



Applied Chemistry

Que. No.	Sub. Que.	Model Answer	Marks	Total Marks
		<p><u>Important Instructions to examiners:</u></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>		



SUMMER– 15 EXAMINATION

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1.		Attempt any NINE:		18
	a)	Give various zones of reactions in blast furnace with their temperature range. i) Zone of reduction ($300 - 800^{\circ}\text{C}$ i.e. dull red heat) ii) Zone of heat absorption ($800 - 1200^{\circ}\text{C}$ i. e. bright red heat) iii) Zone of fusion ($1200 - 1500^{\circ}\text{C}$ i.e. white heat)	2	2
	b)	What are the products of Blast furnace? i) Pig Iron ii) Slag iii) Flue Gases	2	2
	c)	Write composition of ALNICO. Composition: Al = 20% Ni = 20% Co = 10% Steel = 50%	2	2
	d)	Define heat treatment. Heat treatment of steel may be defined as 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.	2	2
	e)	Define Atmospheric corrosion. This type of corrosion occurs when metals come in contact directly with atmospheric gases like O_2 , Cl_2 , Br_2 , I_2 , H_2S , CO_2 , SO_2 , NO_2 etc and moisture. OR The corrosion which is brought about by the atmospheric conditions is called atmospheric corrosion.	2	2



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1.	f)	<p>Why gold does not corroded in air?</p> <p>In case of gold metal the oxide film formed is Unstable oxide film So as soon as the film is formed it decomposes back into original metal & oxygen. Therefore corrosion is not possible here.</p> $2M + O_2 \longrightarrow 2MO \longrightarrow 2M + O_2$ <p style="text-align: center;">Metal Metal oxide</p>	1 1	2
	g)	<p>What are the constituents of the paint?</p> <p>The constituents of the paint are:-</p> <ol style="list-style-type: none">1) Pigments2) Drying Oil / Medium3) Thinners4) Driers5) Extenders6) Plasticizers <p>(consider any four constituents)</p>	½ mark each	2
	h)	<p>Why galvanized containers are not used to store the food stuffs?</p> <p>Galvanized container contains zinc coating. Since zinc is more active metal, zinc gets dissolved in dilute acids forming poisonous (toxic) zinc compounds which will poison the content. Therefore galvanized containers can not be used for storing food stuff.</p> <p>List <u>any two</u> advantages of gaseous fuels over solid fuels.</p>	2	2
	i)	<p>List <u>any two</u> advantages of gaseous fuels over solid fuels.</p> <ol style="list-style-type: none">1) They have higher calorific value as compared to solid fuels.2) They are easy to ignite & extinguish.3) Their combustion can readily controlled by the use of regulator.4) They are ashless & smokeless.5) They have high thermal efficiency.6) They require only slight excess air for complete combustion.7) They can be used in I.C. engines.8) They undergo complete combustion without polluting the environment.9) They can be easily supplied through pipes.	1 mark each	2



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1.	j)	State any two properties of bio-diesel. Properties:- 1) It is biodegradable, safe & ecofriendly. 2) It is non toxic. 3) It is cheaper than petroleum diesel. 4) It has lower emission or it produces less air pollutants. 5) It has demonstrated similar power rating & fuel efficiency to petrol base diesel. 6) It has high oxygen content for efficient combustion. 7) It is powerful solvent which helps to keep tanks, fuel lines, injectors and other engine components clean.	1 mark each	2
	k)	Write the composition of biogas. The average composition of biogas is : 1) CH ₄ (methane) = 50 – 60% 2) CO ₂ (carbon dioxide) = 30 – 40% 3) H ₂ (Hydrogen) = 5 – 10% 4) N ₂ (Nitrogen) = 2 - 6 % 5) H ₂ S (Hydrogen sulphide) = traces		2
	l)	Define viscosity index and cloud point. Viscosity Index: The rate of change of viscosity of a liquid (Oil) with the change of temperature is known as viscosity index. Cloud point: Cloud point indicates the temperature at which the oil becomes cloudy in appearance, due to separation of wax.		1 1
2.		Attempt any FOUR :		16
	a)	Explain stepwise chemical reaction taking place in zone of reduction of blast furnace. The reduction of iron oxide is done in the following stages:- $\text{Fe}_2\text{O}_3 \longrightarrow \text{Fe}_3\text{O}_4 \longrightarrow \text{FeO} \longrightarrow \text{Fe}$ i) In between 300 – 500⁰C , when charge is heated, Fe ₂ O ₃ (Ferric oxide) is reduced to Fe ₃ O ₄ (Ferroso ferric oxide). $3\text{Fe}_2\text{O}_3 + \text{CO} \longrightarrow 2\text{Fe}_3\text{O}_4 + \text{CO}_2 \uparrow$ This Fe ₃ O ₄ is stable upto 650 ⁰ C in presence of CO, CO ₂ & free coke.	1 mark each	4



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2.	a)	ii) In between 650 – 700⁰C , Fe ₃ O ₄ is reduced to FeO $\text{Fe}_3\text{O}_4 + \text{CO} \longrightarrow 3\text{FeO} + \text{CO}_2 \uparrow$ iii) At temperature between 700 – 800⁰C , FeO is reduced to metallic iron. $\text{FeO} + \text{CO} \longrightarrow \text{Fe} + \text{CO}_2 \uparrow$ iv) Simultaneously, the limestone present in the charge is also decomposed to produce lime. $\text{CaCO}_3 \longrightarrow \text{CaO} + \text{CO}_2 \uparrow$ v) The metal produced is spongy; simultaneously a part of metallic iron reacts with CO to form Fe ₂ O ₃ or Fe ₃ O ₄ . $2\text{Fe} + 3\text{CO} \longrightarrow \text{Fe}_2\text{O}_3 + 3\text{C}$ $3\text{Fe} + 4\text{CO} \longrightarrow \text{Fe}_3\text{O}_4 + 4\text{C}$ <p>(Note: consider any four reactions)</p>												
	b)	<p>Write the effect of alloying elements carbon and chromium on properties of steel?</p> <p>Effect of alloying element Carbon:-</p> i) It increases the hardness. ii) It increases tensile strength of steel, but reduces its ductility. <p>Effect of alloying element Chromium:-</p> i) It increases hardness, toughness and tensile strength. ii) It increases wear resistance and resistance to corrosion.	2 2	4										
	c)	<p>Differentiate between annealing normalizing.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">Annealing</th> <th style="width: 50%; text-align: center;">Normalising</th> </tr> </thead> <tbody> <tr> <td>1.It is the process of heating the steel at a temperature (760-925⁰C) and cooling it slowly in the furnace along with the furnace</td> <td>1.It is the process of heating the steel at a temperature of 50 ⁰C above the critical temperature (725⁰C) and cooling it freely in air at a rate of 5 ⁰C/Sec.</td> </tr> <tr> <td>2.Due to annealing steel becomes more soft, pliable, malleable & ductile</td> <td>2. Due to normalising steel becomes homogenous & more soft. The mechanical properties of steel are more improved than annealing.</td> </tr> <tr> <td>3.Time required for annealing is more than normalising</td> <td>3.Time required for normalising is less than annealing</td> </tr> <tr> <td>4. Consumption of fuel or electric power is more.</td> <td>4. Consumption of fuel or electric power is less.</td> </tr> </tbody> </table>	Annealing	Normalising	1.It is the process of heating the steel at a temperature (760-925 ⁰ C) and cooling it slowly in the furnace along with the furnace	1.It is the process of heating the steel at a temperature of 50 ⁰ C above the critical temperature (725 ⁰ C) and cooling it freely in air at a rate of 5 ⁰ C/Sec.	2.Due to annealing steel becomes more soft, pliable, malleable & ductile	2. Due to normalising steel becomes homogenous & more soft. The mechanical properties of steel are more improved than annealing.	3.Time required for annealing is more than normalising	3.Time required for normalising is less than annealing	4. Consumption of fuel or electric power is more.	4. Consumption of fuel or electric power is less.	1 mark each	4
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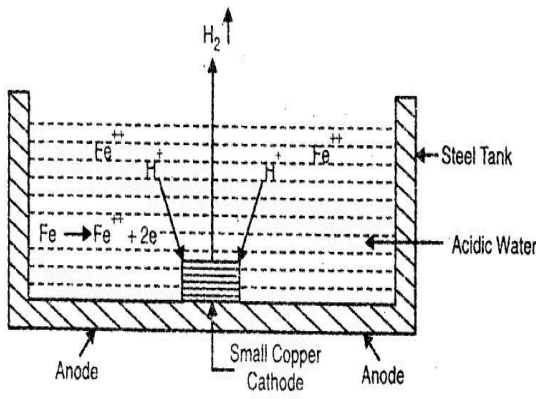
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Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2.	d)	<p>List <u>any four</u> characteristics of a good fuel.</p> <p>Characteristics:</p> <ol style="list-style-type: none"> 1) A good fuel should have a high calorific value. 2) A good fuel should 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 which causes air pollution. 	1 Mark each	4
	e)	<p>State composition, properties and applications of CNG.</p> <p>Composition:-</p> <ol style="list-style-type: none"> 1) CH₄ (methane) = 88.5% 2) C₂H₆ (ethane) = 5.5% 3) C₃H₈ (Propane) = 3.7% 4) C₄H₁₀ (butane) = 1.8% 5) Rest is H₂, CO₂, H₂S etc. <p>Properties:- (Any one)</p> <ol style="list-style-type: none"> 1) It is cheaper than petrol or diesel. 2) Its ignition temp is high (540⁰C). 3) It is odourless & non corrosive. 4) It is light weight gas. 5) Its calorific value is high. 6) Being free from lead & sulphur, its use substantially reduces harmful engine emissions. <p>Applications: (Any one)</p> <ol style="list-style-type: none"> 1) It is used in traditional petrol I.C. engine cars (petrol / CNG) 2) It is also used in locomotive generators to generate electricity that drives the motors of the train. 	2 1	4

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Que. No.	Sub. Que.	Model Answers	Marks	Total Marks
2.	f)	<p>Write the process of determining percentage of moisture and volatile matter in coal sample by proximate analysis.</p> <p>1) Percentage of Moisture:-</p> <p>i) About 1 gm of finely powdered air- dried coal sample is weighed (W g) in a crucible.</p> <p>ii) The crucible is placed in an electric hot oven for 1 hour at 105⁰C.</p> <p>iii) Cool it to room temp in a dessicator & weighed it again (W₁ g).</p> <p>iv) Loss in weight (W – W₁ g) is due to loss of moisture from the coal.</p> <p style="text-align: center;">% of moisture = $\frac{\text{Loss in weight}}{\text{Weight of coal sample}} \times 100$</p> <p style="text-align: center;">= $\frac{(W-W_1)}{W} \times 100$</p> <p>2) Percentage of Volatile Matter (V.M):-</p> <p>i) The above sample of moisture free coal left in crucible (W₁g) is covered with a lid.</p> <p>ii) Then the crucible is placed in a muffle furnace at 925⁰C for 7 min.</p> <p>iii) Cool it in desiccator to room temp & weigh it again. (W₂g) (Without lid)</p> <p style="text-align: center;">% of Volatile matter = $\frac{\text{Loss in weight}}{\text{Weight of coal sample}} \times 100$</p> <p style="text-align: center;">= $\frac{(W_1-W_2)}{W} \times 100$</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	4
3.	a)	<p>Attempt any FOUR:</p> <p>Explain stepwise mechanism of electrochemical corrosion by evolution of hydrogen gas.</p>	<p>1</p>	16
				4

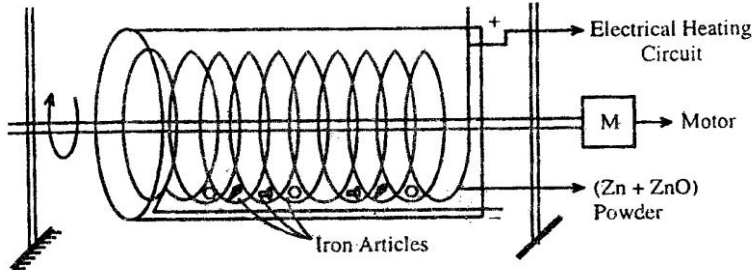


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3.	a)	<p>Steel tank: - Anode Copper strip:- Cathode</p> <p>These types of corrosion occur usually in acidic environments like industrial waste, solutions of non – oxidizing acids. Consider a steel tank containing acidic industrial waste and small piece of copper scrap in contact with steel. The portion of the steel tank in contact with copper acts as anode & is corroded most with the evolution of hydrogen gas.</p> <p>Reactions: At Anode: $\text{Fe} \longrightarrow \text{Fe}^{++} + 2\text{e}^{-} \quad (\text{Oxidation})$ These electrons flow through the metal from anode to the cathode that is piece of copper metal where they are accepted by H^{+} ions to form H_2 gas At cathode : H^{+} ions are eliminated as H_2 gas $2\text{H}^{+} + 2\text{e}^{-} \longrightarrow \text{H}_2 \uparrow (\text{Reduction})$ Thus, over all reaction is $\text{Fe} + 2\text{H}^{+} \longrightarrow \text{Fe}^{++} + \text{H}_2 \uparrow$</p>	1	4													
	b)	<p>Differentiate between Galvanizing - Tinning.</p> <table border="1"> <thead> <tr> <th>Sr.No.</th> <th>Galvanizing</th> <th>Tinning</th> </tr> </thead> <tbody> <tr> <td>i)</td> <td>A process of covering iron or steel with a thin coat of Zinc to prevent it from rusting.</td> <td>A process of covering iron or steel with a thin coat of Tin to prevent it from corrosion.</td> </tr> <tr> <td>ii)</td> <td>In galvanising, zinc protects the iron as it is more electropositive than iron.It does not allow iron to pass into solution.</td> <td>Tin protects base metal iron from corrosion, as it is less electropositive than iron and higher corrosion resistance.</td> </tr> <tr> <td>iii)</td> <td>In galvanizing Zn continues to protect the metal by galvanic cell action, even if coating of Zn is broken.</td> <td>In tinning, tin protects the iron, till the coating is perfect.Any break in coating causes rapid corrosion.</td> </tr> <tr> <td>iv)</td> <td>Galvanized containers can not be used for storing acidic food stuff, since Zn reacts with food acids forming Zn compounds which are highly toxic i.e. poisonous.</td> <td>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 does not causes food poisoning.</td> </tr> </tbody> </table>	Sr.No.		Galvanizing	Tinning	i)	A process of covering iron or steel with a thin coat of Zinc to prevent it from rusting.	A process of covering iron or steel with a thin coat of Tin to prevent it from corrosion.	ii)	In galvanising, zinc protects the iron as it is more electropositive than iron.It does not allow iron to pass into solution.	Tin protects base metal iron from corrosion, as it is less electropositive than iron and higher corrosion resistance.	iii)	In galvanizing Zn continues to protect the metal by galvanic cell action, even if coating of Zn is broken.	In tinning, tin protects the iron, till the coating is perfect.Any break in coating causes rapid corrosion.	iv)	Galvanized containers can not be used for storing acidic food stuff, since Zn reacts with food acids forming Zn compounds which are highly toxic i.e. poisonous.
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3.	c)	<p>Name and explain the method used to coat small and irregular shaped articles.</p> <p>The method used to coat small and irregular shaped articles is sherardizing.</p>  <p>Process:</p> <p>i) The iron articles (bolts, screws, nails etc) to be coated are first cleaned and then packed with Zn dust and ZnO powder in a steel drum, which is provided with electrical heating circuit arrangement.</p> <p>ii) The drum is slowly rotated for 2-3 hours and its temp is kept between $350^{\circ} - 400^{\circ}\text{C}$ during this process Zn gets diffused slowly into iron forming Fe - Zn alloy at the surface which protects iron surface from corrosion.</p>	1 1 2	4
	d)	<p>State <u>four functions</u> of lubricant in mechanical industry.</p> <ol style="list-style-type: none"> 1. It reduces the surface wear & tear & deformation, so that direct contact between the rubbing surfaces is avoided. 2. It reduces the loss of heat, so it acts as a coolant. 3. It reduces expansion of metal by local frictional heat. 4. It reduces unsmooth relative motion. 5. It reduces the maintenance & running cost of machine. 6. It reduces the power loss in I.C. engine. 7. In I.C. engine, the lubricant acts as a seal between the piston & cylinder wall, hence it prevents the leakage of gases at high pressure. 	1 mark each	4



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3.	f)	<p>i) Internal combustion engines: Mineral oils containing additives are used.</p> <p>ii) Sewing machines: Thin vegetable & animal oils like palm oil, hazel nut oil, neat foot oil, olive oil etc. are used.</p> <p>iii) Rail axel boxes: Greases or thick oils or thick blended oils are used.</p> <p>iv) Cutting tools: Mineral oil containing additives like fatty oils and oil-emulsions are used.</p>	1 1 1 1	