

**Marking Scheme**  
**CLASS-XII (2018-19)**  
**MECHANICAL ENGINEERING (626)**

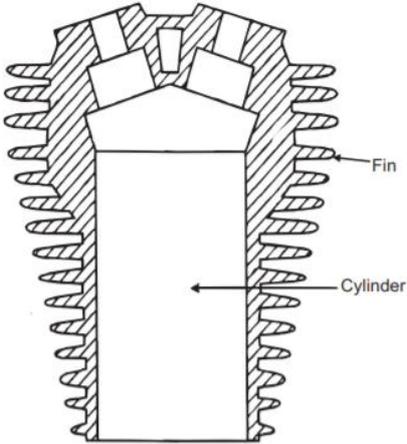
**(Section A)**

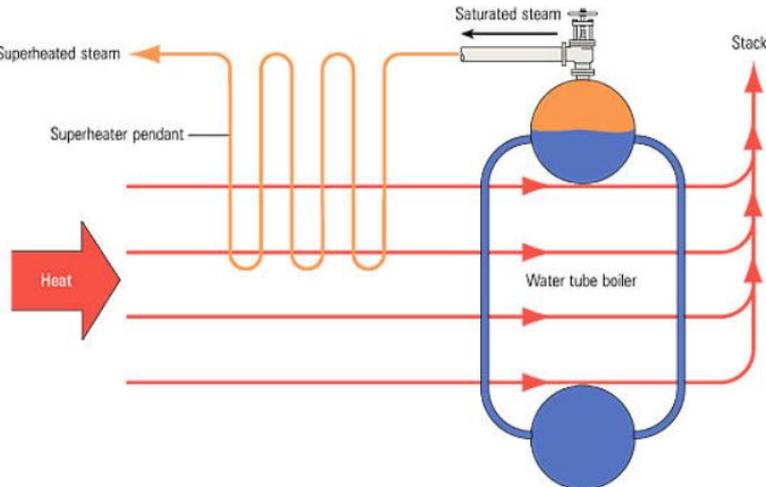
| Question No. | Answers | Marks |
|--------------|---------|-------|
| Q1           | A       | [1]   |
| Q2           | C       | [1]   |
| Q3           | A       | [1]   |
| Q4           | B       | [1]   |
| Q5           | B       | [1]   |
| Q6           | D       | [1]   |
| Q7           | D       | [1]   |
| Q8           | A       | [1]   |
| Q9           | A       | [1]   |
| Q10          | A       | [1]   |
| Q11          | B       | [1]   |
| Q12          | C       | [1]   |

| Question No. | Answers   | Marks |
|--------------|---|-------|
| Q13          | Slip in the belt drive is a phenomenon of the relative motion between belt and pulley. Due to insufficient grip of friction between pulley and belt, there is a relative motion between the belt surface and the surface of pulley, reducing the speed ratio, and hence power transmission. | [2]   |
| Q14          | A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have an inertia called the moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed.    | [2]   |
| Q15          | There are normally two to six safety valves provided in the drum depending upon the capacity. The super heater outlet will have one to three safety valves on either side of the boiler The reheater pipes both at  | [2]   |

|     |   |     |
|-----|---|-----|
|     | the inlet and outlet side will also have safety valves which can range from two to eight both in the inlet and outlet of the reheater put together.   |     |
| Q16 | Boiler mountings are the machine components that are mounted over the body of the boiler itself for the safety of the boiler and for complete control of the process of steam generation.   | [2] |
| Q17 | The nozzles in impulse turbines are in effect the stators of the turbine. They direct the motive fluid angle and increase the velocity onto the buckets. Single or multiple nozzles may be used with either water or steam. The nozzle expands the steam, increasing its velocity and redirecting the flow into the turbine blades. | [2] |
| Q18 | Swept Volume is volume between top dead centre and bottom dead centre. As piston moves from one dead centre to another it sweeps this volume, so it is called swept volume. It is also called displacement volume. Which is mentioned in unit cc (cubic centimeter).  | [2] |
| Q19 | "Stroke length" is defined as the distance travelled by the piston from Top Dead Centre (T.D.C.) to Bottom Dead Centre (B.D.C.) in a reciprocating type Internal Combustion Engine.   | [2] |

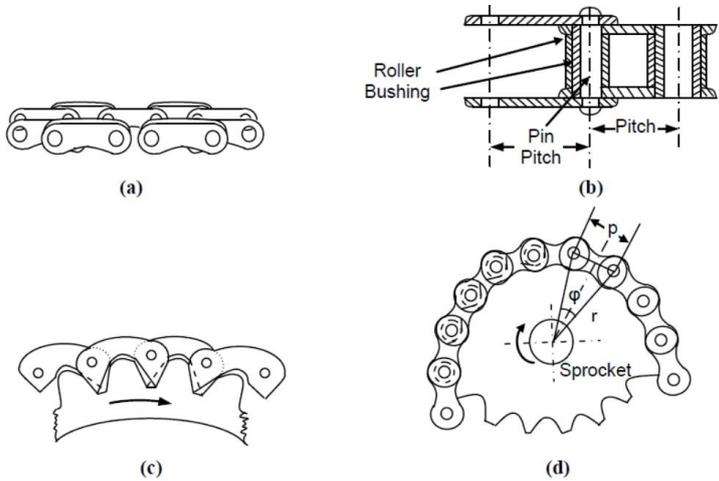
| Question No. | Answers   | Marks |
|--------------|---|-------|
|              |   | [3]   |
| Q20          | <ol style="list-style-type: none"> <li>1. As no slip takes place during chain drive, hence perfect velocity ratio is obtained.</li> <li>2. Since the chains are made of metal, therefore they occupy less space in width than a belt or rope drive.</li> <li>3. The chain drive may be used when the distance between the shafts is less.</li> <li>4. The chain drive gives a high transmission efficiency (up to 98 percent).</li> <li>5. The chain drive gives less load on the shaft.</li> <li>6. The chain drive has the ability to transmit motion to several shafts by one chain only.</li> </ol> |       |
| Q21          | <p>There are various sizes and types of pulleys, but they are broadly classified into three main categories.</p> <p><b>1. Immovable or fixed pulley</b></p> <p>This is the simplest type of pulley system. In this, the wheel is fixed at a</p>   |       |

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|     | <p>particular point like a pivot and works by changing the direction of the force applied</p> <p><b>2. Movable pulley</b></p> <p>In this type of pulley, the wheel moves with the object it is displacing. This arrangement allows the pulley to lift the load with much lesser force. Only that much force is applied to the load as much as the force levied on the rope</p> <p><b>3. Combined pulley</b></p> <p>These kinds of pulleys are a combination of both fixed and moveable pulleys.</p>   |  |
| Q22 | <p>In this system fins or extended surfaces are provided on the cylinder walls, cylinder head, etc. Heat generated due to combustion in the engine cylinder will be conducted to the fins and when the air flows over the fins, heat will be dissipated to air. The amount of heat dissipated to air depends upon :</p> <p>(a) Amount of air flowing through the fins.</p> <p>(b) Fin surface area.</p> <p>(c) Thermal conductivity of metal used for fins.</p>  |  |
| Q23 | <p>I.C. Engines have many applications including</p> <ol style="list-style-type: none"> <li>1) Road Vehicles (e.g. scooters, cars, buses etc)</li> <li>2) Air crafts</li> <li>3) Motorboats</li> <li>4) Small machines such as chainsaws and portable engine generator.</li> </ol>  |  |
| Q24 | <p>Turbines are essentially propellers in reverse, both of which work in direct accordance to Isaac Newton's third law – namely, for every action there has to be an equal and opposite reaction. In propellers,</p>  |  |

|            |   |  |
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|            | <p>that means energy is put into a spindle of asymmetrical blades that puts pressure on the air or water, which pushes back to propel the vehicle.</p> <p>Turbines are usually fixed in place, so when a fluid flows through it there is a drop in pressure at the back edge of each blade that causes the turbine to turn. The principle is the same for air or water and the faster the medium is moving, the greater the pressure drop, and the faster the turbine spins.</p>  |  |
| <p>Q25</p> | <p>The function of super heater is to increase the temperature of the steam generated by boiler above its saturation point, using the hot flue or exhaust gases coming from the combustion chamber of the furnace. Super heaters are heat exchangers.</p> <p>Advantages :</p> <ul style="list-style-type: none"> <li>i) Steam consumption of the engine or turbine is reduced.</li> <li>ii) Losses due to condensation in the cylinders and the steam pipes are reduced.</li> <li>iii) Erosion of turbine blade is eliminated.</li> <li>iv) Efficiency of steam plant is increased.</li> </ul>  |  |
| <p>Q26</p> | <p>A bulldozer is a heavy duty equipment that can be used at several places. Some of the most common places that a bulldozer is used include construction sites, places where snow is to be removed, places where demolition is required, etc</p> <ol style="list-style-type: none"> <li>1. Earthmoving<br/>Bulldozer is an heavy duty equipment that can clear the land and easily move the soil</li> <li>2. Snow Plowing<br/>Bulldozer can also be used to plow snow. The accumulated snow can be carried with the front blades of the bulldozer and put onto another vehicle.</li> <li>3. Demolition</li> </ol>  |  |

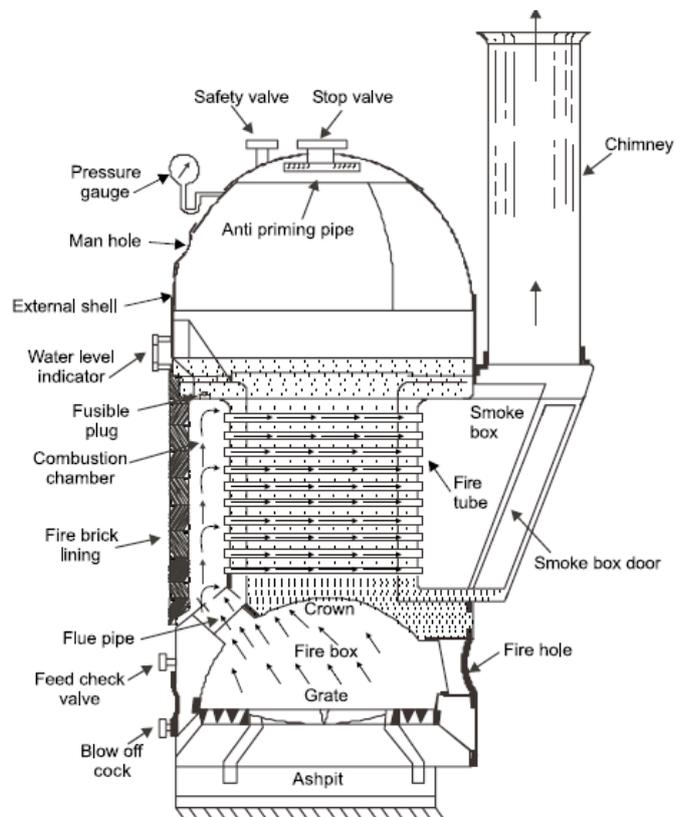
|  |   |  |
|--|---|--|
|  | <p>If you want to reconstruct or renovate something, you can use a bulldozer to demolish the existing structure on a piece of land.</p> <p>4. Construction<br/>The process of construction involves using several types of heavy duty equipment and a bulldozer can be used for multiple purposes</p> <p>5. Military<br/>A modified version of a bulldozer is used for military purposes.</p> |  |
|--|---|--|

**(Section B)**

| Question No.  | Answers  | Marks       |            |   |  |   |  |   |  |     |
|---|--|-------------|------------|---|--|---|--|---|--|-----|
| Q27   | <p>The chain drive is a positive drive. Like belts, chains can be used for larger centre distances. They are made of metal and due to this chain is heavier than the belt but they are flexible like belts The chain and chain drive are shown in Figure below</p> <div style="text-align: center;">  </div> <p style="text-align: center;">Difference between chain drive and gear drive</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="background-color: #f4a460;"> <th style="width: 50%;">Chain Drive</th> <th style="width: 50%;">Gear Drive</th> </tr> </thead> <tbody> <tr> <td>In chain drive, an intermediate element (chain) connects the sprockets of driver and driven shafts.</td> <td>No such intermediate element exist in gear drive. Gears of the driver and driven shafts mesh directly.</td> </tr> <tr> <td>It is one flexible drive because of the presence of flexible chain.</td> <td>It is one rigid drive as no flexible link exist.</td> </tr> <tr> <td>It can damp vibrations and protect the drive unit from failure.</td> <td>It cannot protect the system from vibration.</td> </tr> </tbody> </table> | Chain Drive | Gear Drive | In chain drive, an intermediate element (chain) connects the sprockets of driver and driven shafts. | No such intermediate element exist in gear drive. Gears of the driver and driven shafts mesh directly. | It is one flexible drive because of the presence of flexible chain. | It is one rigid drive as no flexible link exist. | It can damp vibrations and protect the drive unit from failure. | It cannot protect the system from vibration. | [5] |
| Chain Drive   | Gear Drive   |             |            |   |  |   |  |   |  |     |
| In chain drive, an intermediate element (chain) connects the sprockets of driver and driven shafts. | No such intermediate element exist in gear drive. Gears of the driver and driven shafts mesh directly.   |             |            |   |  |   |  |   |  |     |
| It is one flexible drive because of the presence of flexible chain.                                 | It is one rigid drive as no flexible link exist.   |             |            |   |  |   |  |   |  |     |
| It can damp vibrations and protect the drive unit from failure.                                     | It cannot protect the system from vibration.   |             |            |   |  |   |  |   |  |     |

|     |  |   |  |
|-----|--|---|--|
|     | Chain drive is suitable for transmitting power and motion over short to medium centre distance.  | Gear drive is preferred for short distance power and motion transmission.             |  |
|     | Chain drive cannot be used for non-parallel shafts.  | Certain gear drives (like bevel and worm) are meant for non-parallel shafts only.     |  |
|     | With chain drive, the driver and driven shafts rotate in same direction.   | With gear drive, the driver and driven shafts rotate in opposite direction.           |  |
|     | Chain drive is not true positive drive. Although it is free from slip, but velocity ratio may vary due to polygonal effect.  | Gear drive offers positive drive and velocity ratio remains constant.                 |  |
|     | Chain drive is not suitable for very high speed reduction.   | Gear drive can be advantageously used for small to high speed reduction.              |  |
|     | Although it requires regular lubrication, chain drive does not require full lubrication.   | Gear drive requires full lubrication for smooth operation and prolonged service life. |  |
| Q28 | <ul style="list-style-type: none"> <li>▪ In Cochran boiler first the fuel is inserted into the fire box and placed on the grate. The fuel is ignited through the fire hole provided at the right bottom of the boiler.</li> <li>▪ The fuel is burnt in the fire box and due to the burning of the fuel, smoke and hot flue gases emerges out. The hot flue gases enter into the combustion chamber through flue pipes.</li> <li>▪ From the combustion chamber hot gases enters into the fire tubes. The fire tubes are surrounded by water. The hot flue gases inside the tubes exchange the heat from the hot gases to the water. Due to the exchange of heat, the temperature of the water start increasing and it gets converted into steam. The steam produced rises upward and collected at top of the boiler in the hemispherical dome. An anti-priming pipe is installed at top of the boiler which separates the water from the steam and makes it dry steam. This dry steam is then transfer to the turbines through the steam stop valve.</li> <li>▪ The hot flue gases and smoke after exchanging heat moves to the smoke box. From the smoke box the burnt gases and smoke is discharge to the atmosphere through the chimney.</li> <li>▪ Burnt fuel is transferred to the ash pit. Blow off cock is preset at left bottom of the boiler and is used to blow of the impurities, mud and sediment from the boiler water.</li> <li>▪ A fusible plug is also provided at top of the combustion chamber. When the temperature of the combustion chamber crosses the permissible level, the fusible plug melts and the water through the combustion chamber enter into the furnace of the boiler and stop the fire. In this way a big fire accident can be prevented to take place and also protects the boiler from damage.</li> </ul> |   |  |

- Various boiler mounting and accessories are attached to the boiler for its efficient working.

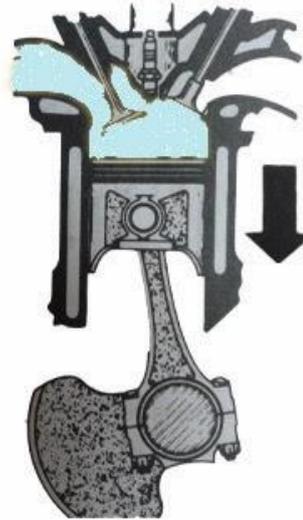


Q29

**The power generation process in four stroke diesel engine is divided into four parts**

**Suction stroke:**

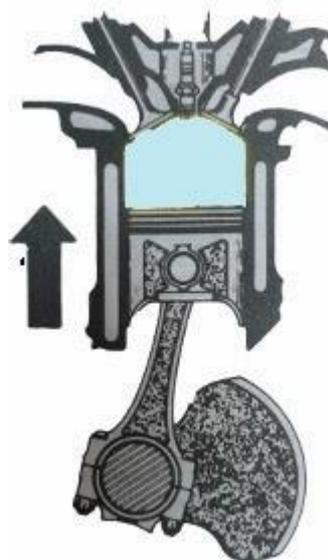
In the suction stroke or intake stroke of diesel engine the piston start moves from top end of the cylinder to bottom end of the cylinder and simultaneously inlet valve opens. At this time air at atmospheric pressure drawn inside the cylinder through the inlet valve by a pump. The inlet valve remains open until the piston reaches the lower end of cylinder. After it inlet valve close and seal the upper end of the cylinder.



INTAKE STROKE

**Compression stroke:**

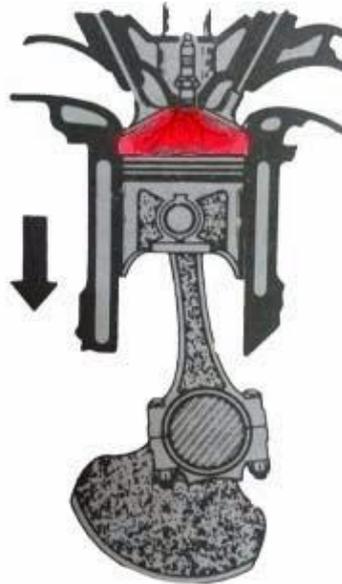
After the piston passes bottom end of the cylinder, it starts moving up. Both valves are closed and the cylinder is sealed at that time. The piston moves upward. This movement of piston compresses the air into a small space between the top of the piston and cylinder head. The air is compressed into 1/22 or less of its original volume. Due to this compression a high pressure and temperature generate inside the cylinder. Both the inlet and exhaust valves do not open during any part of this stroke. At the end of compression stroke the piston is at top end of the cylinder.



COMPRESSION STROKE

**Power stroke:**

At the end of the compression stroke when the piston is at top end of the cylinder a metered quantity of diesel is injected into the cylinder by the injector. The heat of compressed air ignites the diesel fuel and generates high pressure which pushes down the piston. The connection rod carries this force to the crankshaft which turns to move the vehicle. At the end of power stroke the piston reach the bottom end of cylinder.



**POWER STORKE**

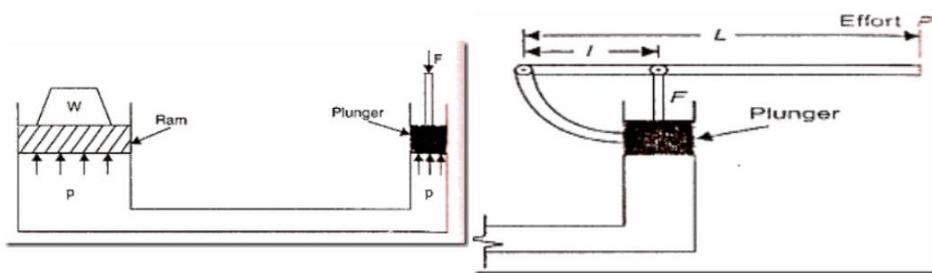
**Exhaust stroke:**

When the piston reaches the bottom end of cylinder after the power stroke, the exhaust valve opens. At this time the burn gases inside the cylinder so the cylinder pressure is slightly high from atmospheric pressure. This pressure difference allows burn gases to escape through the exhaust port and the piston move through the top end of the cylinder. At the end of exhaust all burn gases escape and exhaust valve closed. Now again intake valve open and this process running until your vehicle starts.



| Q30 | Impulse Turbine  | Reaction Turbine   |
|-----|--|--|
|     | 1. In impulse turbine only kinetic energy is used to rotate the turbine.   | 1. In reaction turbine both kinetic and pressure energy is used to rotate the turbine.   |
|     | 2. In this turbine water flow through the nozzle and strike the blades of turbine.   | 2. In this turbine water is guided by the guide blades to flow over the turbine.   |
|     | 3. All pressure energy of water converted into kinetic energy before striking the vanes.   | 3. In reaction turbine, there is no change in pressure energy of water before striking.  |
|     | 4. The pressure of the water remains unchanged and is equal to atmospheric pressure during process.  | 4. The pressure of water is reducing after passing through vanes.  |
|     | 5. Water may admitted over a part of circumference or over the whole circumference of the wheel of turbine.  | 5. Water may admitted over a part of circumference or over the whole circumference of the wheel of turbine.  |
|     | 6. In impulse turbine casing has no hydraulic function to perform because the jet is at atmospheric pressure. This casing serves only to prevent splashing of water. | 6. Casing is absolutely necessary because the pressure at inlet of the turbine is much higher than the pressure at outlet. It is sealed from atmospheric pressure. |
|     | 7. This turbine is most suitable for large head and lower flow rate. Pelton wheel is the example of this turbine.  | 7. This turbine is best suited for higher flow rate and lower head situation.  |
| Q31 | A jack is a device that uses force to lift heavy loads. Hydraulic jacks tend to be stronger and can lift heavier loads higher, and include bottle jacks              |  |

and floor jacks. It depend on force generated by pressure. Essentially, if two cylinders (a large and a small one) are connected and force is applied to one cylinder, equal pressure is generated in both cylinders. However, because one cylinder has a larger area, the force the larger cylinder produces will be higher, although the pressure in the two cylinders will remain the same. Hydraulic jacks depend on this basic principle to lift heavy loads: they use pump plungers to move oil through two cylinders. The plunger is first drawn back, which opens the suction valve ball within and draws oil into the pump chamber. As the plunger is pushed forward, the oil moves through an external discharge check valve into the cylinder chamber, and the suction valve closes, which results in pressure building within the cylinder.



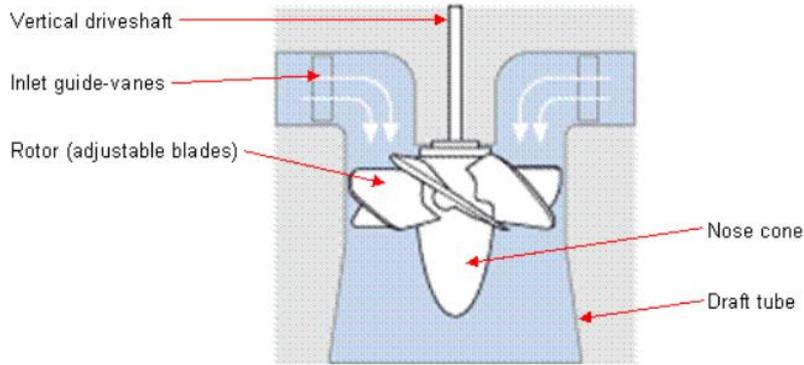
Q32

The water coming from the pen-stock is made to enter the scroll casing. The scroll casing is made in the required shape that the flow pressure is not lost. The guide vanes direct the water to the runner blades. The vanes are adjustable and can adjust itself according to the requirement of flow rate. The water takes a 90 degree turn, so the direction of the water is axial to that of runner blades.

The runner blades start to rotate as the water strikes due to reaction force of the water. The runner blades has twist along its length in order to have always optimum angle of attack for all cross section of blades to achieve greater efficiency.

From the runner blades, the water enters into the draft tube where its pressure energy and kinetic energy decreases. Kinetic energy is gets converted into pressure energy results in increased pressure of the water.

The rotation of the turbine is used to rotate the shaft of generator for electricity production.



Q33

**Following are the stages involved in working of 2 strokes petrol engines**

**1. The induction-compression stroke.**

A fresh charge of air and fuel is taken into the crank chamber as a result of the depression created under the piston as it advances towards the cylinder head. At the same time, last compression of the charge transferred earlier in the stroke beginning the crank chamber to the cylinder takes place above the advancing piston.

**2. The power-exhaust stroke.**

The combustible charge in the cylinder is ignited instantly preceding the power stroke, during which the gases enlarge and perform useful work on the retreating piston. At the same time, the previously induced charge trapped under the retreating piston is partially compressed. Towards the end of the stroke, the exhaust gases are evacuated from the cylinder, a process that is facilitated by the scavenging stroke of the new charge transferred from the crankcase.

Thus, the cycle is completed in two strokes of piston and one revolution of crank shaft

