Table of Contents

Lesson plans based on using Motor-Works manufactured by Natural Science Industries Ltd and available from Haines Education.

Foreword

All students enter our classrooms with diverse backgrounds, diverse interests, and a variety of pathways that they wish to pursue as a career. This teacher resource book has been written for students wishing to pursue mechanics as a possible career path. There are a variety of worksheets addressing a variety of concepts. They range from easy to quite challenging.

It is not expected that all students will complete each sheet, but rather that they can further develop their understandings by working through a few of the tasks.

There are several research tasks giving the students the opportunity to interview a mechanic, look in detail at a workshop, ask questions to garner information about such things as safety, work conditions etc., thus taking the student into the real world to view an interest of theirs outside the classroom.

The main focus is upon the students constructing an engine. By constructing this engine the students will learn about the function of the various parts, the integral nature of all components and how an engine works. The support material further develops this understanding and extends the knowledge of the students.

All activities can be used to gather useful assessment data and supplied record sheets help to maintain knowledge of student progression.

It is an intention that students who find mainstream lessons and tasks mundane find these activities stimulating and motivating. It is desired that the students working through these have the opportunity to investigate fully and follow up interests in mechanics, engineering, engine construction, maintenance and so on.

One of the best insurances you can give your students is to teach them to respect and look after the equipment that they are using and to instill in them right from the start the importance of safe working practices and procedures.

I would like to acknowledge the great support and technical advice from Neil Falkingham without whom this book would not have happened. After 40 years in the motor trade his technical advice is trusted and greatly appreciated. Many thanks to Neil and his wife Shirley for their dedication to this valuable teacher resource book.

Sandra Bishop Dip.T., B.Ed, Grad.Dip.Ed.Admin.,

M.Ed.

NAME

How an Engine Works: Basic Principles

When pressure is applied to the head of the piston, it is forced downwards. The piston pushes against the connecting rod, which pushes against an arm of the crankshaft, causing it to rotate. Thus the up and down motion of the piston is converted to the rotary motion of the crankshaft.

When the key is turned to start the engine, the starter (an electric motor) rotates the crankshaft thus moving the pistons up and down.

As a piston moves down from the top dead centre, a mixture of fuel and air is sucked into its cylinder through an open valve. This is called the *intake* stroke. The starter continues to rotate the crankshaft. As it pushes the piston upwards, the open inlet valve closes and the fuel/air mixture is compressed in the space between the piston and the cylinder head. This is called the *compression* stroke. As the piston nears the top of its travel, the fuel/air mixture is ignited by a spark jumping across the gap of the spark plug. The burning mixture then begins to expand rapidly in a high temperature, high pressure controlled combustion.* This combustion pressure forces the piston downwards. This is the *power* stroke. The exhaust valve opens and the piston moves from its lowest position back to the top again, forcing the combustion residue from the cylinder. This is the *exhaust* stroke. The complete set of strokes is called the four-stroke cycle.

The inlet and the exhaust valves are maintained in the closed position by their respective springs. As the engine turns, the valves are pushed open via the rocker arm which is controlled by the camshaft and is timed to open and close valves with the up and down motion of the piston. Once rocker arm pressure is removed from a valve, it is forced back into the closed position by its spring.

* If fuel/air mixture explodes in the combustion chamber (This is called *detonation* or *engine knocking*), the engine will be destroyed and pistons will melt because of extreme overheating. Fuel mixture and engine timing are critical in the modern four-stroke engine.

Draw a series of diagrams to illustrate the processes described above.

NAME

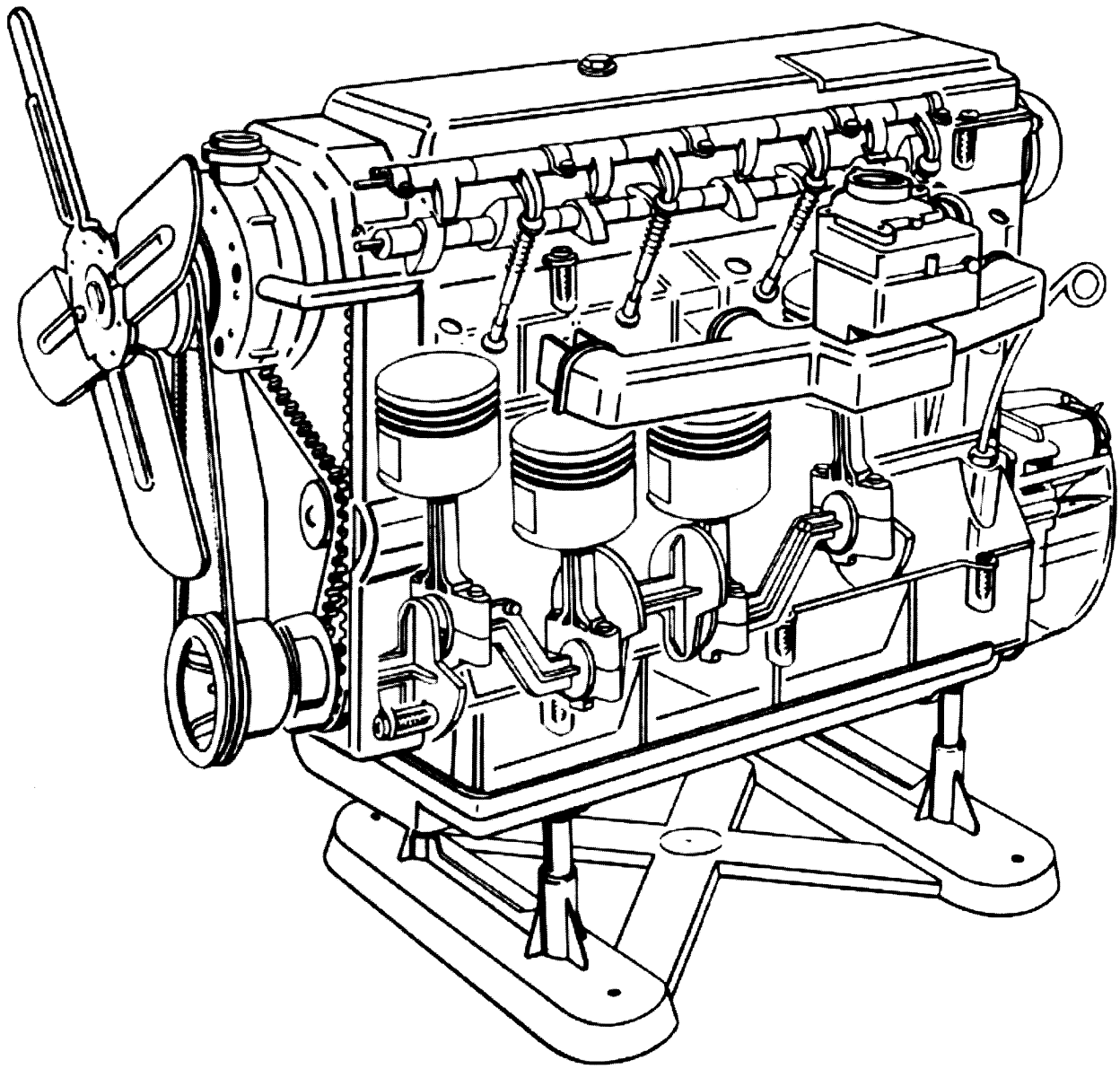
Basic Operating Principles

When the _____/_____ mixture burns in the _____ chamber, it generates _____ which forces the _____ to move up and _____. These _____ are connected to a _____ via a connecting rod. The crankshaft is connected to the _____ which has internal gearing. The transmission shaft applies a _____ force to the wheels thus moving the car _____ or _____. Many engines have been designed with a specific objective in mind: More _____, better _____, reduced fuel _____, lower _____ levels in _____ gases.

crankshaft	pollution	exhaust	energy
down	pistons	consumption	reliability
power	fuel/air	pistons	combustion
forward	backward	rotary	transmission

NAME

Label as many parts of the engine as you can.



NAME

True or False?

The first stroke: Intake

The piston starts from its highest point of travel in the cylinder. _____
The exhaust valve is open and the intake valve closed. _____
As the piston descends, it sucks in the fuel/air that supplies energy to the engine. _____
The fuel that enters into the cylinder through a hole controlled by the intake valve is a mixture of fuel and air. _____
The intake valve is now open. _____
Another name for the intake stroke is the *induction* stroke. _____

The second stroke: Compression

The two valves are open. _____
The crankshaft continues to turn and the piston is driven upwards. _____
The volume of the combustion chamber is progressively reduced as the piston travels up. _____
This causes two things to happen. _____
One: The pressure of the fuel/air mixture decreases sharply. _____
Two: The temperature of the mixture decreases. _____
This completes the compression stroke. _____

The third stroke: Power

The compressed air and fuel mixture is now very hot due to the compression and ready to combust. _____
The actual combustion is set off by the spark created by the spark plug. _____
This stroke is therefore called the *combustion* or *power* stroke. _____
A very low voltage applied to the spark plug causes a spark to jump across the gap between the spark plug points in the combustion chamber. _____
This ignites the fuel mixture. _____
Subjected to the force of this combustion, the piston is driven violently upwards. _____
This downward motion is transmitted to the crankshaft by the connecting rod. _____
This causes the crankshaft to rotate. _____
Two things happen during this third stroke. _____
The two things are combustion and expansion of the burning fuel. _____
Expansion is due to the fact that the volume of the combustion chamber rapidly increases while the pressure inside the cylinder also increases. _____

The fourth stroke: Exhaust

As the piston starts to rise again, the exhaust valve closes. _____
The combustion residue is discharged. _____
This is the exhaust stroke. _____
The exhaust valve then closes and the four-stroke cycle starts all over again. _____
The combustion of the fuel/air mixture is a very fast controlled burn. _____