WINTER– 2017 EXAMINATION

Model Answer

Subject Code: 17203

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.

Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Attempt any nine of the following:**	**18**
	(a)	**Name any two iron ores with formulae.** 1) Magnetite - Fe_3O_4 (Ferroso ferric oxide) 2) Haematite - Fe_2O_3 (Ferric oxide) 3) Limonite - 2 $Fe_2O_3.3H_2O$ (Hydrated ferric oxide) 4) Iron Pyrite - FeS_2 5) Siderite - $FeCO_3$ (Ferrous carbonate)	**2** 1 Mark each
	(b)	**Write two functions of coke in blast furnace.** **Functions of coke-** **1)** Coke (C) is used as a reducing agent for oxides of metals. **2)** Coke (C) converts the ore into molten metal.	**2** 1 mark each
	(c)	**Define heat treatment of steel**. **Heat treatment: -** The process of heating steel to a certain high temperature and then cooling it at a controlled rate in order to develop certain physical properties without changing its chemical composition is known as heat treatment of steel.	**2** 2

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1	(d)	**State any two effects of alloying element Ni on steel.**	**2**
		1) Alloying element Ni is added into the steel to increase hardness, strength, ductility, toughness properties.	1
		2) It also increases the elasticity, heat & corrosion resistance properties of the steel.	1
	(e)	**State types of oxide films in atmospheric corrosion. Which oxide film is most corrosive?**	**2**
		Types of oxide films: (any two) 1) Stable film: a) Porous film b) No-porous film 2) Unstable film 3) Volatile film	½ mark each
		volatile film is most corrosive.	1
	(f)	**State any two factors affecting electrochemical corrosion.** **Factors affecting electrochemical corrosion:** 1) Position of metal in electrochemical series 2) Purity of metal 3) Nature of the oxide film 4) Solubility of corrosion products 5) Physical state of the metal 6) Relative areas of anode and cathode **(Note: Consider any relevant factor)**	**2** 1 Mark each
	(g)	**Write any four characteristics of good paint.** **Characteristics of good paints –** 1) It should possess highly surface coverage. 2) It should produce glossy, smooth film. 3) It should be available in required shades. 4) It should dry quickly. 5) It should produce tough, uniform, adherent and nonporous film. 6) It should be fluid enough so that can be applied easily. 7) It should produce water resistant film. 8) It should produce stable and inert film.	**2** ½ mark Each

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Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(h)	**Name and define the process used for protection of small iron articles from corrosion.**	2
		Sherardizing process is used for protection of small iron articles.	1
		Definition: It is the process of coating small iron or steel articles by alloying at surface with zinc metal.	1
	(i)	**Define calorific value, ignition temperature.**	2
		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.	1
		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
	(j)	**How percentage of moisture determined from solid fuel?**	2
		Percentage of Moisture:- i) About 1 gm of finely powdered air- dried coal sample is weighed (W g) in a crucible. ii) The crucible is placed in an electric hot oven for 1 hour at 105^0C. iii) Cool it to room temp in a dessicator & weighed it again (W1 g). iv) Loss in weight (W – W1 g) is due to loss of moisture from the coal.	1
		% of moisture = $\frac{\text{Loss in weight}}{\text{Weight of coal sample}}$ x 100 = (W-W1) / W x 100	1
	(k)	**Write any two applications of biodiesel.**	2
		1. It is an alternative fuel formulated exclusively for diesel engines with 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.	1 Mark each

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Q. No.	Sub Q. N.	Answer	Marking Scheme
1	(l)	**Write any two functions of good lubricant.** **Functions of lubricants -** 1) The first and foremost function of a lubricant is to reduce friction. 2) It reduces surface deformation, wear and tear because the direct contact between the rubbing surfaces is avoided. 3) It reduces loss of energy in the form of heat. In other words, it acts as a coolant. 4) It reduces waste of energy, so that efficiency of machine enhanced. 5) It reduces expansion of metal by local frictional heat. 6) It reduces unsmooth relative motion of the moving/sliding parts. 7) It reduces the maintenance and running cost of the machine as it prevents rust and corrosion. 8) It keeps out dirt. 9) It improves efficiency of the machine.	**2** 1 Mark each
2		**Attempt any FOUR of the following**	**16**
	(a)	**Write chemical reactions taking place in absorption zone of blast furnace.** **Heat absorption zone (800 to 1200 °C)** Following reactions take place in this zone. i) Any oxide of iron which has escaped from reduction is reduced by red hot carbon $Fe_2O_3 + 3C \rightarrow 2Fe + 3CO\uparrow$ ii) Carbon dioxide is reduced to carbon monoxide by heat absorption. $CO_2 + C \rightarrow 2CO + 39\ Kcal$ The hot spongy iron melts the ascending CO and decomposes a part of it to produce finely divided carbon. $2CO \rightarrow CO_2\uparrow + C$ lime obtained in the zone of reduction forms slag with silica. $CaO + SiO_2 \rightarrow CaSiO_3$ (Flux) (Gangue) (Slag) At about 1200℃, non-metallic and metallic oxides are reduced by coke to respective elements. 1) $SiO_2 + 2C \rightarrow Si + 2CO\uparrow$ 2) $MnO_2 + 2C \rightarrow Mn + 2CO\uparrow$ 3) $P_2O_5 + 5C \rightarrow 2P + 5CO\uparrow$ 4) $SO_2 + 2C \rightarrow S + 2CO\uparrow$ **(Consider any four reaction)**	**4** 1 mark each

Q. No.	Sub Q. N.	Answer	Marking Scheme
2	(b)	**How plain carbon steel are classified? Write properties and applications of any one plain carbon steel.**	**4**
		Classification of steel on the basis of carbon content – Plain Carbon steel is classified in three ways, **1.** Mild or low carbon steel **2.** Medium carbon steel **3.** High carbon steel	2
		1. Mild or low carbon steel (0.05-0.3%) **Properties –** It is soft, malleable and ductile. It is tough, it has good weldability, machinability **Uses –** It is used for thin soft wires, wires for rope etc. It is also used for general engineering items such as rods, channel sections, plates, bolts, nails, screws etc	2
		2. Medium carbon steel (0.3 - 0.6) **Properties –** It is hard and tough than mild steel, it has high tensile strength, it is shock resistant **Uses –** It is mainly used in railway engineering for railroads, wheels, and railway axles and fish plates. It is also used in making machines and gun parts, springs and various shafts.	
		3. High carbon steel (0.6 – 1.5%) **Properties –** It is quite hard and wear resistant. It has high tensile strength; its hardness can be increased by heat treatment. **Uses –** It can be used for carpentry tools, metal working tools such as chisels, hammers, dies, cutter, drills, knives etc. **(Consider any two properties and two applications of any one carbon steel)**	
	(c)	**Name and explain the heat treatment method which is used to increase cutting ability of steel.**	**4**
		Hardening or Quenching: It is applied to tools and some important machine parts made of alloy steel.	1
		'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'.	2
		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. 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. 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

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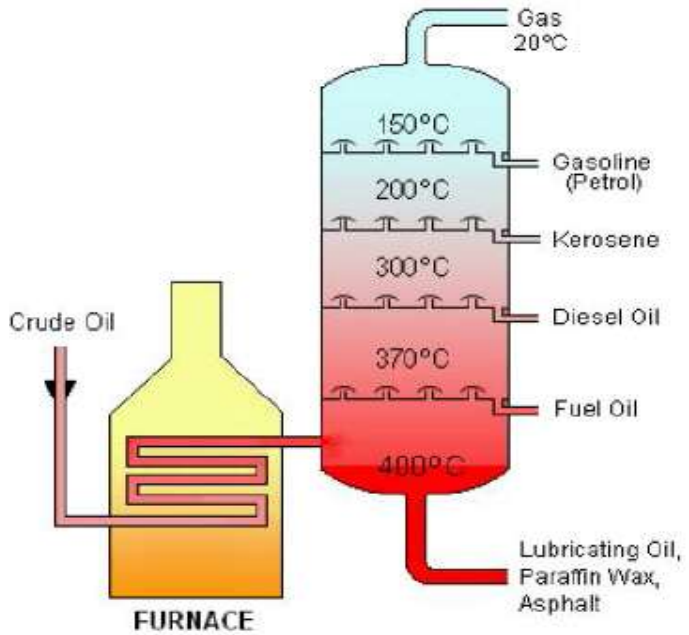
Q. No.	Sub Q.N.	Answer	Marking Scheme
	(d)	**Define fuel. List any three characteristics of good fuel.** **Fuel:** A fuel can be defined as any combustible substance which during combustion gives large amount of heat energy. **Characteristics of good fuel.** 1) It should have moderate ignition temperature. 2) It should have high calorific value. 3) It should possess moderate velocity of combustion. 4) It should have low contents of non-combustible matter. 5) It should have low moisture content. 6) Its products of combustion should not be harmful. 7) It should be available in bulk at low cost. 8) It should be easy to store and transport. 9) It combustion should be easily controllable. 10) It should not undergo spontaneous combustion. 11) It should burn in air with efficiency.	**4** 1 1 mark each
	(e)	**Draw a neat labeled diagram for refining of crude petroleum. Write composition and applications of any two petroleum fractions.**  	4 2

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Q. No.	Sub Q. N.	Answer	Marking Scheme
2.			

Sr. No.	Petroleum Fractions	Composition	Applications
1	Uncondensed gases	CH_4-C_4H_{10}	1. Domestic or industrial fuel as LPG for making carbon black
2	Gasoline (petrol)	C_5H_{12}-C_9H_{20}	1. As a solvent 2. As automobile fuel 3. In dry cleaning
3	Kerosene	$C_{10}H_{22}$-$C_{16}H_{34}$	1. As an illuminant 2. In stoves and jet engine fuel 3. In manufacturing of oil gas
4	Diesel Oil or fuel oil	$C_{15}H_{32}$-$C_{18}H_{38}$	1. Diesel engine fuel
5	Heavy oil- a. Lubricating oil, b. Petroleum jelly c. Greases d. Paraffin wax	$C_{17}H_{36}$-$C_{30}H_{62}$	a. As lubricant b. As lubricant, in medicines and cosmetics c. As lubricant d. In ointments, candles, shoe polishes etc.
6	Asphalt (Residue)	$C_{30}H_{62}$ and above	1. In road making and 2. Water proofing of roofs

2

(Consider any two fractions)

(f) **Write composition, properties and applications of CNG.** **4**

Composition: -

1) CH_4 (methane) = 88.5%
2) C_2H_6 (ethane) = 5.5%
3) C_3H_8 (Propane) = 3.7%
4) C_4H_{10} (butane) = 1.8%
5) Rest is H_2, CO_2, H_2S etc.

2

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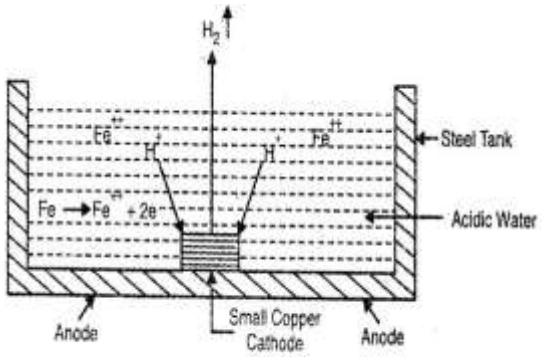
Q. No.	Sub Q. N.	Answer	Marking Scheme
2		**Properties: - (Any one)** 1) It is cheaper than petrol or diesel. 2) Its ignition temp is high (540^0C). 3) It is odorless & non-corrosive. 4) It is light weight gas. 5) Its calorific value is high. 6) Being free from lead & Sulphur, its use substantially reduces harmful engine emissions.	1
		Applications: (Any one) 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.	**1**
Q. 3		**Attempt any four of the following:**	**16**
	(a)	**Explain hydrogen evolution mechanism of electrochemical corrosion.**	**4**
			1

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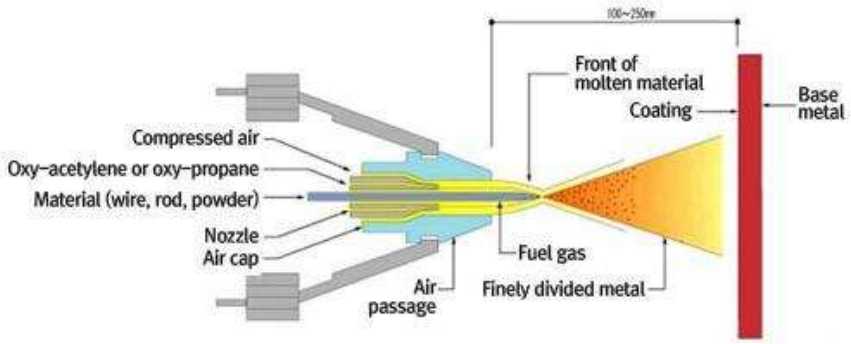
Q. No.	Sub Q. N.	Answer	Marking Scheme
3		**Steel tank: - Anode** **Copper strip:- Cathode** These types of corrosion occur usually in acidic environments like industrial waste, solutions of non – oxidizing acids. Consider a steel tank containing acidic industrial waste and small piece of copper scrap 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. **Reactions:** **At Anode:** **$Fe \longrightarrow Fe^{++} + 2e^{-}$ (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 **$2H^+ + 2e^{-} \longrightarrow H_2\uparrow$ (Reduction)** Thus, over all reaction is **$Fe + 2H^+ \longrightarrow Fe^{++} + H_2\uparrow$**	1 1 1
	(b)	**Distinguish between Galvanizing and tinning.**	**4**

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 galvanizing, 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 cannot be used for storing acidic food stuff, since Zn reacts with food acids forming Zn compounds which are highly toxic i.e. poisonous.	Tin coated containers and utensils can be used for storing any food stuff since Tin is nontoxic and protects the metal from corrosion and does not causes food poisoning.

1 mark each

Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	(c)	**Explain metal spraying method used for protection of metal from corrosion** **Diagram:**  **Process: -** In this method, coating metal sprayed on the surface of base metal with the help of spraying gun or pistol. The spraying gun consist of a duct for compressed air and is fitted with the oxy- hydrogen flame. The coating metal in the form of wire is fed into the gun which is then melted inside the gun with the help of oxy hydrogen flame. The molten metal then sprayed on the surface of base metal with the help of compressed air.	4 1 3
	(d)	**Define:** **i) Cloud point** **ii) Pour point** **iii) Acid value** **iv) Viscosity index.** **i) Cloud point:** It is defined as the temperature at which the oil becomes cloudy or hazy in appearance (due to separation of wax). **ii) Pour point:** It is defined as the temperature at which oil ceases to flow or pour on cooling. **iii) Acid value:** It is defined as the number of milligrams of KOH required to neutralize free acids present in one gram of oil. **iv) Viscosity Index:** The rate of change of viscosity of a liquid (Oil) with the change of temperature is known as viscosity index.	**4** 1 Mark each

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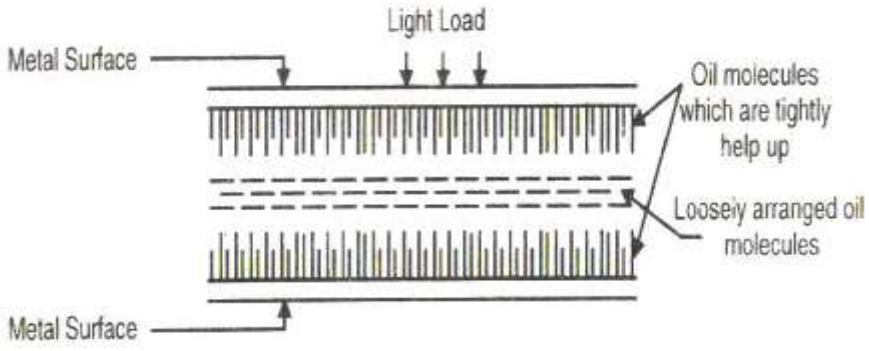
Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	**(e)**	**Explain mechanism of fluid film lubrication with diagram.** **Fluid film lubrication:** i) It is carried out by introducing the liquid lubricants in between the moving or sliding surface. The lubricant film covers the irregularities of the sliding or moving surface & forms a thin layer in between them. This thin layer of lubricant avoids metal to metal contact & reduces wear & friction. 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. iii) In fluid film lubrication, the lubricant chosen should have the minimum viscosity under working condition & at the same time it should remain in place & separate the surfaces. **Examples:** This type of lubrication is provided in case of delicate instrument and light machines like watches, clocks, guns, sewing machines, scientific instrument etc. **Diagram**  	**4** 3 1

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Q. No.	Sub Q. N.	Answer	Marking Scheme
3.	**(f)**	**Write operating conditions and name the lubricant for following:** **i) lC engine** **ii) Cutting tools** **iii) Sewing machine** **iv) Gears**	**4**

Sr. No.	Machine	Operating conditions	Lubricant
i)	**IC engine**	When it is exposed to high temperatures	Mineral oils containing additives
ii)	**Cutting tools**	High friction between tool and metal work piece results in liberation of large amount of heat	Mineral oil containing additives like fatty oils and oil-emulsions
iii)	**Sewing machine**	When it is not exposed to high temperatures, heavy loads or water	Thin vegetable & animal oils like palm oil, hazel nut oil, neat foot oil, olive oil etc.
iv)	**Gears**	When it is subjected to extreme pressure	Thick Mineral Oil containing extreme pressure additives

1 mark each