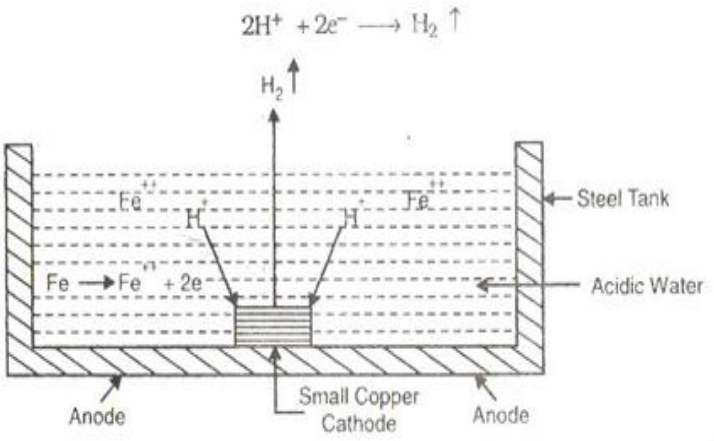
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		Important Instructions to examiners: 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme. 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the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

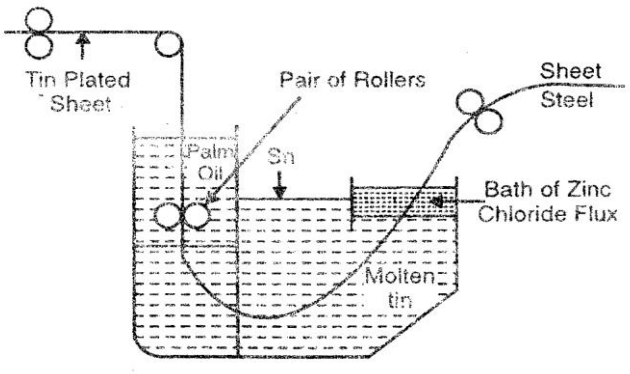
Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.		**Attempt any NINE:**		18
	a)	**Name the purest form of iron and write its two applications.** **Wrought iron** is the purest form of iron. **Applications**: (any two) i) It is used for making small size water pipes and fittings. ii) It is used for corrugated sheets, ornamental sheets, metal works, wires, anchors, chains, bolts, nails etc. iii) It is also used in making cores of electromagnets and making hard steel.	1 ½ mark each	2
	b)	**Name four ores of iron with their composition. (any four)** **Ore of iron** — **Composition** Magnetite (or Ferroso ferric oxide or Fe_3O_4) — 72 % Fe Hematite (or Ferric oxide or Fe_2O_3) — 70 % Fe Limonite (or Hydrated ferric oxide or $2Fe_2O_3.3H_2O$) — 60 % Fe Siderite (or Ferrous Carbonate or $FeCO_3$) — 40-45 % Fe Iron pyrites (or Iron sulphide or FeS_2) — 50-55 % Fe	½ mark each	2
	c)	**Write two properties of medium carbon steel.** **Properties**: (any two) i) It is tougher and harder than mild steel. ii) It is shock resistance. iii) It can be hardened by heat treatment. iv) It has high tensile strength than mild steel.	1 mark each	2
	d)	**What is cast iron? Where is it used?** **Cast iron:** The molten metal is poured into moulds of desired shape and the iron obtained is known as cast iron. **Uses:** (any two) i) Used in casting of articles like stoves, radiators, toys, cooking ranges, water pipes, drain pipes, agricultural implements etc. ii) Used in railway sleepers, lamp posts, drainage covers, railing and fire gates. iii) Used in manufacturing wrought iron and steel.	1 ½ mark each	2
	e)	**Define atmospheric corrosion. Name two factors affecting it.** **Atmospheric corrosion**: "The corrosion which is brought about by atmospheric conditions is called atmospheric corrosion". Or Atmospheric corrosion is defined as the decay or destruction of metal due to the gases like hydrogen, oxygen, and sulphur dioxide etc. present in the atmosphere. **Factors:** i) Impurities in the atmosphere ii) Moisture	1 ½ mark each	2

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	f)	**Compare rate of corrosion of iron when it is in contact with zinc and copper.** When iron comes in contact with zinc, zinc protects the iron from corrosion, as it is more electropositive than iron and does not allow iron to pass into the solution. When iron comes in contact with copper, iron undergoes corrosion as it is more electropositive than copper.	1 1	2
	g)	**Write two advantages of metal spraying process.** **Advantages of metal spraying: (any two)** i) The thickness of coating can be controlled. ii) Large and irregular surfaces can be coated efficiently. iii) Non metals can be coated. iv) Coating can be applied to fabricated structure.	1 mark each	2
	h)	**What is sacrificial anodic protection?** The metallic structure to be protected from corrosion is connected to the anodic metal (active) by an insulating wire is the sacrificial anodic protection.	2	2
	i)	**Define calorific value and ignition temperature.** **Calorific value:** The total amount of heat produced by the complete combustion of unit weight or unit volume of the fuel is known as calorific value. **Ignition temperature:** The minimum temperature at which combustion of a fuel takes place when the firing is once started is known as ignition temperature.	1 1	2
	j)	**Which properties of biodiesel make it an important fuel?** The properties of biodiesel such as biodegradable, non-toxic, free from sulphur compounds, aromatics, produces less air pollutants and high oxygen content make it an important fuel.	2	2
	k)	**Write two functions of a lubricant.** **Functions of a lubricant: (any two)** i) It reduces surface wear and tear and deformation, so that direct contact between rubbing surfaces is avoided. ii) It reduces waste of energy in the form of heat, so it acts as a coolant. iii) It reduces expansion of metal by local frictional heat. iv) It reduces unsmooth relative motion. v) It reduces maintenance and running cost of machine. vi) It reduces the power loss in internal combustion (I.C) engine. vii) It acts as seal between the piston and cylinder wall so it prevents the leakage of gases at high pressure.	1 mark each	2

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
1.	l)	**Classify lubricants giving one example of each.** **Classification with examples:** **i) Solid lubricants:** Examples: graphite, molybdenum disulphide, soap, soap stone, wax, talc, chalk, mica, teflon etc. **ii) Semi-solid lubricants:** Examples: greases and vaseline. **iii) Liquid lubricants:** Examples: vegetable and animal oils such as castor, olive, coconut, palm, neem, linseed, hazel nut, tallow, lard, whale, codliver oil etc. and fatty acids like oleic acid, stearic acid etc., silicones, blended oils, and mineral oils.	2	2
2.		**Attempt any FOUR:**		16
	a)	**With the help of balanced chemical reactions, describe the zone of heat absorption in the blast furnace.** **Zone of heat absorption (800-1200^{0}C):** Following reactions take place in this zone. i) Any oxide of iron which has escaped from reduction is reduced by red hot carbon $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ ii) Carbon dioxide is reduced to carbon monoxide by heat absorption. $CO_2 + C \rightarrow 2CO + 39Kcal$ iii) The hot spongy iron melts the ascending CO and decomposes a part of it to produce finely divided carbon. $2CO \rightarrow CO_2 \uparrow + C$ iv) lime obtained in the zone of reduction forms slag with silica. $CaO + SiO_2 \rightarrow CaSiO_3$ (Slag) v) At about 1200^{0}C, non-metallic and metallic oxides are reduced by coke to respective elements. $SO_2 + 2C \rightarrow S + 2CO \uparrow$ $SiO_2 + 2C \rightarrow Si + 2CO \uparrow$ $P_2O_5 + 5C \rightarrow 2P + 5CO \uparrow$ $MnO_2 + 2C \rightarrow Mn + 2CO \uparrow$	1 ½ ½ 1 1	4
	b)	**Describe the method of heat treatment used to increase cutting ability of steel.** **Hardening or Quenching:** It is applied to tools and some important machine parts made of alloy steel. 'In this process, steel is heated to high temperature (800- 900^{0}C) and then suddenly cooled by dipping or quenching in some suitable medium'. The quenching medium used is either cold water or mineral or animal or vegetable oil, 4-6% caustic soda, 6-20% sodium chloride solution etc.	1	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
2.		By this process steel becomes extremely hard and brittle. The hardness developed depends upon: i) The rate of cooling and ii) the medium used for cooling.	2	
		The purposes of hardening are: i) To increase its resistance to wear or abrasion and ability to cut other metals. ii) To improve strength, elasticity, ductility and toughness.	1	
	c)	**Write composition, two properties and two applications of stainless steel.**		
		Composition: Chromium: 18 %, Nickel: 8% and remaining is mild steel.	2	4
		Properties: (any two) i) Strong and tough ii) Non-magnetic iii) Good resistant to heat iv) Resistant to atmospheric and chemical corrosion v) Difficult to weld vi) Having high hardness and tensile strength vii) It does not tarnish	½ mark each	
		Applications: (any two) i) Used for household utensils. ii) Used in hydraulic machinery. iii) Used in dairy and food industry. iv) Used dental and surgical instruments. v) Used in chemical industries.	½ mark each	
	d)	**Describe the mechanism of electrochemical corrosion by evolution of hydrogen gas.**		4
		Hydrogen evolution mechanism of electrochemical corrosion:		
		This type of corrosion occurs usually in acidic environments like industrial waste, solutions of non-oxidising acids like dilute HCl.		
		Consider a steel tank containing acidic industrial waste and small piece of copper scrap in contact with steel. The portion of steel tank in contact with copper is corroded most with the evolution of hydrogen gas.	1	
		Steel tank acts as **anode**: $Fe \longrightarrow Fe^{+2} + 2e^-$	1	
		Electrons flow through the metal from anode to the cathode.		
		Piece of copper scrap acts as **cathode**: At cathode H^+ ions from acidic solutions are eliminated as hydrogen gas. $2H^+ + 2e^- \longrightarrow H_2 \uparrow$	1	

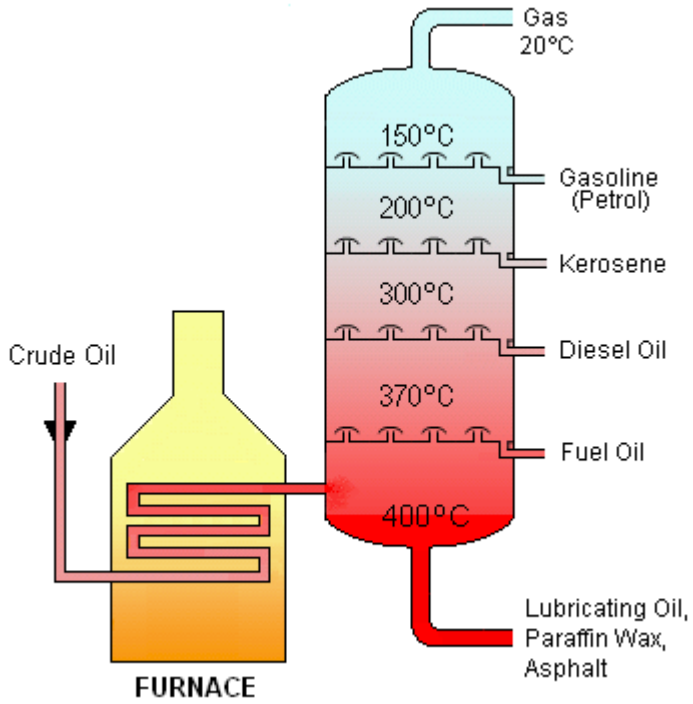
Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
2.		**Diagram:**  	1	
	e)	**Write two functions each of pigments and thinner in paint.** **Functions of pigments: (any two)** i) provide opacity and colour to the paint film ii) give an aesthetical appeal to the paint film iii) give strength to the film iv) give protection to the paint film by reflecting harmful ultraviolet light v) provide resistance to paint film against abrasion, moisture and weather. **Functions of thinner: (any two)** i) they are suspended pigments ii) they dissolve film forming materials iii) they reduce the viscosity of paints for proper handling and to impart better covering power iv) they help the drying of film by evaporation.	1 mark each 1 mark each	4
	f)	**Describe tinning process with a labeled diagram.** **Tinning process:** It is the process of covering iron or steel sheets with a thin coat of tin to prevent it from corrosion. The sheet of steel to be tinned is first cleaned by dilute sulphuric acid to remove the oxide film and the impurities, if any. Then it is dipped in a bath containing molten flux of zinc chloride, which helps the molten metal to get adhered to the metal sheet. Then it is dipped in another bath containing molten tin. Finally, it is dipped in a suitable vegetable oil, to protect the hot tin coated surface against oxidation. It is then passed through a series of hot rollers. The rollers remove the superfluous and make the coating uniform all over the surface of the metal sheet.	2	4

Que. No.	Sub. Que.	Stepwise Solution	Marks	Total Marks
3.	a)	**Diagram:**  **Attempt any FOUR:** **Write four differences between solid and liquid fuels.** (any four points)	2 1 mark each	16 4

Solid fuels	**Liquid fuels**
1. low calorific value	high calorific value
2. very high ignition temperature	moderate ignition temperature
3. high ash content	ash content is negligible
4. large volatile matter and moisture	volatile matter and moisture is negligible
5. velocity of combustion is non-controllable	velocity of combustion is easily controllable
6. required large space to store but no risk for fire hazard	required small space to store but risk for fire hazard
7. very low thermal efficiency	better thermal efficiency
8. burn with smoke	smoke is negligible
9. cannot be used in I.C. engine	convenient in I.C. engine
10. transportation is laborous but risk free	transportation can be piped but risky
11. cost is low	Cost is high

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.	b)	**With the help of labeled diagram, illustrate various fractions obtained during refining of crude petroleum.**		4

Diagram:

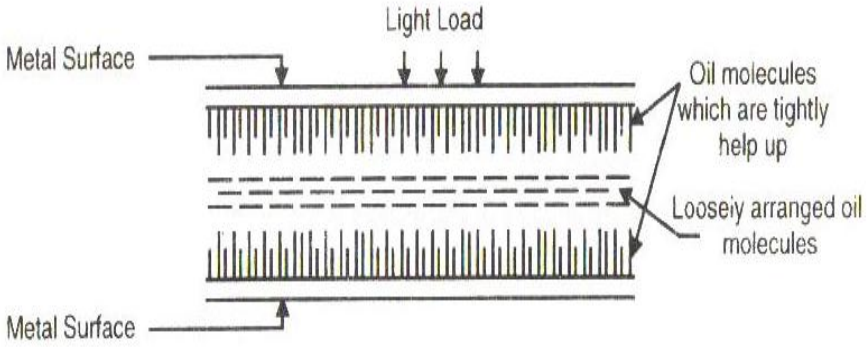


2

Sr. No.	Fractions	Chemical Formula	Boiling range
1	Uncondensed gases	CH_4-C_4H_{10}	Below 30^0C
2	Gasoline (petrol)	C_5H_{12}-C_7H_{16}	30^-70^0C
3	Kerosene	$C_{10}H_{22}$-$C_{16}H_{34}$	180^-200^0C
4	Diesel Oil	$C_{15}H_{32}$-$C_{18}H_{38}$	250^-320^0C
5	Fuel oil	C_5H_{12}-C_7H_{16}	320^-400^0C
6	Lubricating oil, Paraffin wax, Asphalt	$C_{30}H_{62}$ and above	Above 400^0C

2

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.	c)	**Define proximate analysis. How is moisture content in coal determined by proximate analysis?** **Proximate analysis**: The analysis of a coal sample in which the moisture content, volatile matter content, ash content and fixed carbon content are found, is known as proximate analysis. **Determination of moisture content in coal:** About 1 gram of finely powdered air-dried coal sample is weighed in a crucible. The crucible is placed in an electric oven for 1 hour at 105^{o}C. Then the crucible is taken out from the oven and cooled in a desiccators and weighted (w_1 g). Loss in weight (w- w_1 g) is due to loss of moisture from the coal. % of moisture = Loss in weight / weight of coal sample X 100 = $\frac{(w - w_1\ g)}{w}$ X 100	1 1 1 1	4
	d)	**Write two properties and two application of LPG.** **Properties: (any two)** i) It is highly inflammable. ii) It is colorless, odorless gas. iii) Its calorific value is very high. iv) It is non-corrosive to steel and copper alloys. v) It does not produce any harmful product on combustion. vi) It is slightly toxic and anesthetic if inhaled in large concentrations. **Applications: (any two)** i) It is mainly used as a domestic fuel and industrial fuel. ii) It is also used as motor fuel as it easily mixes with air and burns cleanly. iii) It is also used in aerosol industries. It is alternating ingredients of CFC gases in aerosol industry. iv) It is also used in portable blow lamps, soldering, welding, brazing and steel cutting etc.	1 mark each 1 mark each	4
	e)	**Describe fluid film lubrication with the help of diagram, working conditions and lubricants used.** **Fluid film lubrication**: This type of lubrication is done in machines working at low pressure and high speed. In this method the liquid lubricant is introduced in between the moving or sliding surfaces. The lubricant film covers or fills the irregularities of the moving or sliding surfaces and forms a thin layer in between them. This thin layer of lubricant avoids metal-to-metal contact and reduces the friction.	2	4

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
3.		The resistance to movement of moving parts is only due to internal resistance between the particles of the lubricant moving over each other. Thus lubricant should have the minimum viscosity. **Diagram**  	1	
		Uses: This type of lubrication is provided in case of delicate instrument and light machines like watches, clocks, guns, sewing machines, scientific instrument etc.	1	
	f)	**With reason, suggest proper lubricants for sewing machine and road roller.**		4
		Sewing machine: is a delicate instrument which is not exposed to high temperatures, heavy loads or water so that mineral oil, silicones, thin vegetable and animal oils like palm oil, hazel nut oil, neat foot oil etc. are used as lubricants.	2	
		Road roller: is machinery in which extreme pressure and low speeds are employed where thick oil film cannot be maintained so that solid lubricants like graphite, soap- stone, and molybdenum disulphide are most commonly used.	2	