GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

REMOTE LEARNING ACTIVITY BOOK

(RELAB)

SUBJECT: AUTOMOTIVE

GRADE: 10

TEACHER GUIDE

INTRODUCTION AND PURPOSE OF THE RELAB

The Covid 19 pandemic has caused serious impact to schooling resulting in major learning loss and instructional time. This scenario has resulted in school implementing rotational timetables- where learners attend school on alternate days or weeks. The Remote Learning Activity Book was conceptualized to engage learners in constructive learning on days they are at home. Hence the RELAB was developed as a strategy to enhance remote learning.

The RELAB is underpinned by the following Legislative demands:

a) Responding to GDE Strategic goal 2 promoting quality education across all classrooms and schools
b) **DBE Circular S13 of 2020** the requires the GDE to support the implementation of the Recovery Annual Teaching Plan (RATP)
c) **GDE Circular 11 of 2020** requiring districts to issue Learning Activity Packs to support schools for lockdown learning. Understanding learning constraints at home as majority of learners do not have access to devices or data to use for online learning. Many households are depending on schools to provide them with learning resources packs

RELAB is designed as workbook with activities based on the Revised Annual Teaching Plan. The exercises are pitched at a standard to expose learners at Grade 10 & 11 to content at different cognitive levels. The NSC diagnostic reports in different subjects have revealed that learners fail to analyse questions and as a result fail to respond accordingly.

The RELAB is intended to ensure that learners work on exercises that consolidate and reinforce topics taught while at school. These exercises are be completed at home and would receive feedback as groups or individually when at school. It is therefore of paramount importance that teachers assess the work with learners in class, as a way of providing constructive feedback. Teacher are also required to diagnose learner responses, remediate where necessary and plan further intervention.

Educators are encouraged to create whatsapp groups to remind learners on what is expected of them in a particular week/ day(s). Effective utiisation of the RELAB activity book would further ensure that all topics in the RATP are covered simultaneously. Feedback from learners at home will confirm usage of the RELAB material and assist to prepare learners for formal assessments.

Automotive- Topics

1. **Safety – Generic**
2. **Tools – Generic**
3. **Engines- Generic**
4. **Engines- Specific**
5. **Joining Methods - Generic**
6. **Forces- Generic**
7. **Maintenance - Generic**
8. **Terminology- Drive Trains**
9. **Maintenance- Specific**
10. **Systems and Control – Specific (Mechanical)**
11. **Systems and Control – Specific (Electricity)**

EXPECTED ANSWERS

SAFETY -Question 1 and 2

Below is a rubric to assess the essay question on HIV and Aids.

Level of Achievement	General Approach	Comprehension
Exemplary **(10 pts)**	•Addresses the question. •States a relevant, justifiable answer. •Presents arguments in a logical order. •Uses acceptable style and grammar (no errors).	•Demonstrates an accurate and complete understanding of the question. •Backs conclusions with data and warrants. •Uses 2 or more ideas, examples and/or arguments that support the answer.
Adequate **(6 pts)**	•Does not address the question explicitly, although does so tangentially. •States a relevant and justifiable answer. •Presents arguments in a logical order. •Uses acceptable style and grammar (one error).	•Demonstrates accurate but only adequate understanding of question because does not back conclusions with warrants and data. •Uses only one idea to support the answer. •Less thorough than above.
Needs Improvement **(3 pts)**	•Does not address the question. •States no relevant answers. •Indicates misconceptions. •Is not clearly or logically organized. •Fails to use acceptable style and grammar (two or more errors).	•Does not demonstrate accurate understanding of the question. •Does not provide evidence to support their answer to the question.
Not Answered well. Poor attempt (1 pts)		

Question 3

Should there be an emergency, that mean somebody got hurt or seriously hurt, that immediate attention can be given to the wound before professional help can be obtained.

Question 4

- Adhesive Plaster Strips
- Bandage
- Cotton Wool
- CPR Resuscitation Barrier Device
- First Aid Dressing
- Gauze Swabs
- Gloves
- Gloves
- Scissors (General)
- Splints
- Tweezers (Metal)
- Wound Cleaner
- Any other that may not appear in this memorandum

Activity 5.1 - Multiple-choice questions

5.1.1. d

5.1.2. a b c

5.1.3. b c

5.1.4. d

5.1.5 a

5.1.6. a

5.1.7. c

5.1.8. b

5.1.9. d

5.1.10. a

5.1.11. b

Activity 5.2 – True or False

5.2.1. True

5.2.2. True

5.2.3. False

5.2.4. True

5.2.5. True

5.2.6. False

5.2.7. True

5.2.8. False

5.2.9. True

5.2.10. False

Activity 5.3.

5.3.1 The Occupational Health and Safety Act aims to provide for the health and safety of persons at work and for the health and safety of persons in connection with the activities of persons at work and to establish an advisory council for occupational health and safety.

5.3.2 Any five of the following:

- the right to life
- freedom from torture and degraded treatment
- freedom from slavery and forced labour
- the right to liberty
- the right to a fair trial
- the right not to be punished for something that wasn't a crime when you did it
- the right to respect for private and family life
- freedom of thought, conscience and religion
- freedom of expression
- freedom of assembly and association
- the right to marry or form a civil partnership and start a family

- the right not to be discriminated against in respect of these rights and freedoms
- the right to own property
- the right to an education
- the right to participate in free elections

5.3.3. Any of the following:

- emails
- internet access
- telephone calls
- data
- images

5.3.4. FIVE responsibilities of the employer:-

- Provide and maintain systems of work, plant and machinery that are safe and without risks to health.
- Take steps to eliminate or reduce any danger or potential hazard to the safety or health of employees.
- Make arrangements to ensure the safety and absence of risks to the health of employees in connection with the production, processing, use, handling, storage or transport of articles or substances.
- Provide training and supervision as may be necessary to ensure the health and safety at work of the employees.
- Ensure that work is performed and that plant or machinery is used under the general supervision of a person trained to understand the hazards associated with it and who has the authority to ensure that precautionary measures taken by the employer are implemented.

FIVE responsibilities of the employee:

- Ensure the health and safety of themselves and of other persons who may be affected by their acts.
- As regards any duty or responsibility imposed on the employer or any other person by this Act, co-operate with such employer or person to enable that duty or responsibility to be performed or complied with.

- Carry out any official order given to them, and obey the health and safety rules and procedures laid down by the employer or by anyone authorised by their employer, in the interest of health or safety.
- If any situation which is unsafe or unhealthy comes to their attention, report such situation to their employer or to the health and safety representative as soon as possible.
- If they are involved in any incident which may affect their health or which has caused an injury to them, report such incident to their employer or to anyone authorised by the employer, or to their health and safety representative, as soon as possible.

5.3.5. Good housekeeping in a workshop simply means an orderly arrangement of tools, equipment, operations, storage facilities and materials. To put it in simpler words, housekeeping can be defined as everything in its place and a place for everything.

5.3.6.

- Equipment and materials are stored in their proper places
- The first aid kit is easily accessible and contains the necessary medical items.
- Fire extinguishers are maintained and in good working order.
- Warning signs are visible and easily understood.
- Areas containing machinery are demarcated and clean
- Walking path are clearly indicated and obstacle free
- Places where mortar, plaster or cement is mixed are thoroughly cleaned after use.
- Poisonous materials are safely stored and used.
- Sharp objects are used with caution.
- Games and jokes are prohibited in the workplace.
- Smoking and drinking are prohibited in the workplace.
- Any materials or liquids that are spilled are immediately cleaned
- Any damaged or broken tools or machinery are immediately repaired.

5.3.7.

- Physical hazards are the most common hazards and are present in most workplaces at some time. Examples include: frayed electrical cords, unguarded machinery, exposed moving parts, constant loud noise, vibrations, working from ladders, scaffolding or heights, spills, tripping hazards.
- Ergonomic hazards occur when the type of work you do, your body position and/or your working conditions put a strain on your body. They are difficult to

identify because you don’t immediately recognize the harm they are doing to your health. Examples include: poor lighting, improperly adjusted workstations and chairs, frequent lifting, repetitive or awkward movements.

- Chemical hazards are present when you are exposed to any chemical preparation (solid, liquid or gas) in the workplace. Examples include: cleaning products and solvents, vapours and fumes, carbon monoxide or other gases, gasoline or other flammable materials.
- Biological hazards come from working with people, animals or infectious plant material. Examples include: blood or other bodily fluids, bacteria and viruses, insect bites, animal and bird droppings.

5.3.8.

- Plan the arrangement of the machines and worktables to ensure enough space to manoeuvre.
- Calculate the number of machines and workshop accessories.
- Calculate the number of workers (people) in the workshop.
- Are there enough electrical circuits to supply your power needs.
- Plan and design the storage place.

5.3.9. An accident is an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury.

5.3.10.

- Defective tools, equipment or supplies.
- Inadequate supports or guards.
- Congestion in the workplace.
- Inadequate warning systems.
- Fire and explosion hazards.
- Poor housekeeping.
- Hazardous atmospheric condition.
- Excessive noise.
- Poor ventilation.
- Rough and slippery floors
- Insufficient light in a workshop
- Badly planned workshop

5.3.11.

- Operating without qualification or authorization.
- Failure to tag out/lockout.
- Operating equipment at unsafe speed.
- Failure to warn.
- Bypass or removal of safety devices.
- Using defective equipment.
- Use of tools for other than their intended purpose.
- Working in hazardous locations without adequate protection or warning.
- Improper repair of equipment.
- Horseplay.
- Wearing unsafe clothing.
- Taking an unsafe position.

5.3.12.

COLOUR	**MEANING OR PURPOSE**	**INSTRUCTION & INFORMATION**
RED	Prohibition/Danger alarm	Dangerous behavior; stop; shutdown; emergency cut-out devices; evacuate
YELLOW or **AMBER**	Warning	Be careful; take precautions; examine
BLUE	Mandatory	Specific behavior or action e.g. wear personal protective equipment
GREEN	Emergency escape; first aid. No danger	Doors; exits; escape routes equipment and facilities Return to normal
RED(fire-fighting signs)	Firefighting equipment	Identification & location

5.3.13.

	SIGN	DESCRIPTION	COLOUR
What the group name of this type of signs: ***Information Signs***		First aid equipment	White on green background
		Eye wash	White on green background
		Emergency telephone	White on green background
		Escape Route Right	White on green background
		Eye wash	White on green background

	SIGN	DESCRIPTION	COLOUR
What is the group name of this type of signs: ***Safety Signs***		Electric shock hazard	Black border with a yellow centre and a black symbol inside
		Warning of fire hazard	Black border with a yellow centre and a black symbol inside

	SIGN	DESCRIPTION	COLOUR
		Warning of slippery surface	Black border with a yellow centre and a black symbol inside
		Ionizing radiation hazard	Black border with a yellow centre and a black symbol inside
		Suspected loads hazard	Black border with a yellow centre and a black symbol inside

	SIGN	DESCRIPTION	COLOUR
What is the group name of this type of **Prohibition Signs**:		Proceeding beyond this sign is prohibited	White on red background
		Loose clothing, ties, jewelry and unconfined long hair prohibited	Red sign with black symbol
		Use of compressed air to dust body prohibited	Red sign with black symbol

	SIGN	DESCRIPTION	COLOUR
		Thoroughfare for pedestrians prohibited	Red sign with black symbol
		Drinking of this water prohibited	Red sign with black symbol

	SIGN	DESCRIPTION	COLOUR
What is the group name of this type of signs: ***Fire Safety Signs***		Location of fire blanket	Red on white background
		Location of fire-fighting equipment	Red on white background
		Fire extinguisher	Red on white background
		Fire hose	Red on white background

	SIGN	DESCRIPTION	COLOUR
		Fire hydrant	Red on white background

	SIGN	DESCRIPTION	COLOUR
Regulatory Signs What is the group name of this type of signs:		Eye protection	White on blue background
		Respiratory protection	White on blue background
		Hearing protection	White on blue background
		Hand protection	Hand protection
		Keep area clean	White on blue background

Activity 5.4

5.4.1. All the electrically operated equipment must have a disconnecting device, to make it easy to break the circuit in case of emergency. Where the main switch must be placed on an electrical machine?

The main switch (Double Pole Single Throw Switch - DPST) is on an electrical machine it must be on the front panel of the machine.

5.4.2. All domestic installation must have a disconnecting device, to make it easy to break the circuit in case of emergency. Where the main switch of a domestic installation must be placed?

The main switch (Double Pole Single Throw Switch - DPST) of a domestic installation must be placed at the point of the entry of the main power supply.

5.4.3. Briefly describe what is meant by critical and non-critical emergencies.

- Non-Critical Emergencies – It is a condition not in a state of crisis or emergency
- Critical Emergencies – It is a situation in a state of crisis or emergency

5.4.4.

- Class C: electrical fires - Class C fires are contained using Carbon Dioxide (CO_2) fire extinguishers and Dry Chemical fire extinguishers

5.4.5.

- Faulty electricity
- Heated surfaces.
- Lightning
- Friction
- Static electricity

5.4.5.

- Class A: wood, paper, etc.
- Class B: flammable liquids such as petrol, oil and paraffin.
- Class C: electrical fires.
- Class D: flammable metals such as magnesium, lithium, etc.

Activity 5.5

5.5.1.

(a) Struck by lightning
(b) Mixing water with electricity
(c) Touching a high voltage source such as a high tension wires fell during storm
(d) Touching a low voltage, current source such as an electric socket or worn or bare electrical wire.

5.5.2.

(a) Look first, do not touch the victim.
(b) Turn the source of electricity at the control panel or fuse box
(c) Pull the victim away from the source by means of non-conductive material such as dry wood if the victim is under immediate danger.
(d) Do not remove the victim unless the he is under immediate danger.
(e) Check for signs of circulation. If absent begin cardiopulmonary resuscitation (CPR) immediately.
(f) Prevent shock by lying the victim down with his feet slightly higher than the head.
(g) Cover the victim with a blanket to maintain body heat.
(h) Call for help.

5.5.3.

- On hearing the evacuation alarm, immediately prepare to leave the building. Secure confidential materials and valuables, collect personal belongings, shut down experiments, and switch off computers, electrical appliances, equipment and machinery.
- If the evacuation alarm sounds, or if instructed to do so, leave the building by the nearest and safest exit route. All doors should be closed (but not locked) on leaving.
- If possible take hand held personal belongings (such as handbags and briefcases) with you when you leave. Do not return to collect belongings.
- Assist any person with a disability to leave the building. Do not attempt to carry people down stairs.
- Walk quickly and calmly to the designated assembly area for your building.

- DO NOT USE THE LIFTS
- Remain at the assembly area (in groups) until instructed to leave by Rescue Services personnel.
- Do not re-enter the building until informed that it is safe to do so by Rescue Services personnel. Do not enter a building in alarm

5.5.4.

Ventilation is one of the most important engineering controls available to the industrial hygienist for improving or maintaining the quality of the air in the occupational work environment.

5.5.5

- Always wear an apron when working with ferric chloride because it will stain your clothes on contact.
- Protective glasses are essential, as any chemical that comes into contact with your eyes may possibly lead to blindness. Also wear protective glasses during the drilling process.
- Use gloves when doing the etching. The chemical will stain the skin and can cause skin irritations.
- Work in a well-ventilated room.
- Store all used ferric chloride in a big plastic container, with a lid, that can be disposed of by a special waste removal company when full.
- Never work in metal containers; rather use plastic or ceramic. Ferric chloride attacks most metals.

6.1.1.

- When using any tool, always wear safety glasses for eye protection.
- Screwdrivers should only be used for their intended purpose—driving or removing screws. Screwdrivers should never be used for prying, punching, chiselling, scoring or scraping.
- While both slotted and cross-slotted screwdrivers will fit many fastener sizes, it is best to use screwdrivers of the proper sizes that fit snugly into the slot or recessed portion of the fastener head.

- Plastic handles should be made of fire and heat resistant materials. If properly designed, they give excellent grip. Rubber or vinyl is often used as a non-slip or insulating cover on plastic handles.
- Typical screwdriver handles will not insulate the user from electric current.
- It is time to discard the tool when the handle of a screwdriver becomes worn or breaks, if the tip is damaged or if the shaft is bent.
- Always keep the screwdriver shank in line with the screw shank. This will avoid damaging the screw slot and pushing the screw out of line.
- Never use pliers for added turning leverage on the shank of a screwdriver. However, a wrench may be used on square-shank drivers.
- Screwdriver slippage can cause injury. Never hold the piece you're working on in your hand while driving or loosening screws or bolts. Place it on a work surface and use a vice or a clamp to hold the material, whenever possible.
- Never carry a screwdriver in your pocket. The tip of the screwdriver is so sharp and hard that will hurt your body.

6.1.2.

- Always inspect the hammer before use. Loose hammer heads or nails stuck in the claw might fly off and cause injury.
- If a hammer head is loose on the handle, immediately take it to the instructor.
- Never use a hammer to anything but unhardened nails and nail sets; use a ball-peen hammer for still chisels and punches
- Never strike two hammers together. The faces are very hard and a blow might cause a chip to break off and fly out at a high speed.
- Knuckles can be injured if you "choke up" too far on a hammer when striking a blow.
- Unless the blow is truck squarely the hammer ma bounce off the work and cause injury.
- Place a hammer on the bench carefully; a falling hammer can cause serious injury.

6.1.3.

- Never use a file without a handle. Painful injuries may result.
- Use a file card to clean the file, NOT your hand. The chip can penetrate your skin and cause a painful infection.
- Files are very brittle and should never be used as a pry.
- Use a piece of cloth to wipe the surface being filed. Short burrs are formed in filing and can cause serious cuts.
- Never hammer on or with a file, it may shatter and ships fly in all directions.

6.1.4.

- All work being cut must be clamped properly to the table.
- Maintain a margin of safety, keeping your hands and fingers at a safe distance from the blade.
- Always concentrate on your work; becoming distracted can cause injuries.

6.1.5.

- Read and follow the manufacturer’s instructions and warning labels.
- Wear personal protective equipment that is appropriate for the hazards you may be exposed to while performing the required task.
- Ensure the work area is clear of debris.
- Ensure there is adequate lighting in the work area.
- Oil pliers and wire cutters regularly. A drop of oil on the hinge will make the tool easier to use. Pull on pliers; do not push away from you when applying pressure. If the tool slips unexpectedly, you may lose your balance or hit your hand against something.
- Cut material at right angles.
- Do not expose pliers or wire cutters to excessive heat.
- Do not hammer on pliers or wire cutters to cut wires or bolts.

6.1.6.

- Use utility pliers to grip round, square, flat and hexagonal objects.
- Ensure that toothed jaws are clean and sharp.
- Greasy or worn jaws can result in compromised safety.
- Such tools also require increased force to hold the workpiece. Inspect the tool for damage prior to each use.
- Ensure the tool is in good working condition.
- Do not expose pliers or wire cutters to excessive heat.
- Do not use pliers on nuts and bolts; use a wrench.

6.1.7.

- Steel rules are precision measuring instruments.
- Don’t use your steel rule as a scraper, screwdriver or pry bar.
- Don’t drop it or bang it around.
- Keep your steel rule very lightly oiled.
- Inspect your steel rule periodically.
- Be sure that it is not bent or dented.
- Check that the corners are square and sharp.
- Be sure there are no burrs anywhere on the steel rule. If you find any of these problems, replace your steel rule.

6.1.8.

- Take special care with these sharp pointed tools.
- Never use one of these tools in place of the other.
- Each tool has a specific duty, be sure to use the proper tool for the proper activity.

6.2.

- Choose the correctly sharpened drill for the type of work you need to do and the material you are about to drill.
- Do not leave the key in the chuck when you are not at the machine

- Never leave the machine running if unattended
- Clamp the workpiece securely to the table and do not hold it by hand
- Never attempt to stop the workpiece by hand if it slips from the clamp
- A drill should run at the correct speed for the job
- Do not force the drill into the workpiece – this may cause broken or splintered drills and may cause injury
- Use a brush or wooden rod to remove chips from the drill – and not your fingers, waste or rags
- When reaching around a revolving drill, be careful that your clothes do not get caught in the drill or chuck

7.1.1.

- Make sure that all guards are in place.
- Do not use a machine or come close to its moving parts while wearing loose clothing such as ties, unbuttoned sleeves, etc. and keep any cleaning material such as waste and rags away from rotating parts.
- See that there is no oil or grease which can cause slipping on the floor around the machine.
- Spanners or keys must never be left on rotary parts. Always disconnect, remove or stand clear of hand wheels, levers or chuck keys before setting machine or feeds in motion. Never apply a wrench to revolving work or parts.
- Select the correct tool for the job.
- Work pieces and holding devices must always be clamped safely and firmly. Pay special attention when fitting spanners and keys as a loose fit may cause slips, resulting in injury to your arm or hand.
- Do not use your hands to remove cuttings while the machine is in motion. Use a wire hook or a brush.
- Never adjust or attempt to adjust the cutting tool while the machine is running.
- Do not lean on the machine at any time. This is very dangerous habit which one does without thinking and can result in serious injury.
- Do not attempt to stop the machine by placing your hand on the chuck while the machine is slowing down.
- Give attention to cutting-fluid control before switching the machine on.

7.1.2.

- Never use the machine unless the guards are correctly fitted.
- See that there is no oil or grease which can cause slipping on the floor around the machine.
- Check that the tool rest is not more than 3 mm from the grinding wheel.
- When setting the machine in motion, never stand in front of the wheel. Before the grinding operation takes place, let it run idle for a few seconds.
- When the wheel is running out of balance, trim it with an emery-wheel dresser.
- Never grind on the side of a straight wheel, use one the face.
- Use various wheels for the purpose for which they are made.
- Do not grind soft materials such as lead, copper, aluminium, etc., on wheels which are not made for such work.
- Never jab grinding matter onto the wheel, but approach it with care.
- Never force grind, so that it stops the motor or slows it excessively.
- Never adjust the tool rest while the machine is running.
- Work pieces and holding devices must always be clamped on safely and firmly
- Never let the wheel stand in cutting fluid, as this may cause it to become out of balance.

7.1.3.

- Select the correct type of wheel for the job.
- Inspect the wheel for cracks and tap it to apply the “ring test”.
- Make sure that the wheel’s speed does not exceed the manufacturer’s recommendation.
- Never force the wheel onto the spindle.
- Use smooth paper washers on each side of the wheel.
- Use true and correctly recessed flanges of the same size and at least one third the diameter of the wheel.
- Gently tighten the grinding wheel with a spanner only enough to hold the wheel firmly.
- Replace guards correctly.
- Stand aside and set the machine in motion. Let the machine idle before you dress the wheel, using an emery-wheel dresser.
- Finally stop the machine and reset the tool rest within 2 mm of the wheel surface.
- Ensure that the tool rest is parallel to the wheel surface.

7.1.4

- A fixed guard which prevents hands or fingers reaching through, over, under or around the guard into the point of operation.
- A self-adjusting guard which automatically adjusts itself to the thickness of the material being worked and which prevent hands or fingers reaching through, over, under or around the guard into the point of operation.
- See that there is a supporting guard on the machine that will hold the plate down while it is being bent.
- Another safety device is the automatic sweep-away or push-away that pushes any part of the operator's body out of the danger zone when the working stroke starts.
- Today there are electronic presence-sensing devices which stop the working stroke if the device senses any foreign object in the danger zone.

7.1.5.

- See that all the guards are in place.
- See that no oil, grease or obstacles are around the machine.
- Select the correct blade for the material to be cut.
- When changing blades, ensure that the machine is switched off at the main switch.
- When removing or replacing the blade, do it gently. Quick movements, such as pulling the blade off, may result in a severe cut on your hand.
- Do not adjust guides while the machine is running.
- All material must be clamped properly before cutting is started.
- Long pieces off material must be supported at the end.
- Always stop the machine if you leave it unattended.

TOOLS- Expected Answers

1.1. An open-ended spanner can be used for general work where it is impossible to use a ring spanner. It is also used when tightening a bolt to avoid the opening stretching and the spanner slipping.

1.2. Ratchets

Various extensions (short and long)

In places where you cannot get your hands.

Sockets

In places where you cannot get a spanner

Universal joint

In places where you cannot turn a spanner, but if you work at an angle, you can turn the bolt or nut.

2.1. Diagonal pliers

2.2. In hard to reach places where your hand or fingers cannot reach.

3.1.1. Head, shaft and handle.

3.1.2. Shaft must be well-seasoned, straight-grained wood; absorb shock; length of handle should suite size.

3.1.3. The striking face is used for driving, blows and the pein for riveting.

3.1.4. The hole or eye, into which the shaft fits, is tapered. This allows the end of the shaft to expand when a wedge is driven into the shaft. The wedge is made of steel or hard wood.

3.1.5. It is used on finished surfaces which should not be damaged.

4. Four sides will be in contact with the screw. The chances of the screwdriver slipping are very small.

5. With the fastening and loosening of Allen cap screws or in conjunction with sockets.

6.1. Fixed type (frame cannot be adjusted and takes only one length of blade) and adjustable type (frame can adjust and takes blades of various lengths)

6.2. There are two main type of blades – high speed steel blades (used on harder metals) and medium carbon steel blades (used on softer metals such as copper)

6.3. The length is measured between the outside edges of the holes in the blade.

6.4. The teeth are set to saw a wider cut than the blade itself, and this prevents it from binding in the saw-cut and breaking. Blades can be set alternatively or in a wavy pattern. Alternate teeth are set slightly outward to the left and right. This method is used on blades with fine teeth.

7. Files are designed for the different types of filing operations and are graded and classified according to their length, section, cut and degree of coarseness.

8. This file has a second series of parallel teeth cut in the opposite direction. The first set is cut at about 45° and the other set is cut at about 70° to 80° to the axis of the file.

9.1. The flat chisel

The flat chisel, also known as the cold chisel, is the most commonly used for general dressing, chipping and cutting. The cutting edge should be slightly convex as this prevents damage to the outer corners and gives a longer life.

Cross cut chisel

This chisel is used for cutting grooves, slots, recesses and keyways.

Round nose chisel

The straight type is used for drawing over drill centres, in drilling and cutting oil grooves along flat or convex surfaces such as slides, bearings, etc. The curved type is used for cutting oil grooves along the curved surface of a bearing.

Diamond point chisel

The diamond point chisel is used mainly for finishing off and cleaning out corners, and for cutting ‘V’ grooves

9.2. When chipping, watch the cutting edge and not the head of the chisel. Place a suitable guard in front of the work to protect others from injury.

Wear goggles to protect your eyes.

Dress the head of the chisel when it becomes mushroomed or ragged, as the chips that may break off are liable to cause serious injury to yourself or anyone else nearby.

9.3. The cutting edge should be slightly convex as this prevents damage to the outer corners and gives a longer life

10.1. Single-cut files, double-cut files and rasps

10.2. There are rough, bastard, second-cut and smooth files

10.3. Uses for files

a) They are used for general purposes
b) They are used for filing corners, slots and square holes.
c) They are used for opening out holes and for filing round corners
d) They are used for filing corners less than 90° and for filing concave surfaces.
e) They have three 60° corners and are used for sharpening saw-teeth and to file corners less than 90°.

10.4. Always ensure that the file tang fits tightly into the handle, as a file with a loose handle is liable to cause serious injury.

11.1. The stock made of steel and the blade is hardened and tempered.

11.2. For correct checking of square-ness, the stock should be held firmly against the true side of the job. The blade is lowered onto the face which is to be checked. This should be done against a bright light.

12.1. The square and blade can be used for:

- Checking and marking-off of external and internal right angles
- as a depth gauge
- checking and marking-off of 45° angles
- the square head may be used alone as a spirit lever

12.2. The protractor head alone can be used to determine the incline of a work piece as follows;

- Release the protractor head on the work piece
- Release the two protractor locknuts

- Turn the protractor until the bubble indicates level
- Tighten the two locknuts and test the level again
- On the protractor, read off the incline in degrees at which the work piece is placed

12.3. Determining of centre on round work piece with a combination set.
When the centre head is fitted to the blade, the side of the blade is exactly in the centre of the V formed by two legs. The purpose of the centre head is to determine the middle point on the face of a round work piece.

11.1. A steel tape is used to measure long lengths.

11.2. The case is made of leather or plastic.

14.1. A rule is made of spring steel, cast steel or stainless steel, the latter being the best as it does not rust.

14.2. Take care so that the edges do not get knocked about, particularly the end where the graduations begin.

15.1. A scriber is used to draw lines on materials.

15.2. A scriber is made of tool steel and is available in various sizes.

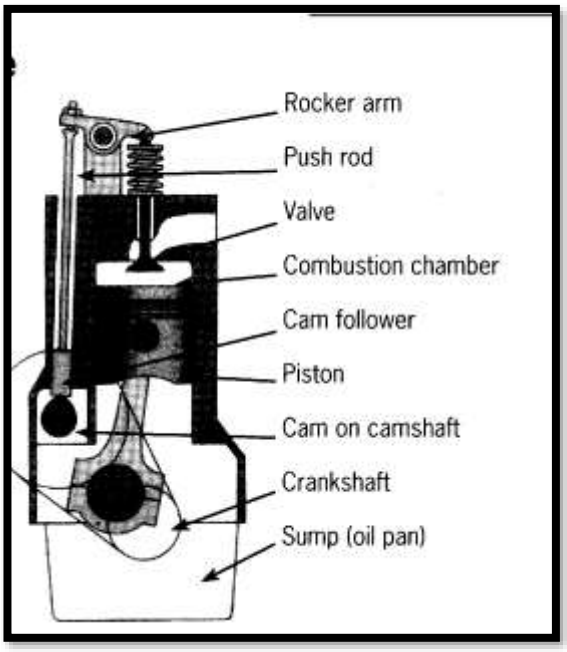
16.1. (a) 60 degrees (b) 90 degrees

16.2. The punch is used to mark or “pop” scribed lines to make them prominent. The punch can also be used to indicate the centre of a circle.

16.3. This punch is made of tool steel.

Activity – Heat Engines

1. .



2. a. Top dead centre (t.d.c.) is when the piston is at the end of the upward stroke i.e. the highest point which the piston can reach in the cylinder.
   b. Bottom dead centre (b.d.c.) is when the piston is at the end of the downward stroke, i.e. the lowest point which the piston can reach in the cylinder.
   c. A stroke is the maximum distance of piston movement between extreme points. These extreme points are t.d.c. and b.d.c.
   d. A cycle refers to the four strokes of the piston. One cycle is completed during two crankshaft revolutions (720◦) and one camshaft revolution.
3. **The intake stroke**
   The piston moves from t.d.c. toward b.d.c. When the piston descends from t.d.c. the intake valve has just started opening. With the exhaust valve closed during the stroke, a partial vacuum or depression is created in the cylinder above the piston. Atmospheric pressure tends to fill this partial vacuum and, in doing so, passes through the carburettor barrel. In the carburettor barrel petrol is mixed with air. This air-fuel mixture fills the cylinder via the intake manifold and past the open intake valve. Just after the piston reaches b.d.c .the intake valve is closed.

   The compression stroke
   Both the intake valve and the exhaust valve remain closed during this stroke and the piston moves form b.d.c. to t.d.c. the petrol mixture is compressed in a relatively small combustion chamber. Just before the piston reached t.d.c., a high tension spark is introduced into the combustion chamber by means of the sparkplug and the petrol mixture is ignited.

The power stroke

Both valves still remain closed and as a result of ignition combustion of the petrol mixture is taking place gradually. High temperatures are developed as a result of combustion and cause expansion of the gases. This expansion exerts considerable pressure on the piston and the force is transmitted to the crankshaft via the connecting rod, thereby giving a rotary motion to the crankshaft.

The exhaust stroke

As the piston reaches b.d.c. the exhaust valve is opened. The crankshaft rotates as a result of momentum in the crankshaft, assisted by the flywheel, and the piston moves from b.d.c. to t.d.c. The piston forces out the burnt gases past the open exhaust valve to the exhaust manifold from where it is fed to the atmosphere by means of pipes. When the piston reaches t.d.c. the engine is ready to start the following intake stroke and cycle.

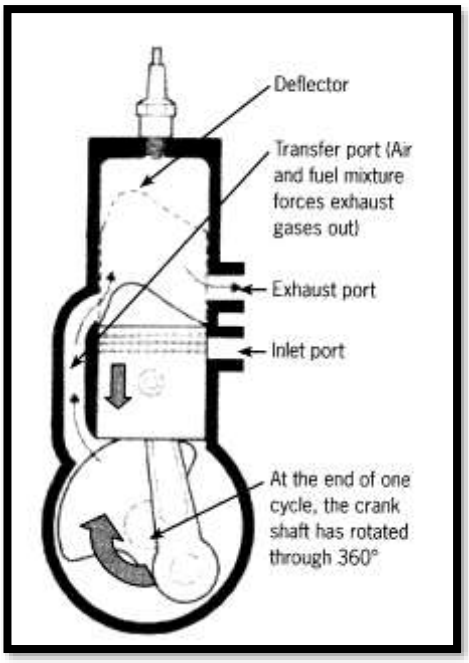
4. **Two-stroke engine**

   The piston crown is designed so that the incoming petrol mixture is deflected. This design is necessary to prevent the petrol mixture from escaping together with the burnt gases. If this should happen, that the petrol mixture will be wasted to a large extent while the upper section of the cylinder will still be filled with burnt gases.

   Four-stroke engine

   The head of the piston is flat.

5. .



6. **Scavenging:**

   Scavenging is the most important aspect of the two-stroke petrol engine. Because the direct pumping action of the piston cannot be made use of in this case, the burnt gases are scavenged by the incoming petrol mixture. Scavenging occurs when the new gases

from the bypass port push the burnt gases out of the inlet port and so clears the cylinder.

7. **Three-port two-stroke engine: the intake and compression strokes.**
   With the piston at b.d.c. the intake port is closed and the other two ports open and the cylinder above the piston is filled with petrol mixture. As the piston travels from b.d.c. to t.d.c. the transfer port is first closed by the piston and then the exhaust port. As the piston ascends further, the petrol mixture is compressed in the combustion chamber while a vacuum is created in the crankcase.
   With the upward movement of the piston, the intake port is opened and the petrol mixture fills the vacuum in the crankcase. Just before the piston reaches t.d.c. , the compressed petrol mixture is ignited by a high tension spark
   Note that the exhaust and transfer ports are opened above the piston while the intake port is opened below the piston.
   The power and exhaust strokes
   After ignition of the petrol mixture, combustion is in progress. This causes high temperatures to develop as a result of which the gases expand. The expanding gases force the piston towards b.d.c. and a powerful rotational movement is given to the crankshaft. As the piston moves towards b.d.c., the intake port is closed and the petrol mixture is compressed in the crankcase. With further movement of the piston, the exhaust port is opened first and the burnt gases start escaping. Just after this, the transfer port opened and the compressed petrol mixture in the crankcase enters the cylinder under pressure and assists in driving out the burnt gases.
   Note that the piston crown is designed so that the incoming petrol mixture is deflected. This design is necessary to prevent the petrol mixture from escaping together with the burnt gases. If this should happen, the petrol mixture will be wasted to a large extent, while the upper section of the cylinder will still be filed with burnt gases.
8.

Two-stroke engine	Four-stroke engine
Fewer moving parts	More moving parts
Two piston strokes per cycle	Four piston strokes per cycle
One crankshaft revolution to complete a cycle	Two crankshaft revolutions to complete a cycle
Gas-tight sealed crankcase	Crankcase is not gas-tight
No oil in crankcase for lubrication. Oil is mixed with petrol for lubrication	Crankcase is filled with oil for lubrication purposes
Spaced on top and bottom of piston is pressurised for compression purposes	Only the top of the piston is gas pressurised

Piston controls the flow of gases in the cylinder	Valves control the flow of gases in the cylinder
No camshaft	Camshaft controls the operation of the valves

9. Carbon monoxide

Activity 2

1. **Advantages of petrol injection**
    - The air fuel mixture may be measured exactly at all engine speeds, which has the effect of less fuel being used while the engine develops more power.
    - Ignition knock is improbable because of correct mixture strengths at all times.
    - Air pollution is less
    - More than 100% volumetric efficiency is possible at certain engine speeds because of “air ram” effect.
    - Higher CR;s may be used because of better mixture control.
    - Icing of inlet manifold cannot occur as only air passes through.
    - Valve overlap may be increased resulting in better scavenging because only air is let in during the first part of the stroke.
    - Petrol injection is more responsive, which give better acceleration.
    - Design of the inlet manifold is simple; therefore air passes easily to the cylinders, which increases volumetric efficiency.
    - Fuel surge is eliminated with fuel injection when cornering fast or due to heavy braking

2. **Disadvantages of petrol injection**
    - High initial cost of the petrol injection system increases the price of the vehicle.
    - The system is complex and special equipment as well as high skills are necessary to service and adjust the system
    - Very often a defective injector nozzle cannot be repaired and must be replaced as a unit.

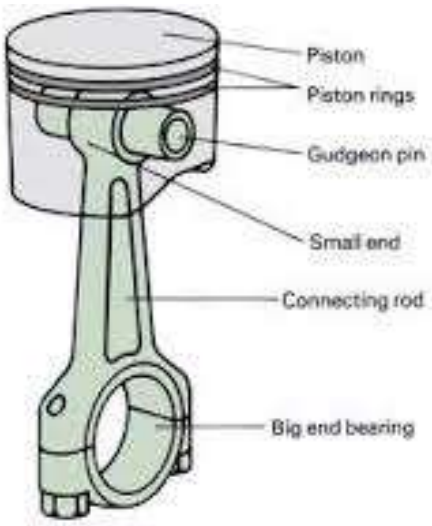
- Special servicing equipment is necessary to diagnose fuel-injection systems faults and failures.
- More fuel-injection equipment and pipe plumbing is required, which may be awkwardly placed and can be bulky.
- More electrical and mechanical wearing components to go wrong.
- Generally increased care and attention are needed and there are more servicing problems likely to arise.
- Power is necessary, be it electrical or mechanical, to drive the fuel pressure pump or injection discharge devices.
- Increased mechanical and hydraulic noise due to pumping and metering of the fuel.
- Very careful filtration is needed due to the fine working tolerances of the metering and discharging components.

Model answer

1. **Intake stroke**
   A few degrees before the piston reaches top dead centre (t.d.c.) of the previous exhaust stroke, the intake valve opens while the exhaust valve remains closed.
   The piston moves from t.d.c. to b.d.c. and this downward movement of the piston creates a partial vacuum in the cylinder, which is filled with pure air under atmospheric pressure.
   A few degrees after the piston reaches, bottom dead centre (b.d.c.) the intake valve is closed.
2. **Power stroke**
   Combustion of the mixture follows the ignition, as a result of which the temperature rises still higher. The heat generated causes the gases to expand and the expanding gases force the piston downwards in the cylinder. In this way the heat energy is converted into useful work.
3. Operation of the ‘Uniflow’-type two-stroke engine.
   Just before the piston reaches the top dead centre, fuel is injected into the cylinder.
   - The fuel mixes with the air and is ignited by the hot, compressed air after which it burns and the temperature is raised.
   - The high temperature causes the gases to expand and the expanding gases force the piston downwards in the cylinder.
   - When the piston has moved through three-quarters of its downward stroke, the exhaust valves in the cylinder head are opened and the spent gases, which are still under pressure, start escaping.
   - With a slight movement of the piston further downwards, the intake port is exposed.
   - Fresh air, under pressure from the blower at approximately 150 kPa, enters the cylinder.
   - The fresh air forces the spent gases out through the exhaust port in the cylinder head.
   - As the piston moves upwards again, the exhaust valves are closed.
   - The intake ports are now closed by the piston with the result that the fresh air charge is trapped.
4. **Exhaust and intake stroke**
   When the piston has moved through three-quarters of its downward stroke, the exhaust port is uncovered. The spent gases, which are still under pressure, escape through the exhaust port. The piston moves further downwards and uncovers the intake port. Fresh air, under pressure from the blower at approximately 150 kPa, enters the cylinder. As a result of the design of the intake port, the spent gases are forced out by the incoming fresh air charge.

Memorandum

1. Answer: b
   Explanation: In a two stroke engine, the working cycle is completed in one revolution of the crankshaft.
2. Answer: c
   Explanation: None.
3. Answer: b
   Explanation: A two stroke cycle engine occupies less floor area than a four stroke cycle engine.
4. Answer: a
   Explanation: As compared to a four stroke cycle engine, the mechanical efficiency of two stroke engine gives higher.
5. Answer: a
   Explanation: None.
6. Answer: b
   Explanation: None.
7. Answer: b
   Explanation: In a petrol engine, only at the end of suction stroke, the mixture has the lowest pressure.
8. Answer: b
   Explanation: In compression ignition engines, swirl denotes a rotary motion of the gases in the chamber as swirl is always related to rotary motion.
9. Answer: d
   Explanation: The injector nozzle of a compression ignition engine is required to inject fuel at a sufficiently high pressure in order to
   a) inject fuel in a chamber of high pressure at the end of compression stroke.
   b) inject fuel at a high velocity to facilitate atomization.
   c) ensure that penetration is not high
10. Answer: a
    Explanation: The flywheel in a four stroke petrol engine is heavier than in a two stroke petrol engine and there is no flywheel in a diesel engine.

11. 

12. A & C – BDC
    B – TDC

13. The following project must evaluated by the educator and the peers in the different groups
    Educator to make copies of rubric for groups as well as for himself/herself

Activity 4- Expected Answers

Topic: Engines:	Two and four stroke internal combustion engines: Identification and function of components

Identify component/Part:	Component Identified	Describe function of component or part
1. Piston		Create vacuum with downward movement, pushes out burnt gasses and compress air fuel mixture
a. Piston crown		Combustion takes place on piston crown
b. Piston skirt		Piston to move smoothly up and down in bore
c. Oil ring groove		Oil ring fits into groove, excess oil dispersed through holes in ring grove
d. Compression ring groove		Compression ring fits into groove. Ensures good cylinder compression. Prevents blow-by.
e. Gudgeon pin		Connects piston and conrod together sturdily with movement
2. Connecting rod		Connects the piston to the crankshaft
a. Small end		The gudgeon pin fits in the small end.
3. Bearings		Minimise friction. To support the rotating parts
4. Crankshaft		Converts reciprocating movement to rotary movement.

a. Main journal		Main journal is where crankshaft is connected to engine block and allows for smooth turning with main bearings
b. Big end journal		Conrod big end side connecting to big end journal of crank
5. Camshaft		Convert rotary movement to reciprocating movement.
a. Cam lobe		Lift valves through mechanism to open them a certain distance.
6. Gears		Drive chain or belt to turn camshaft at a certain ratio. Could also drive other parts e.g. oil pump, distributor
a. Crank gear		Gear is used for crankshaft to be able to turn camshaft at a fixed ratio
b. Camshaft gear		Gear is used for crankshaft to be able to turn camshaft at a fixed ratio
7. Valves		Intake open for air mixture to enter (could be only air) Exhaust for burnt gasses to leave the cylinder
8. Valve springs		Close intake or exhaust valves.
9. Valve lifter		Mechanism used to open engine valves.
10. Flywheel		Provides smooth running of engine to carry it through the non power strokes Provides mounting for clutch and ring gear for starter motor.

11. Cylinder head		Part of the engine that houses the valves, valve mechanisms and normally the camshaft. Closes of cylinder to enable compression of mixture.
12. Cylinder block/Engine block		Hold cylinders rigidly in position/ wet or dry Crankshaft mounted in cylinder block Water jackets in engine block Houses oil channels and main oil channel Other parts attaches to engine block
13. Oil pump		To supply pressure to oil to be pumped through engine to lubricate all moving parts
14. Manifolds		
a. Intake		To supply air/mixture to cylinders equally with the least resistance-all cylinders to receive equal volume.
b. Exhaust		Conducts exhaust gasses to exhaust system after combustion - allow for free flow of gasses
15. Carburettor		Atomise fuel Provide correct air/fuel mixture for all engine speeds Control engine speeds
16. Water pump		Circulate coolant through the cooling system
17. Gaskets		Seal oil, liquid and gas to not to escape from chambers where it is suppose to be.
18. Seals		Seal oil, liquid and gas to not to escape from chambers where it is suppose to be

Activity 5- Expected Answers

Topic: Engines:	**Construction of a 2 Stroke engine**
	• Use various components of the two stroke engine, identify and explain the function of part or component

Complete the tasks below	**Component Identified** ***Tick if learner could identify part***	**Description**
1. Identify Inlet port	☐	Learner to identify inlet port on engine
2. Describe the function of the inlet port		Port will allow fuel mixture to enter into crankcase from carburettor
3. Identify outlet port	☐	Learner to identify outlet port on engine
4. Describe the function of the outlet port		Conduct exhaust gasses away from engine
5. Identify Transfer port	☐	Learner to identify transfer port on engine
6. Describe the function of the transfer port		Gasses transferred via transfer port from bottom of crankcase top of piston
7. Crankshaft rotations to complete the cycle: a)Two Stroke		One Revolution
b)Four Stroke		Two Revolutions

Activity 6- Expected Answers

Topic: Engines:	**Conventional Layouts**
Instruction to learner:	• List 10 different vehicles from various manufacturers • Describe the drive train lay-out of each **Complete work sheet below**

Vehicles	**Describe drive train lay-out of each**
1. Chevrolet Spark	Front mounted transversal engine front wheel Drive
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

MAINTENANCE - Memorandum Activity 1

1) Increases efficiency, slows wear

    - Lubricate
    - Cool
    - Antifreeze only cools the upper engine
    - Corrosion Protection
    - Stop/hinder oxidation & acid build up
    - Clean
    - Stop deposit formation & hold particles in suspension

2) The engine starts to heat up

   Friction increase

   Eventually engine failure

3) The SAE designation for multi-grade oils includes two viscosity grades; for example, **10W-30** designates a common multi-grade oil. The first number '**10W**' is the viscosity of the oil at cold temperature and the second number is the viscosity at 100 °C

4) It is the resistance of an oil to flow and is calculated by the time it takes a set quantity of oil to flow through a tube of fixed diameter.

   The longer the oil takes to flow, the higher the oil's viscosity, and the higher the viscosity number which identifies it.

5) There are SAE (Society of Automotive Engineers) grades for gear oils and crankcases (engines)

   International Standards Organization Viscosity Grade, ISO VG for short.

6) **Multi-grade oils** are those **oils** that have two numbers on the **grade**, indicating that the **oil** is able to maintain engine performance in high and low temperatures. A **multigrade** lubricant minimises viscosity differences under temperature variations.

7) The first number on a **multi-grade oil** is normally followed by a **W**, which **stands for** winter. This number represents the lubricant's viscosity under lower temperatures, giving an indication of how the **oil will** flow in the winter. The lower the first number, the thinner it is at low temperatures.

8) Manufacturers are using thinner and thinner **oils** in **cars**. (5w-30 wt is **recommended** for many **new cars**.
9) The **American Petroleum Institute** gravity, or API gravity, is a measure of how heavy or light a petroleum liquid is compared to water: if its API gravity is greater than 10, it is lighter and floats on water; if less than 10, it is heavier and sinks.
10) It means that the oil must be changed in the vehicle.
11) Basic - categories are barrier agents axi & chemically **active agents**, sometimes **called** reactive agents.

a) It increases the pour point of oil so it can still be fluid at very low temperatures.
b) Viscosity improvers are primarily used in multigrade engine oils, gear oils, automatic transmission fluids, power steering fluids, greases and various hydraulic fluids. Most of these uses involve an automobile, and this is because automobiles are subjected to tremendous temperature swings.
c) Modifiers for improved fuel economy, Reduces oil burn-off and consumption and conditions seals to prevent leaks.

12) All oil looks pretty black within a couple of days after an oil change, so the only way to avoid running on oil that's so dirty that it becomes a liability is to keep a record of when it was last changed and to change it frequently — as often as every 7500 kilometres.
13) Adverse driving conditions can lead to abnormally high oil temperature or oil consumption. Below are some examples of adverse driving conditions.
Check the oil level more frequently for long journeys:

- towing a caravan or trailer
- in mountainous regions
- at high speeds
- in temperatures colder than -30 °C or hotter than +40 °C.

The above also apply to shorter driving distances at low temperatures.

14) You see this symbol on many quality oils. API is an acronym for the American Petroleum Institute. The institute’s Starburst stamp of approval—it reads “American Petroleum Institute Certified”—was created to help consumers identify engine oils that meet specific performance standards set by vehicle and engine manufacturers.
15) Synthetic base stock lubricant oils are man-made and tailored to have a controlled molecular structure with predictable properties. They are composed of organic and

inorganic base stock oils combined with polymer packages to produce synthesised oil compounds (API Groups III, IV & V).

16) The technical advantages of synthetic motor oils include:
    - Better low- and high-temperature viscosity performance at service temperature extremes
    - Better (higher) Viscosity Index (VI)
    - Better chemical and shear stability
    - Decreased evaporative loss
    - Resistance to oxidation, thermal breakdown, and oil sludge problems
    - Possibility to extended drain intervals, with the environmental benefit of less used oil waste generated
    - Improved fuel economy in certain engine configurations
    - Better lubrication during extreme cold weather starts
    - Possibly a longer engine life
    - Superior protection against "ash" and other deposit formation in engine hot spots (in particular in turbochargers and superchargers) for less oil burnoff and reduced chances of damaging oil passageway clogging.
    - Increased horsepower and torque due to less initial drag on engine[citation needed
    - Improved Fuel Economy - from 1.8% to up to 5% has been documented in fleet tests

17) Synthetic oil is used as a substitute for lubricant refined from petroleum when operating in extremes of temperature, because, in general, it provides superior mechanical and chemical properties to those found in traditional mineral oils. Aircraft jet engines, for example, require the use of synthetic oils, whereas aircraft piston engines do not. Synthetic lubricants are also used in metal stamping to provide environmental and other benefits when compared to conventional petroleum and animal fat based products. These products are also referred to as "non-oil" or "oil free.

18) The life cycle for synthetics is typically 11,000 to 16,000 kilometres, a big change from conventional oil.

Memorandum- Activity 2

1) Below SAE 20
2) It is a compound of water-soluble oil and water.
3) Cutting tool life prolonged
   Better finish obtained
   Cuttings washed away
   Prevents corrosion
   Cuttings are washed away, keeping the cutting tool free from debris
   The machine is protected because the cutting process is eased
   The machine operator is protected from very fine metal chips and dust
   Productivity is increased because the cutting process is faster
   The soluble oil prevents corrosion
4) Avoid contamination of the cutting fluid by draining and regularly replacing it.
   Always clean the machine's splash tray of metal cuttings after use.
   Regularly wipe cutting fluid splashes off machine parts.
   Ensure that the sump is topped up from time to time and check that there is sufficient flow of cutting fluid to the cutting tool.

Memorandum- Activity 2

1. Friction is a Force that always pushes against an object when it touches another object. When 2 things are in contact with each other, there will be friction acting between them.
2. Reduce the contact area by using rollers/ball-bearings/wheels
   Change the surfaces of the materials that are touching by using lubrication eg. Oil
   Create a cushion of air eg. Like a hovercraft or air hockey table.
3.
   a) The friction that acts on objects that are not moving is called **static friction.** Because of static friction, you must use extra force to start the motion of stationary objects. For example, think about what happens when you try to push a heavy desk across a floor. If you push on the desk with a force less than the force of static friction between the desk and the floor, the desk will not move. To

make the desk move, you must exert a force greater than the force of static friction.

Once the desk is moving, there is no longer any static friction.

b) **Sliding friction** occurs when two solid surfaces slide over each other.

Sliding friction can be useful. For example, you can spread sand on an icy path to improve your footing.

Ballet dancers apply a sticky powder to the soles of their ballet slippers so they won't slip on the dance floor. And when you stop a bicycle with hand brakes, rubber pads slide against the tire surfaces, causing the wheels to slow and eventually stop.

c) When an object rolls across a surface, **rolling friction** occurs. Rolling friction is easier to overcome than sliding friction for similar materials. This type of friction is important to engineers who design certain products. For example, skates, skateboards, and bicycles need wheels that move freely.

d) This type of friction is what happens with liquids and gases *(In Physics, liquids and gases are both called "fluids". They behave in similar ways.)* Fluid friction is also known as "**drag**". On aircraft it's also called "**air resistance**".

It depends on:

how thick the fluid is (it's "viscosity")

the shape of the object

the speed of the object

Memorandum- Activity 3

1.

a) It is a set of activities that are performed on plant equipment, machinery, and systems before the occurrence of a failure in order to protect them and to prevent or eliminate any degradation in their operating conditions.

b) Predictive maintenance is a set of activities that detect changes in the physical condition of equipment (signs of failure) in order to carry out the appropriate

maintenance work for maximising the service life of equipment without increasing the risk of failure.

c) A process used to determine what must be done to ensure that any physical asset continues to do what its users want it to do in its present operating context

2. The need for an adequate number of staff in the maintenance department in order to perform this type of maintenance.
   The right choice of production equipment and machinery that is suitable for the working environment and that can tolerate the workload of this environment.
   The required staff qualifications and skills, which can be gained through training.
   The support and commitment from executive management to the PM programme.
   The proper planning and scheduling of PM programme.
   The ability to properly apply the PM programme.
3. The **main difference** between preventive maintenance and predictive maintenance is that predictive maintenance uses monitoring the condition of machines or equipment to determine the actual mean time to failure whereas preventive maintenance depends on industrial average life statistics.
4. Revised maintenance schedules and practices
   Revised Operating procedures
   Recommended Engineering Changes
   Database of maintenance requirements
   Useful to provide documentation for decisions
   Analysis team members gain a deeper understanding of the asset

Memorandum- Activity 4

1. Excessive engine wear is very often caused by improper vehicle operation and subsequent momentary poor lubrication (momentary oil flow discontinuation). Momentary poor lubrication may follow during cold engine excessive load, excessive engine load at low RPM, and high RPM (temperature increase causes oil thinning), as well as “aggressive driving”, old pump oil or clogging of oil passages.
2. The pistons start to swell and eventually engine seizure.
3. The most common problems that occur in the master cylinder is wear in the piston bore and piston seal failure. The classic symptom of a failing master cylinder is a brake pedal that slowly sinks while pressure is held against the pedal. The cure is to replace the master cylinder.

MATERIALS- Memorandum Activity 5

1. Alloy steel is that which contains elements in addition to carbon and iron
2. Aluminium
3. Chemical; mechanical; physical
4. A tough metal possesses very high strength. It also has capacity to deform permanently and resist rupture.
5. Coke, limestone or dolomite; air
6. Iron ore
7. Open heath furnace process; electric (arc) furnace process, basic oxygen furnace process.
8. Carbon causes big changes in the nature of the metal, and also determines the hardness of the metal
9. Alloys are added to steel to:
    - Improve mechanical properties to permit higher tempering temperature while maintaining high strength and improving ductility.
    - Improve mechanical properties at low or elevated temperature.
    - Increase strength and toughness
    - Increase resistance high temperatures
    - Secure grater hardness for wear resistance
    - Provide high-impact resistance
    - Secure better machinability
10. (a) when metal fractures with little or no deformity

    (b) Material's ability to change shape or to be drawn into wire form

    (c) Materials ability to absorb forces and flex in different directions and return to its original shape when the load is removed

Memorandum- Activity 6

1. Characterized by their corrosion resistance, high strength and ductility, and high chromium content. Stainless as a film of chromium oxide protects the metal from corrosion.

2. **Domestic** – cutlery, sinks, saucepans, washing machine drums, microwave oven liners, razor blades

   Architectural/Civil Engineering – cladding, handrails, door and window fittings, street furniture, structural sections, reinforcement bar, lighting columns, lintels, masonry supports

   Transport – exhaust systems, car trim/grilles, road tankers, ship containers, ships chemical tankers, refuse vehicles

   Chemical/Pharmaceutical – pressure vessels, process piping.

   Oil and Gas – platform accommodation, cable trays, subsea pipelines.

   Medical – Surgical instruments, surgical implants, MRI scanners.

   Food and Drink – Catering equipment, brewing, distilling, food processing.

   Water – Water and sewage treatment, water tubing, hot water tanks.

   General – springs, fasteners (bolts, nuts and washers), wire.

Memorandum- Activity 7

1.

Metal	Property	Uses
Copper	*Red in colour and is tough, ductile and malleable.*	*Electrical tubing, soldering, irons, electrical wires*
Tin	*Silvery shiny, soft and malleable, poor conductor of electricity.*	*Basis of white metal bearings, canning industry, protective layer for copper wires*
Lead	*Soft, bluish in colour, tough but low tensile strength, malleable, ductile, low melting point*	*Soft solder, plumbing, roof sheeting, bullets, cables, battery plates*
Zinc	*Bluish white in colour and high gloss, hard, brittle malleable*	*Galvanising on sheets, water tanks and wire*
Aluminium	*Bluish in colour, hard and very light, resistant to corrosion, malleable and ductile*	*Cooking utensils, foil, electrical connectors, and long distance high-tension transmission lines*

Memorandum- Activity 8

1. Bronze is an alloy of copper and any other metal. As with brasses, there are many formulas for bronzes, depending on the application.
2. Aluminum bronzes, tin bronzes, phosphor bronzes, nickel bronzes, and silicon bronzes are all examples of varying alloys.
3. Bronzes are used in applications such as bearings, some limited structural applications, decorative uses, and applications which require them not to spark when struck with another metal.

   This makes them useful in the transport and handling of items such as explosives, fuels, and flammable materials.

   Bronzes are often used in statues and can be seen to form the familiar green oxidized coating.

4. Brass is a metal alloy made of copper and zinc; the proportions of zinc and copper can be varied to create a range of brasses with varying properties. It is a substitutional alloy: atoms of the two constituents may replace each other within the same crystal structure.
5. Brass is used for decoration for its bright gold-like appearance;
   for applications where low friction is required such as:
   Locks, gears, bearings, doorknobs, ammunition casings and valves; for plumbing and electrical applications; and extensively in brass musical instruments such as horns and bells where a combination of high workability (historically with hand tools) and durability is desired. It is also used in zippers. Brass is often used in situations in which it is important that sparks not be struck, such as in fittings and tools around explosive gases.
6. White metals include antimony, bismuth, cadmium, lead, tin, and zinc. Of these, lead, tin, and zinc are of primary interest.
7. Ball bearings and engine bearings.
8. It's light strong alloy of aluminum, copper, manganese, and
   Duralumin is soft, ductile, and workable in the normal state; they may be rolled, forged, extruded, or drawn into a variety of shapes and products.
   Its' light weight and high strength makes them suitable for something that needs to be strong and light at the same time.
   That's why it is suitable for an airplane.

TERMINOLOGY – DRIVE TRAINS SPECIFIC

Activity 1

Grade 10	Term: 3	Week No:	2	Class	
Topic: Terminology:	**Construction and operation of single plate clutch assembly**				

Questions	Answers
1. Explain the function of the clutch unit in a vehicle	Transfer engine torque smoothly from spinning flywheel to input of drive system Provide a disengagement/engagement of power/torque from engine to driving system when needed
2. Explain what the disengagement of the clutch means	Clutch plate is not making contact with surfaces of flywheel and pressure plate, thus no torque can be transmitted
3. What type of material is used as a friction material on the clutch plate?	Kevlar, ceramic mixed with copper, nylon polymers, fibreglass and copper mix Learner can do research for more types of friction materials The use of asbestos is banned in most countries
4. What is the purpose of the clutch master and slave cylinder?	Clutch master and slave will transfer movement of when the clutch pedal is depressed to movement to the thrust bearing to engage or disengage the clutch

Activity 2

Grade 10	Term: 3	Week No:	2 - 4	Class	
Topic: Terminology:	**Constant mesh manual gearbox**				

Questions	Answers
5. Name all the types of gears that are used in the gearbox (The actual gearbox you are working on)	This could be spur gears, helical or double helical gears. The learner must name all the types on the gearbox he/she is working on
6. Make a line drawing of the gears/shafts (gearbox and demonstrate the power flow through reverse and top gear. (Teacher can change this to any gears to demonstrate)	**Do this on a separate pièce of paper or in your work book** *To be done by learner*
7. Explain what synchronisation means with relation to the manual gearbox.	To bring two gears to the same rotational frequency(speed) in order to engage them
8. What is the function of the synchro ring in the synchro unit?	The friction surface of the synchro ring will make contact with the cone of the gear to speed up or slow gear selected
9. Explain the function of the selector mechanism in the constant mesh gearbox.	The selector mechanism allow the driver to select a gear and lock selected gear in place

Activity 3

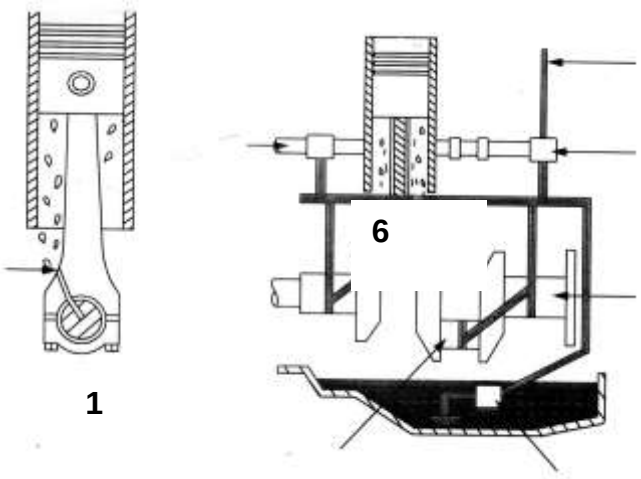
Grade 10	Term: 3	Week No:	4	Class	
Topic: Terminology:	**Drive shafts**				

Questions	**Answers**
	Slip joints
Make a neat sketch to explain why slip joints are used on drive shafts	Learner to complete
Explain the function of the universal joint.	Must transmit torque/drive between two components e.g. gearbox and differential that are not aligned and angle that changes continuously while driving
What is the difference between a universal joint and a constant velocity joint?	With a common type of universal joint when driving at an angle velocity of the driving shaft and driven shaft will not be the same CV joints transmits even velocity to drive and driven shaft
Explain one advantage obtained by making use of the flexible coupling.	Cushions vibrations No lubrication needed

POSSIBLE ANSWERS

MAINTENANCE SPECIFIC - Activity 1

Grade 10	Term: 3	Week No:	5	Class	
Topic: Maintenance:	Lubrication systems				

Questions	Answers
1. Explain the difference between a pressure feed system and a full pressure feed system.	With the pressure feed system all components in the engine are lubricated through oil channels with the exception of the small end of the conrod. With full pressure feed there is a oil channel in the conrod to the small end force feeding the gudgeon pin
2. Explain what oil contamination is and why oil gets contaminated over a time period.	Oil contamination is when oil gets contaminated by impurities over a period of time. With combustion many impurities is formed and some finds it way into the lubricating oil e.g. carbon, acids and lead oxide from the tetraethyl lead in petrol. Wear and tear causes small metal particles to enter oil. Carbon deposits from the combustion of fuel and air. Dust when filtering system is not serviced regularly. Water as a by product of combustion Acid and sludge due to churning of oil in the sump.
3. Identify the type of lubrication system drawing A and B represent. (Answer on left side)	**A** **B** 
4. Label all components of A and B.	

	A _ Part of pressure feed system B _ Full pressure feed system 1. Oil hole in conrod to lubricate cylinder 2. Oil channel to lubricate 3. Main journal 4. Oil pump 5. Big end journal 6. Cam shaft
5. Investigate oil channels in engine block and cylinder head. a. Point out main oil channel to teacher in engine block.	Main oil channel: Learner must be able to point out main oil channel in engine block.
b. Trace all oil channels from oil pump to top of engine.	Trace all oil channels: Learner must be able to trace oil channels from oil pump to top of engine.
6. Do a condition report on oil pump, gaskets and seals. Specify which gasket and seals you checked.	Condition report: Learner to examine parts and write condition report

Activity 2

Grade 10	Term: 3	Week No:	5-7	Class	
Topic: Maintenance:	Cooling systems - Diagnostics - Pressure testing cooling system and visual inspection				
Teacher:	• Learner to complete the work sheet after the lesson • Teacher to supply necessary tools, equipment to enable the learner to complete the task				
Learner:	• Complete work sheet below • Record all your findings				

Questions	**Answers/Explanation**
Do a visual inspection of the cooling system and list the items/areas you checked on the opposite side of the page as well as any faults you found. Use the radiator pressure tester and test the cooling system of a running engine in the workshop. (switched off) Record the steps on how you carried out the test and any findings. **Note:** Method and specifications important. Use a thermostat and test if it is operating correctly for the engine. Record method/steps and any findings on opposite side of the page. **Note:** Method and specifications important.	Learner to record what he/she has done Guide: • Engine should have cooled off • Select correct fittings to fit system • Remove radiator cap and fit tester cap • Fit pressure tester • Pump to a slightly higher pressure than specifications of system • See if pressure gauge drops • Inspect for possible leaks *Learner to record steps and specifications* 1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

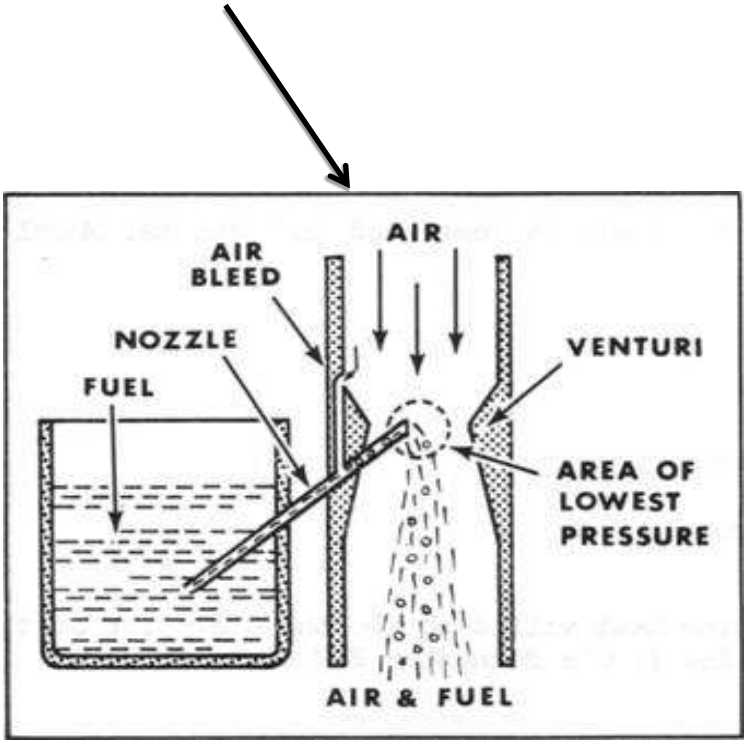
Activity 3

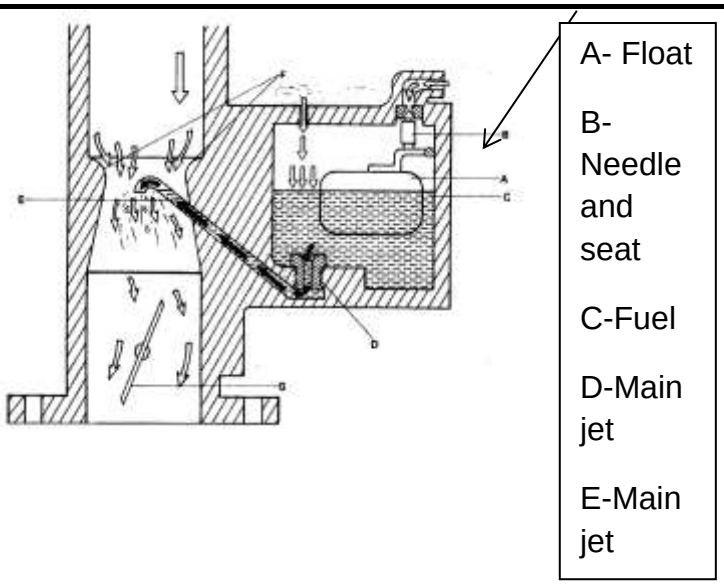
Grade 10	Term: 3	Week No:	5-7	Class	
Topic: Maintenance:	Cooling systems - Diagnostics - Checking fluid levels of a vehicle				

Questions	Answers/Explanation
7. Name the fluid levels of a vehicle that should be checked regularly.	• Coolant level • engine oil level • Brake fluid/ clutch level • Power steering
8. Why is it necessary to maintain correct fluid levels on a vehicle?	The modern vehicle should not loose any fluids often. Checking of levels regularly could prevent serious damage and expenses.
9. Describe in point form how you would check and top up the brake fluid level.	• Ensure vehicle is standing level • Locate master cylinder reservoir • Normally clear transparent with MIN and MAX levels marked • Level should be between the two levels • Unscrew cap and add brake fluid if necessary - do not spill as brake fluid is corrosive and will lift paint of vehicle if left • If spilled, immediately wash off with clean water - do not just wipe with a rag • Use good quality DOT specification brake fluid as prescribed • Replace reservoir cap and close hood

Activity 4

Grade 10	Term: 3	Week No:	8	Class	
Topic: Systems and control:	Basic carburetion - Basic carburation				

Questions	Answers/Explanation
10. With the aid of a simple sketch explain the venturi principle.	Atmospheric pressure 
11. Label the components of the basic carburettor in opposite Colum. (A - H)	_____ _____ **Volume of air flowing through a tube with a narrowing. Narrowing called a venturi.** **When a certain volume of air is flowing through the tube it will speed up in the narrow part of the tube to maintain a constant flow of air through the tube.** **Because of the air speeding up in the narrow part of the tube it causes a low pressure.** **This low pressure allow for fuel to pushed by atmospheric pressure into the passing air stream** **Basic carburettor** **H**



12. Explain the construction, function and operation of the float circuit.

Float circuit:
Construction - consist of a small chamber that will essentially be a small reservoir.
In chamber will be a float that could close a needle on a seat when
required level of fuel is reached in the chamber.

Function - To keep fuel at predetermined level to be used as necessary.

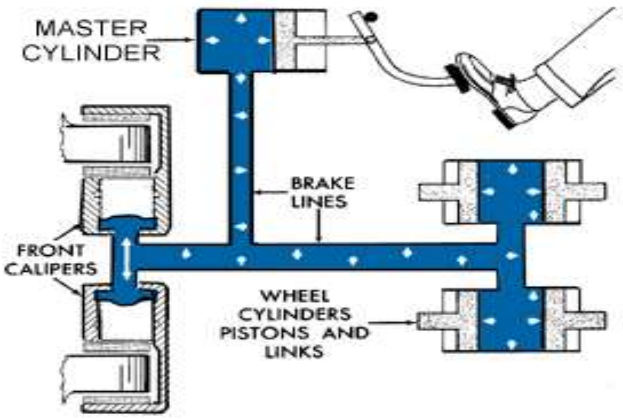
Operation - As the engine starts running, fuel will be pumped to the float chamber.
As soon as the predetermined fuel level is reached will the float close the
needle valve onto its seat to prevent any more fuel entering.
This process will be repeated as engine is using fuel

13. State three functions of the air filter

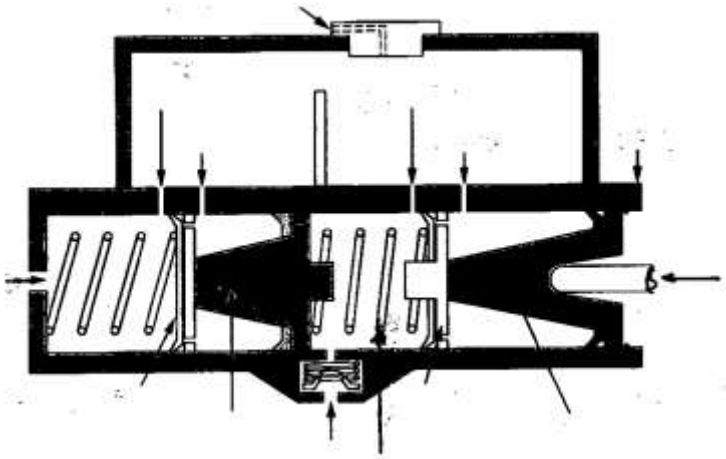
1. Extract dust particle from the air entering the cylinders.
2. Muffle sound of the air streaming into cylinders
3. Serve as flame oppressor when engine misfires through carburettor intake

Activity 5

Grade 10	Term: 3	Week No:	8	Class	
Topic: Systems and Control:	**Hydraulic brake system - Master and wheel cylinders**				

Questions	**Answers/Explanation**
Which factors would determine the efficiency of a brake system?	• Area of brake lining surface • Piston areas of master cylinder, wheel cylinders and callipers • Diameter of brake discs/drums • Tyre contact/friction co-efficiency to road surface • Friction co-efficiency between brake linings and drum/disc
Make a neat simple sketch to show a lay-out of a simple brake system.	**Simple brake system**  _____ _____ _____ _____ _____ _____

Label the components of the tandem/dual master cylinder.



Why is brake pedal free play necessary between the brake pedal and the master cylinder? Explain.

_____
_____

N

_____ B _____ D __
_____

C E
_____
_____

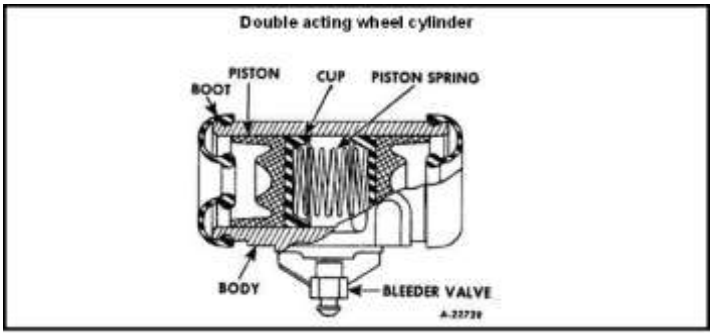
Make a neat sketch of a double acting wheel cylinder. Label all components.

_____
_____

MASTER CYLINDER COMPONENTS

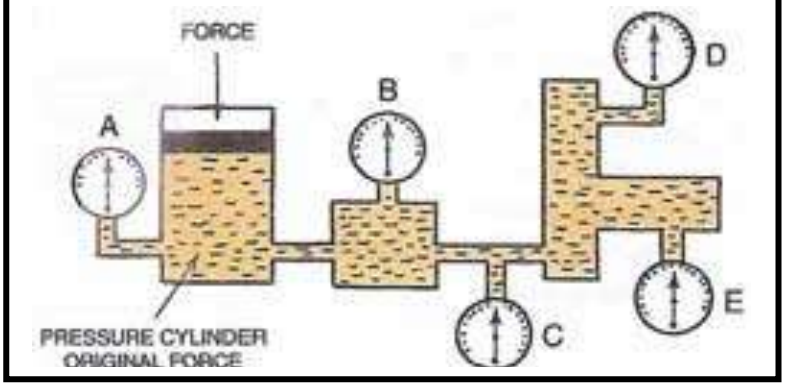
A-outlet
B-compensating port
C-inlet port
D-compensating port
E-inlet port
F-lock ring
G-push rod
H-primary piston
I-primary washer
J-calibrated spring
K-combined outlet return valve
L-secondary piston
M-secondary washer
N-vent in cap

Brake pedal free play is necessary for pistons in master cylinder to return to their rest position. If they do not

	return to their rest position build up of pressure can occur which could lead to brake bind. 

Activity 6

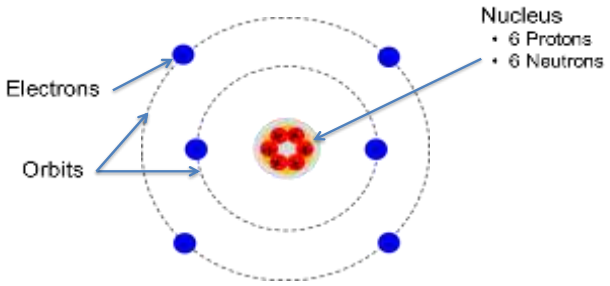
Grade 10	Term: 3	Week No:	9	Class	
Topic: Systems aand Control:	Hydraulic brake system - Disc brake and shoe assembly				

Questions	Answers/Explanation
14. Make use of a sketch and explain Pascal's law.	**Pascal's law.**  —— Pressure applied through force on liquid give same reading on all gauges **Explanation:** Pressure applied to the surface of a liquid in a confined space will lead to pressure difference to be the same in all directions. If you would connect a pressure gauge anywhere on the system it will show equal pressure on all.
15. What is the difference between a fixed and floating calliper? Explain.	Fixed calliper has two/four pistons on either side of disc that move towards the disc when brakes are applied.

	The floating calliper makes use single/double piston on one side of disc with fixed point on other side that can move as brakes are applied or wearing down
16. Explain the operation of a double leading brake shoe assembly.	Double leading brake shoe assembly has a piston to activate each brake shoe each brake shoe. Both shoes will operate as primary shoes. Self ratification doubles to that of single servo brake shoe assembly.
17. What is the function of the parking brake/handbrake?	To serve as a parking brake and not a emergency brake.
18. Use the axle or vehicle in the workshop and replace the front brake pads or rear brake shoes. Describe the procedure followed in the opposite column in point form. Write a condition report on Brake Pads/ Shoes and other components	Learners to each replace brake pads or rear brake shoes and record procedure they used as well as condition report.

Activity 7

Grade 10	Term: 4	Week No:	1	Class	
Topic: Systems and control:	Electricity - Electron theory				

Questions	Answers/Explanation
19. Make use of a sketch to explain the structure of an atom and the movement of the electrons to create electric current. 20. Explain the difference between a conductor and an insulator.	**The Atom**  The distribution of electrons in the orbital rings around an atom's nucleus determines the element's electrical properties. Some basic principles of electricity:-Opposite electrical charges always attract each other, and like electrical charges always repel. _____ _____ ___ _____ _____ ___ **Explanation:**_____ _____ ___ _____ _____ ___

21. What is meant by the term "electron drift/speed"? 22. Do research and give two examples where pulse with modulation is used in a motor vehicle. 23. Give two examples each of where digital and analogue signals could be used in a motor vehicle. 24. Explain briefly the effects of electricity.	_____ _____ __ _____ _____ __ **Conductor:** It is a material that allows current to flow through it fairly freely Its got a lot of free electrons. **Insulator:** Is a material that does not allow current to flow through it Has not got free electrons. **Electron drift:** The rate at which the electrons drift from atom to atom determines the amount of current. In order to create a drift of electrons through a circuit it is necessary to have electrical pressure or voltage. **Learner to give examples** **Learner to give examples** Heating effect: When current flows through a conductor heat is generated. The more current flows the more heat is generated Magnetic effect: When current flows through a conductor a magnetic field is produced. The greater the current the larger the magnetic field Chemical effect: Electric current can be passed through certain chemical solution and cause chemical changes. The chemical reaction can produce electrical current

Activity 8

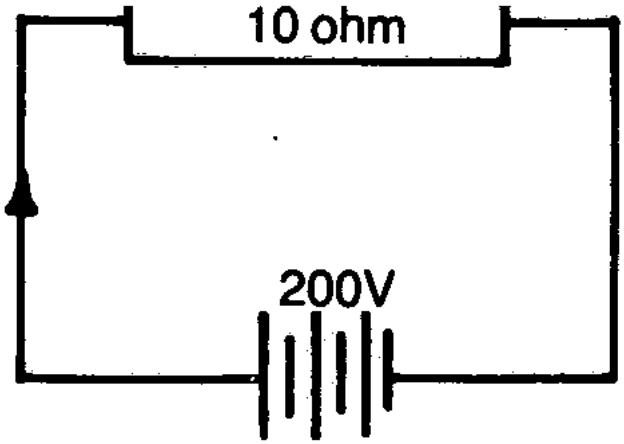
Grade 10	Term: 4	Week No:	1	Class	
Topic: Systems and control:	**Electricity - Characteristics of magnetism - Electromagnets**				

Questions	**Answers/Explanation**
25. List six characteristics of magnetism.	• The magnetic field consists of flux lines. • Flux lines travel outside the magnet from the north-pole to the south-pole. • Flux lines cannot touch or cross each other. • The closer to the pole the field is measured, the stronger the field will be. • The density of the flux lines will determine the strength of the magnetic field at a certain point. • Flux lines will cause a loop around the magnet • Flux Lines will always try to be as small as possible. • Like poles will repel each other and opposite poles will attract.
26. Explain the difference between a permanent magnet and an electromagnet.	**Permanent magnet:** A good permanent magnet should produce a high magnetic field with a low mass, and should be stable against the influences which would demagnetize it. Permanent magnetic field around it **Electromagnet:** Magnetic field produced by electric current Magnetic field disappears when current is switched off
27. How can the magnetic field strength of a solenoid be increased or decreased? Name two methods.	• Increasing the number of coils • Increasing the current flow • Placing a soft iron core inside the coil
28. Give two examples of where electromagnetic fields or solenoids are being used in a vehicle.	• Starter motor solenoid • Alternator • Idle valve/solenoid He proved that there is a definite relationship between current and magnetism.

29. What did Oersted's theory prove? Explain.	He proved the definite existence of a magnetic field around all current carrying conductors

Activity 9

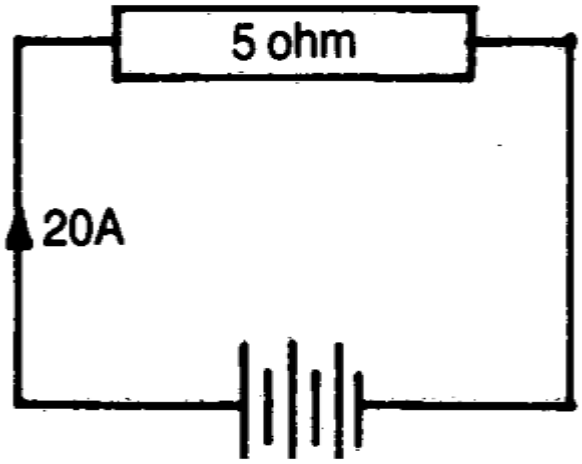
Grade 10	Term: 4	Week No:	1 - 2	Class	
Topic: Systems and control:	**Electricity - Electrical units and measurements**				

Questions	**Answers/Explanation**
30. Define Ohm's Law	Ohm's Law: George Simon Ohm discovered that there is a relationship between current, electrical pressure and resistance in a circuit. He proved that when electrical pressure is increased, current will increase and also that current will decrease with more resistance $\text{Current} = \frac{Pressure}{Resistance}$ or $I = \frac{V}{R}$
31. Name the unit and symbol for the following: a. Amount of current flowing through a conductor at a certain point. b. External energy that forces current to flow in a conductor. (Potential difference) c. Resistance.	Current - Symbol = I measured in *ampere* Voltage - Symbol = V measured in volts Resistance - Symbol = R measured in ohm
32. Calculate the value of current flowing when a 10 Ωresistance is connected to a potential difference of 200 V? Also draw the circuit.	 $I = \frac{V}{R}$ $= \frac{200}{10}$ = 20 *amperes*

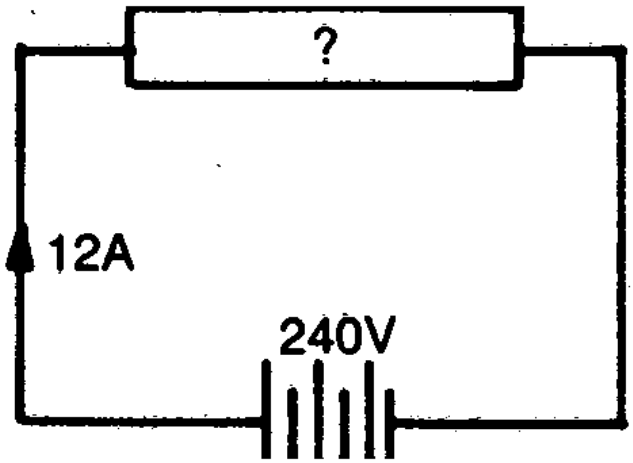
33. Calculate the potential difference (V) when a current of 20 A flows through a 5 Ω.
Also draw the circuit.

p.d (V) = I x R

20 x 5 = 100 *volts*



34. Calculate the value of resistance required when a pressure of 24 V is applied causing a current of 12 A to flow.
Also draw the circuit.



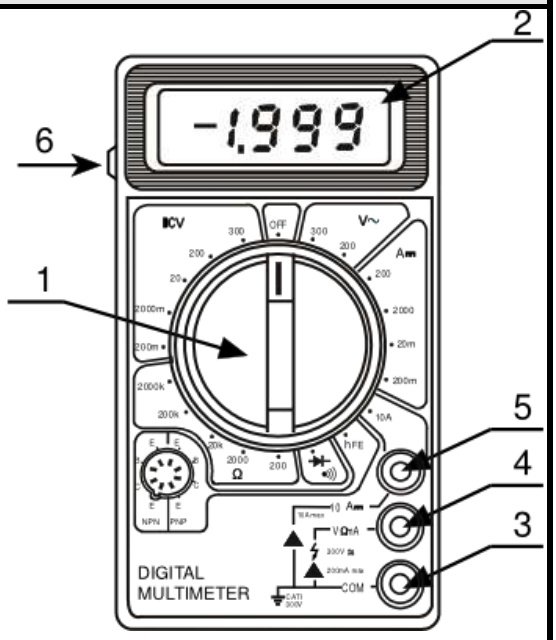
$R = \frac{V}{I}$

$= \frac{240}{20}$

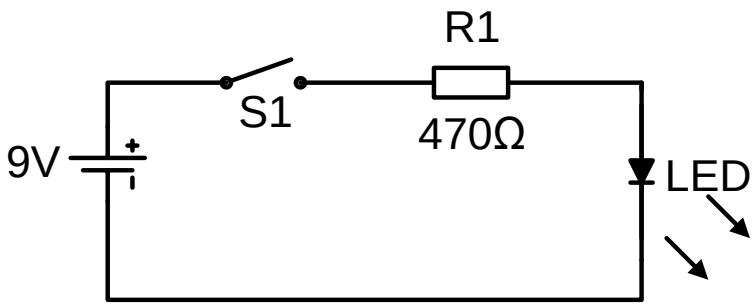
$=$ 20 *ohms*

Activity 9

Grade 10	Term: 4	Week No:	2	Class	
Topic: Systems and control:	**Electricity - Use of the multimeter - Basic series and parallel circuits**				

Questions	Answers/Explanation
35. Most mustimeters have the following jacks available to plug in either the red or black cable. Which colour cable would you plug into the following jacks: a. COM(3) b. VΩmA(4) c. 10A(5)	**a. Black** **b. Red** **c. Red** 
36. The multimeter has many uses. Explain how you would use it to measure the voltage of a 12 V battery.	• Disconnect earth cable from battery • Connect black cable to COM of multimeter • Connect red cable to VΩmA(4) • Switch dial to 20V • Touch red cable to pos and black to neg and take a reading
37. Use the components shown in the circuit diagram circuit shown.	Battery Switch Resistor

38. Switch the circuit on. Do the following tests and record the results:
    a. Indicate if the LED is ON. (If Not - Correct your circuit)
    b. Measure the voltage drop across the LED only.
    c. Measure the voltage drop across the resistor.



Learner to conduct test and record findings

a) _____

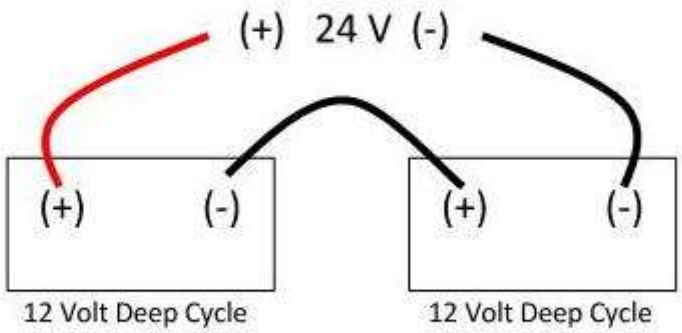
b) _____

c) _____

Activity 10

Grade 10	Term: 4	Week No:	2	Class	
Topic: Systems and control:	Electricity - Lead Acid -Type Battery				

Question	Answers/Explanation
39. What does the cell of a simple battery consist of?	One cell: • Outer casing • Positive plate (Normally contain lead dioxide) • Negative plate (Normally contain sponge lead) • Separators (Porous non conducting material
40. What does a solution of electrolyte consist off and what should the specific gravity be of a fully charged battery?	Specific gravity: 1.265 could go as high as 1.280
41. What is the purpose of the separator in the lead acid storage battery?	Prevent the active chemicals in the plates from touching each other through expansion
42. How many cells does a 12 volt battery consist of?	6 x 2volts = 12V Each cell can go up to 2.2V
43. What type of safety apparel should you use when testing a lead acid storage battery?	Acid proof apron, gloves and full safety helmet
44. Why is it important to remove vent caps when charging a lead acid storage battery?	Charging produces heat and pressure - could explode

45. What would happen to voltage and current When you connect two 12 V batteries in parallel?	**Series Connection – Doubles Voltage Amp Hours Same as Each Battery**  Note: Batteries used in this manner must be identical. If both batteries have 20 ah then this series connection is 20 ah.
46. Why is it important to have a battery clamped down in a vehicle?	A battery that is not clamped down can move and create a short circuit
47. What does a 90 amp-hour rating for a battery mean?	Theoretically it means if it is a 90 amp hour battery and 9 amps is drawn from it, the battery should last 10 hours = $\frac{90}{9}$= 10
48. Name any five electrical systems served by the battery in a vehicle.	Lights, alarm, hooter, engine management, all sensors