



Summer – 15 EXAMINATION
Model Answer

Subject Code: 17407

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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.

Marks

1. a) Attempt any SIX of the following.	12
i) Define: 1. Sensible heat 2. Latent heat	2
Answer : 1. Sensible Heat -It is the heat which is sensed by thermometer and usually used to increase the temperature of water is called as sensible heat. OR The amount of heat added up to saturation temperature is called sensible heat.	1
2. Latent Heat -It is defined as the quantity of heat required for phase change of working substance at saturation temperature. OR The amount of heat added at saturation temperature is called latent heat.	1
ii) Draw P-V diagram of dual combustion cycle.	2
Answer: <p>The diagram shows a P-V plot for a dual combustion cycle. The vertical axis is labeled 'PRESSURE (P)' and the horizontal axis is unlabeled. The cycle consists of five states: 1, 2, 3, 4, and 5. Process 1-2 is a curve labeled 'compression'. Process 2-3 is a horizontal line with an arrow pointing right, labeled 'Qa'. Process 3-4 is a horizontal line with an arrow pointing down, labeled 'Qa'. Process 4-5 is a curve labeled 'Expansion'. Process 5-1 is a vertical line with an arrow pointing down, labeled 'Qr'. A diagonal line from 4 to 1 is labeled 'PV^γ = C'.</p>	2

Figure. Dual combustion cycle



iii) Write formula for work done in polytrophic process and write meaning of terms.	2
Answer: Work done in polytrophic process: $dW = \frac{P_1V_1 - P_2V_2}{n-1}$ Where- dW = work done P = Pressure V = Volume n = polytrophic index	1 1
iv) State function of steam condenser and its location in steam power plant.	2
Answer: Functions of condenser in steam power plant:- i) To increase the turbine output by maintaining low backpressure on exhaust side of steam turbine. ii) The secondary function of condenser is, to convert used stream into hot water & supply to the boiler thro feed pump. Location- It is located in between turbine and feed pump.	1 1
v) Write two applications of compressed air.	2
Answer:(any TWO) 1. Operating tools in factories 2. Operating drills and hammers in road building 3. Starting diesel engines 4. Operating brakes on buses, trucks and trains 5. Spray painting 6. Excavating 7. To clean the large workshops	2
vi) What is meant by conventional and non conventional sources of energy?	2
Answer: Conventional energy source: Energy source which cannot be used again and again is called as Conventional energy source. e. g. Coal, natural gas, oil, and firewood. Nonconventional energy source- Energy source which can be used again and again is called as nonconventional energy source. e. g. Solar power, Hydro-electric power, Wind power, Tidal power, Ocean wave power, Geothermal power, Ocean thermal power, Biomass, Bio-fuel etc.	1 1
vii) Define- Calorific value of fuel.	2
Answer: Calorific value of fuel: It is defined as the amount of heat liberated during complete combustion of 1 kg of fuel.	2
viii) What is combustion?	2
Answer: Combustion: It is a chemical process in which inflammable matter in a substance combine with oxygen at a temperature above the ignition temperature of the substance and results in the evaluation of heat and light.	2

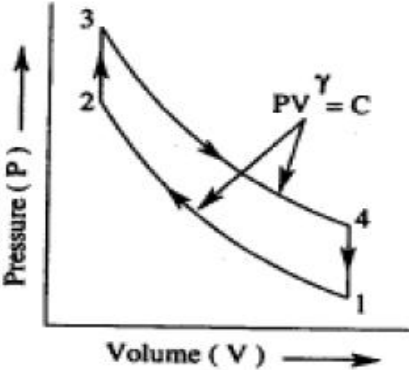
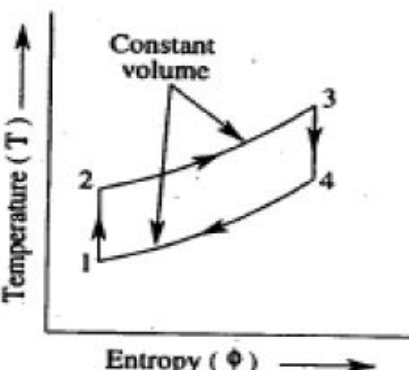


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<p>b) Attempt any TWO of the following:</p>	<p>8</p>
<p>i) What are the modes of heat transfer? Explain with suitable examples.</p>	<p>4</p>
<p>Answer: Mode of heat transfer:- 1) Conduction 2) Convection 3) Radiation</p> <p>1) Conduction- It is the mode of heat transfer from one part of substance to another part of same substance or one substance to another without displacement of molecules or due to the vibrations of molecules. Example-Heat transfer in between metal rod.</p> <p>2) Convection: It is the mode of heat transfer from one part of substance to another part of same substance or one substance to another with displacement of molecules or due to the fluid flowing. Example: Heat flow from boiler shell to water.</p> <p>3) Radiation: It is the transfer of heat through space or matter. For Radiation there is no need of medium as like convection and conduction. It passes through vacuum in the form of electromagnetic waves. Example: The heat energy receives from sun to the earth surface.</p>	<p>1 1 1 1</p>
<p>ii) Represent otto cycle on P-V and T-S diagram and write equation for air standard efficiency.</p>	<p>4</p>
<p>Answer- P-V and T-S diagram for Otto Cycle:</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p>Equation for air standard efficiency:</p> $\eta = 1 - \frac{1}{r^{\gamma-1}}$ <p>Where, r = compression ratio γ = specific heat ratio</p>	<p>3 1</p>
<p>iii) With sketch explain working of Lamont boiler.</p>	<p>4</p>
<p>Answer: Working of Lamont boiler: This is modern high pressure boiler; it is water tube steam boiler working on forced circulation. Circulation is maintained by the centrifugal pump. The feed water passes through the economizer to the drum from which it is drawn to the circulating Pump. The pump delivers the water to the evaporating section which in turn sends a mixture of Steam and water to the drum. The steam in the drum is then drawn through the super heater. The superheated steam so obtained is then supplied to the prime mover.</p>	<p>2</p>



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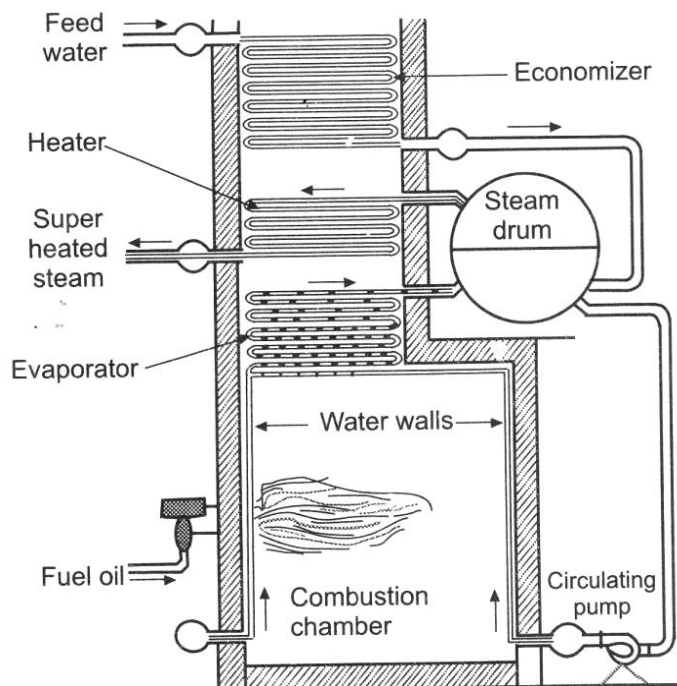
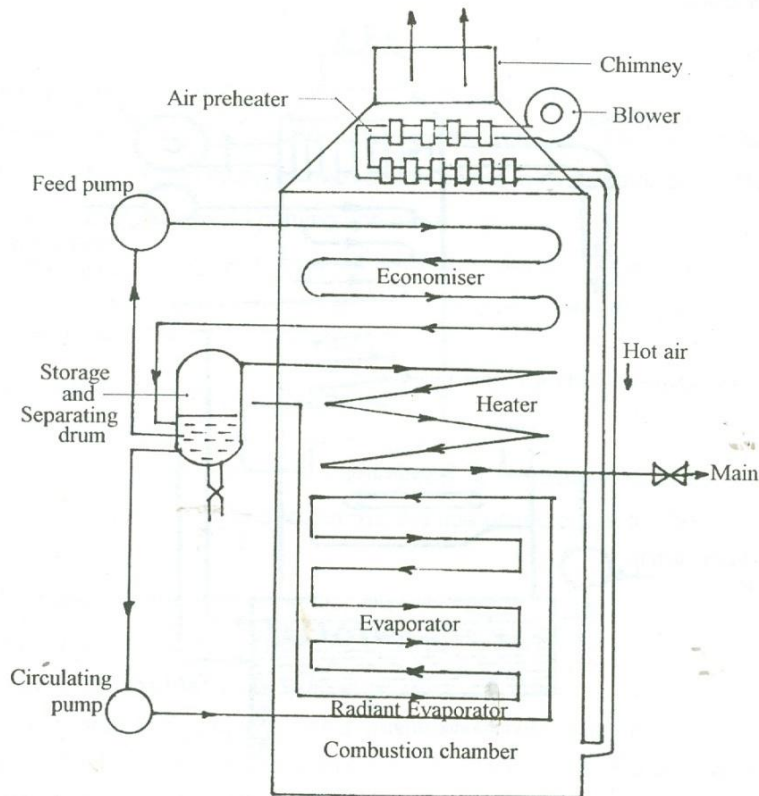


Figure: Lamont boiler
OR





2. Attempt any FOUR of the following

16

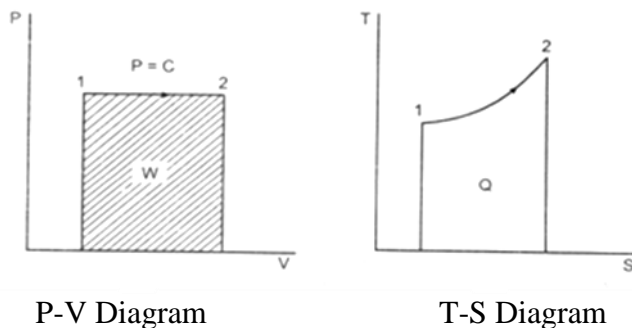
a) Represent following thermodynamic processes on P-V and T-S diagram:

- i) Isobaric Process
- ii) Isochoric Process
- iii) Isothermal Process
- iv) Adiabatic Process

4

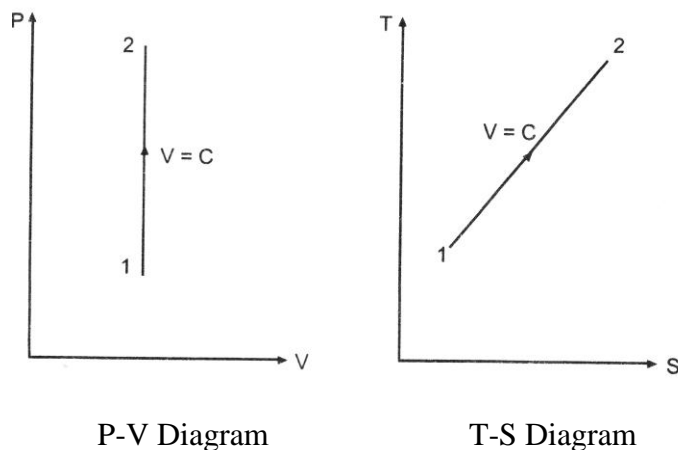
Answer :

i) Isobaric Process



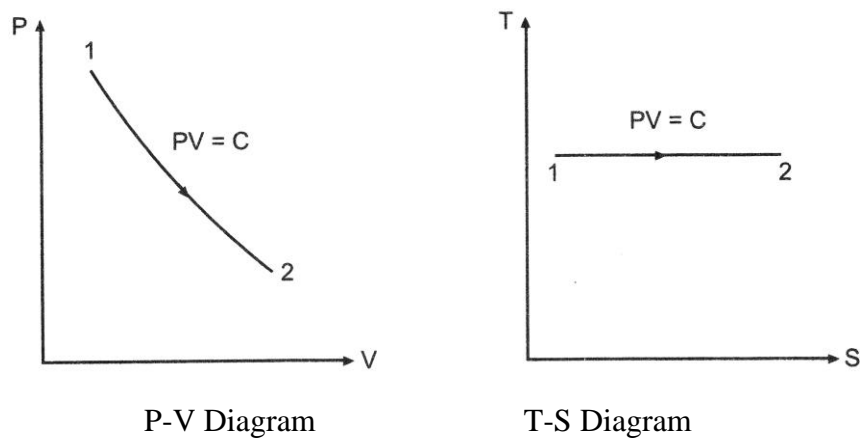
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ii) Isochoric Process



1

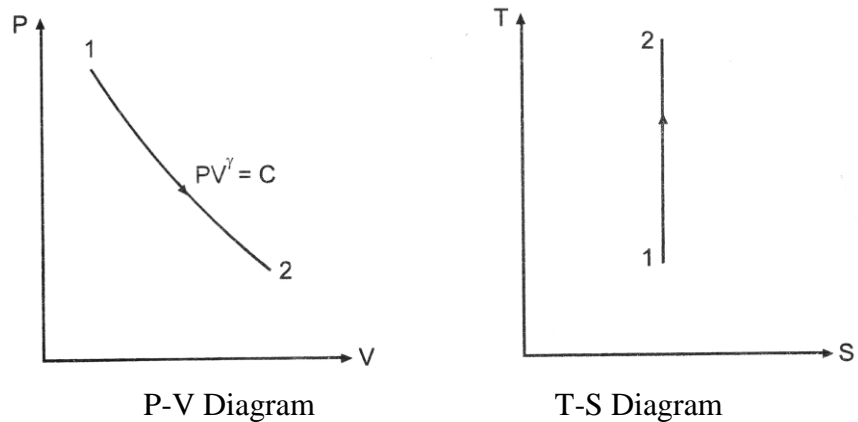
iii) Isothermal Process



1



iv) Adiabatic Process



1

b) State and explain different phases in formation of steam.

4

Answer : Different phases of Formation of steam-

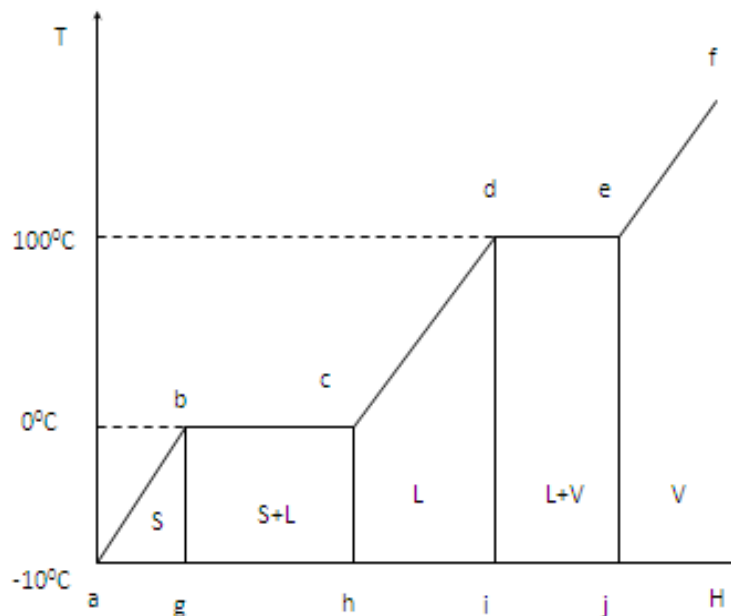


Fig. Formation of steam

2

Consider formation of steam from ice at -10°C

i) Solid phase- When the heat is added in ice which is at -10°C the temperature of ice increases to 0°C as shown in figure by process a-b. in this stage solid phase exists.

ii) Solid+ Liquid phase- The point b is called is saturation point when heat is further added this heat cannot increase the temperature but ice is converted into water that means phase transformation takes place, thus in-between region b-c, solid and liquid phase exists.

iii) Liquid phase- From point c-further heat is added up to 100°C , in this region no phase change takes place, there is only liquid phase present.

2

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iv) **Liquid+ Vapour** phase- Point d is saturation point; further addition of heat will not increase the temperature but liquid phase change into vapors phase. In this region only liquid and vapour is present.
v) **Vapour phase**- Point e is called as saturation point, further adding heat increase the temperature of steam which is called as superheating and in this region only vapour is present.

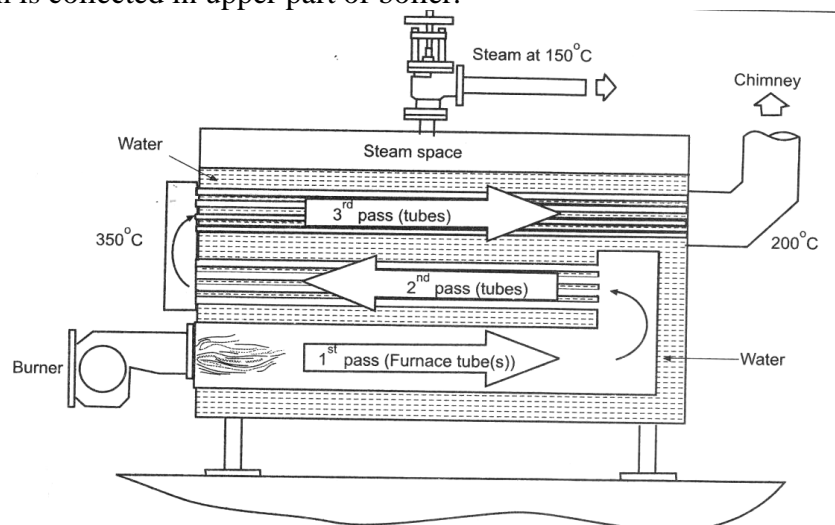
c) Explain working of three pass packaged type boiler.

4

Answer: Working of three pass packaged type boiler:

In this boiler pulverized coal is used as a fuel. Hot gases are produced by burning coal. The flue gases coming from first pass or combustion chamber passes through number of tubes in different passes. Tubes are surrounded by water. Heat released by flue gases is absorbed by water and gets converted into the steam. After passing through all tubes flue gases exhausted to atmosphere through chimney and steam is collected in upper part of boiler.

2



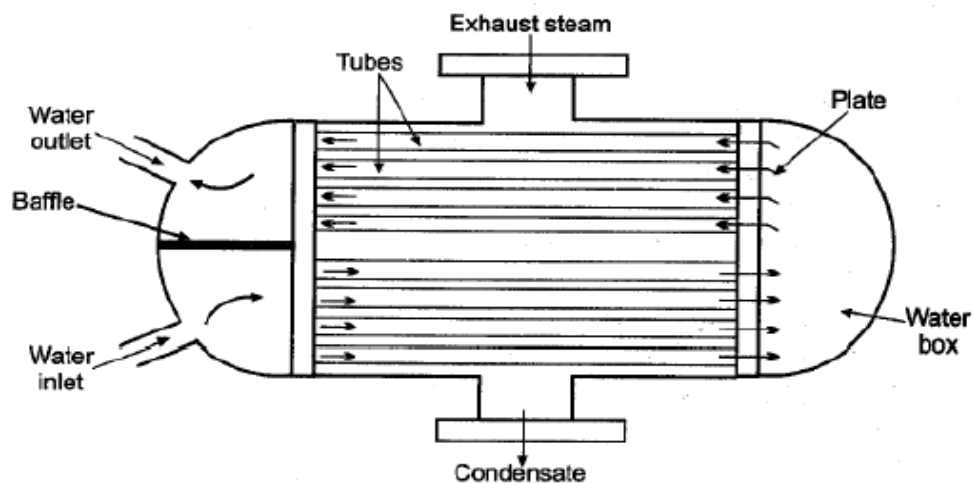
2

Figure. Three pass packaged type boiler

d) Draw a neat sketch of two pass down flow surface condenser.

4

Answer:



4

Fig. Two pass down flow surface condenser



e) What are the sources of air leakage in condenser?	4																											
Answer: Sources of air leakage in condenser are: 1. At the joint of part because condenser pressure is less than atmospheric pressure. 2. Air also comes with steam from boiler feed water. 3. In jet condenser, air comes with the cooling water in which it is dissolved. 4. Air leaks if any bypass seal is broken.	4																											
f) Compare centrifugal compressor with axial flow compressors.	4																											
Answer: Comparison between Centrifugal and Axial flow compressor. (Any Four)	4																											
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:5%;">Sr. No.</th> <th style="width:45%;">Centrifugal compressor</th> <th style="width:50%;">Axial Flow Compressor</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Flow is perpendicular to axis of compressor.</td> <td>Flow of air is parallel to the axis of compressor.</td> </tr> <tr> <td>2</td> <td>Low manufacturing and running cost.</td> <td>High manufacturing and running cost.</td> </tr> <tr> <td>3</td> <td>Requires low starting torque.</td> <td>Requires high starting torque.</td> </tr> <tr> <td>4</td> <td>Not suitable for multi-staging.</td> <td>Suitable for multi-staging.</td> </tr> <tr> <td>5</td> <td>Requires large frontal area for given rate of flow.</td> <td>Requires less frontal area for given rate of flow.</td> </tr> <tr> <td>6</td> <td>Pressure ratio per stage is 4:1.</td> <td>Pressure ratio is 1.1 to 1.2</td> </tr> <tr> <td>7</td> <td>Isentropic efficiency is 70%</td> <td>Isentropic efficiency is 80%</td> </tr> <tr> <td>8</td> <td>Used in supercharging I.C. engine and for refrigerants and industrial gases.</td> <td>Used universally with large gas turbine.</td> </tr> </tbody> </table>	Sr. No.	Centrifugal compressor	Axial Flow Compressor	1	Flow is perpendicular to axis of compressor.	Flow of air is parallel to the axis of compressor.	2	Low manufacturing and running cost.	High manufacturing and running cost.	3	Requires low starting torque.	Requires high starting torque.	4	Not suitable for multi-staging.	Suitable for multi-staging.	5	Requires large frontal area for given rate of flow.	Requires less frontal area for given rate of flow.	6	Pressure ratio per stage is 4:1.	Pressure ratio is 1.1 to 1.2	7	Isentropic efficiency is 70%	Isentropic efficiency is 80%	8	Used in supercharging I.C. engine and for refrigerants and industrial gases.	Used universally with large gas turbine.	4
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3. Attempt any FOUR of the following:	16																											
a) Explain construction and working of screw compressor.	4																											
Answer: Screw compressor: <div style="text-align: center;"> <p>Fig. Screw Compressor</p> </div>	2																											



<p>Construction: It consists of two mutually engaged helical grooved rotors which are suitably housed in a casing. Out of two rotors male rotor is driver and female rotor is a driven. Male rotor has four lobes and female rotor as six flutes.</p> <p>Working: During rotation of rotor, air enters and takes space between male and female rotor. This air traps and moves axially and radially with rotation of rotors and gets compressed due to volume reduction. Then this air discharged from upward direction. Speed of rotors is different due to different number of lobes and flutes. It handles 3.5 to 300 m³/min and maximum pressure ratio of 20. This system requires lubrication. This compressor is noisy In operation. Used in refrigeration industry.</p>	1 1
<p>b) State necessity of multi-staging and inter-cooling of air compressor.</p>	4
<p>Answer: Necessity of multi-staging and inter-cooling of air compressor: It has been experienced that if we employ single stage compression for producing high pressure air (say 8 to 10 bar) it suffers the following draw backs</p> <ol style="list-style-type: none">1. The size of cylinder will be too large.2. Work required to drive the compressor is more3. Due to high pressure loss of air due to leakage is more.4. Sometimes, the temperature of air, at the end of compression is too high. It may be heat up the cylinder head or burn the lubricating oil.5. Volumetric efficiency of compressor is less <p>In order to overcome the above mentioned difficulties two or more cylinders are provided in series with inter-cooling arrangement between them. Such an arrangement is known as multistage compression with inter-cooling.</p>	4
<p>c) Define the following terms in relation to air compressor ;</p> <ol style="list-style-type: none">i) I.P.ii) B.P.iii) Volumetric efficiencyiv) Compressor efficiency	4
<p>Answer:</p> <p>i) I.P. - It is the ratio of polytrophic work into speed of compressor in revolution per second.</p> $I.P. = \frac{W \times N}{60} \text{ Watts}$ <p>ii) B.P. - It is the power required to drive the compressor or power delivered to the shaft of compressor</p> <p>iii) Volumetric efficiency - It is the ratio of volume of free air delivery per stroke to the swept Volume of piston.</p> <p>v) Compressor efficiency - For the same pressure ratio, It is the ratio of theoretical isothermal work to the actual work required to drive the compressor. OR It is the ratio of isothermal power to the shaft power or brake power of motor required to drive the compressor</p>	1 1 1 1

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$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

$$\frac{T_2}{T_1} = \frac{P_2 V_2}{P_1 V_1} \dots\dots\dots(2)$$

From (1)

$$\frac{V_2}{V_1} = \left(\frac{P_1}{P_2}\right)^{1/\gamma} \dots\dots\dots(3)$$

Put equation (3) into equation (2)

$$\frac{T_2}{T_1} = \frac{P_2}{P_1} \left(\frac{P_1}{P_2}\right)^{1/\gamma}$$

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{\gamma}}$$

$$\frac{P_2}{P_1} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}} \dots\dots\dots(4)$$

From equation (1) & (4)

$$\frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^{\gamma} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$$

$\frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^{\gamma} = \left(\frac{T_2}{T_1}\right)^{\frac{\gamma}{\gamma-1}}$
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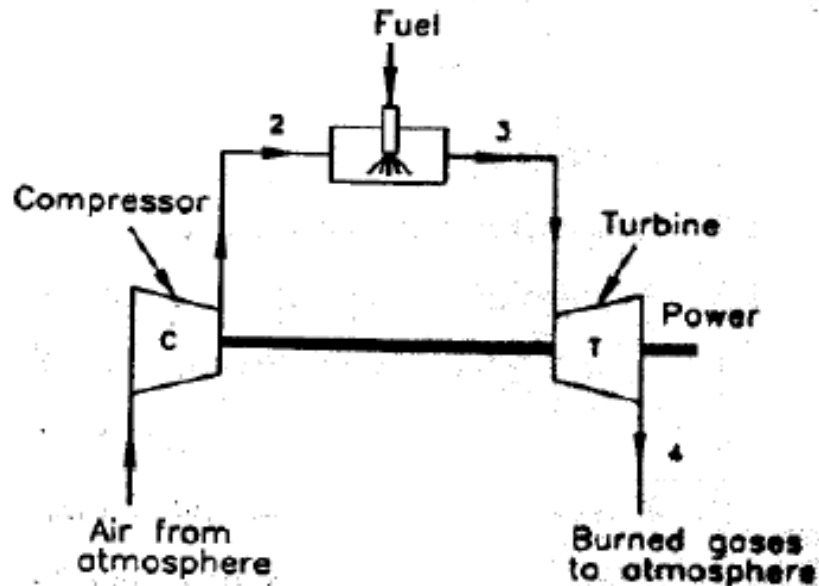
b) Explain with schematic diagram, working of :

- i) Open cycle gas turbine
- ii) Closed cycle gas turbine

Answer:

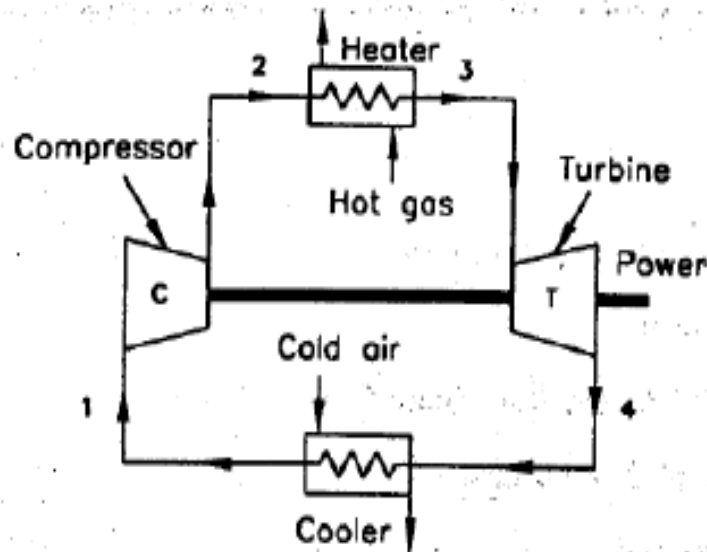
i) Working Open cycle gas turbine:

Fresh air enters the compressor at ambient temperature where its pressure and temperature are increased. The high pressure air enters the combustion chamber where the fuel is burned at constant pressure. The high temperature (and pressure) gas enters the turbine where it expands to ambient pressure and produces work. Finally exhausted to atmosphere.



2

ii) Working of Closed cycle gas turbine:



2

2

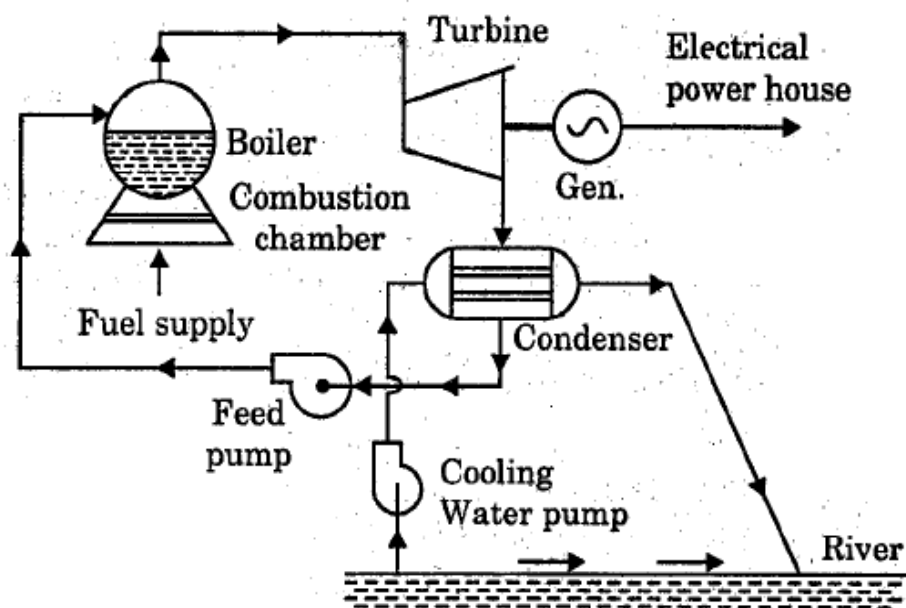
Fig. Closed cycle gas turbine.

Fluid enters the compressor from the cooler where its pressure and temperature are increased. The compressed fluid comes out from the compressor is heated in heater by an external source at constant pressure. This high pressure and temperature fluid expands in turbine and develops the useful work. Then this exhausted fluid is cooled to its original temperature in the cooler using external cooling source before passing into the compressor.

c) Draw a neat layout of 'Thermal power plant'. List the components. Explain working of thermal power plant.

8

Answer: Layout of 'Thermal power plant':



4

Fig : Thermal Power Plant

Components of thermal power plant:

1. Boiler
2. Turbine
3. Generator
4. Condenser
5. Feed Pump

1

Working of thermal power plant:

In this power plant, coal is used as a fuel for combustion in combustion chamber. After combustion of fuel the heat is generated and this heat is given to the water in the boiler. Due to this heat, water start to boil and steam is generated. The generated steam is used to run the steam turbine. Turbine is mounted on the shaft which is coupled to the generator and electricity is produced. After passing the turbine, steam is supplied to the condenser and gets condensed by using cooling water and this condensate again used for the boiler with the help of feed pump.

3

5. Attempt any FOUR of the following:

16

a) Explain construction and working of Rock drill using compressed air

4

Answer: Construction and working of Rock drill using compressed air:

It works on compressed air & it is also called as pneumatic drill. Initially the valve is in closed position; at this position drill will rotate by compressed air. When we press the button on the handle, valve will open due to this high pressure air gives downward force on drill bit.

2

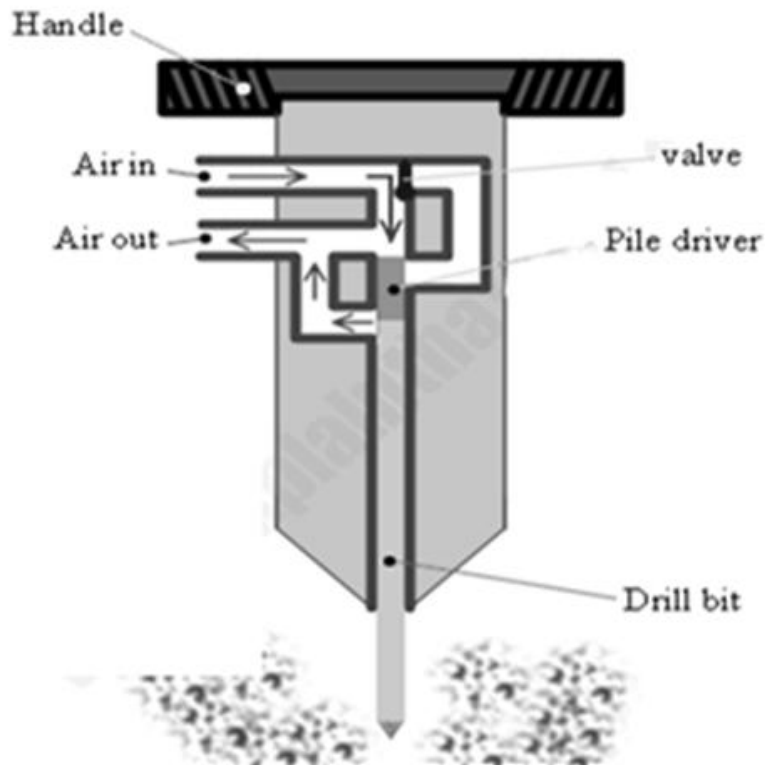


Fig. Rock drill

Note: Equivalent credit shall be given to any other suitable answer with sketch.

b) What are the factors effecting volumetric efficiency of reciprocating air compressor?	4
<p>Answer: Factors effecting volumetric efficiency of reciprocating air compressor (any four)</p> <ol style="list-style-type: none"> 1) Clearance Volume 2) Restricted passage and leakage at inlet valves 3) Speed of rotation 4) Piston ring leakages 5) If fresh air comes in contact with hot wall, it get expanded, which decreases the charge taken in therefore volumetric efficiency decreases. 	4
c) Explain construction and working of bomb calorimeter.	4
<p>Answer: Construction and working of bomb calorimeter:</p> <p>The calorific value of solid and liquid fuels is determined in the laboratory by ‘Bomb calorimeter’. It is so named shape resembles that of bomb. Figure shows the schematic sketch of bomb calorimeter.</p> <p>Construction and working:</p> <p>The calorimeter is made of austenitic steel which provides considerable resistant to corrosion and enables it to withstand high pressure. In the calorimeter use of a strong cylindrical bomb in which combustion occurs. The bomb has two valves at the top. One supplies oxygen to the bomb and other releases the exhaust gases. A crucible in which a weighed quantity of fuel sample is burnt is arranged between the two electrodes as shown in fig. The calorimeter is fitted with water jacket which surrounds the bomb To reduce the losses due to radiation calorimeter is further provided with a jacket</p>	2

of water and air. A stirrer for keeping the temperature of water uniform and a thermometer the temperature up to accuracy of 0.0010 C is fitted through the lid of the calorimeter. The heat released by the fuel on combustion is absorbed by the surrounding water and the calorimeter. From the above data the calorific value of the fuel can be found

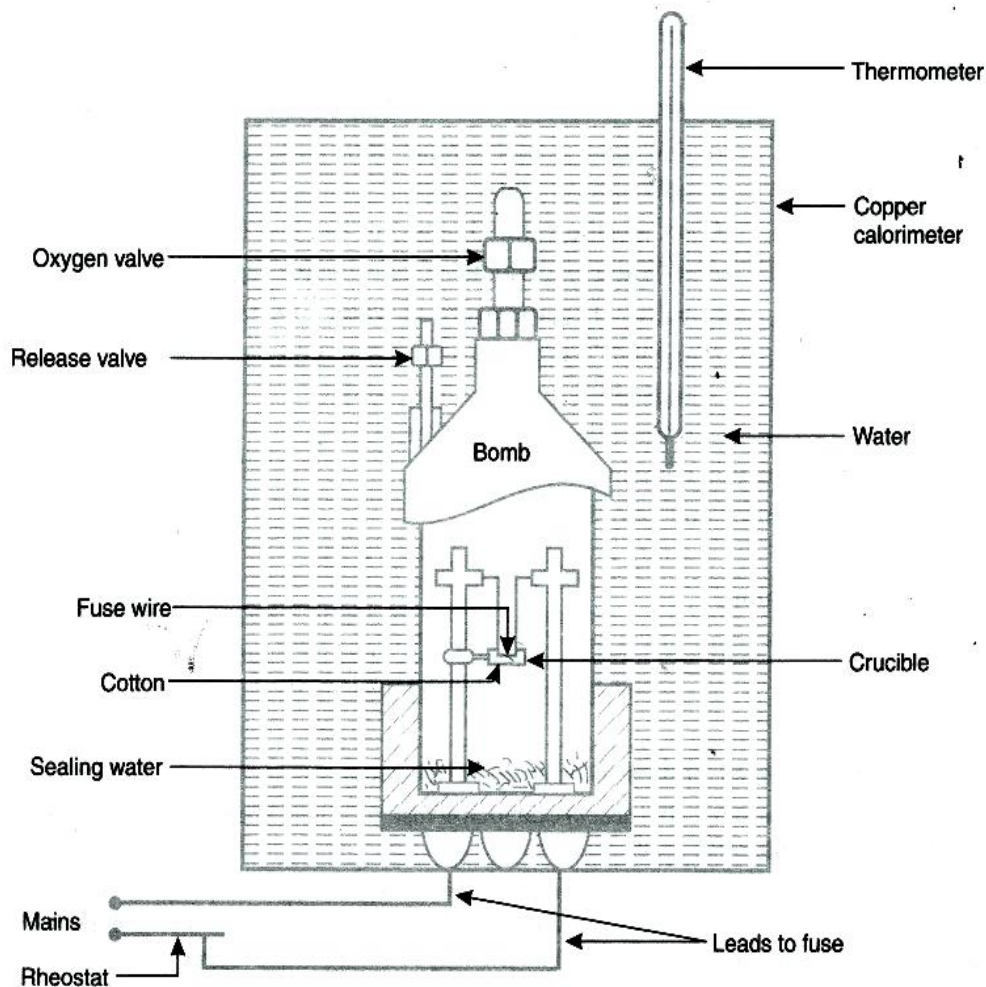


Fig. Bomb calorimeter

2

d) Explain concept of tidal power plant.

4

Answer:

Working of Tidal power plant:

During high tide the water flow from sea into the tidal basin through water turbine as the level of water in sea is more than tidal basin. This operates the turbine and generator and power is produced. Potential energy of sea water converted into mechanical energy by turbine and it converts into electrical by generators. During low tide water flow from tidal basin into sea as water level in the sea is lower than basin level in both cases generation of power is same. Only difference in that rotation of turbine blade is opposite.

2

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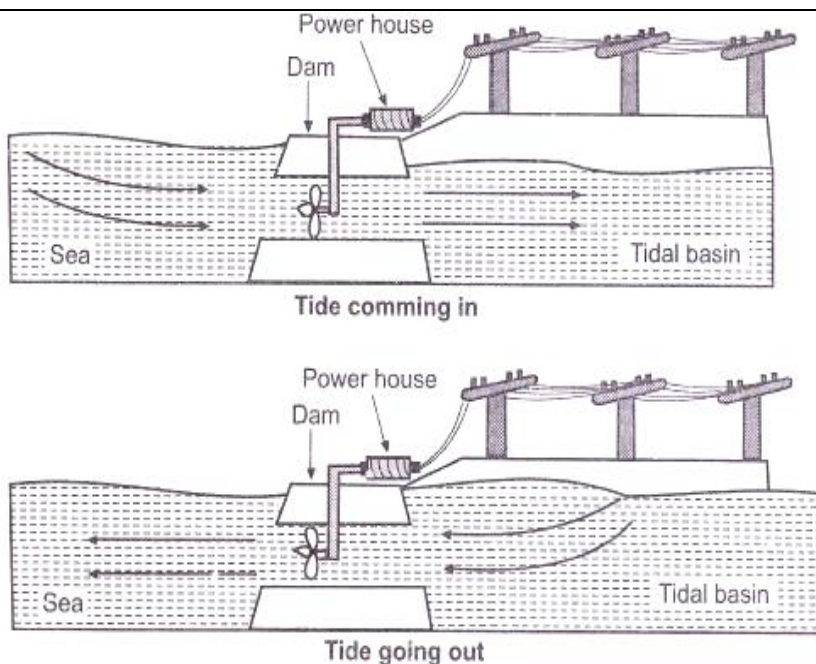


Figure: Tidal power plant

2

e) List parameter for the site selection of Nuclear Power Plant.

4

Answer: Parameter for the site selection of Nuclear Power Plant:(any four)

- i) Site should be away from the population due to radiation problem.
- ii) Land should have high bearing capacity.
- ii) The land should be available at low cost.
- iii) There should be availability of transportation facility.
- iv) Labor availability.
- v) Availability of raw material such as nuclear reactor.
- vi) There must be sufficient space near the plant site for the storage of radio-active waste for short time during the working of plant.

4

f) Compare conventional source of energy with non conventional energy sources.

4



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Answer: (any four)

Sr. No.	conventional source of energy	Non-conventional source of energy
1	These are non-renewable energy sources	These are renewable energy sources
2	Creates pollution	Does not creates pollution
3	It is not clean energy source	It is clean energy source
4	Harnessing cost is more	Harnessing cost is less
5	Efficiency is more	Efficiency is less
6	Fuel is required	Fuel is not required
7	Exhaustible energy source	Non-Exhaustible energy source
8	Affects on ozone layer	Does not affects on ozone layer
9	Ex.-Petrol, Diesel, Kerosene etc.	Ex.-Solar, Wind, Tidal, Geothermal, Biomass, Etc.

4

6 Attempt any FOUR of the following

16

a) Estimate higher and lower calorific value of a coal having following composition by mass- carbon 79%, Hydrogen -6.5 %, Oxygen- 8%, Nitrogen -2.5 %, sulphur-1.5%, and reaming is ash.

4

Answer:

$$\text{Carbon } C = 79\% = 0.79$$

$$\text{Hydrogen} = H_2 = 6.5\% = 0.065$$

$$\text{Oxygen} = O_2 = 8\% = 0.08$$

$$\text{Nitrogen} = N = 2.5\% = 0.025$$

$$\text{Sulphur} = S = 1.5\% = 0.015$$

$$\text{Ash} = 2.5\% = 0.025$$

Dulong's formula:

$$\text{H.C.V. of coal} = 33800 C + 144500 (H_2 - O_2/8) + 9300 S \text{ KJ / Kg}$$

$$= 33800 \times 0.79 + 144500 (0.065 - 0.08/8) + 9300 \times 0.015$$

$$\text{H.C.V. of coal} = 34789 \text{ KJ / Kg}$$

$$\text{L.C.V. of coal} = \text{H.C.V.} - 9H_2 \times 2442 \text{ KJ / Kg}$$

$$= 34789 - 9 \times 0.065 \times 2442$$

$$\text{L.C.V. of coal} = 33360.43 \text{ KJ / Kg}$$

1

1

1

1

b) Determine the amount of heat required to produce 1 kg of steam at a pressure of 5 bar at a temperature of $24^{\circ}C$, under the following conditions:

4

i) When the steam is the wet having a dryness fraction 0.9.



ii) When the steam is dry saturated
Assume specific heat = 2.35 kJ /kgK.

Answer:

Given Data

$$P = 5\text{bar}$$

$$T = 24^{\circ}\text{C}$$

$$x = 0.9$$

$$m = 1\text{kg}$$

$$C_p = 2.35\text{kJ} / \text{kgK}.$$

At pressure 5 bar saturation Temp

$$T_{sat} = 151.8^{\circ}\text{C}$$

$$h_f = 640.1\text{kJ} / \text{kg}$$

$$h_{fg} = 2107.4\text{kJ} / \text{kg}$$

i) Heat required when steam is wet

$$h = h_f + xh_{fg}$$

$$= 640.1 + 0.9 \times 2107.4$$

$$= 2536.76\text{kJ}$$

since the water is at 24°C ,

heat already in water = specific heat of water \times rise in temperature

$$= 4.2 \times 24 = 100.8\text{kJ}$$

Heat actually required

$$= 2536.76 - 100.8$$

$$= 2435.96\text{kJ}$$



ii) When the stem is dry saturated

$$h_g = h_f + h_{fg}$$

$$= 640.1 + 2107.4$$

$$= 2747.5 \text{ kJ}$$

Heat actually required

$$= 2747.5 - 100.8$$

$$= 2646.7 \text{ kJ}$$

2

c) Explain Solar Power Plant and write its two advantages.

4

Answer: Solar power plant :-

Construction:

The basic components of solar power plant are also exactly identical to thermal power plant except the boiler is replaced by solar collector. The arrangement of component is as shown in figure. The energy from solar radiation is collected and utilized to generate steam to run the turbine.

1

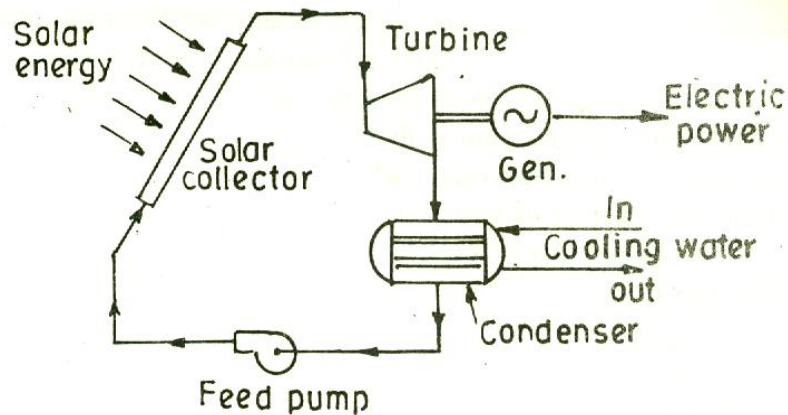


Figure: Solar power plant

1

Working:

Steam is generated in solar collector of solar power plant. The steam generated is passed through steam turbine where part of its thermal energy is converted into mechanical energy which is further used for generating the electric power. The steam coming out of steam turbine is condensed in condenser and condensate is supplied back to solar collector with the help of feed pump.

1

Advantages (any two)

- i) It is renewable energy source
- ii) Pollution free
- iii) Available all over the world.
- iv) Less maintenance.

1

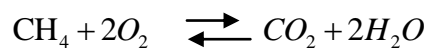


<p>d) State merits and demerits of Wind Energy Power Plant.</p>	<p>4</p>															
<p>Answer:</p> <p>Merits of Wind Energy Power Plant:</p> <ul style="list-style-type: none"> i) It is renewable energy sources ii) It is pollution free iii) Does not affect on ozone layer. iv) It is clean energy source v) Fuel is not required. <p>Demerits of Wind Energy Power Plant:</p> <ul style="list-style-type: none"> i) Depends on wind which is not available throughout the year. ii) Noisy operation iii) High weight iv) Initial cost is high v) Required specific location vi) Required wind mills. 	<p>2</p> <p>2</p>															
<p>e) Compare Petrol and Diesel on the basis of :</p> <ul style="list-style-type: none"> (i) Composition (ii) Specific gravity (iii) Gross calorific values (iv) Volatility 	<p>4</p>															
<p>Answer: Comparison of Petrol and Diesel:</p> <table border="1" data-bbox="199 1205 1456 1583"> <thead> <tr> <th>Parameter</th> <th>Petrol</th> <th>Diesel</th> </tr> </thead> <tbody> <tr> <td>Composition</td> <td>Petrol consists of 85.5% carbon, 14.4% hydrogen and 0.1% sulphur</td> <td>Diesel consists of 86.3% carbon, 12.8% hydrogen and 0.9% sulphur</td> </tr> <tr> <td>Specific gravity</td> <td>Petrol has low specific gravity in the range of 0.7-0.79</td> <td>Diesel has high specific gravity in the range of 0.82-0.92</td> </tr> <tr> <td>Gross calorific values</td> <td>Gross calorific value of petrol is in the range of 42-45 MJ/Kg</td> <td>Gross calorific value of diesel is in the range of 50-52 MJ/Kg</td> </tr> <tr> <td>Volatility</td> <td>Petrol is more volatile than diesel.</td> <td>Diesel is less volatile than petrol.</td> </tr> </tbody> </table>	Parameter	Petrol	Diesel	Composition	Petrol consists of 85.5% carbon, 14.4% hydrogen and 0.1% sulphur	Diesel consists of 86.3% carbon, 12.8% hydrogen and 0.9% sulphur	Specific gravity	Petrol has low specific gravity in the range of 0.7-0.79	Diesel has high specific gravity in the range of 0.82-0.92	Gross calorific values	Gross calorific value of petrol is in the range of 42-45 MJ/Kg	Gross calorific value of diesel is in the range of 50-52 MJ/Kg	Volatility	Petrol is more volatile than diesel.	Diesel is less volatile than petrol.	<p>4</p>
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<p>f) Explain combustion chemistry of carbon, methane and hydrogen</p>	<p>4</p>															
<p>Answer: Combustion chemistry of carbon, methane and hydrogen:</p> <p>i) Carbon: Burning of carbon to carbon dioxide (complete combustion)</p> $C + O_2 \rightleftharpoons CO_2$ <p>i.e. $12 + (16 \times 2) = 12 + 16 \times 2$</p> <p>i.e. $12 + 32 = 44$</p> <p>$1 + 2.67 = 3.67$</p> <p>That means 1 kg of carbon needs 2.67 kg oxygen and produces 3.67 kg of carbon dioxide</p>	<p>1</p>															



ii)Methane (CH₄):

Burning of methane with oxygen to carbon dioxide and water/ steam



i.e. $(12 + 1 \times 4) + 2(16 \times 2) = (12 + 16 \times 2) + 2(1 \times 2 + 16)$

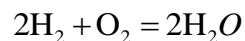
$$16 + 64 = 44 + 36$$

$$1 + 4 = \frac{11}{4} + \frac{9}{4}$$

That means 1 kg of methane needs 4 kg of oxygen to produce 11/4 kg of carbon dioxide and 9/4 kg of water /steam

iii)Hydrogen:

The union of hydrogen with oxygen produces steam it is represented by the following equation



$2(1 \times 2) + (16 \times 2) = 2(1 \times 2 + 16)$

$$1 + 8 = 9$$

1 kg of hydrogen combines with 8 kg of oxygen to produce 9 kg of steam.

2

1