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Unit Standard 30477

PRACTICE PAPER - ANSWER BANK

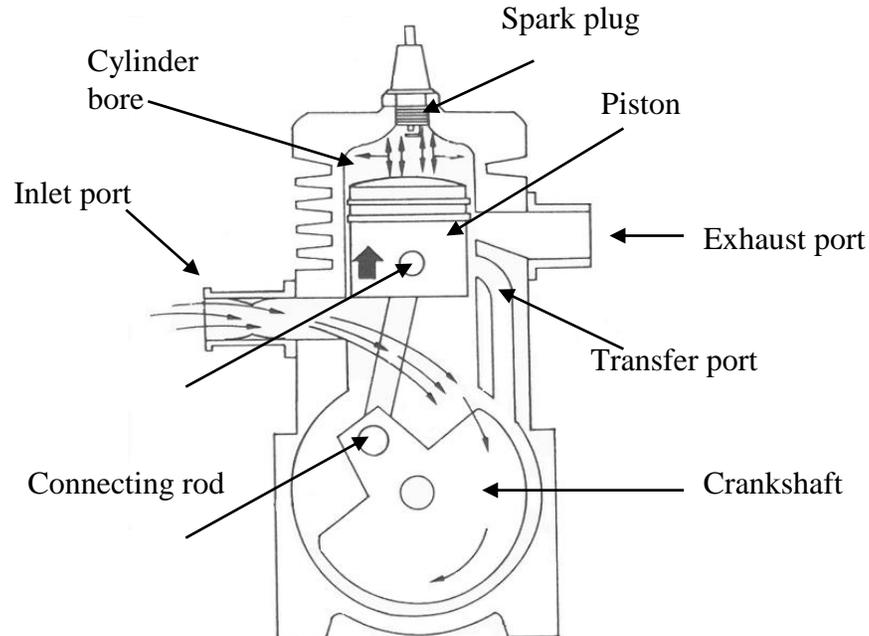
Assessors Note:

This answer bank should be used as the primary resource when marking students work. However, responses to some questions may be subjective and tutors are advised to exercise their professional judgement when making assessment decisions.

ELEMENT ONE

Demonstrate knowledge of spark ignition engine operation.

1. Study the diagram and answer the question that follows below.

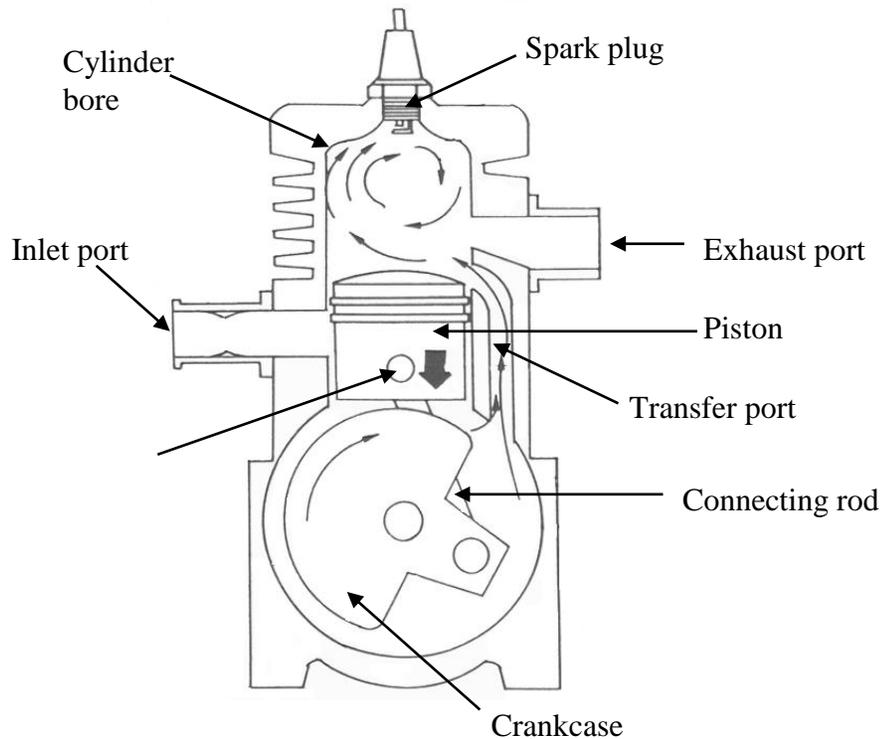


When the piston is moving up [as shown in the diagram above of a 2 stroke SI engine], explain what is happening.

As the piston moves up it compresses a charge already in the cylinder. At the same time a depression or partial vacuum is created below the piston in the sealed crankcase which allows air-fuel mixture from the carburettor to flow through a valve into the crankcase.

When the piston reaches T.D.C (Top Dead Centre) the compressed charge trapped on top of the piston is ignited and the piston moves down on a power stroke.

2. Study the diagram and answer the question that follows below.



When the piston is moving down [as shown in the diagram above of a 2 stroke SI engine], explain what is happening.

The downward moving piston creates pressure in the crankcase which now closes the intake port (One way valve) and because the crankcase is sealed, the previous in-coming air-fuel mixture is now being compressed in the crankcase. (If the crankshaft seals are worn the air fuel mixture can escape from the crankcase and combustion force will be reduced).

As the piston approaches Bottom Dead Centre (B.D.C) it uncovers the exhaust port, in the cylinder allowing the exhaust gas to escape from the cylinder.

The partially compressed fresh charge is also allowed to pass from the crankcase into the cylinder by the transfer port and some of this fresh air-fuel mixture flows over the top of the piston, forcing out any remaining exhaust gas from the cylinder. This is known as scavenging.

3. Using the following descriptions to identify the two stroke engine ports.

It is through this port that the air-fuel mixture enters the crankcase. The port is opened and closed by the movement of the piston skirt.

Engine port: **Inlet Port**

This is a passage way between the crankcase and the cylinder. The air-fuel mixture is transferred from the crankcase to the cylinder when the movement of the piston uncovers the transfer port.

Engine port: **Transfer Port**

This port is nearest to Top Dead Centre (T.D.C.) and is uncovered as the piston descends, allowing the burnt gases to leave the cylinder.

Engine port: **Exhaust Port**

4. List the four strokes of a four stroke engine.

1. Induction

2. Compression

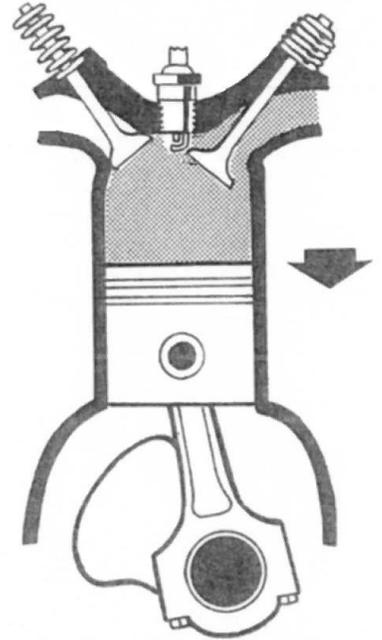
3. Power

4. Exhaust

5. **Identify the stroke shown in the diagram of a four stroke petrol engine and explain what happens during this stroke.**

First stroke (Intake)

This is the first movement of the piston and is a downward movement of the piston that develops a vacuum in the cylinder. The intake valve is open as the piston starts to descend. This allows an air-fuel mixture to fill the empty cylinder. When the piston reaches the bottom of the stroke the intake valve will close trapping the mixture inside the cylinder.

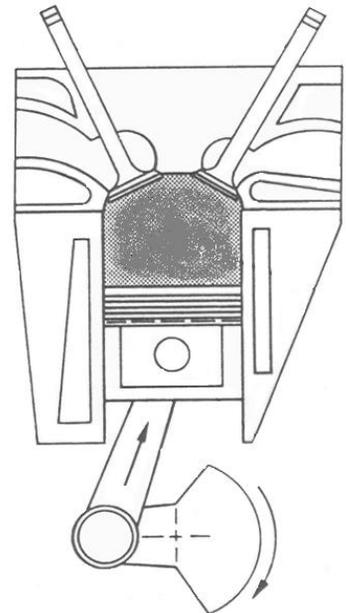


6. **Identify the stroke shown in the diagram of a four stroke petrol engine and explain what happens during this stroke.**

Second stroke (Compression)

On the second stroke the mixture is compressed.

Both the inlet and exhaust valves are closed. The weight of the crankshaft and flywheel drive the piston up to TDC compressing the mixture. The temperature of the mixture has now increased to a highly flammable charge.

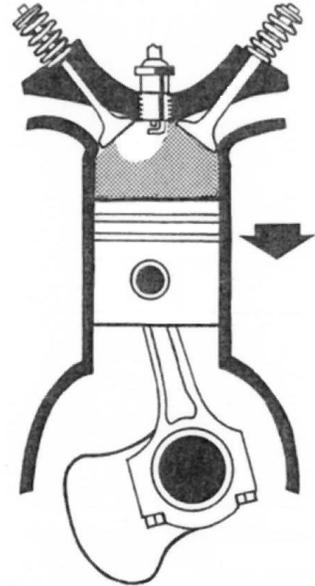


7. **Identify the stroke shown in the diagram of a four stroke petrol engine and explain what happens during this stroke.**

Third stroke Combustion (Power)

On the third stroke the engine produces its power. Just before the piston reaches the top of the compression stroke TDC.

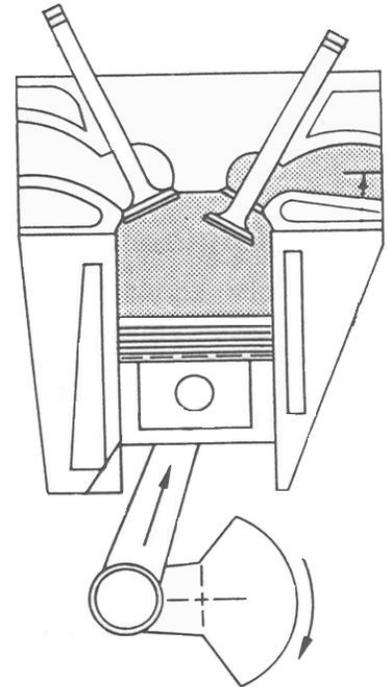
(Top Dead Centre) the spark plug produces a high voltage spark. As the mixture explodes the temperature and pressure inside the enclosed cylinder increases. The force of hot gas and pressure (combustion gases) drives the piston downward in the cylinder, and by means of the connecting rod produces movement of the crankshaft.



8. **Identify the stroke shown in the diagram of a four stroke petrol engine and explain what happens during this stroke.**

Fourth stroke (Exhaust)

On the fourth and final stroke the burnt gas is discharged from the cylinder. As the piston starts moving upwards from BDC (Bottom dead centre) the exhaust valve opens and the burnt gases are forced from the cylinder through the open exhaust valve. The cycle repeats itself after the exhaust stroke. The crankshaft has made two revolutions, and the engine has completed one cycle consisting of four strokes.



9 Which ONE of the following statements is true? Please tick the appropriate box.

In a four stroke cycle the crankshaft rotates faster than the camshaft

In a four stroke cycle the crankshaft and camshaft rotate at the same speed.

In a four stroke cycle the camshaft rotates faster than the crankshaft

10. Match up the engine component with its description: For example

A – Camshaft = 6 – Opens the valves

| | | | | |
|----------|-----------------------|------------|----------|---|
| A | Camshaft | A6 | 1 | Converts linear motion of pistons to rotary motion |
| B | Carburettor | B9 | 2 | Contains the cylinder bore, oil galleries and cooling system chambers |
| C | Connecting rod | C8 | 3 | Uses a set of star shaped rotors in a housing to pressurise the oil |
| D | Crankshaft | D1 | 4 | Forms a moveable gas tight plunger in the cylinder |
| E | Cylinder block | E2 | 5 | Contains the inlet passage, the exhaust passage and the combustion chamber |
| F | Cylinder head | F5 | 6 | Opens the valves |
| G | Flywheel | G11 | 7 | Provides a seal between the piston and the wall of the cylinder |
| H | Piston | H4 | 8 | Links the crankshaft to the piston |
| I | Piston rings | I7 | 9 | Mixes air and fuel and delivers mixture to the engine |
| J | Pressure relief valve | J10 | 10 | Consists of a spring and plunger valve |
| K | Rotary oil pump | K3 | 11 | Absorbs energy during the power stroke for use to carry the engine over the non power strokes |

ELEMENT TWO

Demonstrate knowledge of compression ignition engine operation.

- 1. Using the following descriptions to identify the two stroke CI engine cycles.**

Stroke: **Inlet**

Stroke: **Combustion (Power)**

Stroke: **Exhaust.**

- 2. In the diagram of the two stroke diesel engine shown explain what takes place when the piston is on the upward stroke.**

On the upward stroke the exhaust valves close, the rising piston covers the intake ports. The air in the cylinder is being compressed. Fuel is injected into the cylinder when the piston is nearing top dead centre. The heat generated by the compression of the air ignites the fuel.

- 3. Explain what happens during the intake stroke of a diesel four stroke engine and what is taking place during this stroke**

Stroke: Intake (Induction)

Air is introduced into the cylinder during the intake stroke. The inlet valve opens just before top dead centre (T D C.) Air is induced into the cylinder by the descending piston that creates a depression in the cylinder. The inlet valve closes after the piston has just passed bottom dead centre (B D C.). The exhaust valve is closed during the intake stroke.

- 4. Explain what happens during the Compression stroke of a diesel four stroke engine and what is taking place during this stroke**

Stroke: Compression

Both the intake and exhaust valves are closed.

The Piston ascends and compresses the air introduced on the intake stroke into a very small volume at the top of the stroke. The heat generated by the compression raises the temperature of the air to approximately 710 degrees Celsius.

- 5. Identify the stroke shown in the diagram of the diesel four stroke engine and describe what takes place during this stroke.**

Stroke: Power

The atomised fuel is injected into the cylinder just before the piston reaches T D C on the compression stroke. The heat of the compressed air in the cylinder will ignite this fuel.

The expansion of the burning gases forces the piston downward on its power stroke producing a torque on the crankshaft. The exhaust valve opens just before the piston reaches B.D.C. The amount of power is controlled by the time duration that the fuel is injected into the cylinder.

- 6. Identify the stroke shown in the diagram of the diesel four stroke engine and describe what takes place during this stroke.**

Stroke: Exhaust

The spent gases are forced out of the cylinder as the piston ascends for its exhaust stroke. The cylinder is scavenged and the inlet valve opens before the piston reaches the top of its stroke.

The next cycle commences as the piston descends on induction stroke and the exhaust valve closes just after the piston has passed T.D.C.

ELEMENT THREE

Demonstrate knowledge of engine capacity and performance ratings.

1. Explain the term Torque.

Turning force that is produced by the engine.

- 1B Explain the term Power.

Rate or speed at which work is done

2. Complete the following sentences.

Engines with high **TORQUE** will reach maximum acceleration faster from a lower RPM when the accelerator is applied. These engines are ideally suited for towing and carrying loads.

Engines with high **POWER** can carry more weight for further distances over a period of time. These engines are ideally suited to travelling at high speeds.

- 3a. Provide ONE way in which torque can be rated (measured).

Nm
lbf.ft, (pound foot)
kgm.

- 3b. Provide ONE way in which power can be rated (measured).

Watt
Kilowatt
BHP

4. Using the formula provided calculate the engine capacity of the following 4 cylinder engine:

Bore: 7.0cm
 Stroke: 7.5cm
 Cylinders: 4

$$\text{Capacity} = \frac{(\text{bore}^2 \times 3.14)}{4} \times \text{stroke} \times \text{No. cylinders}$$

Answers in cubic centimetres (cc) or litres (l)

$$\frac{7^2 \times 3.14}{4}$$

$$\frac{49 \times 3.14}{4} \quad \frac{153.86}{4} \quad 38.46$$

$$38.46 \times 7.5 \quad 288.49 \times 4 =$$

Answer: 1153.95 cubic cm or 1.154 litres

5. Explain the term swept volume

Swept volume is the volume that is swept when the pistons move from TDC (Top Dead Centre) to BDC (Bottom Dead Centre).

6. Explain the advantages of high compression engines over low compression engines.

Two major advantages of increasing the compression ratio are that the power and economy of the engine will improve without added weight and size. The improvements come about because with higher compression ratios the air-fuel mixture is squeezed more. This means a higher initial pressure at the start of the power stroke. As a result there is more force on the piston for a greater part of the power stroke and more power can be obtained from every power stroke.