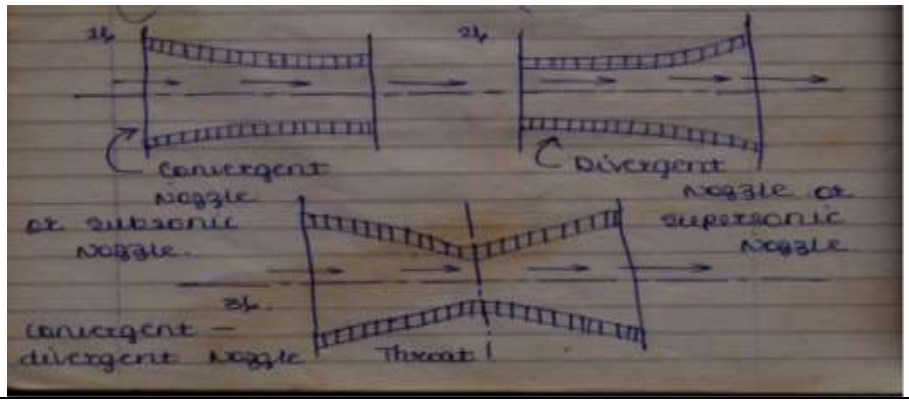
SUMMER – 15 EXAMINATIONS

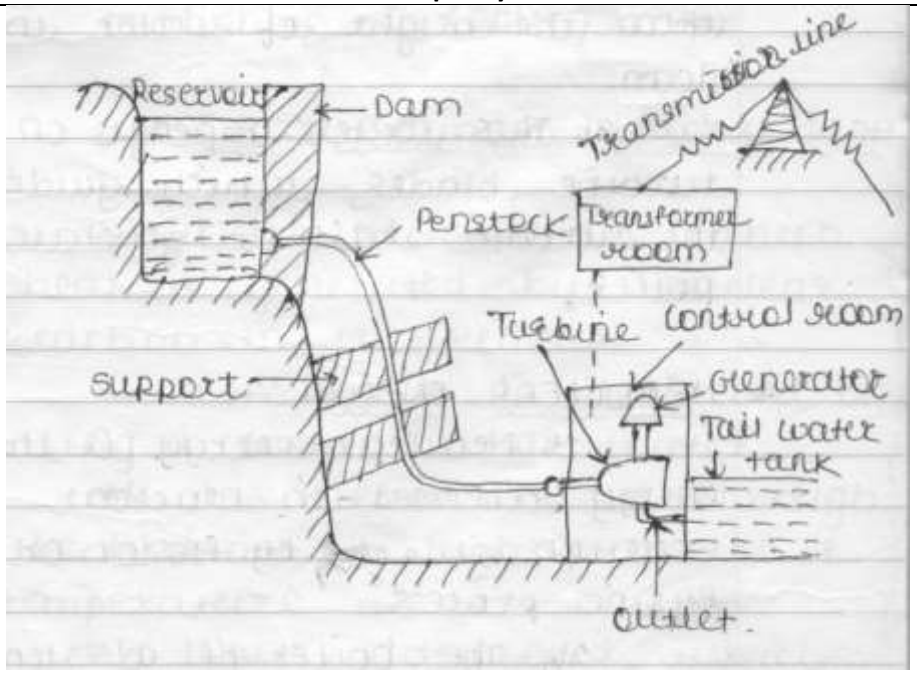
Subject Code: **17554** **Model Answer** Page No: ____/ N

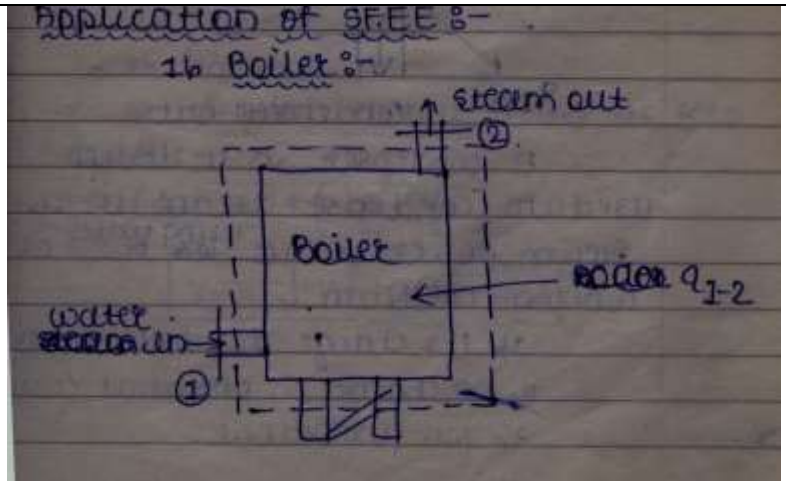
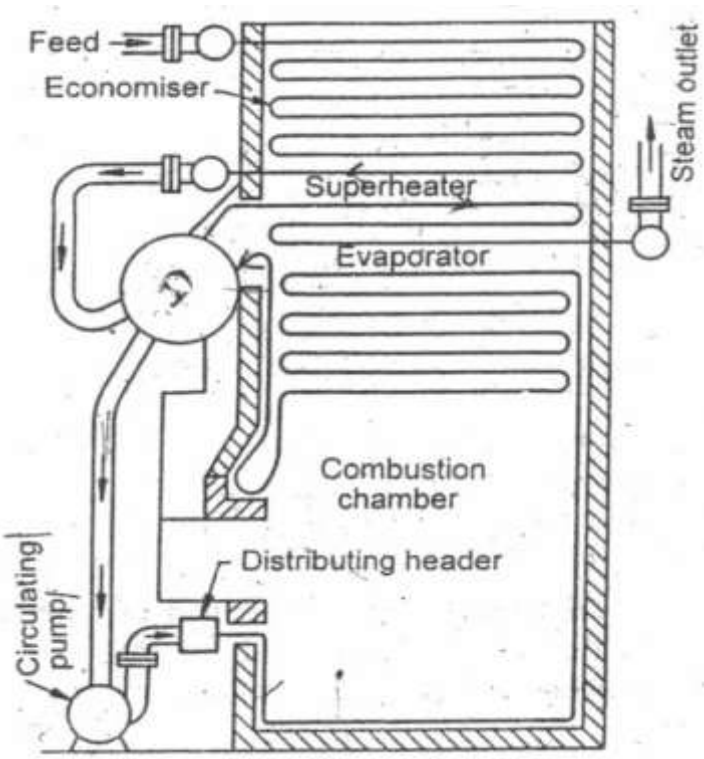
Important Instructions to examiners:

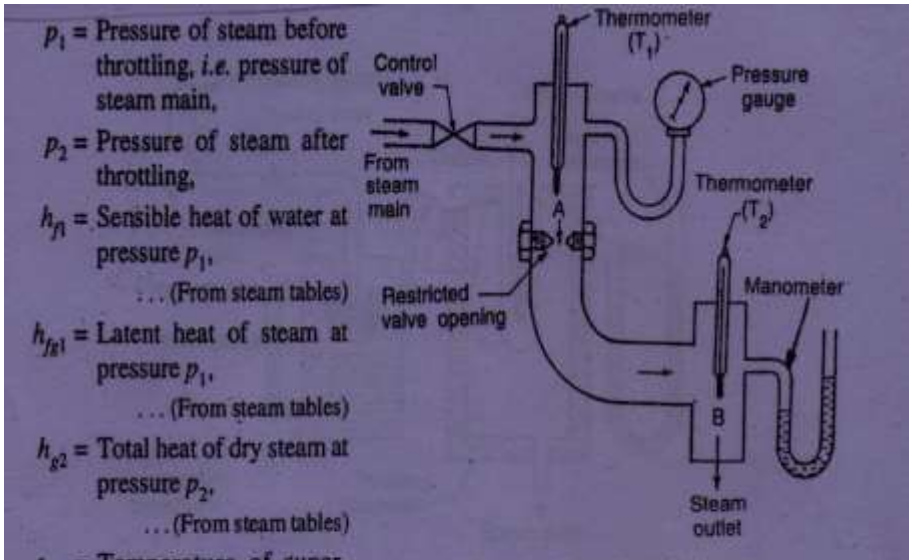
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1 A	**Attempt any six**	**6 x 2m**	**12m**
a)	Renewable source of energy : These are source of energy which are continuously produced by nature.They never get exhausted by their use. e.g. Solar, wind ,tidal, geothermal etc.	2m	2m
b)	Advantages of bio gases: 1) Mythane gas has high calorific value 2) It has light and ordorless flame 3) Rigested liquid can be used as fertilizer	2m(any two)	2m
c) i)	**Intensive Properties:-** An intensive property is a bulk property, meaning that it is a physical property of a system that does not depend on the system size or the amount of material in the system. Examples of intensive properties include temperature, refractive index, density, and hardness of an object.	1m	1m
ii)	**Extensive Properties:-** By contrast, an extensive property is one that is additive for independent, noninteracting subsystems. The property is proportional to the amount of material in the system. For example, both the mass and the volume of a diamond are directly proportional to the amount that is left after cutting it from the raw mineral	1m	1m
d)	Zeroth law of thermodynamic: Ths law states"when two system are each in thermal equilibrium separately with a third system,then two systems are also in themal equilibrium in each other."	2m	2m
e)	Heat: Heat is energy interaction due to temperature difference.Heat is low grade energy.Entire heat cannot be converted to work.Heat received by system is positive and heat rejected by a system is negative. Work: Work is a product of force and displacement.Work is high grade energy.Entire work can be converted to heat.Work done by a system is positive and work done on system is negative	1m 1m	2m
f)	Dryness fraction or quality of wet steam. It is the ratio of tfle mass of actual dry steam, to the mass of same quantity of wet steam, and is generally denoted by 'x'. Mathematically, x = mg/mg +mf =mg/mf Where mg = Mass of actual dry steam, mf = Mass of water in suspension, and m = Mass of wet steam = mg + mf	2m	2m
g)	TYPES OF STEAM NOZZLES: There are three important types; 1. Convergent nozzie. 2. Divergent nozzle.	2m	2m

	3. Convergent - divergent nozzle. 		
h)	Classification of I.C. Engine: 1) According to type of fuel used: a) Petrol engine b) Diesel engine c) Gas engine 2) According to method of igniting the fuels: a) Spark ignition engine(S.I engine or petrol engine) b) Compression engine(C.I engine or diesel engine) 3) According to number of stroke per cycle: a) Four stoke b) Two stoke 4) According to the cycle: a) Otto cycle b) Diesel cycle c) Dual cycle 5) According to speed of engine: a) Low speed b) Medium speed c) High speed 6) According to cooling system: a) Air cooled b) Water cooled 7) According to method of fuel injection: a) Carrborator engine b) Air injection engine	2m(any four)	2m
i)	Type of fuel cell: 1) Hydrogen cell 2) Fossil fuel cell 3) Hydrocarbon fuel cell 4) Alcohol fuel cell 5) Hydrozeni fuel cell 6) Polymer electrolyte membrane fuel cell(PEMFC) 7) Alkali fuel cell(AFC)	2m(any four)	2m

	8) Molten carbonate fuel cell(MCFC) 9) Phsphric acid fuel cell(PAFC) 10) Solid xode fuel cell(SOFCs)		
B	**Attempt any two**	**4m x 2**	**8m**
a)	 HYDRO-ELECTRIC POWER PLANT fig.shows a general lay-out of a hydro-electric power plant which consists of: (i)A dam constructed across a river to store water. (ii)Pipes of large diameters called penstocks, which carry water under pressure from the storage reservoir to the turbines. These pipes are made of steel or reinforced concrete. (iii)Turbines having different types of vanes fitted to the wheels. (iv)Tail race, which is a channel which carries water away from the turbines after the water has worked on the turbines. The surface of water in the tail race is also known as tail race.	2m(dia.) 2m(expl.)	4m
b)	SFEE: $h_1+V_1^2/2+gZ_1+q_{12}= h_2+V_2^2/2+gZ_2+W_{12}$	1m	4m

	 For boiler It is a device which supplies heat to water and generates steam. 1) No change in kinetic energy 2) No change in potential energy 3) No work done. SFEE $q_{12} = h_2 - h_1$	1m 2m	
c)	La-Mont Boiler  This is a modem high pressure water tube steam boiler working on a	2m(dia)	4m

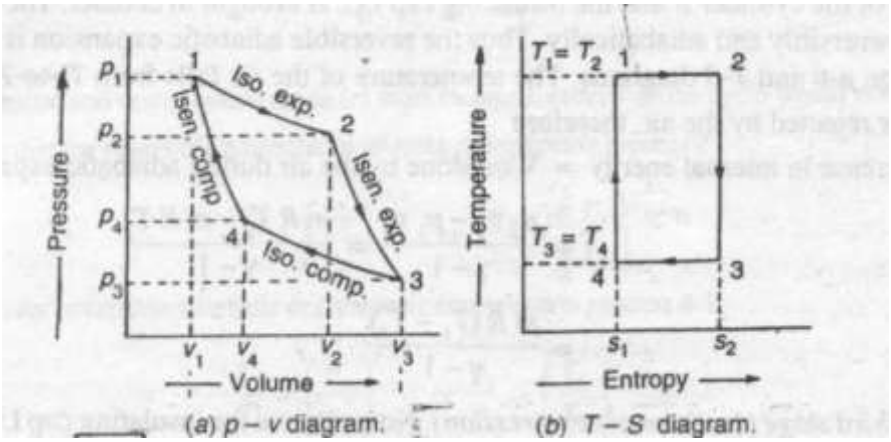
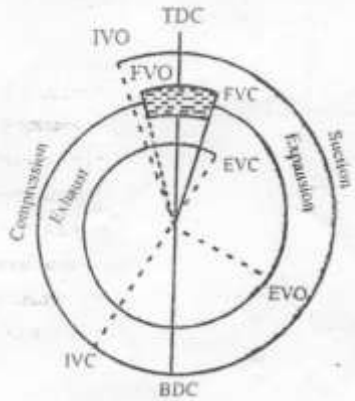
	forcedcirculation. The circulcrtion is maintained by a centrifugal pump,driven 'by a steam turbine, using steam from the boiler. The forced circulation causes the feed water to circulate through the Water walls and drums equal to ten timesthe mass of steam evaporated. This prevents the tubes from being overheated. A diagrammatic sketch of La-Mont steam, boiler is shown in Fig.The feed water passes through the economiser to an evaporating drum.It is then drawn to the circulating pump through the tube. The pump delivers the feed to the headers, at a pressureabove the drum pressure; The header distributes water through nozzles into the generating tubes acting in parallel. The water and steam from these tubes passes into the drum, The steam in the drum is then drawn through the superheater.	2m(expl.)	
2	**Attempt any four**	**4m x 4**	**16m**
a)	p_1 = Pressure of steam before throttling, *i.e.* pressure of steam main, p_2 = Pressure of steam after throttling, h_{f1} = Sensible heat of water at pressure p_1, ... (From steam tables) h_{fg1} = Latent heat of steam at pressure p_1, ... (From steam tables) h_{g2} = Total heat of dry steam at pressure p_2, ... (From steam tables) t_{sup} = Temperature of super-heated steam after throt-tling, t_2 = Saturation temperature at pressure p_2, ... (From steam tables) c_p = Specific heat of superheated steam, and x = Dryness fraction of steam before throttling.  Fig. 7.5. Throttling calorimeter. A throttling calorimeter used to determine the dryness fraction of steam is shown in fig. It consists of a separator A into which steam is admitted through a control valve from the steam main. The pressure and temperature are measured by the pressure gauges and thermometer T_1 provided in this section .It may be noted that temperature recorded by T_1 is same as the saturation temperature corresponding to the pressure of steam in calorimeter B .This steam is then throttled through a narrow aperture of restricted valve opening, its total heat remaining constant. The steam is the superheated state after throttling at a lower pressure than previous. The temperature and pressure of steam leaving the calorimeter B	2m(dia.) 2m(expl.)	4m

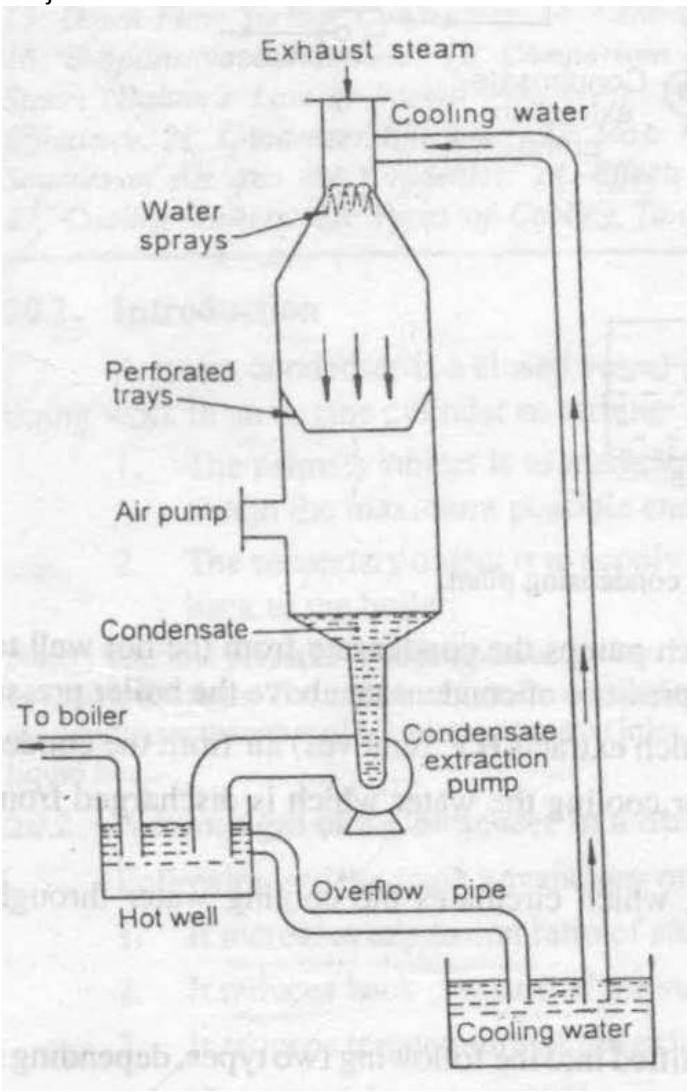
	is noted by the thermometer T_2 and manometer respectively. Since the stream has undergone a throttling process, therefore Total heat before throttling = Total heat after throttling $H_{f1}+xh_{fg1} = h_{g2}+c_p(t_{sup}-t)$		
b)	Given data: m= 1kg p=12bar Vg=0.16321m^3/kg (from steam table at pressure 12 bar) (1) When steam is dry saturated, Volume(V) = Vg =0.16321 m^3/kg (2) When steam is wet at x= 0.8 Volume(V)= x.Vg =0.8 x 0.16321 =0.1305 m^3/kg volume of 1Kg of steam i) When steam is dry saturated, =0.16321 m^3/kg ii)When steam is wet =0.1305 m^3/kg	2m 2m	4m
c)	1. Natural draught: The draught produced by means of a chimney alone is known as natural draught. It is a natural draught and has induced effect. Since the atmospheric air (outside the chimney) is heavier than the hot gases (inside the chimney), the outside air will flow through the furnace into the chimney. It will push the hot gases to pass through the chimney. The chimney draught varies with climatic conditions, temperature of furnace gases and height of chimney. 2. Mechanical or fan draught: The draught, produced by means of a fan or blower, is known as mechanical draught or fan draught. The fan used is, generally, of centrifugal type and is driven by an elecvic motor In an induced fan draught, a centrifugal fan is placed in the path of the flue gases before they enter the chimney. It draws the flue gases from the surface and forces them up through the chimney. The action of this type of draught is similar to that of the natural draught. In case oiforcedfan draught, the fan is placed before the grate, and air is forced into the grate through the closed ash pit	2m 2m	4m
d)	Dalton'S Law of Partial Pressures It states "The pressure of the mixture of air and steam is equal to the sum of the pressures which each constitutent would exert, if it occupied the same space by itself." Mathematically, pressure in the condenser containing mixture of air and steam, Pc=Pa+Ps	3m	4m

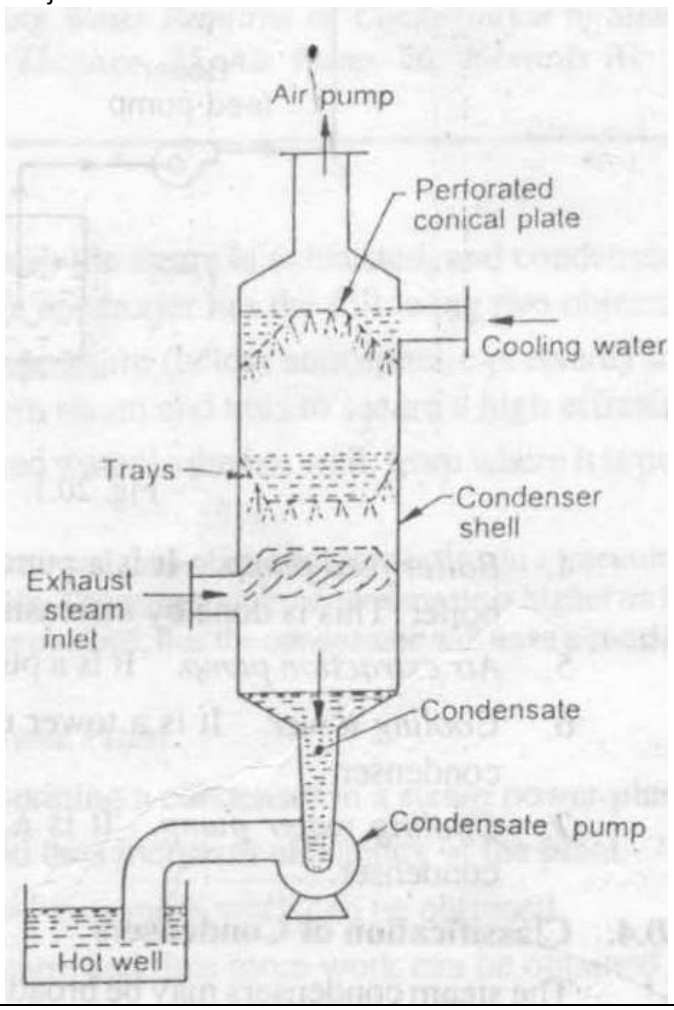
<table>
<tr><td></td><td>Pa = Partial pressure of air, and
Ps = Partial pressure of steam.
Note: In most of the cases, we are required to find partial pressure of air, therefore Dalton's law may also
used as:
Pa =Pc-Ps</td><td>1m</td><td></td></tr>
<tr><td>e)</td><td>Sources of Air into the Condenser
The following are the main sources through which the air may en r into the condenser:
1.The dissolved air in the feed water enters into the boiler, whicfri rn enters into the condenser with the exhaust steam. .
2. The air leaks into the condenser, through various joints, due to high vacuum pressure in the condenser.
3. In case of jet condensers, dissolved air with the injection water enters into the condenser</td><td>4m</td><td>4m</td></tr>
<tr><td>f)</td><td><table>
<tr><td>Sr no</td><td>Two Stroke</td><td>Four Stroke</td></tr>
<tr><td>1</td><td>The two-stroke engine completes one cycle of events for every revolution of the crankshaft</td><td>completes one cycle of events with the two revolutions required for the four-stroke engine cycle.</td></tr>
<tr><td>2</td><td>Theoratical power developed is more</td><td>Theoratical power developed is less</td></tr>
<tr><td>3</td><td>There are fewer working parts in a two-stroke engine</td><td>There are more working parts in four-stroke engine.</td></tr>
<tr><td>4</td><td>Cheap to manufacture</td><td>Expensive to manufacture.</td></tr>
<tr><td>5</td><td>Maintenance is less</td><td>Maintenance is more.</td></tr>
<tr><td>6</td><td>Self lubrication by mixing with fuel.</td><td>Separate lubrication is required.</td></tr>
<tr><td>7</td><td>Need of Scavenging</td><td>No need of scavenging.</td></tr>
<tr><td>8</td><td>Operation is smooth.</td><td>Operation is not much smooth.</td></tr>
<tr><td>9</td><td>More Pollution</td><td>Less pollution.</td></tr>
<tr><td>10</td><td>Light in weight</td><td>Heavier than two stroke.</td></tr>
</table></td><td>4m(any four)</td><td>4m</td></tr>
<tr><td>3</td><td colspan="2">Attempt any four</td><td>4m x 4</td><td>16m</td></tr>
<tr><td>a)</td><td>Pre-ignition occur'sdue to following reasons:
1) High compression ratio
2) Overheated spark plug point
3) Incandescent carbon deposit in cylinder wall
4) Overheated exhaust valve
5) It may occur due to faulty timing of spark production.

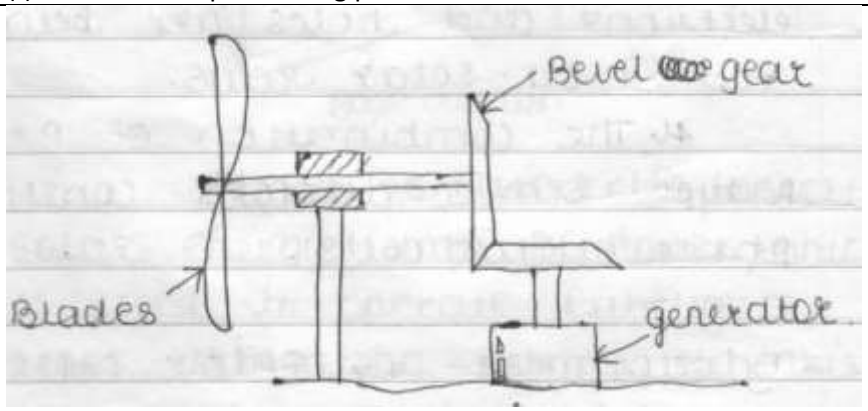
Effect of pre-ignition
1. Reduce useful work per cycle
2. Increase heat losses from engine</td><td>2m

2m</td><td>4m</td></tr>
</table>

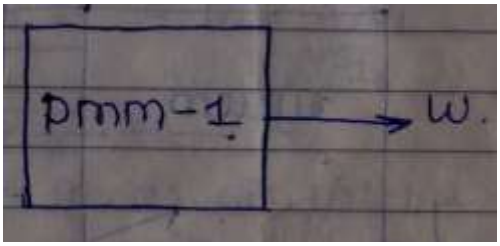
	3. Reduction in thermal efficiency. 4. Subject the engine components to excessive pressure.		
b)	 Carnot Cycle: It is an ideal cycle with maximum efficiency.(more than any othercycles) Processes are as follows 1) Process 1-2: reversible isothermal heat addition at constant temperature T1 2) Process 2–3: Reversible adiabatic expansion or isentropic expansion from T2 to T3 3) Process 3–4 : Reversible isothemal heat rejection at constant temperature at T3 4) Process 4-1: Reversible adiabatic compression or isentropic expansion compression from T4 to T1 Air standard efficiency of carnot cycle is η = Net work done/Heat addition = QA –QR /QA η = T1-T3 / T1 η = 1-(T3 / T)	2m(dia.) 2m(expl.)	4m
c)	Valve Timing Diagram for four –stroke cycle Diesel Engine:-  TDC : Top dead centre BDC : Bottom dead centre IVO : Inlet valve opens (10°-20° before TDC) IVC : Inlet valve closes (25°-40° after BDC) FVO : Fuel valve opens (10°-15° before TDC) FVC : Fuel valve closes (15° - 20° after TDC) EVO : Exhaust valve opens (39° - 50° before BDC) EVC : Exhaust valve closes (10° - 15° after TDC)	4m	4m

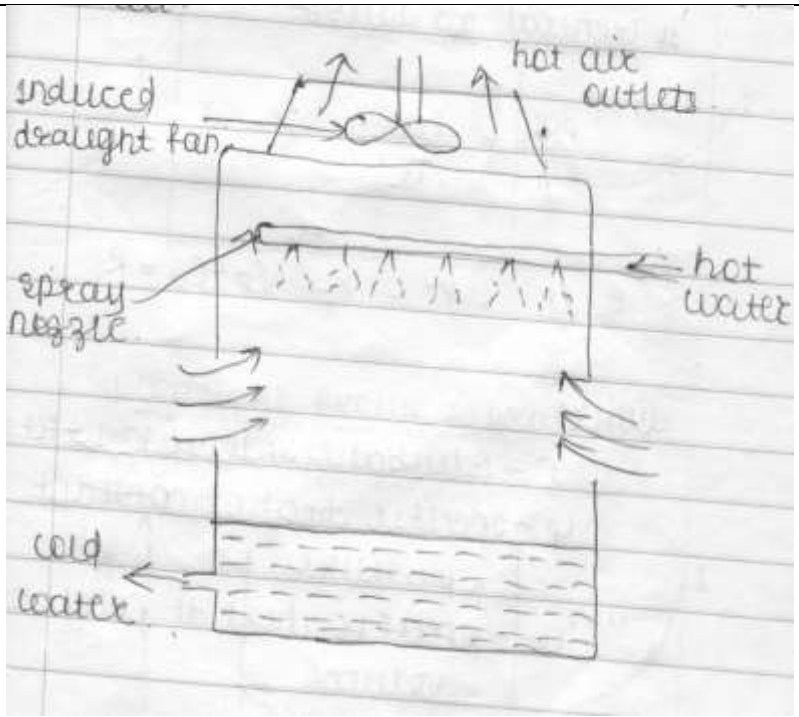
d)	Supercharging: It is the process of increasing the mass of air fuel mixture or air induced into engine cylinder. This is done with the help of compressor or blower known as supercharger. Supercharging in necessary because of following point. 1) To increase the power output of an engine when greater power is required. 2) To reduce mass of the engine per brake power. 3) To reduce space occupied by the engine. 4) To reduce the consumption of lubricating oil. 5) To maintain power of aircraft engine at high altitudes where less oxygen is available for combustion	2m 2m	4m
e)	Parallel flow jet condenser.  	4m(any one dia.)	4m

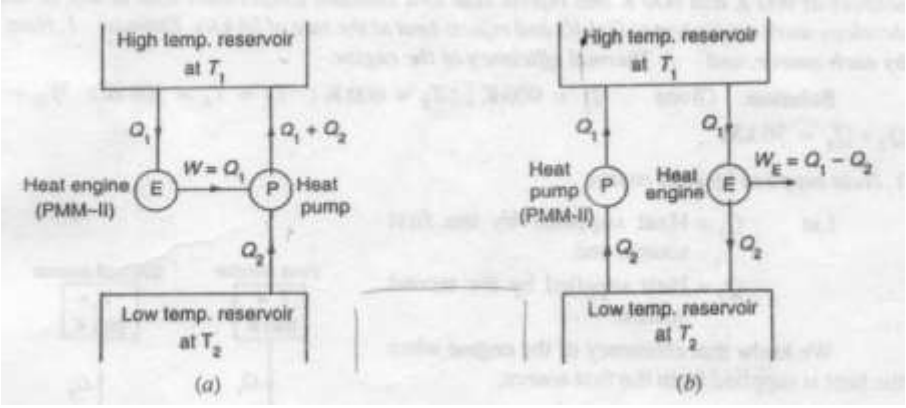
	Counterflow jet condenser  		
f) i	Condenser efficiency: Condenser efficiency is defined as ratio of temperature rise of cooling water to the difference in vacuum temperature and inlet cooling water. n_c =Temperature rise of cooling water/Vacuum temperature inlet cooling water temperature $=t_o-t_i/t_v-t_i$ Where t_o = outlet temperature of cooling water t_i= inlet temperature of cooling water t_v =Vacuum temperature or saturation temperature corresponding to condenser pressure	2m	4m
ii	Vacuum Efficiency: Vacuum efficiency is the ratio of actual vacuum at inlet to condenser to the maximum or ideal vacuum which can be obtained in a perfect condensing plant n_v=Actual vacuum/Ideal vacuum Actual vacuum = barometric pressure- Actual pressure Ideal vacuum =Barometric pressure- Ideal pressure (or pressure corresponding to temperature of condenser)	2m	

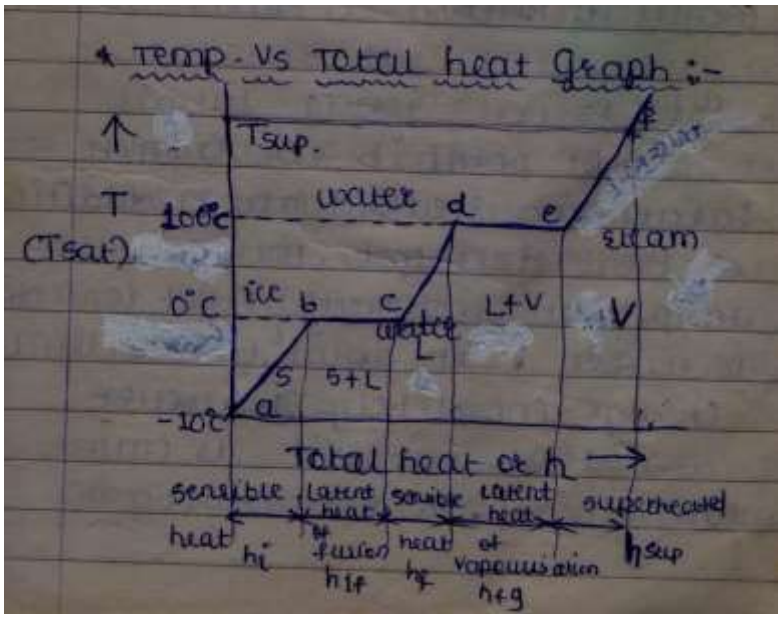
<table>
<tr><th>4</th><th>Attempt any four</th><th>4m x 4</th><th>16m</th></tr>
<tr><td>a)</td><td>Applications of heat exchanger:
(a) Dairy industry.
(b) Food industries.
(c) Refrigeration and air-conditioning.
(d) Steam and gas turbine power plants.
(e) Internal combustion engines.
(f) Milk chiller of pasteruzing plant</td><td>4m(any four)</td><td>4m</td></tr>
<tr><td>b)</td><td> 

Wind energy is kinetic energy associated with movement of large mass of air over the earh's surface due to non uniform heating of the earth's surface.
1) Wind energy is converted to mechanical energy by wind mill.
2) The wind approaching the blade move the wind mill shaft,thereby rotating the rotor of generator which produces electricity.
3) It can also be used for water pumping,drinking in rural area.</td><td>2m(dia.)

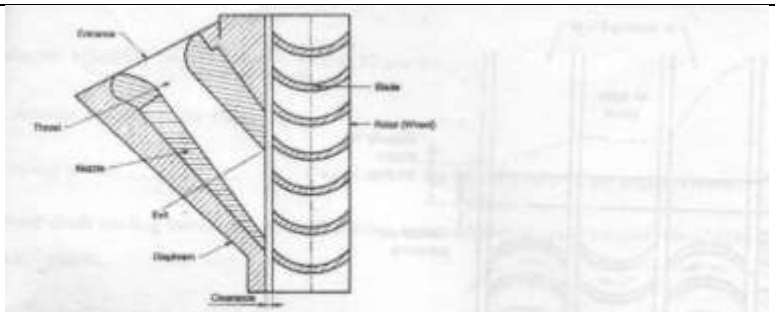
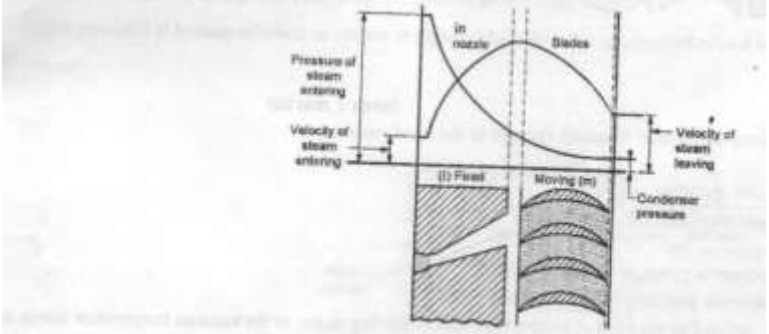
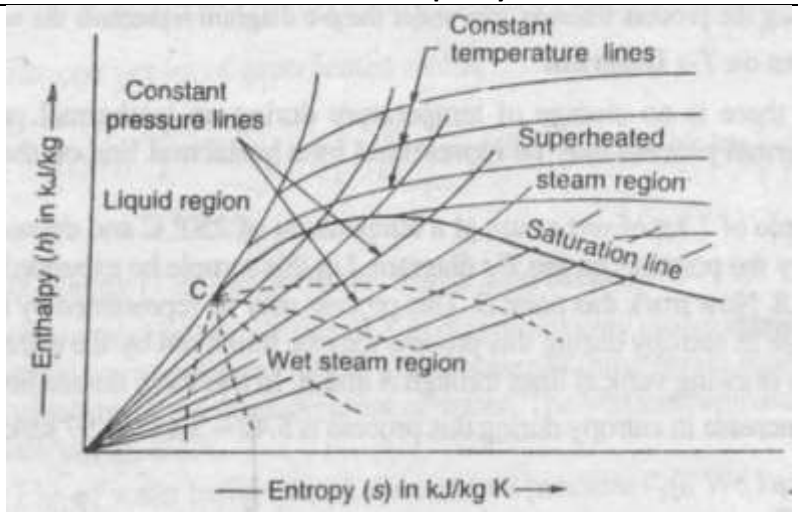
2m(expl.)</td><td>4m</td></tr>
<tr><td>c)</td><td>PMM -1(Perpetual motion machine of first kind)
A machine which violates the first law of thermodynamics is known as PMM -1. It is a machine which produced a work without consuming an equivalent of energy in any other form. Such machine is impossible to construct.
 
</td><td>4m</td><td>4m</td></tr>
<tr><td>d)</td><td><table>
<tr><td>Open System</td><td>Closed system</td></tr>
<tr><td>1.Mass of the system does not remains constant.</td><td>1.Mass of the system remains constant.</td></tr>
<tr><td>2.Mass and energy tranferes across control volume</td><td>2.Only energy tranferes across sytem boudries.</td></tr>
</table></td><td>4m(any four)</td><td>4m</td></tr>
</table>

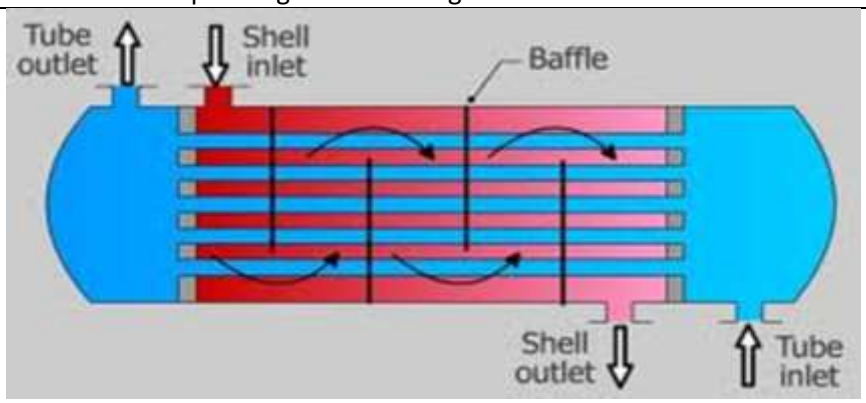
	3.It can be explain with concept of control volume and control surface.	3.It can be explain with concept of the concept of boundries.		
	4.e.g.Turbine,Compressor,Boiler, I.C.Engine.	4.e.g.Piston and cylinder without valve.		
e)	Heat engine	Heat pump	4m(any four)	4m
	1. It is a work developing device.	1.It is a work absorbing or consuming device.		
	2. It obeys Kelvin-Plank's statement of second law of thermodynamics.	2. It obeys Clausius statement of second law of thermodynamics.		
	3. In heat engine, heat is supplied from heat source or a hot body and work is produced with rejection of some quantity of heat to the heat sink or a cold body.	3. In heat pump, heat is pumped from heat sink or a cold body and is supplied to hot body, on consuming external work supplied.		
	4. Its performance is measured in terms of "efficiency".	4. Its performance is measured in terms of "coefficient of performance".		
	5. $\eta E = Q2 - Q1 / Q2$	5. $(C.O.P)p = Q2 / Q2 - Q1$		
	6. $\eta E = T2 - T1 / T2$ for carnot engine	6. $(C.O.P)p = T2 / T2 - T1$ for carnot pump		
	7. Efficiency is always less than 100%.	7. COP of heat pump is always greater than 1.		
f)			4m	4m

5	Attempt any two	8m x 2	16m
a)	Kelvin - Planck Statement: According to Kelvin-Planck "It is impossible to construct an engine working on a cyclic process, whose sole purpose is to convert heat energy from a single thermal reservoir into an equivalent amount of work." Clausius Statement; According to Clausius statement "It is impossible for a self acting machine. working In a cyclicprocess, to transfer heat from a body at a lower temperature to a bodyat a higher temperature without the aid of an external agency. " Equivalence of Kelvin-Planck and Clausius Statements Though Kel vin-Planck and Clausius statements of the second law of thermodynamics appear to be different, from each other, but these two statements are virtually equivalent in all respects. The equivalence of the Kelvin-Planck and Clausius statements can be proved if it can be shown that the violation of Kel vin-Planck statement implies the violation of Clausius statement and vice versa. This is discussed as follows:  1.Consider a system as shown in fig.a.In this system a heat engine having 100percent efficiency (i.e. PMM-ll) is violating the Kelvin-Planck statement as it converts the heat energy (Q1) from a single high temperature reservoir at T1 into an equivalent amount of work (i.e. W = Q1). This work output of the heat engine can be used to drive a heat pump (or refrigerator) which.; receives an amount of heat Q2 from a low temperature reservoir at T2 and rejects an amount of heat (Q1 + Q2) to a high temperature reservoir at T1. If the combination of a heat engine and a heat .pump (or refrigerator) is considered as a single system, as shown in Fig. (a), then the result is a device that operates in a cycle and has no effect on the surroundings other than the transfer of heat Q2 from a low temperature reservoir to a high temperature reservoir, thus violating the Clausius statement. Hence, a violation of Kelvin-Planck statement leads to a violation of Clausius statement. 2. Consider a system as shown in Fig. (b). In this system, a heat pump or refrigerator (i.e. PMM-II) is violating the Clausius statement as it transfers	2m 2m 2m(dia.) 2m(expl.)	8m

	heat from a low temperature reservoir at T2 to a high temperature reservoir at TI without any expenditure of work. Now let a heat engine,operating between the same heat reservoirs, receives an amount of heat Q1 (as discharged by the heat pump) from the high temperature reservoir at TI' does work (WE = QI - Q2) and rejects an amount of heat Q2 to the low temperature reservoir at T2. If the combination of the heat pump (or refrigerator) and the heat engine is considered as a single system, as shown in Fig.(b), then the result is a device that operates in a cycle whose sole effect is to remove heat at the rate of (Q 1 - Q2) and convert it completely into an equivalent amount of work, thus violating the Kelvin-Planck statement. Hence, a violation of Clausius statement leads to a violation of Kelvin-Planck statement. From above, we see that the Kelvin-Planck and Clausius statements of the second law of thermodynamics are complimentary to each other. The truth of the first statement implies the truth of the second statement and vice versa.		
b)	 (i)Sensible heat (a-b): When heat is added to ice, temperature of ice will increase which can be sensed by a thermometer .Therefore it is called sensible heat. During this only solid phase will exist. It is denoted by h_i (ii) Latent heat(b-c): At point b ice is at saturation state, further addition of heat does not increase the temperature .But ice will start converting to water and at point c ice will change completely to water. Heat supplied is called latent heat. It is denoted by h_{if} (iii) Dryness fraction:	4m(dia.) 4m(expl.)	8m

	It is the ratio of mass of actual dry steam in a quantity of wet steam to the mass of same quantity of wet steam and it is denoted by x Where x= mass of dry steam vapour /mass of wet steam mixture x=mg/mg+mf where mg= mass of actual dry steam mf = mass of water in suspension m= mass of wet steam (iv) Superheated steam: When stem is further heated at constant pressure. Thus raising its temperature.it is said to be superheated steam.		
c)	Classification of steam turbine. (i) According to working principles: (a) Impulse turbine (b) Reaction turbine (c) Impulse - reaction turbine (ii) According to no. of stages of expansion of steam. (a) Single stage turbine (b) Multi stage turbine (iii) According to position of shaft axis (a) Horizontal axis turbine (b) Vertical axis turbine (iv) According to their nature of steam supply (a)High pressure turbine (b) Low pressure turbine (v) According to direction of steam flow (a)Axial flow turbine (b) Radial flow turbine (c) Tangential flow turbine (vI) According to exhaust steam pressure (a)Condensing type steam turbine (b)Non - Condensing type steam turbine Impulse turbine - Impulse turbine consists of one set of nozzle mounted on a stationary diaphragm which is followed by one set of moving blade ring for a single stage impulse turbine. - The high velocity steam jet are obtained by complete expansion of steam in the stationary nozzles fitted in diaphragm then this high velocity steam passes through moving blades with no drop in pressure but gradual reduction in velocity.	4m(any four) 2m(expl.)	8m

	 Fig: Simple impulse turbine  Fig: Variation of pressure and velocity	2m(dia.)	
6	**Attempt any two**	**8m x 2**	**16**
a) i)	 Mollier Chart: it is a graphical regrphical represation of the steam table in which enthaphy is plotted along the y axis and Entropy is along the X axis .The digram is divided into two portions by a line termed as saturatation line.In the lowe (Wet) region the temperature of steam remains constant at a given pressure in the upper (suoerheat)region the temperature of steam increases at the give pressure. The mollier diagram has the following lines; (1) Dry ness fraction line:The dry ness fraction line are drawn only below saturatuin line .This line represents the condition of wet steam between various value h and s.	3m(dia.) 3m(expl.)	8m

	(2) Constant volume line:Constant volume line are drawn in both the wet and superheated region.This line are straight in the wet region and curved upwards above the saturation curve i.e.superheated region. (3) Consant pressure line: The constant pressure linrs are drawn in both the wet and superheated region.This lines are straight in the wet region andcurved upwards above the saturation curve i.e.superheated region. (4) Constant temperature line(Isothemal line):The isothemal lines are drawns only above the saturation line.This line represents the codition of superheated steam between various values of h and s		
ii)	Classification of calorimeter: 1. Barrel calorimeter; 2. Separating calorimeter, 3. Throttling calorimeter, and 4. Combined separating and throttling calorimeter.	2m	
b)	 Working:- A shell and tube heat exchanger is a class of heat exchanger designs. It is the most common type of heat exchanger in oil refineries and other large chemical processes, and is suited for higher-pressure applications. As its name implies, this type of heat exchanger consists of a shell (a large pressure vessel) with a bundle of tubes inside it. One fluid runs through the tubes, and another fluid flows over the tubes (through the shell) to transfer heat between the two fluids. The set of tubes is called a tube bundle, and may be composed of several types of tubes: plain, longitudinally finned, etc. Two fluids, of different starting temperatures, flow through the heat exchanger. One flows through the tubes (the tube side) and the other flows outside the tubes but inside the shell (the shell side). Heat is transferred from one fluid to the other through the tube walls, either from tube side to shell side or vice versa. The fluids can be either liquids or gases on either the shell or the tube side. In order to transfer heat efficiently, a large heat transfer area should be used, leading to the use of many tubes. In this way, waste heat can be put to use. This is an efficient way to conserve energy.	4m(dia.) 4m(expl.)	8m

c) i)	To improve the properties by addition of chemical of compound called additives The main additives as following: 1) Detergents- dispersant: These additives improve the detergent action of the lubricating oil by keeping the deposit in suspension form ads this additives are oil soluble. E.g.Metalics salts or organic acids 2) Pour point depressors: Lubricant contain paraffin compound and form wax precipitates as they cooled .Wax reduc e fluidity of oil temperature pour depressants are add to lower the pour points of lubrication oil. e.g. polymerized phenols , Easter ,alkylated naphthalene oil 3) Anti-foam agent: This assistive prevent the formation of foam by reducing surface tension, which allow air bubble to separate from oil more rapidly. e.g. Silicon polymers 4) Rust inhibitors: These prevent rusting of ferrous engine parts during storage and from acidic moisture accumulation during cold engine operation e.g. Metal sulphates, fatty acid and amines.	4m(any two)	8m
ii)	Detonation:- The land pulsating noise heard within the engine cyiinder known as 'denotation' (also called knocking or pinking). It is, caused due the propagation of a high speed pressure wave created by the auto-ignition. of end portion of unbumt fuel. The blow of this pressure wave may be of sufficiea strength to break the piston. Thus,the denotation is harmful to the engine aed must be avoided. The following are certain factors which causes denotation 1) The shape of the combustion chamber. 2) The relativeposition of the sparking plugs in case of petrolengines. 3) The chemical nature of the fuel. 4) The initial teinperature and pressure of the fuel. 5) The rate of combustion' of that portion of the fuel which is the first to ignite. This portion of the- fuel in heating up, compresses the remaining unburnt fuel, thus producing the conditions for auto- ignition.	4m	