you with the opportunity to acquire the expected standard and application of knowledge necessary to succeed in the upcoming exams and tests.

The revision program covers the following topics:

Construction processes:

Electrical energy:12-volt DC
• Basic principles of electrical energy: current, amperes, resistance and
• Potential difference.
• Standard symbols and units as applicable to DC circuits
• Basic calculation

Basic components in an electric ignition system of a motor vehicle:
• Operation, function and troubleshooting:
• Battery/Ignition Coil/Spark Distributor/Spark Plugs/Timing

Basic components of the electrical circuit of a motor vehicle:
Fuses/Lights/Wires/Trailer wiring and coupling (male and female plugs)

Arc welding
Safety, protective clothing and hazards associated with arc welding
Arc welding machine: basic construction and operation
Basic arc welding principles/Arc welding electrodes/Welding defects

Soft soldering: Application and methods/Equipment used/Types of solders/Fluids/Safety

Brazing: Application and method/Equipment used/Types of welding rods/Fluids/Safety

INDEX

1.1	Topic 1 Electrical energy	3
1.1.1	Terminology	3
1.1.2	Mind map	5
1.2	Topic 2: Arc welding	6
1.2.1	Terminology	6
1.2.2	Mind map	9
1.3	Revision questions: Electrical energy	10
1.4	Revision questions: Arc welding	14

TERM 2 CONTENTS

Study the core content below on the topic: Structural materials

1.1 Topic 1: Electrical energy



Did you know? *A mind map is a diagram in which information is visually represented, usually with a central idea placed in the middle and associated ideas arranged around it.*

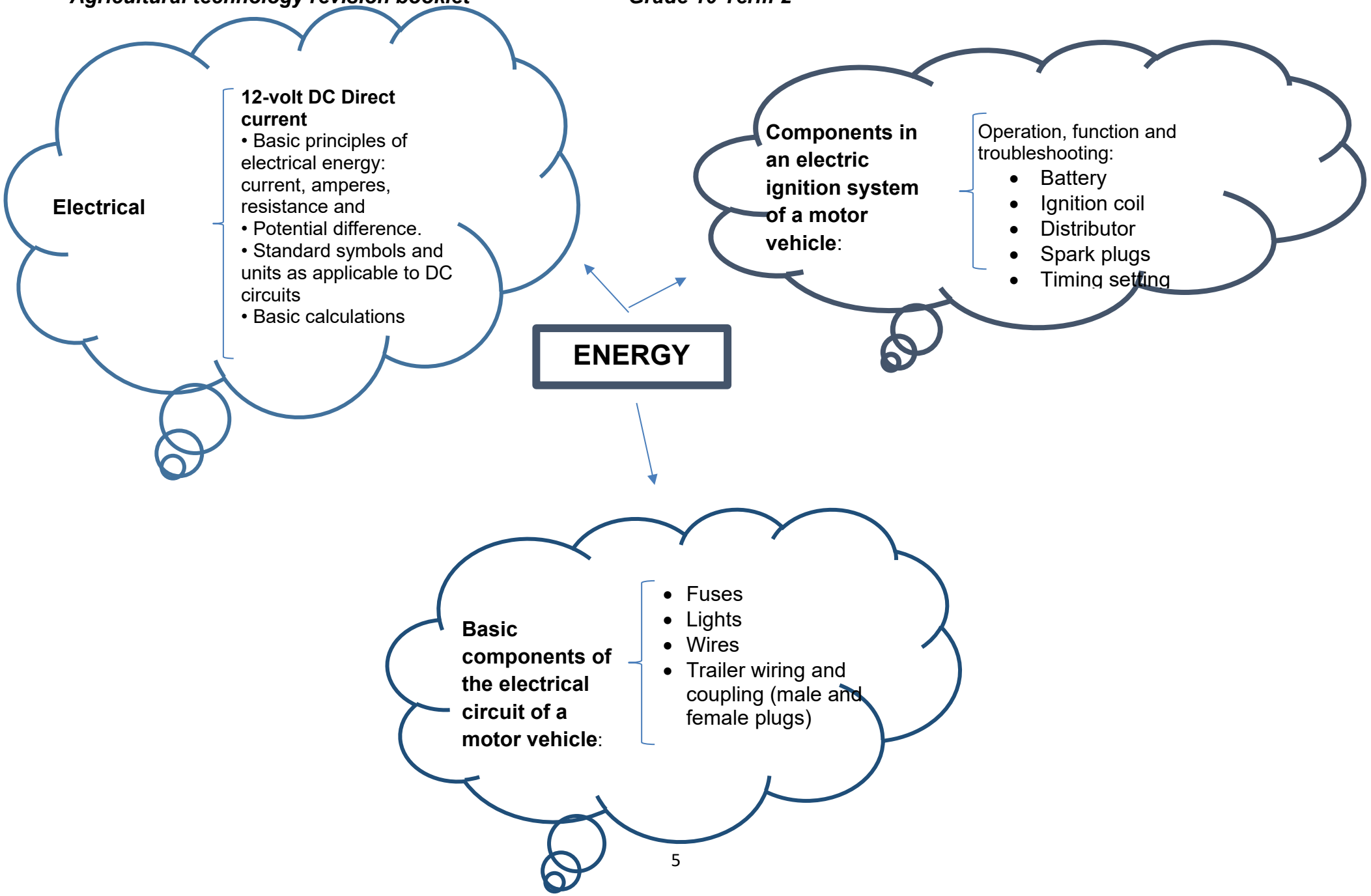
To see the Mind Map of Electrical Energy: please scroll to the next page.

1.1.1 Terminology:

The following list of terms is used in Electrical energy.

N0	CONCEPT	DEFINITION
1.	Current	Flow of electrons from one point to another.
2.	Ampere	Symbol I
3.	Resistance	Every conductor offers a certain resistance to the flow of electrons - Ohm
4.	Tension	The electrical pressure to overcome the resistance of a conductor – volt – symbol V.
5.	Potential difference	One pole is more positively charged than the other and since electrons flow from a negative to positive charge, the charge still exists after the connection is broken.
6.	Ohm's law	Current flowing is proportional to the supply voltage and inversely proportional to the resistance.
7.	Purpose of a battery.	Vehicle has a battery for the starter motor, windshield wipers, heater, radio, ignition system, lights, etc.
8.	Accumulator	Another name for a battery
9.	Colors of the jumper cables	Jumper cables are color-coded, red for positive (+) and black for negative (-).
10.	Connection point for the black jumper cable on a vehicle.	Connect the other end of the BLACK jumper cable to a solid metal ground point on the engine or frame of the vehicle with the discharged battery.
11.	Why may the black cable not be connected to the negative side of the dead battery?	**DON'T** Do not connect the final jumper cable to the negative (-) terminal of the battery itself, as this usually sparks and can ignite the hydrogen vapors in the dead battery and cause an explosion.
12.	Distilled water	. Water used in a battery.
13.	Battery cleaner.	Clean terminals with a baking soda solution.
14.	Sulfuric acid	Type of acid used in the battery
15.	Lead.	Type of metal used to make the plates in the battery.
16.	Direct current. DC	Type of current generated by the battery.

17.	Chemicaselectl energy.	Type of energy used to generate electrical energy in a battery
18.	Ignition coil	This is to increase the voltage in order to achieve an increased voltage in the secondary circuit.
19.	Spark distributor	This distributes the current to the correct spark plug.
20.	Spark plug	Create a gap in the combustion chamber that causes the induced current to bridge the gap under high voltage, producing a spark that in turn ignites the fuel-air mixture.


Electrical
12-volt DC Direct current
• Basic principles of electrical energy: current, amperes, resistance and
• Potential difference.
• Standard symbols and units as applicable to DC circuits
• Basic calculations
ENERGY
Components in an electric ignition system of a motor vehicle:
Operation, function and troubleshooting:
Battery
Ignition coil
Distributor
Spark plugs
Timing setting
Basic components of the electrical circuit of a motor vehicle:
Fuses
Lights
Wires
Trailer wiring and coupling (male and female plugs)

1.2 Topic 2: Arc welding



Did you know? *A mind map is a diagram in which information is visually represented, usually with a central idea placed in the middle and associated ideas arranged around it.*

To see the Arc Welding Mind Map: please scroll to the next page.

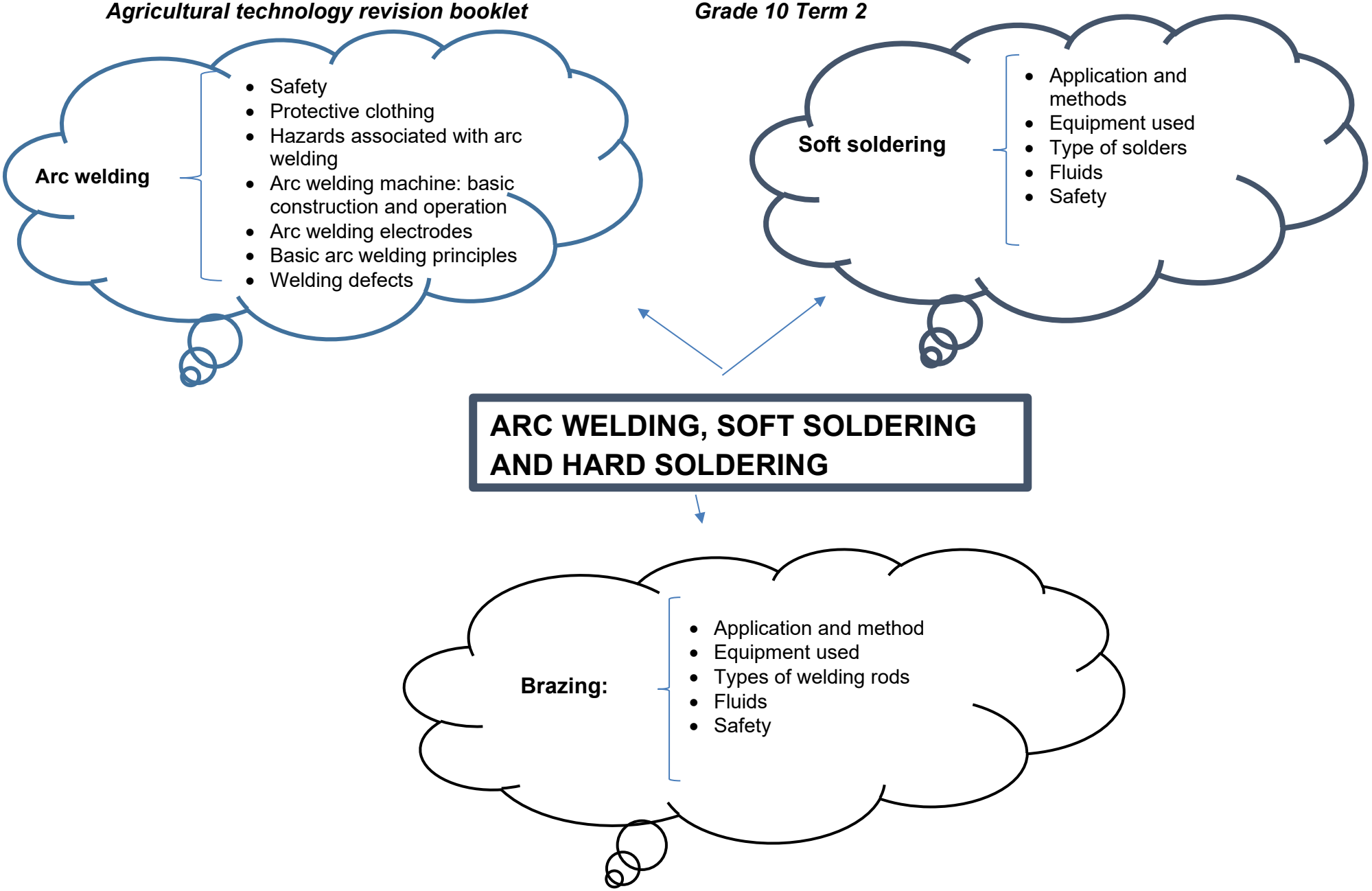
1.2.1 Terminology:

The following list of terms is used in Arc Welding.

N0	CONCEPT	DEFINITION
1.	Arc.	Flame or spark formed between the tip of the electrode and the metal to be welded
2.	Protective arch.	Blue gas forming around the welding arc.
3.	Welding puddle or welding bead.	Puddle/pool of molten metal that forms directly under the electrode when an arc is struck.
4.	Penetration.	When the metal being welded melts and the welding rod penetrates the welded object.
5.	Slag.	Coating formed over the welded area during welding.
6.	Fluid.	Cover the welding rod
7.	Tack weld.	Weld the ends of two pieces to be welded to prevent the parts from shifting when you start welding.
8.	Welding run.	A series of weld pools is called a weld run.
9.	Welding or slag hammer.	Remove slag from weld.
10.	Fire extinguisher	Device used to extinguish fires.
11.	UV light	Ultraviolet light. Very harmful light emitted by the welding flame of a welding machine.
12.	Arc eyes	Damage to the eyes and skin of a person working with a welding machine without personal protective equipment. PPE
13.	PPE welding equipment	A welding helmet, welding apron, welding gloves, welding boots, leggings, gas mask, etc.

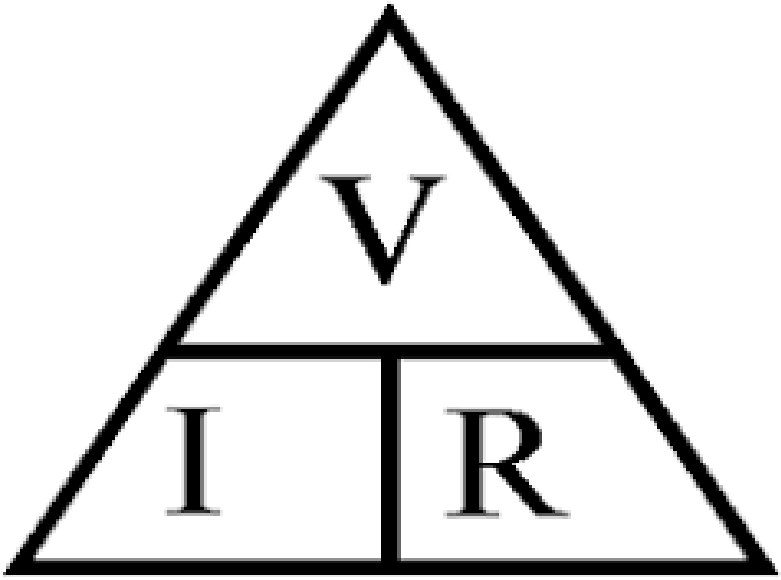
14.	Bakelite	Materials used to insulate and provide the electrode holder
15.	Inverter welding machine	• An inverter welder is a type of welding power source that is capable of providing a high current for welding. • The welding machine uses a series of rectifiers and switches to convert 60 Hz AC input power to DC output power.
16.	Oxy-acetylene welding	Use oxygen and acetylene to obtain the welding flame.
17.	Black	Color of oxygen equipment
18.	Maroon	Color of acetylene equipment
19.	Clockwise or Right-hand thread	Direction of rotation of the oxygen equipment wire
20.	Anti-clockwise or Left-hand thread	Direction of rotation of screw threads of acetylene equipment
21.	Oxygen / Nitrogen	Composition of oxygen gas
22.	Carbon / Hydrogen	Composition of the acetylene gas
23.	3100°C to 6000°C	The combustion temperature of the oxyacetylene flame
24.	Pressure regulator on the acetylene cylinder	This reduces the high pressure of the gas in the cylinder to the lower pressure required for welding.
25.	Names of the two pressure gauges on the regulators.	• Cylinder pressure gauge Measures the pressure in the cylinder • Feed gauge Measures the pressure during the welding process
26.	Can one use oil on any of the parts of the acetylene apparatus?	None!!! Oil and grease can form an explosive mixture when combined with acetylene.
27.	How to detect leaks on the acetylene welding equipment.	Leaks can be detected with a soap and water solution. Do not use a match!
28.	Cutting flame	Used to cut or heat metal
29.	Neutral flame	General welding Thicker metal sheet
30.	Cooling flame	To weld aluminum
31.	Oxidizing flame	Used for welding copper and for welding solder Thinner metal sheets
32.	Leftwards welding technique	Used to weld mild steel up to 5 mm
33.	Rightwards welding technique	Used to weld soft metal thicker than 5 mm
34.	Vertical welding	Welding starts at the bottom of the weld and then moves upward to the end of the workpiece.
35.	Soldering	• Oxyacetylene welding with copper rods. • Brass requires a flux when welding to be done
36.	A flashback arrestor	Device used to prevent flames from blowing back into the pipes and cylinders, thus preventing an explosion
37.	Welding joint	• A weld is used to permanently join two pieces of metal together.

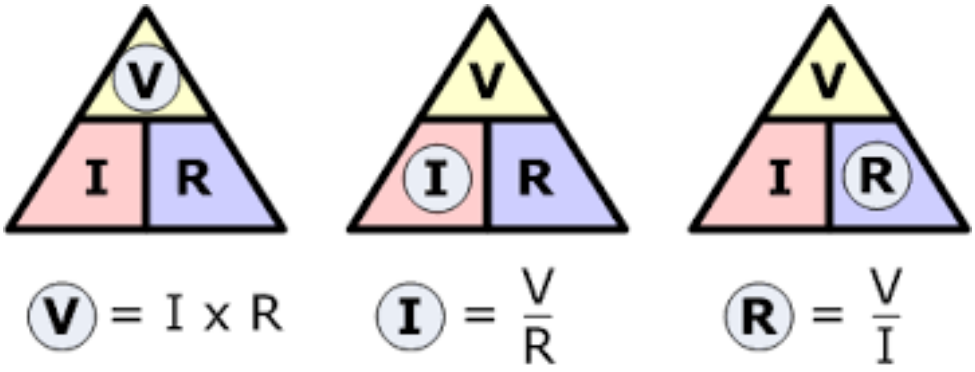
		• This is done by melting the two pieces of metal and then using astuffing to bind them together.
38.	Soldering	Is a process in which two or more metal items are joined by fusion and the flow of a filler metal (solder) into the joint,
39.	Soft soldering	Use a tin-lead alloy as the filler metal,
40.	Soft soldering device	Is done with a heated iron
41.	Silver soldering	Use an alloy with silver in it,
42.	Brazing	Use a copper alloy for the filling.
43.	Copper soldering iron is	An instrument with a large copper head and a long handle that is heated in a smut fire and used to apply heat to sheet metal for soldering.
44.	Wire brush	Wire wool and emery cloth are commonly used to prepare plumbing joints for welding. Electronic joints rarely require mechanical cleaning.
45.	Alcohol or Acetone	Commonly used with cotton swabs or brushes to remove fluid residue.
46.	Fluid	The purpose of the flux is to facilitate the soldering process.
47.	Brazing/welding	Requires a higher temperature for the solder than can be achieved with a heated iron. Gas flame is required for the heat. Oxy-acetylene
48.	Induction brazing	The source of heat in induction soldering is induction heating by high-frequency AC current in a surrounding copper coil.
49.	Pipe soldering	Copper pipe or tube is commonly joined by soldering. Propane gas flame is used.


Arc welding
Safety
Protective clothing
Hazards associated with arc welding
Arc welding machine: basic construction and operation
Arc welding electrodes
Basic arc welding principles
Welding defects
Soft soldering
Application and methods
Equipment used
Type of solders
Fluids
Safety
ARC WELDING, SOFT SOLDERING AND HARD SOLDERING
Brazing:
Application and method
Equipment used
Types of welding rods
Fluids
Safety

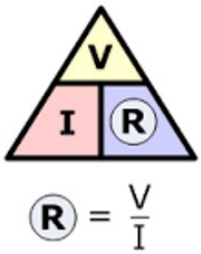
1.3 REVISION QUESTIONS; ELECTRICAL ENERGY

1.3.1 Use the magical triangle shown below for the calculation.





Calculate the resistance in a conductor where the Voltage is 2 Amperes, and the Current is 12 volts.



R = V
I
R = 12
2
R = 6 Ohms

1.3.2 Name FIVE basic safety precautions applicable to batteries. (5)

- Vehicles contain lead-acid batteries with sulfuric acid as electrolyte.
- The acid is highly corrosive and can burn your skin, but this is not the case if the battery contains a type of gel.
- Sealed batteries retain the liquid.
- Battery has removable plugs on the top.
- Do not turn batteries upside down.
- Batteries can explode. During the charging process, hydrogen gas is released and is highly flammable.
- Do not smoke near the battery, nor bring any open flames nearby.
- Frozen batteries are taken out and placed in a warm room before charging.
- Always wear safety glasses.

1.3.3 Name FIVE precautions that should be taken when repairing or replacing batteries. (5)

- It is usually a good idea to disconnect the battery before doing any electrical repairs.
- Disconnect the negative battery cable from the battery first. This will prevent accidental damage to electronic equipment if wiring is accidentally shorted.
- **WARNING**: Never disconnect the battery when the starter is engaged, or while the engine is idling or running.
- **WARNING:** Disconnecting the battery on some LATE MODEL VEHICLES can cause handling or other problems: When the battery is disconnected, power to the PCM and other onboard modules is lost. This can cause a loss of “Keep Alive Memory Settings”.
- Disconnecting the battery can also cause the module system to forget their learned or programmed settings.
- If you are unsure whether disconnecting the battery on your car could cause problems, you should connect a Battery Charger or “Memory” device to the battery cables or the 12 volt power outlet or cigarette lighter before disconnecting the main battery.
- **NEVER REPLACE BATTERY POLARITY!!**This can damage the battery, charging system, electrical components or onboard electronics.
- Finally, when installing a new battery, make sure the battery is fully charged before driving the vehicle. This will reduce the strain on the charging system.

1.3.4 Name FIVE reasons that would cause a battery to discharge. (5)

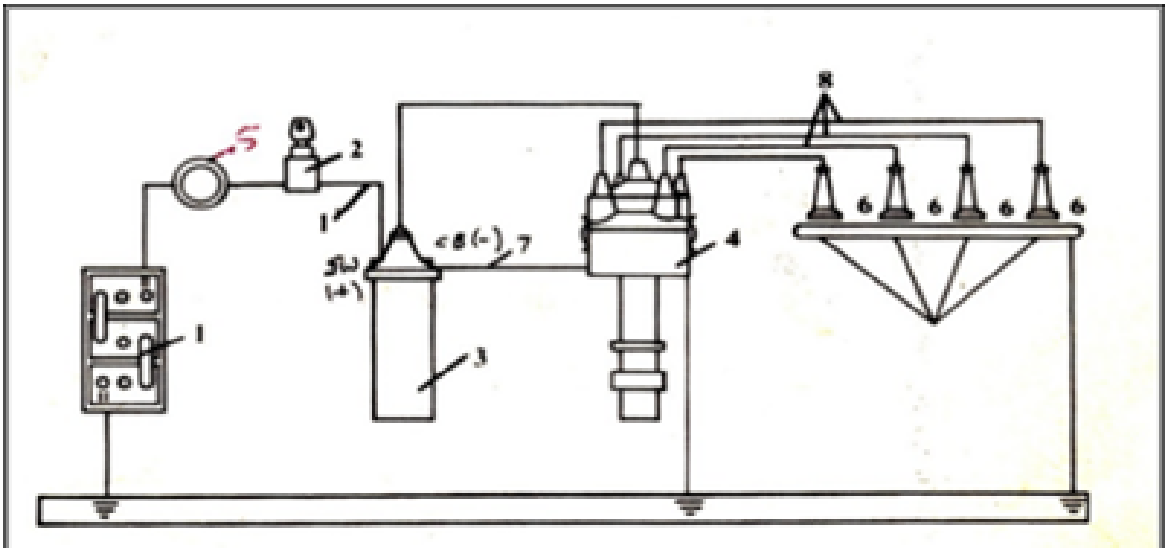
- Short circuit in the car's electrical wiring
- Using the starter motor for a long time when the engine starts with difficulty.
- When the vehicle is only used for short distances for a long period of time and the battery cannot be fully charged by the alternator.
- Defective alternator.
- Short circuit between battery plates.
- Sulfate precipitates on plates.
- Using impure water when topping up battery water.

- Broken connectors and poles.
- Cracked casing.
- Battery freezing at extreme temperatures.
- Excessive use of starter motor

1.3.5 Name FIVE symptoms that indicate that battery cables are faulty. (5)

- The starter turns slowly.
- Cables get hot.
- Cables are coated with an acid layer.
- Cables are broken.
- Lights shine dimly.
- The horn is barely audible.
- Battery is fully charged, but electrical parts
- Functioning poorly.

1.3.6 Label the sketch below.



1. Accumulator
2. Ignition switch
3. Ignition or high voltage coil
4. Spark distributor
5. Ammeter
6. Spark plugs
7. Primary conductors (low voltage)
8. Secondary conductors (high voltage)

1.3.7 Briefly describe how to set the timing of an engine with a stroboscope. (7)

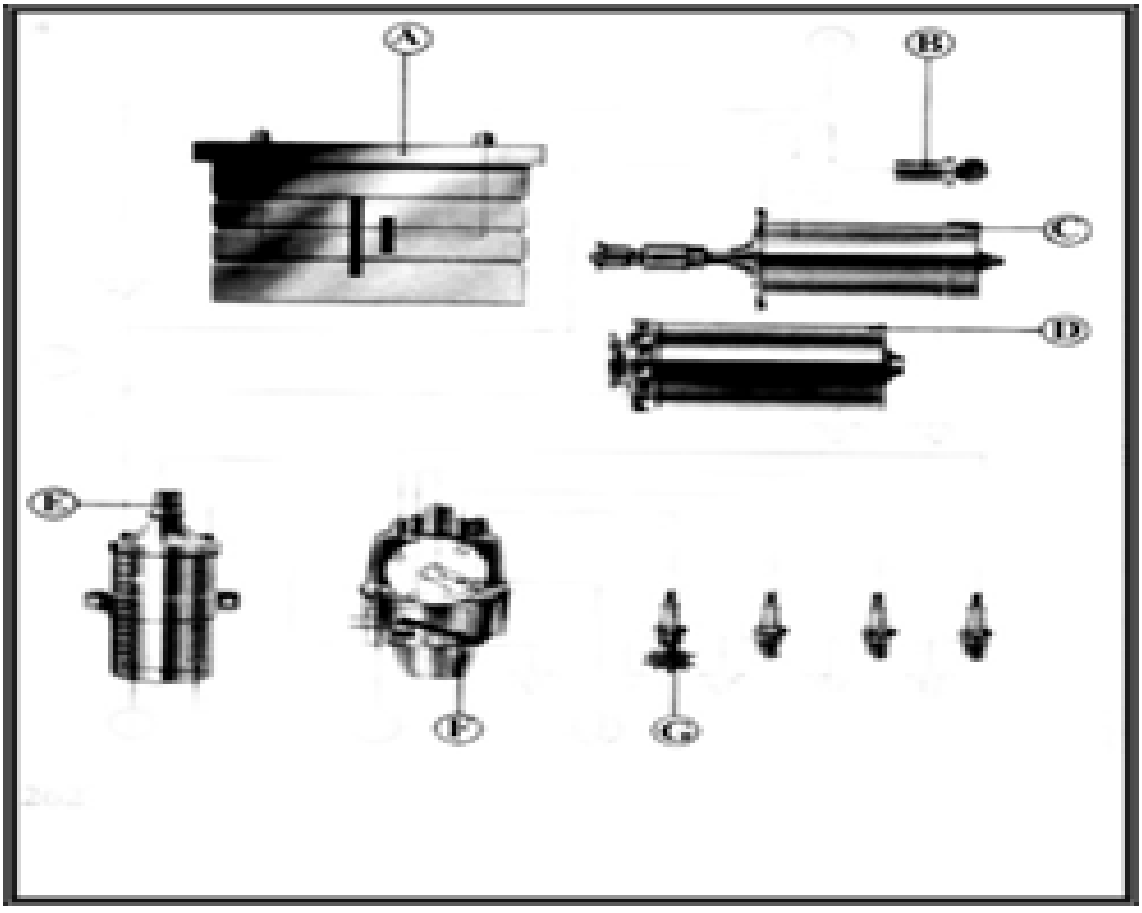
- Engine must be turned on.
- Attach the spark adjustment light to high voltage lead No. 1.
- Remove the vacuum advance mechanism.
- Adjust the idle speed according to the specifications.
- Set the timing light to the spark timing marks of the engine.
- Loosen the clamp bolt of the distributor.

- Turn the distributor until the timing marks match the manufacturer's instructions.

1.3.8 Name SIX symptoms of typical ignition problems in an engine. (6)

- Engine is difficult to start.
- Engine runs irregularly.
- Vehicle runs jerkily.
- Low power.
- Engine idles slowly.
- Blackish smoke from exhaust pipe.

1.3.9 Name the parts of an ignition system as shown below. (7)



A. Battery / accumulator.
B. Starter switch.
C. Starter motor.
D. Alternator.
E. High voltage coil.
F. Spark distributor.
G. Spark plug.

1.4 REVISION QUESTIONS: ARC WELDING

1.4.1 Name FIVE safety precautions when welding. (5)

- Always stand on a rubber mat when arc welding. This protects you from electric shock. Where rubber mats are not available, rubber-soled shoes should be worn. This is especially important in damp areas.
- Always make sure the floor is dry because electric shocks can be experienced if the floor is wet.
- Make sure there are no FLAMMABLE materials in the area that can be easily ignited by sparks from welding. A fire or explosion can easily be caused by sparks.
- Good ventilation is necessary so you can breathe easily.
- Always ensure that the eyes of fellow students are protected from the arc rays by shielding the welding area with tarpaulin or special welding shields.

1.4.2 Name FIVE hazards associated with arc welding. (5)

- Never work with a welding machine where the power supply is not connected to the earth leakage circuit breaker.
- Never stand in water and weld.
- Electrode holder must be thoroughly insulated.
- Keep flammable materials away from flying sparks.
- A helmet with clear glass should be worn to protect the eyes from flying slugs.
- A shield with dark filter glass, which fits over the clear glasses, must be worn to protect the user from ultraviolet rays when welding.
- It is extremely dangerous to look at the open flame with uncovered eyes when welding. It can cause painful arc eyes or even blindness.
- Caution must be exercised when welding any drums. Explosive gases or substances can lead to explosions.
- Certain metals such as copper, manganese steel and galvanized metals can emit toxic fumes when welded.

1.4.3 Describe the following types of Arc Welding Machines: (6)

Alternating current (AC) welding machine	**Direct current (DC) welding machine.**	**Rectifier (I**
• Transformer welding machine. • Suitable for all ferrous metals. • Gives a smoother finish and the transformer is cheaper.	• Generator welding machines. • Welds non-ferrous metals.	• Transform • Transform • Suitable fo ferrous me

1.4.4 Briefly describe an electrode / welding rod. (2)

- An electrode is a filler rod with which the weld is made.
- Consists of a metal rod covered with an insulating material called sheath/fluid.

1.4.5 What is the purpose of the coating on a welding rod? (4)

- Stabilize the current.
- Melts away impurities.
- Helps to form slag.
- Helps the welding process happen faster.

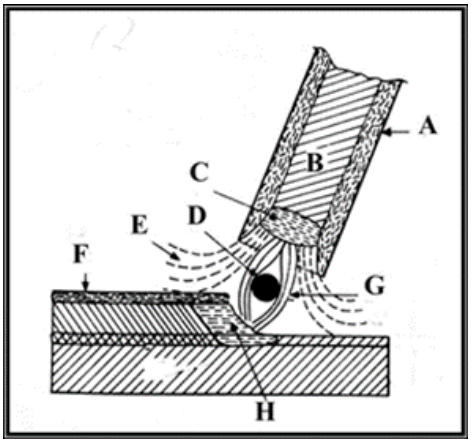
1.4.6 What is the purpose of the slag formed on the weld run? (3)

- Protect the molten metal from airborne contamination.
- Prevent the metal from cooling too quickly.
- Causes an even weld. (Slag must be removed with a pickaxe after welding)

1.4.7 Tabulate the different defects that can occur on electrodes and give the effect of each defect. (12)

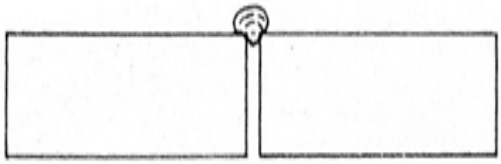
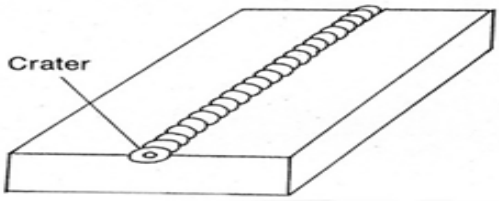
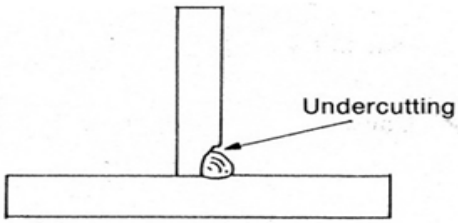
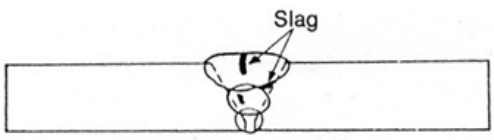
Defect	**Effect**
A. Tip of electrode covered with insulating material	No bow can be drawn.
B. Color code absent or unclear	Difficult to choose the correct rod for a specific metal
C. Stafie's coating absent	• Current cannot be stabilized. • Impurities on the surface of the • Metal cannot be melted away. • Sludge cannot be formed. • Melting time delayed. • An even weld is not possible. • Protected arc cannot be obtained.

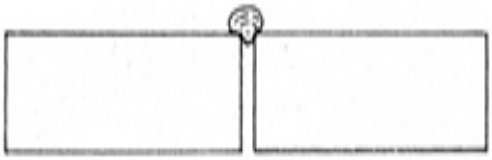
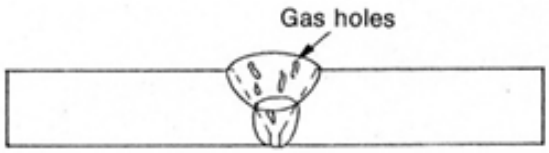
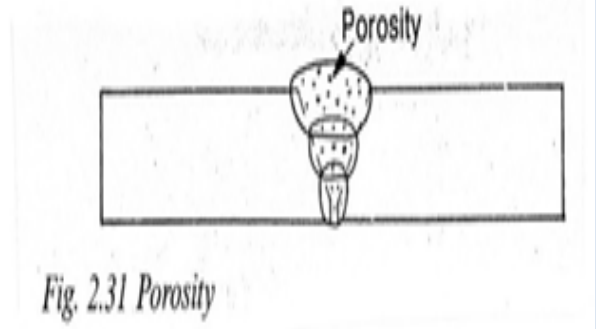
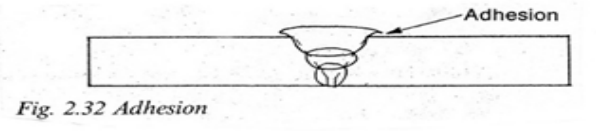
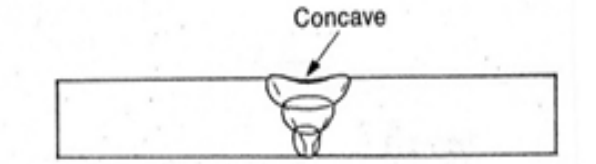
1.4.7 Label the sketch below. (8)

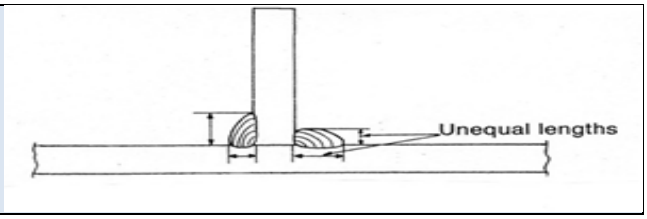


A. Cover.
B. Core of the electrode.
C. Molten metal.
D. Molten flux.
E. Shielding gas.
F. Solidified fluid.
G. Electric arc.
H. Molten pool.

1.4.8 Draw, name and give the causes of the various welding defects. (30)

Name of welding defect	Causes	Sketch
Insufficient penetration	• Welding torch flame too small or amperage too low • Incorrect welding technique • Insufficient load preparation	
Welding crater	• Too large flame or too high arc current • Incorrect welding technique • Too thin electrode or rod	
Indentation	• Too high amperage/current or too high a flame • An incorrect electrode angle • An incorrect welding torch angle	 *Fig. 2.27 Undercutting*
Snail inclusion	• The arc current is too low. • Slag is not removed after each welding run • An incorrect electrode angle	 *Fig. 2.28 Slag inclusion*

	• Incorrect preparation of weld • Insufficient penetration	
Insufficient penetration	• Root gap too small • Arc current too low or welding torch flame too small • Electrode or rod too heavy	
Gas cavities	• Dirty metal • Base metal melted too quickly • Weld metal cooled too quickly	
Porosity	• Too high arc current or too large flame • Removing the arc or torch too suddenly causes the molten metal to become contaminated by atmospheric gases. • Wrong electrode or rod	 *Fig. 2.31 Porosity*
Adhesion	• Incorrect welding technique • Wrong electrode or rod	 *Fig. 2.32 Adhesion*
Hollow/Concave welds	• Too little welding material deposited • Too large a flame or too high an arc current	 *Fig. 2.33 Concave weld*

Uneven leg lengths	• Wrong electrode angle • Wrong burner nozzle angle	

1.4.9 Describe the process of striking a welding arc. (9)

- Make sure the ground cable clamp makes thorough contact with the welding table and workpiece.
- Use an electrode with the correct diameter that matches the thickness of the workpiece.
- Adjust the amperage of the welding machine according to the table.
- Put on a welding helmet to protect your eyes.
- Start the weld by making a scratching motion with the welding rod.
- A crackling noise is a sign that the weld is going smoothly.
- Make a zigzag movement with the electrode.
- When the electrode gets stuck, bend the electrode back and pick it up.
- At the end of welding, the slag must be removed with a pickaxe.

1.4.10 Step-by-step instructions for doing soft soldering.

Safe positioning of soldering iron

- When using a soldering iron, you must be careful not to burn yourself or any part of the vehicle you are working on.
- The tip of the soldering iron is hot enough to melt metal solder, so make sure it is in a safe place and not touching anything.

Prepare the wires to be connected

- Remove an appropriate amount of the protective insulation around the wires while the soldering iron heats up.
- Always use a proper stripping tool that is in good condition.

Weld the wires mechanically

- Twist the wires together to make a good mechanical connection between them.
- If there are impurities in the solder, and the wires are not touching each other directly, there may not be a good electrical connection even though there may be a strong physical connection.
- This is known as a "dry connection".
- It is also very important that the surfaces are very clean before soldering is done otherwise there will be a poor connection.

Place solder on wires

- Use the soldering iron to carefully heat the wires and melt some solder.
- Place the soldering iron on the wires to ensure that just enough solder flows into the wires.
- Be careful not to use too much solder, and if you apply too much heat you will melt the wire insulation.
- When you are finished soldering, you should clean any excess flux from the joint with a cloth and a little solvent.

Place a cover over the joint

- Once the electrical connection has been made, and it has cooled down enough for you to handle it, you can cover the joint with an insulator.
- It can also be electrical insulation tape.

Apply the solder.

- Give the wires a thin preparatory coat of solder.
- This is called 'tinning' the wires and helps to make the final connection.
- Prepare the surfaces with flux if it is not incorporated into the core of the solder.
- Place the wire back into the terminal, and place the soldering iron on the terminal to get it hot enough to melt more solder between the terminal and the tinned wire.
- Be careful not to use too much solder, and if you heat the terminals too much the wire insulation will start to melt.

Cover the terminals

- Once the electrical connection has been made, and it has cooled enough for you to handle it, you can place the insulator cover over the terminals and test the connection.

1.4.11 Name the safety precautions associated with soldering. (5)

- The soldering iron tip must be very hot to melt the solder. Do not burn yourself with the soldering tip.
- Do not inhale the fumes released during the soldering process; they can irritate your respiratory system.
- Do not use the electric soldering iron while standing in water.
- Never solder on a live electrical circuit.
- Make sure you understand and maintain all legislative and personal safety procedures.

1.4.12 Name the advantages of brazing. (3)

- Lower heat input resulting in less distortion.
- The steel to be welded does not need to be melted to create the weld.
- Different materials can be easily joined where it may not be possible with gas welding

1.4.13 Name the basic conditions for soldered joints. (5)

- The pipe and fittings must be cleaned to leave metal with no impurities.
- Any pressure created by heating the pipes must have an outlet.
- Copper is only one material that is connected in this way.
- Copper fittings are often used for valves or as a connection between copper and other metals.
- Brass pipes are soldered in this manner in the making of brass and some woodwind (saxophone and flute) musical instruments.

1.4.14 Name FIVE soldering defects. (5)

- Various problems may arise in the soldering process that result in joints that are not functional immediately or after a period of use.
- The most common defect in hand soldering is when the solder does not reach its flow temperature. The result is a “cold solder joint.” This is usually the result of the soldering iron being used to heat the solder directly, rather than the parts themselves.
- A proper weld is when the soldering iron heats the parts to be joined, which in turn melts the solder. This ensures sufficient heat in the welded parts for thorough wetting.
- An improperly selected or applied flux can cause a joint to fail, or if the flux is not properly cleaned from the joint, the metals in the joint can corrode over time and cause eventual failure of the joint.
- Movement of metals that have been soldered before the solder has cooled will cause a highly unreliable cracked joint.

1.4.15 Name the parts in the sketches below. (16)

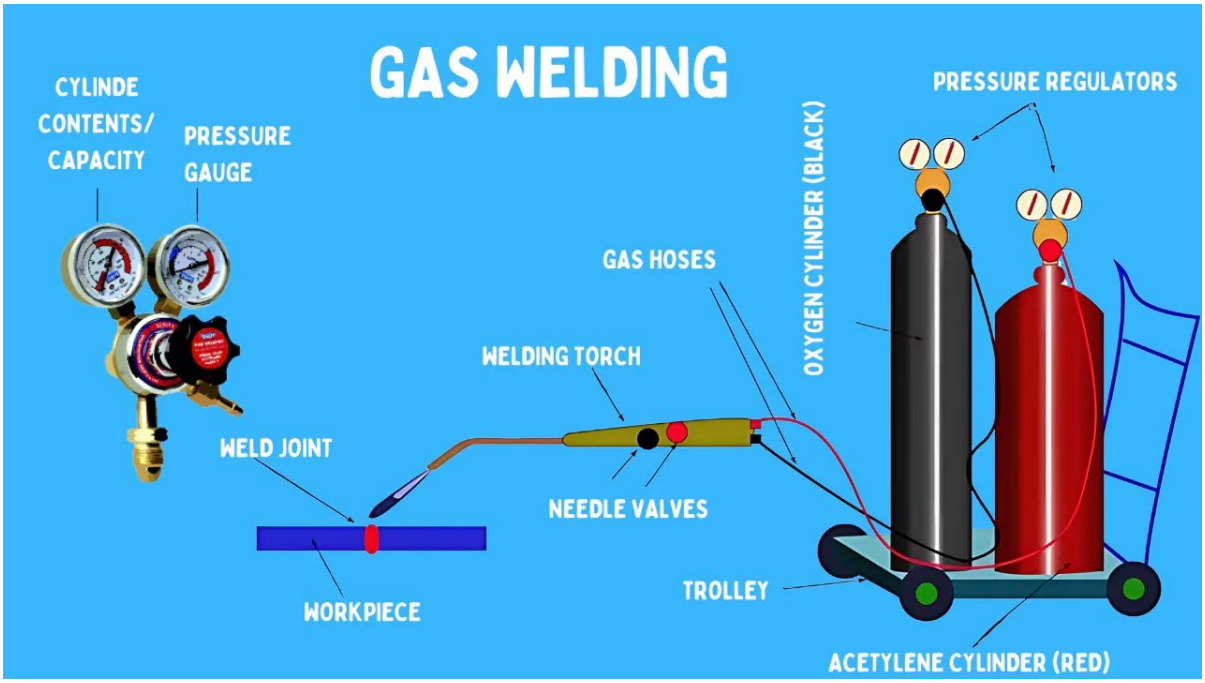
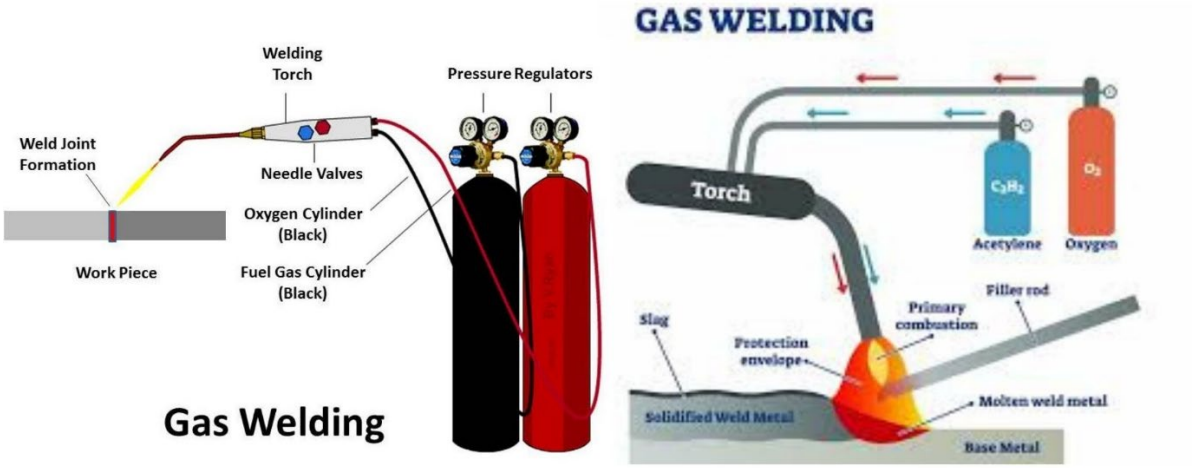


Diagram of Gas Welding



MechLesson