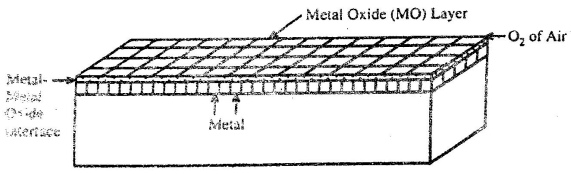
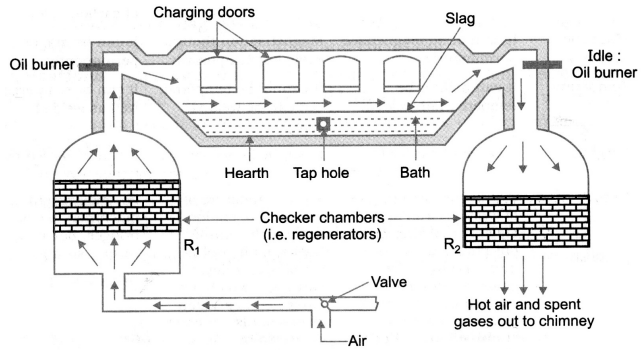
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		Important Instructions to examiners: **1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.** **2) The model answer and the answer written by candidate may vary but the examiner may try to assess 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 judgement 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.**		

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1		**Attempt any NINE of the following:**		**18**
	a)	**Write four names of iron ore with chemical formula.**		
		Sr.No. | **Name of Ore** | **Chemical formula.** 1 | Magnetite | (Fe_3O_4) 2 | Haematite | (Fe_2O_3) 3 | Limonite | ($2Fe_2O_3.3H_2O$) 4 | Siderite | ($FeCO_3$) 5 | Iron Pyrites | (FeS_2) **(Any four ½ mark eachwith formula)**	**½ mark each**	**2**
	b)	**Pig iron melts at lower temperature than pure iron.Why?** Melting point of pure iron is 1530^0C whereas pig iron melts at 1250 – 1300^0C. Because pig iron contains the impurities of free elements like S, P, Mn& Si etc. Due to presence of these impurities, pig iron melts at lower temperature than pure iron.	**2**	**2**
	c)	**Define heat treatment .State its two purposes.** **Heat Treatment:** It is the process of heating steel to a certain high temperature and then cooling it at a controlled rate, in order to develop certain desirable physical properties in it without changing its chemical composition.	**1**	
		Purpose of heat treatment:- 1) To change the structure of steel, 2) To increase surface hardness. 3) To increase resistance to heat & corrosion. **(State any two relevantpurposes)**	**1/2 mark each**	**2**
	d)	**Name the alloy steel which is used for making leaf and coil springs. State its composition.** **Name of alloy: Heat resisting steel**	**1**	**2**
		Composition: **(**Nichrome) Ni = 60% ,Cr = 23-30% ,C=0.35% & Remaining steel.	**1**	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	**e)**	**Define immersed corrosion .State two factors on which it depends.** **Immersed corrosion:**The corrosion which is brought about through ionic reactions in the presence of moisture or solution as a conducting medium when two dissimilar metals are in contact with each other is called electro chemical corrosion. **Factors on which immersed Corrosion depends:-** A) Nature of the metal B) Nature of the Environment	**1** **1**	**2**
	f)	**Give the mechanism of corrosion take place due to oxygen.** $M \longrightarrow M^{2+} + 2e^-$ (loss of electrons) (Metal ion) $O + 2e^- \longrightarrow O^{2-}$ (gain of electrons) $M + O \longrightarrow M^{2+} + O^{2-} \longrightarrow MO$ (Metal oxide)  	**1** **1**	**2**
	g)	**What is meant of differential aeration principle?** This occurs when one part of the metal is exposed to different concentration of air .It is found that poor or least oxygenated part becomes anodic to the remaining part of metal and it is corroded.	**2**	**2**
	h)	**Why galvanized containers are not used for storing and canning food stuffs?** Galvanized containers (zinc coated) are not used for storing and canning food stuffs, which are acidic in nature as zinc gets dissolved in dilute acids forming poisonous zinc compounds which will poison the content.	**2**	**2**
	i)	**Define fuel.Classify it depending on its nature.** "A fuel can be defined as any combustible substance which during combustion gives large amount of heat energy."	**1**	**2**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.		**Depending on its nature.** 1) Solid Fuels 2) Liquid Fuels 3) Gaseous Fuels.	**1**	
	j)	**What is meant by calorific value and ignition temperature.** **Calorific value :** It is defined as "the total amount of heat produced the by complete combustion of unit mass or unit volume of the fuel." **Ignition temperature:** "It is the minimum temperature at which combustion of a fuel takes place when the firing is once started ."	**1** **1**	**2**
	k)	**Write two application of Biodiesel.** **Applications of Biodiesel:-** 1) It is an alternative fuel formulated exclusively for diesel engines little or no modification in engines. 2) It is also used as a heating fuel in domestic & commercial boilers 3) It is used in rocket fuels. **(Any two applications)**	**1** **mark each**	**2**
	l)	**Define lubricants.Name the types if lubricants.** **Lubricants:** Any substance introduced between two moving or sliding surface to reduce the frictional resistance between them is known as **lubricant.** **Types if lubricants** 1) Solid Lubricants **2)** Liquid Lubricants 3) Semi – Solid Lubricants	**1** **1**	**2**
2.		**Attempt any FOUR of the following:**		**16**
	a)	**What are the chemical reactions taking place in zone of reduction of blast furnace.** The reduction is done in stages as given below:- $Fe_2O_3 \rightarrow Fe_3O_4 \rightarrow FeO \rightarrow Fe$ i) In between $300 - 500^0C$ $3Fe_2O_3 + CO \rightarrow 2Fe_3O_4 + CO_2\uparrow$	**1** **mark each**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.		ii) In between 650 – 700^{0}C $Fe_3O_4 + CO \rightarrow 3FeO + CO_2\uparrow$ iii) At temperature between 700 – 800^{0}C $FeO + CO \rightarrow Fe + CO_2\uparrow$ iv) The limestone present in the charge is also decomposed to produce lime. $CaCO_3 \rightarrow CaO + CO_2\uparrow$ v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe_2O_3 or Fe_3O_4 $2Fe + 3CO \rightarrow Fe_2O_3 + 3C$ $3Fe + 4CO \rightarrow Fe_3O_4 + 4C$ **(Note: Any four step reactions one mark each)**		
	b)	**How is the steel prepared from pig iron using open hearth process?** **Procedure:-**1) The charge consists of pig / cast iron (Cold or molten), scrap iron / steel &hematite (Ore). 2) Heating the charge on the hearth of furnace by the heat produced by burning fuel in air or by producer gas. 3) **First Phase of Cycle: -**Producer gas / air is passed through previously heated regenerator (R) while the products of combustion flow through the regenerator. 4) The charge is fed through a charging door & heated to 1600^{0}C to 1650^{0}C by means of producer gas. Fuel is fired through nozzles. 5) The hot gases formed in (R_1) pass over the hearth to its opposite end & metal charge supported on the hearth is openly exposed to the flames & is converted into molten metal. Metal charge is also heated by the radiations from the walls. 6) After passing over the hearth, the products of combustion pass through R_2(Checker chamber) & heat it after about 25 to 30 min.	**1**	**4**

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2		**7) Second Phase Cycle:-**Idle burner fires the fuel. 8) Regenerators R_1, R_2store & release large quantities of heat which would have escaped to the atmosphere & thus wasted. 9) Tap hole in the lowest part of the hearth always closed with refractory plug until metal is ready to be poured. **Reaction:-** a) Oxidation of impurities of Mn, P and Si by hematite. $2Fe_2O_3 + 6Mn \rightarrow 4Fe + 6MnO$ $5\ Fe_2O_3 + 6P \rightarrow 10Fe + 3P_2O_5$ $2Fe_2O_3 + 3Si \rightarrow 4Fe + 3SiO_2$ b) Formation of slag for the removal of Mn, P & Si. $MnO + SiO_2 \rightarrow MnSiO_3$ $P_2O_3 + 3Cao \rightarrow Ca_3(PO_4)_2$ Slag $SiO_2 + CaO \rightarrow CaSiO_3$ c) Finally C & S from gaseous oxides which leave the furnace as five gases $2\ Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2\uparrow$ $2Fe_2O_3 + 3S \rightarrow 4Fe + 3SO_2\uparrow$  	**2** **1**	

Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
	c)	**State composition, properties and uses of heat resisting steel.**	**4**	**4**

Steel	**Composition**	**Properties**	**Uses**
Heat resisting steel	(Nichrome) Ni = 60% Cr = 23-30% C=0.35% & Remaining steel	1. resists temperature between 815 – 1150^{0}C 2. It has low coefficient of expansion. 3. retains its mechanical properties even at high temperature 4. does not soften at high working temperature 5. Resistance to oxidation.	1) for making heating coils for furnaces & stoves 2) In making parts of boilers, steam lines, gas turbines, annealing boxes etc. 3) Used in other equipment's exposed to high temperature.

(Comp.- 2 marks, any two Properties and any 2 Uses 1 marks each)

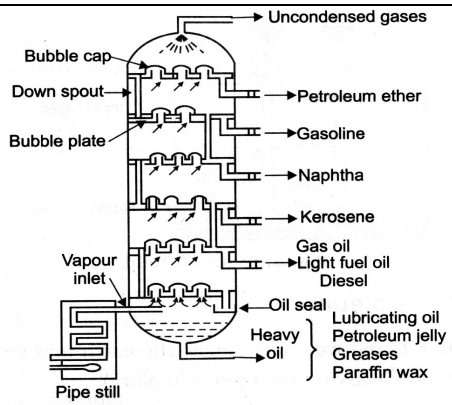
d) **State four characteristics of good fuel.** **4**

Following are the characteristics of a good fuel: **1 mark each**

1) A good fuel should have a high calorific value.
2) A good fuel should have a moderate ignition point.
3) A good fuel should not liberate any polluting or poisonous product gases.
4) The velocity of combustion should be moderate.
5) The combustion should be easily controllable.
6) It should contain low percentage of non-combustible matter.
7) It should be cheap, easily available & convenient for transportation
8) A good fuel requires smaller space to store.
9) A good fuel does not contain any volatile matter causes air pollutio

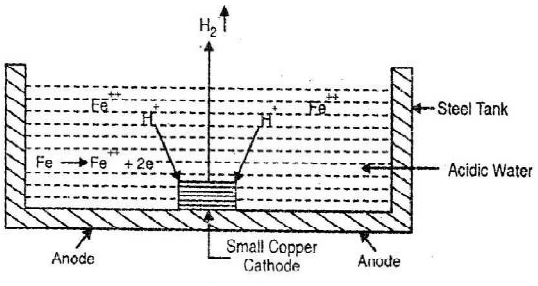
(Any Four relevantcharacteristics 1 mark each)

e) **Write with labeled diagram, composition and applications of petroleum fractions.** **4**

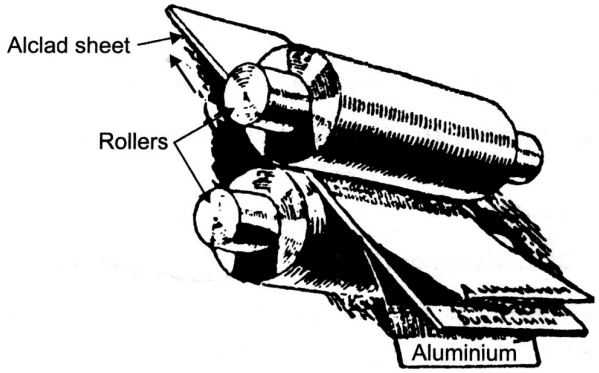
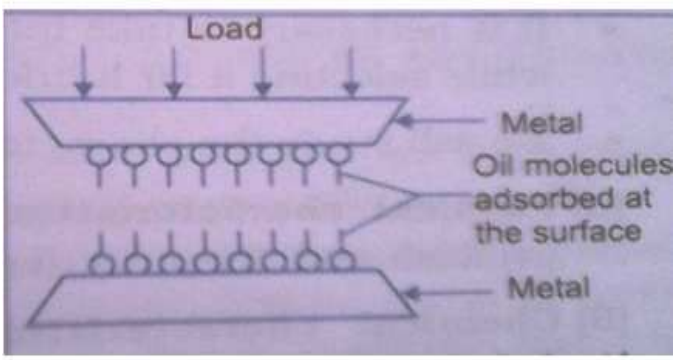
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.			**1**	

Sr. No.	**Name of Fraction**	**Composition of Hydrocarbon**	**Uses**
1	Uncondensed gases	CH_4 to C_4H_{10}	As domestic or industrial fuel as LPG
2	Petroleum ether	C_5H_{12} to C_7H_{16}	As solvent, fuel for aeroplane& helicopter
3	Gasoline (Petrol)	C_5H_{12} to C_9H_{20}	Automobile fuel, solvent & in dry cleaning
4	Naptha or solvent spirit	C_9H_{20} to $C_{10}H_{22}$	As solvent & in dry cleaning
5	Kerosene	$C_{10}H_{12}$ to $C_{16}H_{34}$	As illuminant, jet engine fuel & in making oil gas
6	Diesel oil or light fuel oil	$C_{15}H_{32}$ to $C_{18}H_{38}$	Diesel engine fuel
7	Heavy oil	$C_{17}H_{37}$ to $C_{30}H_{62}$	For obtain gasoline by cracking
	a) Lubricating oils	--	a) Lubricating purpose
	b) Petroleum jelly (Vaseline)		b) As lubricant in medicines & cosmetics
	c) Greases	--	C) As lubricant
	d) Paraffin wax	--	d) In ointments candles, shoe polishes etc
8	Residue (Asphalt)	$C_{30}H_{62}$& above	Road making and water proofing of roofs
(Any three fractions 1 mark each)			

3

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.	**f)**	**Write composition, properties and applications of LPG.** **Composition:** 1) Ethane = 0.20% 2) Propane = 57.30% 3) Butane = 41.10% 4) Pentane = 1.40% **Properties:-** 1) It is highly inflammable. 2) LPG is colorless, odourless gas. 3) Its calorific values it very high. 4) It is non- corrosive to steel & copper alloys. 5) It does not produce any harmful product on combustion. 6) It is slightly toxic and slightly anesthetic if inhaled in large concentration. **Applications** 1) LPG is mainly used as a domestic fuel & industrial fuel. 2) It is also used as motor fuel. 3) It is also used in aerosol industries. 4) It is used in portable blow lamps, soldering, welding, brazing & s cutting etc. **(Any two properties and two applications 1 mark each)**	**2** **1 mark each** **1 mark each**	**4**
3.		**Attempt any FOUR of the following:**		**16**
	a)	**Write the mechanism of electro chemical corrosion with evolution of hydrogen gas.**  **Steel tank: - Anode** **Cu – strip:- Cathode** Such type of corrosion occurs usually in acidic environments like acidic industrial waste, solutions of non – oxidizing acids. Consider a steel tank containing acidic industrial waste and small piece of copper scrap in contact with steel. The portion of the steel tank in contact with copper is corroded most with the evolution of hydrogen gas.	**1** **1**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.		**Reactions:** **At Anode:** **$Fe \longrightarrow Fe^{++} + 2e^-$** These electrons flow through the metal from anode to the cathode **At cathode** H^+ ions are eliminated as H_2 gas **$2H^+ + 2e^- \longrightarrow H_2\uparrow$(Reduction)** Thus, over all reaction is **$Fe + 2H^+ \longrightarrow Fe^{++} + H_2\uparrow$** **[Note: 1mark each to be given to reaction at anode & cathode.]**	**1** **1**	
	b)	**Distinguish between galvanising and tinning.** **Galvanizing** | **Tinning** 1) A process of covering iron or steel with a thin coat of Zinc to prevent it from rusting. | 1)A process of covering steel with a thin coat of tin to prevent it from corrosion. 2) In galvanizing , zinc protects the iron as it is more electropositive than iron . | 2)Tin protects base metal iron from corrosion, due to less electropositive than iron and higher corrosion resistance. 3) In galvanizing articles Zn continues to protect the metal by galvanic cell action even if coating of Zn is broken.. | 3) In tinning , tin protects the iron, till the coating is perfect, any break in coating cause rapid corrosion. 4) Galvanized containers cannot be used for storing acidic food stuff. Since Zn reacts with food acids forming Zn compounds which highly toxic i.e. Poisonous. | 4) Tin coated containers and utensils can be used for storing any food stuff since tin is non toxic and protects the metal from corrosion and avoids any food poisonous.	**1 mark each**	**4**
	c)	**Name the method which is used in making 'alclad' sheets. Write in brief about it.** **Method :** Metal cladding **Process:** i) Base metal is sandwiched or cladded between the two sheets of coating metal. ii) This sandwich is then passed through two heavy rollers maintained at high temp & pressure.	**1** **2**	**4**

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3		iii) Cladded metal is cathodic with respect to the base metal so that electrolytic protection is provided metals like Cu, Ni, Ag ,Pb, Pt& alloys like stainless steel, Ni alloys, Cu & pb alloys & Pb alloys are used as cladding materials..		
			**1**	
	d)	**State with the help of figure principle of boundary lubrication.**		**4**
		This type of lubrication is done when a continuous fluid film of lubricant cannot persist & direct metal to metal contact is possible due to certain reasons. This happens when i) a shaft starts moving from rest or ii) the speed is very low or iii) the load is very high or iv) The viscosity of oil is too low. ii) Under such conditions, the space between the moving parts is lubricated with a thin layer of oil lubricant. The oil is adsorbed by physical or chemical forces or both on the metallic surfaces. iii) The adsorbed layers cannot get removed easily & thus avoids direct metal to metal contact. The load is carried by the layers of the adsorbed lubricant on the metallic surfaces. iv) The property which is responsible for this kind of adsorption is "Oiliness."	**3**	
			**1**	

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3	**e)**	**Define the terms: Viscosity, Oiliness, acid value and emulsification.**		**4**
		i) **Viscosity:** It is defined, as the force in dynes required for moving 1 cm^2 of the liquid over another surface with a velocity of 1cm per second	**1**	
		ii)**Oiliness: -**It is defined as the power of oil to maintain a continuous film under pressure while used as a lubricant.	**1**	
		iii) Acid value: It is the number of milligrams of KOH required to neutralize free acid in one gram of oil.	**1**	
		iv) Emulsification. Certain oils have the tendency to mix with water to form an intermate & stable mixture called emulsion & the process is known as 'emulsification.'	**1**	
	f)	**Write the characteristics and applications of graphite.**		**4**
		Characteristics:-		
		i) Graphite is non flammable, soft & soapy to touch.		
		ii) It is insoluble in water & has high chemical stability.		
		iii) It gets oxidized at about 375^0C in presence of air.Therefore it can be used upto high temperature in absence of air.	**1 mark each**	
		iv) When it is applied between uneven surfaces it makes surface more even.		
		v) It can be used in powdered form or in the form of its suspension in water, oil or grease.		
		Applications:-		
		i) The suspension of graphite in water (aqua – dag) is used in food processing industry.		
		ii) The suspension of graphite in oil (oil – dag) is used in I.C. engines.	**1 mark each**	
		iii) Graphite with grease (graphite grease) is used at high temperature.		
		iv) It is also used in air compressors, lathes, railway track joints, open gears, chains, in machine.		
		(**Note: Any two characteristics and two applications 2 marks)**		