Grade 10 Power Mechanics

Terms 1, 2 and 3 - notes for 11 topics

IN EVERY TOPIC

- What you will learn and the key words.
- Short, clear notes with worked examples.
- Questions to try and a topic test, with the answers at the back.

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Strand 1.0 Fundamentals of Power Mechanics Technology | Term 1

1.1 Overview of Power Mechanics as a learning area

WHAT YOU WILL LEARN

By the end of this topic you should be able to:

- describe power mechanics as a learning area
- identify career opportunities in the power mechanics field
- evaluate activities related to power mechanics in the locality
- acknowledge the importance of power mechanics as a learning area

KEY WORDS

power mechanics, engine, vehicle, workshop, mechanic, technician, career, TVET, maintenance, repair.

1. What power mechanics is and where we meet it every day

What is power mechanics?

Power mechanics is the study of engines, vehicles and machines that make or use power, and of how to look after them. It covers how they work, how they are built, how to find faults, and how to repair and service them safely.

We meet power mechanics every day: in the matatu and the bus that carry passengers, the boda boda and the private car, the lorry that carries goods, the tractor on a farm, the generator that supplies electricity when the power is off, the water pump and the motor boat, and the lawn mower and the chainsaw. All of them need an engine or motor and other parts that carry the power to where it is needed.

In this learning area you will study the fundamentals, such as the workshop and its safety rules; the systems of a vehicle, such as wheels, body and chassis; and engines. You will also learn to use tools and measuring instruments, and to work in a careful and orderly way, because a badly repaired vehicle or machine can harm people.

2. Power mechanics in the curriculum and its links to other subjects

The learning area and its links

The Grade 10 power mechanics learning area is organised in strands. The fundamentals cover the learning area itself, the history of the automobile, the workshop layout, and the rules and regulations for working safely. Vehicle systems cover road wheels, the vehicle body, the chassis and the ways body parts are joined. Engines cover what an engine is, the types of engine and how engines are classified.

Power mechanics links to other subjects. Mathematics is used to measure, to calculate the capacity of an engine, and to read a scale drawing. Physics explains force, pressure, heat and energy. Chemistry explains fuels, burning and rust. Agriculture uses tractors and pumps. Business studies helps a mechanic to cost a job and run a garage. English and computer studies help in reading manuals and finding parts and diagrams online.

The skills you will develop are practical and lasting: working safely, using and caring for tools, measuring accurately, following instructions in order, solving problems step by step, and working with others as a team.

3. Career opportunities in power mechanics I

Jobs in power mechanics

The motor vehicle mechanic services and repairs engines, brakes, steering, suspension and transmission. The auto electrician repairs batteries, starters, alternators, lights and wiring. The panel beater repairs damaged bodies and the spray painter finishes them. The tyre fitter and wheel alignment technician look after wheels and tyres.

The diesel or heavy-machine mechanic looks after lorries, buses, tractors and construction machines such as excavators. The agricultural machinery technician services farm tractors, pumps and harvesters. The vehicle inspector checks vehicles for roadworthiness. The motorcycle mechanic repairs boda bodas. The spare parts dealer sells and advises on parts.

Some workers are employed in garages, transport companies, county governments, manufacturers and dealerships; many run their own garages. A growing area is the maintenance of electric and hybrid vehicles, which needs new skills as well.

4. Career opportunities in power mechanics II: training and self-employment

Training, self-employment and qualities

After school, training can be at a technical and vocational education and training (TVET) institution, where certificate and diploma courses are offered in fields such as motor vehicle mechanics, automotive engineering and agricultural machinery. Universities offer degrees in mechanical and automotive engineering. Many people learn skills through an apprenticeship in a garage, and can later have their skills assessed and certified.

Some mechanics become self-employed and open a garage, a tyre shop, a spare parts shop, or a mobile repair service. They need business skills such as keeping records, pricing a job, dealing with customers and paying tax, as well as technical skills.

Qualities of a good power mechanics worker include: honesty, so that a customer is charged fairly; responsibility, for the safety of the work; patience and good observation to find faults; teamwork; willingness to keep learning as vehicles change; and a strong sense of safety. Career guidance is best done by talking to people in the field and asking about their experience.

5. Practical: investigating power mechanics activities in the locality

Practical: a visit or interview

Materials: an observation guide, notebooks, permission, a supervising teacher; groups of four.

Choose a place in the locality where power mechanics work is done, such as a garage, a matatu or boda boda repair point, a tyre shop, a tractor or pump repairer, or a bus body builder. If a visit is not possible, invite a mechanic to speak, or interview one by phone.

Before the visit: get permission from the school and the owner, agree the questions and the roles in the group, and follow the safety rules: wear closed shoes, stay with the group, touch nothing without permission, keep away from moving parts, jacks and vehicles that are being lifted, and never enter the working area without the owner's agreement.

Record: what jobs are done and how many customers there are in a day; the tools, equipment and spare parts used; the problems they meet; how they keep safe; how they dispose of used oil, batteries and tyres; how the workers were trained; and the income and challenges. Take notes and, with permission, photographs. Thank the owner at the end.

6. Evaluating power mechanics activities in the locality

Evaluating what we found

To evaluate means to look carefully at the evidence and judge how well something works. Sort your findings into headings: the work done and its benefit to the community; the tools and equipment; safety; care of the environment; the skills of the workers; and the challenges.

For each heading write what is done well, what is weak, and one realistic improvement. For example: a garage repairs vehicles quickly and cheaply (a strength), but used oil is stored in open drums (a weakness that risks fire and pollution), and the improvement is to use closed, labelled containers and to give the oil to a licensed collector.

Present your evaluation to the class as a short talk, a poster or a written report, with the main findings, the strengths and weaknesses, and your recommendations. Be fair and respectful: the aim is to learn and to help, not to blame. Ask for questions and give reasons for your judgements.

7. The importance of power mechanics to the community and the country

Why power mechanics matters

Transport depends on engines: goods reach shops and markets, people travel to work and school, and emergency services such as ambulances reach the sick. Farming depends on tractors and pumps; industry on engines and generators; and homes and businesses on generators and pumps during power cuts. Skilled mechanics keep all of these running, and their work creates jobs.

Power mechanics also helps the economy: reliable transport lowers the cost of goods and links producers to markets, and skilled local mechanics save money that would otherwise be spent on imported repairs. Road safety improves when vehicles are properly maintained.

Those who work with engines have responsibilities: to work safely and protect others; to be honest about faults and charges; to reduce pollution, by servicing engines properly and disposing of used oil, batteries and tyres correctly; to save fuel; and to obey the law, such as the rules on roadworthy vehicles. Good power mechanics helps to build a safe and clean community.

8. Power mechanics as a learning area: review and appreciation

Putting it together

Power mechanics is the study of engines, vehicles and machines and how to look after them. It is used in transport, farming, industry and homes. It links to mathematics, physics, chemistry, agriculture, business and computer studies.

Careers include mechanics, auto electricians, panel beaters, spray painters, diesel and machinery technicians, inspectors and parts dealers. People can train at TVET institutions and universities, or learn through apprenticeship, and can work for others or start their own business.

The community depends on power mechanics for safe, reliable transport and power. With the work come responsibilities: safety, honesty and care for the environment. Appreciating this learning area means taking your practical lessons seriously, working carefully and helping others to do the same.

TRY THESE

1. Define power mechanics.
2. Name three machines or vehicles in your community that use an engine.
3. Name the three groups of topics in the Grade 10 power mechanics learning area.
4. Give two other subjects that help a mechanic and say how.
5. What does an auto electrician repair?
6. Name three jobs in the power mechanics field.
7. Give two ways of training for a career in power mechanics.
8. Name two business skills a self-employed mechanic needs.
9. Name three questions you would ask a mechanic during the visit.
10. State two safety rules to follow during the visit.

11. What does it mean to evaluate?
12. Name three headings under which to sort findings from a visit.
13. Give two ways power mechanics helps the economy.
14. Name two responsibilities of someone who works with engines.
15. Give the meaning of power mechanics in one sentence.
16. Name three careers in power mechanics.

TOPIC TEST

T1. Explain how a village with a broken water pump and no one able to repair it would be affected.

T2. Explain why a mechanic who cannot calculate or measure well could make expensive mistakes.

T3. Explain why a country with many vehicles needs many trained mechanics.

T4. Interview a mechanic, or imagine an interview, and write three questions you would ask about how they trained and what they like and dislike about the work.

T5. Explain why used engine oil should not be poured on the ground or into drains.

T6. Explain why a mechanic who follows safety rules may earn more customers over time.

T7. Explain why it is dishonest and dangerous for a mechanic to replace a faulty brake part with a cheap, unsuitable one.

T8. Write a short paragraph explaining to a younger learner why it is worth learning power mechanics.

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1.2 Evolution of automobile

WHAT YOU WILL LEARN

By the end of this topic you should be able to:

- explain the evolution of the automobile globally
- describe trends in the historical developments of the automobile
- explore the importance of innovation in automobile development

KEY WORDS

automobile, steam engine, internal combustion engine, assembly line, innovation, fuel injection, hybrid, electric vehicle, emissions, timeline.

1. Before the engine: human and animal power, the wheel and steam

From feet to steam

For thousands of years people moved themselves and their goods by walking, by using animals such as donkeys, camels, horses and oxen, and by boat. The wheel, invented about 5,500 years ago, made carts and wagons possible, but they still relied on people or animals for power, which limited speed, load and distance.

The steam engine changed this. Steam engines burn fuel outside the cylinder to boil water; the steam pushes a piston, which turns a wheel. Steam power was first used to pump water from mines and to drive factory machines.

In 1769 the French engineer Nicolas-Joseph Cugnot built a steam-powered three-wheeled vehicle for hauling guns, which is often called the first self-propelled road vehicle. It was heavy, slow and hard to steer.

In the nineteenth century, steam locomotives ran on rails and steam ships crossed the seas, and steam carriages ran on some roads. Steam vehicles needed time to raise steam, a boiler and a supply of water and fuel, so they were large and not suited to personal transport. Inventors looked for a lighter engine.

2. The internal combustion engine and the first petrol cars

The internal combustion engine

In an internal combustion engine the fuel burns inside the cylinder, and the hot gases push the piston directly. There is no boiler, so the engine can be lighter and quicker to start. In 1860 Etienne Lenoir built a practical gas engine. In 1876 Nikolaus Otto built the four-stroke engine, whose cycle of intake, compression, power and exhaust is still used in most petrol engines today.

In 1885 and 1886 Karl Benz and Gottlieb Daimler, working separately in Germany, built the first practical petrol vehicles: Benz's three-wheeled Motorwagen was patented in 1886, and Daimler produced a motorised carriage and motorcycle. These are considered the first true automobiles.

In 1892 Rudolf Diesel patented an engine in which air is compressed so much that it becomes hot enough to ignite the fuel without a spark; the first working diesel engine ran in 1897. Diesel engines use less fuel and are strong, so they later became common in lorries, buses, tractors and ships.

3. Mass production and the automobile for everyone

Mass production

At first, cars were built by hand, one at a time, and they were costly and owned by the rich. In 1908 the Ford Motor Company introduced the Model T, a simple, strong and low-priced car. In 1913 Ford introduced a moving assembly line, in which the car body moved past workers who each did one job. The time to assemble a chassis fell from more than 12 hours to about 1.5 hours, a saving of about 12 - 1.5 = 10.5 hours.

Lower cost meant that many more people could buy cars, and the price of the Model T fell over the years. Other makers copied the method, and it spread to other industries. Mass production also created a need for standard parts that fit every car, and for many service workers and garages to repair them.

In the early twentieth century other developments included the electric starter, which replaced the dangerous hand crank; enclosed bodies for protection from weather; pneumatic tyres; and better roads. Petrol stations and garages began to appear to serve motorists.

4. Trends in the twentieth century: safety, comfort and cleaner engines

Twentieth-century trends

Safety. Hydraulic brakes, laminated windscreens, seat belts, crumple zones, anti-lock braking systems (ABS) and airbags were introduced to reduce accidents and injuries. Comfort. Heaters, air conditioning, power steering, automatic transmission and better suspension made driving easier and more pleasant.

Efficiency and performance. Fuel injection replaced the carburettor in many engines, giving better control of fuel and lower consumption; electronic ignition and engine control units, which are small computers, improved reliability. Lighter materials and streamlined shapes reduced fuel use.

Environment. Growing traffic caused smoke and smog, so laws were made to limit exhaust emissions. Leaded petrol was phased out, and the catalytic converter was introduced to change harmful exhaust gases into less harmful ones. Each change came from a problem that people wanted to solve, and each changed the work of the mechanic, who now needed to understand electronics as well.

5. Modern trends: hybrid, electric and connected vehicles

Modern trends

A hybrid vehicle has both a petrol engine and an electric motor with a battery; the motor helps the engine, and the battery is recharged as the vehicle brakes, which saves fuel. The first mass-produced hybrid car, the Toyota Prius, went on sale in Japan in 1997. An electric vehicle (EV) has only an electric motor and a large battery that is charged from the mains or a charging point. It has no exhaust and few moving parts.

Other trends are vehicles that use fuels such as LPG, natural gas and biofuels; vehicles with sensors and computers that warn drivers, help them to park or brake automatically; connected vehicles, which send data on their condition; and research into vehicles that drive themselves. In Kenya, used vehicles imported from other countries are common, and electric motorcycles and buses are being introduced.

These changes affect mechanics. They must be trained to work safely with the high voltage in hybrid and electric vehicles, to use diagnostic scanners that read faults from the vehicle's computer, and to understand batteries and electronic controls. Old skills such as brakes, suspension and tyres are still needed. Workshops also need to deal with used batteries responsibly.

6. The importance of innovation in automobile development