



Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		<p><b><u>Important Instructions to examiners:</u></b></p> <p>1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.</p> <p>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.</p> <p>3) The language errors such as grammatical, spelling errors should not be given more Importance (<u>Not applicable for subject English and Communication Skills</u>).</p> <p>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.</p> <p>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.</p> <p>6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.</p> <p>7) For programming language papers, credit may be given to any other program based on equivalent concept.</p>		



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1		<b>Attempt any <u>NINE</u>:</b>		<b>18</b>																
	a)	<p><b>List any two ores of iron with chemical formula.</b></p> <p><b>Ores of iron metal</b></p> <table border="1"> <thead> <tr> <th>Type of the ore</th> <th>Name of the ore</th> <th>Chemical formula</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Oxide ores</td> <td>Haematite</td> <td>Fe<sub>2</sub>O<sub>3</sub></td> </tr> <tr> <td>Magnetite</td> <td>Fe<sub>3</sub>O<sub>4</sub></td> </tr> <tr> <td>Limonite</td> <td>2Fe<sub>2</sub>O<sub>3</sub>, 3H<sub>2</sub>O</td> </tr> <tr> <td>Sulphide ore</td> <td>Iron pyrite</td> <td>FeS<sub>2</sub></td> </tr> <tr> <td>Carbonate ore</td> <td>Siderite</td> <td>FeCO<sub>3</sub></td> </tr> </tbody> </table> <p><b>(Any two ores along with chemical formula-1mark each)</b></p>	Type of the ore	Name of the ore	Chemical formula	Oxide ores	Haematite	Fe <sub>2</sub> O <sub>3</sub>	Magnetite	Fe <sub>3</sub> O <sub>4</sub>	Limonite	2Fe <sub>2</sub> O <sub>3</sub> , 3H <sub>2</sub> O	Sulphide ore	Iron pyrite	FeS <sub>2</sub>	Carbonate ore	Siderite	FeCO <sub>3</sub>	<b>1 mark each</b>	<b>2</b>
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	b)	<p><b>What is the function of coke and limestone in the extraction of iron from its ore in the blast furnace?</b></p> <ul style="list-style-type: none"> <li><b>Function of coke-</b>In the extraction of iron metal from haematite ore coke is used as a reducing agent. It reduces iron oxide to iron metal.  <math display="block">\text{Fe}_2\text{O}_3 + 3\text{C} \longrightarrow 2\text{Fe} + 3\text{CO} \uparrow</math></li> <li><b>Function of limestone-</b> In the extraction of iron metal from haematite ore lime-stone is used as a flux. It reacts with gangue to form slag. <b>Limestone i.e. CaCO<sub>3</sub></b> <math>\longrightarrow</math> CaO + CO<sub>2</sub>  <math display="block">\text{CaO} + \text{SiO}_2 \longrightarrow \text{CaSiO}_3</math> <p style="text-align: center;">Flux      Gangue                      Slag</p></li> </ul> <p><b>[ Either statement or reaction ]</b></p>	<b>1</b> <b>1</b>	<b>2</b>																
	c)	<p><b>State two properties and two applications of high carbon steel.</b></p> <p><b>High carbon steel</b></p> <p><b>Properties –</b></p> <ol style="list-style-type: none"> <li>It has high tensile strength</li> <li>It is very hard and has high wear and tear resistance</li> <li>It produces keen cutting edges</li> <li>It is unworkable.</li> </ol> <p><b>Applications-</b></p> <ol style="list-style-type: none"> <li>It is used for wood working tools like files, chisels, saws, drills.</li> <li>It is used for metal cutting tools like cutters, knives, saws, blades, razors etc</li> </ol> <p><b>(Any two properties- 1 mark Any two applications: 1 mark )</b></p>	<b>½ mark each</b> <b>½ mark each</b>	<b>2</b>																
	d)	<p><b>Why is an alloying element nickel added in steel</b></p> <p>Alloying element nickel is added into the steel to increase hardness, strength, ductility, toughness ,elasticity, heat &amp; corrosion resistance.</p> <p><b>Define atmospheric corrosion. Name the type of oxide film formed over noble metal like gold and platinum.</b></p>	<b>2</b>	<b>2</b>																
	e)	<p><b>Atmospheric corrosion-</b> The corrosion of metal which is caused by atmospheric gases like O<sub>2</sub>, CO<sub>2</sub> and moisture is known as atmospheric corrosion.</p> <p>The oxide film formed in noble metal like gold and platinum is</p>	<b>1</b>	<b>2</b>																



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1.		<b>unstable oxide film.</b>	<b>1</b>	<b>2</b>								
	f)	<p><b>Write two examples of corrosion due to galvanic cell action.</b> Examples of corrosion due to galvanic cell action.</p> <ol style="list-style-type: none"> <li>1. Rusting of steel pipes connected to copper plumbing.</li> <li>2. Rusting of iron nails used to join copper sheets</li> <li>3. Rusting of steel screws in marine brass hardware</li> <li>4. Rusting of lead antimony solder around the copper wire</li> </ol> <p><b>(Any two examples -1 mark each)</b></p>	<b>1 mark each</b>									
	g)	<p><b>Differentiate between metal spraying and metal cladding (any two points).</b></p> <table border="1"> <thead> <tr> <th>Metal spraying</th> <th>Metal cladding</th> </tr> </thead> <tbody> <tr> <td>1. The process of spraying molten metal on the surface of base metal by using spraying gun or pistol is known as metal spraying</td> <td>1. The process of bonding firmly and permanently the sheet of coating metal on one or both the surfaces of base metal is known as metal cladding</td> </tr> <tr> <td>2. The process is not so effective as coating may be porous or less adherent</td> <td>2. The process is very effective as coating is permanent, adherent and nonporous.</td> </tr> <tr> <td>3. Irregular surfaces can be coated efficiently</td> <td>3. used only for plain surfaces.</td> </tr> </tbody> </table>	Metal spraying	Metal cladding	1. The process of spraying molten metal on the surface of base metal by using spraying gun or pistol is known as metal spraying	1. The process of bonding firmly and permanently the sheet of coating metal on one or both the surfaces of base metal is known as metal cladding	2. The process is not so effective as coating may be porous or less adherent	2. The process is very effective as coating is permanent, adherent and nonporous.	3. Irregular surfaces can be coated efficiently	3. used only for plain surfaces.	<b>1 mark each</b>	<b>2</b>
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h)	<p><b>Name any four important constituents of paint</b> <b>Constituent of paint-</b></p> <ol style="list-style-type: none"> <li>1. Pigment</li> <li>2. Medium or Drying oil</li> <li>3. Thinner</li> <li>4. Drier</li> <li>5. Extenders</li> <li>6. Plasticizers</li> </ol>	<b>½ mark each</b>	<b>2</b>									
i)	<p><b>Define calorific value and ignition temperature.</b> <b>Calorific value-</b> It is defined as the total amount of heat produced by complete combustion of unit weight or unit volume of the fuel. <b>Ignition temperature-</b> It is the minimum temperature at which combustion of fuel takes place.</p>	<b>1</b> <b>1</b>	<b>2</b>									



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1	j)	<b>State any two characteristics of biodiesel.</b> <b>Characteristics of biodiesel-</b> <b>(Any two)</b> 1. It is biodegradable, non toxic and free from sulphur compounds. 2. It is cheaper than petroleum diesel. 3. It produces less air pollutant. 4. Its power rating and fuel efficiency are similar to petrol base diesel. 5. It is a powerful solvent which help to keep tanks, fuel lines, injector and other engine component clean. 6. It has high oxygen content for efficient combustion.	1 mark each	2
	k)	<b>Give any two advantages of gaseous fuel over solid fuel.</b> <b>Advantages of gaseous fuel over solid fuel-</b> <b>(Any two)</b> 1. Gaseous fuel has higher calorific value than solid fuel. 2. Gaseous fuels are clean in use and economic in labour as compared to solid fuels 3. Gaseous fuels burns without smoke and ash formation. 4. Combustion of gaseous fuels can be easily controlled by using regulators 5. Gaseous fuels have high thermal efficiency than solid fuels. 6. Gaseous fuels can be used in I.C. engines but solid fuels can not be used 7. Gaseous fuels produces higher temperature than solid fuel. 8. Gaseous fuels do not contain moisture or volatile impurities hence undergo complete combustion as compared to solid fuels.		1 mark each
	l)	<b>How is oiliness of lubricant important in lubrication process?</b> High oiliness property is important in the lubricant for use under the conditions of boundary lubrication. Even the thin film molecular layers can efficiently reduce the friction under high load conditions. The lubricant with high oiliness gets chemically adsorbed on the surface of metal and forms a uniform & continuous film which does not collapse. <b>[ Any relevant explanation can be considered]</b>	2	2

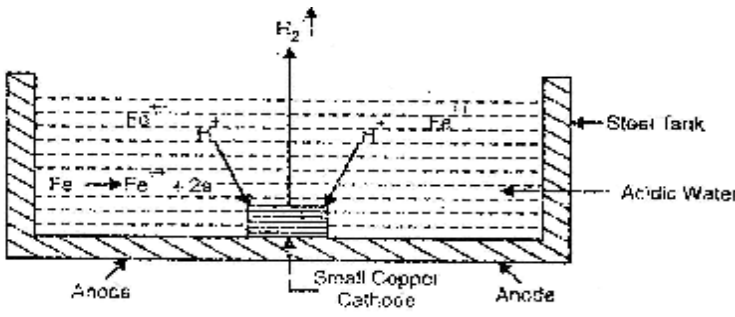


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2.		<b>Attempt any FOUR</b>		<b>16</b>
	a)	<b>Write following chemical reactions occurring in zone of heat absorption in the blast furnace.</b> <b>i) Reduction of iron oxide with red hot carbon.</b> <b>ii) Formation of slag.</b> <b>iii) Reduction of phosphorous pentaoxide.</b> <b>iv) Reduction of manganese dioxide.</b>  Chemical reactions taking place in the zone of heat absorption: i) <b>Reduction of iron oxide</b> $\text{Fe}_2\text{O}_3 + 3\text{C} \longrightarrow 2\text{Fe} + 3\text{CO}\uparrow$ ii) <b>Formation of slag</b> $\text{CaO} + \text{SiO}_2 \longrightarrow \text{CaSiO}_3$ iii) <b>Reduction of phosphorous pentaoxide</b> $\text{P}_2\text{O}_5 + 5\text{C} \longrightarrow 2\text{P} + 5\text{CO}\uparrow$ iv) <b>Reduction of manganese dioxide.</b> $\text{MnO}_2 + 2\text{C} \longrightarrow \text{Mn} + 2\text{CO}\uparrow$	1 1 1 1	4
	b)	<b>Give percentage of composition pig iron with its two properties and two applications.</b> <ul style="list-style-type: none"><li>• <b>Composition:</b><ul style="list-style-type: none"><li>ii) Iron: 92-94%</li><li>iii) Carbon: 2.5- 4.5%</li><li>iv) Silicon: 0.7 – 3%</li><li>v) Phosphorus: 0.5 -1 %</li><li>vi) Manganese: 0.2- 1%</li><li>vii) Sulphur: 0.1 -0.3%</li></ul></li><li>• <b>Properties: ( Any two)</b><ul style="list-style-type: none"><li>i) It is neither malleable nor ductile.</li><li>ii) It can not be forged, rolled, tempered and welded.</li><li>iii) It can not be magnetized permanently.</li><li>iv) It is very soft.</li><li>v) It has low tensile strength.</li><li>vi) It melts at 1150 °c to 1250 °c</li><li>vii) It expands on solidification.</li><li>viii) It does not rust easily.</li></ul></li></ul> <b>( Any two : 1 mark)</b>	2 1	4



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2		<ul style="list-style-type: none"><li>• <b>Applications.</b><ul style="list-style-type: none"><li>i) It is used for casting metal objects such as stoves, lamp posts, drainage covers ,pipes,railings,fire gates etc.</li><li>ii)Used in casting various types of articles such as toys,radiators,cooking ranges, water and drain pipes and agricultural implements</li><li>iii)used for making electric poles,Bunsen burners,bases.</li></ul>Used in making wrought and steel ( Any two : 1 mark)</li></ul>	1	
	c)	<p><b>Explain normalizing method of heat treatment of steel.</b> The process of heating steel to a definite temperature that is about <b>50°C above the critical temperature</b> and then cooling it freely in air at the rate of 5°C per second is known as normalizing.</p> <p><b>Purposes :-</b></p> <ol style="list-style-type: none"><li>1. To remove the coarse grain structure.</li><li>2. To remove internal stresses which are caused by working.</li><li>3. To impart ductility and toughness to steel.</li><li>4. To improve mechanical properties of steel.</li></ol> <p><b>Advantages :</b></p> <ul style="list-style-type: none"><li>i)Time required is less than annealing.</li><li>ii)Consumption of fuel is less.</li><li>iii)Mechanical properties of steel are more improved than annealing</li></ul>	2	4
	d)	<p><b>State any four characteristics of good fuel.</b></p> <ol style="list-style-type: none"><li>1. It should have moderate ignition temperature.</li><li>2. It should have high calorific value.</li><li>3. It should possess moderate velocity of combustion.</li><li>4. It should have low contents of non-combustible matter.</li><li>5. It should have low moisture content.</li><li>6. Its products of combustion should not be harmful.</li><li>7. It should be available in bulk at low cost.</li><li>8. It should be easy to store and transport.</li><li>9. It combustion should be easily controllable.</li><li>10. It should not undergo spontaneous combustion.</li><li>11. It should burn in air with efficiency.</li></ol> <p>( Any four: 1 mark each)</p>	1 mark each	4



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2.	e)	<p><b>What is the source of bio-gas? Give three properties of bio-gas as fuel.</b></p> <p>Bio-gas is produced by degradation of biological matter by bacterial action ( especially anaerobic bacteria) in the absence of free oxygen.</p> <p><b>Properties of bio-gas: (Any three)</b></p> <ol style="list-style-type: none"> <li>1. It on burning liberates large amount of heat which does not produce poisonous gas like carbon monoxide.</li> <li>2. It burns without producing residue, smoke etc.</li> <li>3. It is clean in use and convenient fuel.</li> <li>4. Its calorific value is high i.e. 5300 Kcal/m<sup>3</sup>.</li> <li>5. Its flame temperature is about 540 °c.</li> </ol>	1	4
	f)	<p><b>Give two applications each of petroleum ether and gasoline.</b></p> <p><b>Petroleum ether :</b></p> <ol style="list-style-type: none"> <li>1. Used as a solvent.</li> <li>2. Fuel for aeroplane and helicopters.</li> </ol> <p><b>Gasoline: ( Any two)</b></p> <ol style="list-style-type: none"> <li>1. As a fuel for I.C. engine of automobiles and aeroplanes</li> <li>2. As a solvent</li> <li>3. In dry-cleaning.</li> </ol>	2	
3.		<p><b>Attempt any FOUR</b></p>		16
	a)	<p><b>Explain hydrogen evolution mechanism of immersed corrosion with neat labelled diagram.</b></p>  <p>Steel tank :- Anode , Cu strip : cathode</p> <p><b>Process :</b> This types of corrosion occurs usually in acidic eniveronments, like industrial waste, solutions of non – oxidizing</p>	1	4



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3.		acids (like HCl). For example, consider 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. The reactions : <b>At Anode :</b> $\text{Fe} \longrightarrow \text{Fe}^{++} + 2\text{e}^{-}$ These electrons flow through the metal from anode to the cathode <b>At cathode</b> $\text{H}^{+}$ ions are eliminated as $\text{H}_2$ gas $2\text{H}^{+} + 2\text{e}^{-} \longrightarrow \text{H}_2 -$ Thus, over all reaction is $\text{Fe} + 2\text{H}^{+} \longrightarrow \text{Fe}^{++} + \text{H}_2 \uparrow$ <b>[Reaction at anode: 1 mark , Reaction at cathode : 1 mark]</b>	1  1  1	
	b)	<b>How is sacrificial anodic protection method used for protection of heavy machinery?</b> i) The metallic structure to be protected from corrosion is connected to the anodic metal (active) by an insulating wire. ii) The more active metals like Zn, Al, Mg etc. acts as anode and gets corroded hence it is known as sacrificial anode. For the purpose of increasing electrical contact, the active metal is placed in back fill (coal + NaCl). iii) When the sacrificial metal is consumed completely, it is replaced by fresh piece. <b>Example:</b> Mg , Zn rods are bolted along the sides of ship where Mg, Zn rods acts as anode and undergo corrosion and sides of ships acts as cathode and gets protected. Other examples are hot water tank ,boilers etc. <b>[Any other relevant example can be considered]</b>	2  2	4
	c)	<b>Draw the labelled diagram of galvanizing process and explain why the utensils are tinned and not galvanized.</b> <b>Diagram :</b> 	2	4





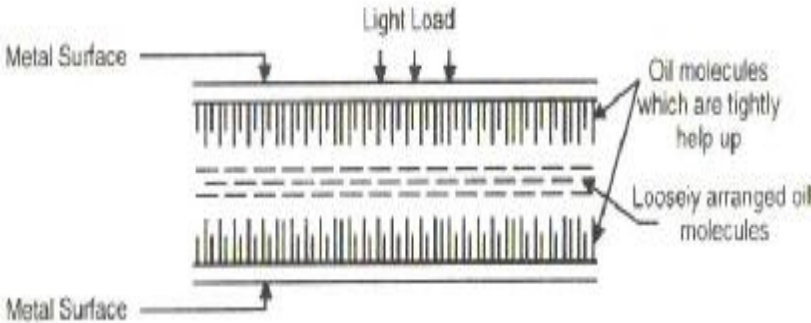
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3		Galvanised utensils (zinc coated) cannot be used for preparing and storing food stuff, which are acidic in nature because zinc gets dissolved in dilute acids forming poisonous zinc compounds which will poison the content. Tinning is used in manufacturing various types of cans for storing food stuff biscuit tins, kitchen utensils, oil, ghee, pickles, medicines, kerosene etc. because tin is less active metal hence protects the metal from corrosion and does not causes food poisoning.	2	
	d)	<b>Define – viscosity, fire point, cloud point and neutralization point.</b> <b>Viscosity :-</b> It is defined, “as the force in dynes required to move 1 cm <sup>2</sup> of the liquid over another surface with a velocity of 1cm per second.” <b>Fire Point :-</b> “Fire point is the minimum temperature at which the oil gives enough vapours which catch fire & burn continuously at least for five seconds when flame is applied to it.” <b>Cloud point :</b> Cloud point can be defined as the temperature at which the oil becomes cloudy or hazy in appearance (due to separation of wax). <b>Neutralization point:</b> It is the number of milligrams of KOH required to neutralize free acids present in one gram of oil.	1 1 1 1	4
	e)	<b>Suggest the type of lubricant used for following jobs:</b> i) Clock ii) Tractor iii) Cutting tools iv) Gears i) <b>Clock :</b> Vegetable and animal oils like palm oil, hazel nut oil, neat foot oil, etc ii) <b>Tractor :</b> Solid lubricants like graphite, soap stone, mica, molybdenum disulphide iii) <b>Cutting tools :</b> Mineral oil containing additives like fatty oils. Oil-emulsions iv) <b>Gears:</b> Thick mineral oils containing extreme pressure additives (like metallic soaps).	1 1 1 1	4
f)	<b>Explain the mechanism of fluid film lubrication with neat labelled diagram.</b>			4



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3.		<p><b>fluid film lubrication :</b></p> <p>i) It is carried out by introducing the liquid lubricants in between the moving or sliding surface. The lubricant film covers the irregularities of the sliding or moving surface &amp; forms a thin layer in between them. This thin layer of lubricant avoids metal to metal contact &amp; reduces wear &amp; friction.</p> <p>ii) The resistance to movement of moving parts is only due to the internal resistance between the particles of the lubricant moving over each other.</p> <p>iii) In fluid film lubrication, the lubricant chosen should have the minimum viscosity under working condition &amp; at the same time it should remain in place &amp; separate the surfaces.</p> <p><b>Examples:</b> This type of lubrication is provided in case of delicate instruments &amp; light machines like watches, clocks, guns etc.</p> <p><b>Diagram :</b></p> 	3	
			1	