HRIDHA Series

Objective Type & Short Questions & Answers on

METALLURGICAL ENGINEERING

Arbind Kumar

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Metallurgical Engineering through Conventional and Objective Type Questions with Answers

for All types of Competition and Interviews

Arbind Kumar
B. Tech (Met. Engg.) ; M. Tech (Foundry)
I.I.T. Khargpur

KHANNA PUBLISHERS®
Investing in Learning®
Operational Office :
4575/15, Onkar House, Opp. Happy School,
Ground Floor, Daryaganj, New Delhi 110 002
Phones : 011-45033819 • *Mob*. 09811541460
email : contactus@khannapublishers.in

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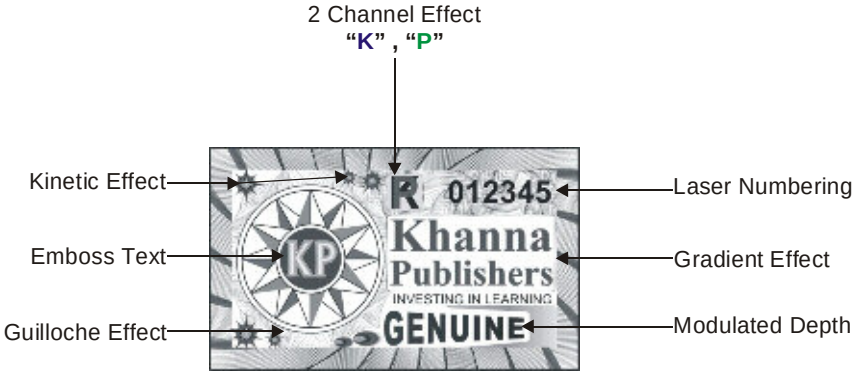

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Preface to the Ninth Edition

The present edition has been thoroughly revised and enlarged. A textbook and question-answer form book have complementary roles to play. Whereas the textbook intends to impart sound knowledge to the student, it fails to convey the important topics and typical questions, on which emphasis has to be given for university and competitive examinations. The present book serves this purpose. It may also be considered as rapid reading book for the revision of metallurgical topics for the students of A.I.I.M., A.M.I.E., diploma and B.Tech. students. The questions have been framed with great care, in view of the modern trend of competitive examinations.

Part I, of this text contains over 1150 short questions and answers and Part II, consists of 1825 objective type of questions with answers.

In Part IV, model test questions have been included for the guidance of students appearing in management trainees (technical) tests. It also contains 410 questions and guidance for group-discussions to be conducted for viva-voce as per latest trends, in the field of metallurgy.

It is hoped that this book will serve as an excellent guide for the students and those preparing for any type of competition or interview in metallurgy.

Suggestions for the further improvement of the book are welcomed and will be gratefully acnowledged.

Bokaro Steel City.

A. Kumar

Contents

PART I

SHORT QUESTIONS AND ANSWERS

1

General Metallurgy

Q. 1. What is metallurgy?

Ans. Metallurgy is that branch of engineering, which deals with the extraction of metals, their uses and service to mankind.

Q. 2. Define metal.

Ans. Metal is that material, which possesses lusture, strength, high hardness, high ductility and high thermal and electrical conductivities.

Examples: aluminium, copper, iron, cobalt, nickel etc.

Q. 3. Define non-metal.

Ans. Non-metal is that material, which has low value of lusture, strength, hardness and conductivity. Examples: carbon, sulphur, phosphorus, glass etc.

Q. 4. Define ferrous and non-ferrous metals.

Ans. Iron is a ferrous metal and rest all are called non-ferrous metals, such as copper, aluminium, zinc, lead, tin, cobalt etc.

Cast iron, wrought iron, steel also come under ferrous group.

Q. 5. What is metalloid?

Ans. Metalloid possesses the characteristics of both metals and non-metals, such as antimony and arsenic.

Q. 6. Can we call lead a non-metal, because of its low hardness?

Ans. No, lead is a metal. It is only an exceptional example of metal.

Q. 7. Is mercury a metal or non-metal?

Ans. Mercury is a metal. It is only metal, which exists in liquid state at room temperature.

Q. 8. Give examples of light, heavy, noble, refractory, radioactive and rare-earth metals.

Ans. Examples of few such metals are as follows:

Light metals	—	Al, Mg, Ca, Ba, Sr, Na, K, Li, Rb.
Heavy metals	—	Ni, Cu, Pb, Zn, Sn.
Noble metals	—	Ag, Au, Pt, Ru, Rh, Pd, Os.
Refractory metals	—	Mo, W, Ti, Ta, Zr, La.
Radioactive metals	—	U, Ra, Po, Th.
Rare earth metals	—	Ce, La, Y, Nd.

Q. 9. Define Ores.

Ans. Ores are metal bearing minerals, from which that metal can be extracted economically.

Q. 10. Do we find metal in free state also?

Ans. Few metals such as gold, silver occur in free state also.

Q. 11. What are the three main magnetic properties of metals?

Ans. These are ferro-magnetism, dia-magnetism and para-magnetism.

Q. 12. Give suitable examples of ferro-magnetic substances.

Ans. Iron, cobalt and nickel are ferro-magnetic substances.

Q. 13. What are different optical properties of materials?

Ans. The optical properties of materials include colour, lusture, diffraction, reflectivity, fluorescene and reflectivity.

Q. 14. What do we mean by lusture property of a metal?

Ans. All metals (except lead), when polished have lusture, which is the ability of the surface to reflect light.

Q. 15. What is brittleness?

Ans. Brittleness is the property of fracturing of a material, without appreciable deformation. Thus brittleness is property opposite to ductility; Examples: cast iron, concrete.

Q. 16. What is malleability?

Ans. It is that property of material, by virtue of which, that can be permanently deformed by compressive force, without fracture or rupture. Gold, silver, steel, nickel, aluminium, ductile iron etc. have malleable property.

Q. 17. Define toughness.

Ans. It is the amount of energy, that a material can absorb before its fracture. In other words, it is a measure of relative degree of resistance of a material, to resist impact. Pneumatic hammers, drop hammers, anvil etc. possess high toughness.

Q. 18. What is resilence?

Ans. It is the capacity of a material to absorb or store energy. An elastic resilence is defined as the amount of energy absorbed in stressing a material up to elastic limit.

Q. 19. What do we mean by term-mechanical metallurgy?

Ans. This branch of metallurgy deals with the response of metals to forces or loads. Thus we get knowledge of strength of materials and other mechanical properties of materials from this subject.

Q. 20. What are the main uses of metals and alloys?

Ans. In almost all fields, metals and alloys are used. Our daily useful items, like window, lock, utensil, stoves, bus, car, engines, aeroplanes, buildings, any structure cann't be imagined, without the use of metals or alloys. Atomic plants utilises U, Th, Zr, electric industry utilises Zr, Si; mechanical working tools utilise carbides of Mo, W and special steels and many metals/ alloys are used for different specific purposes.

Q. 21. What are main metallurgical extractive processes?

Ans. Extractive processes of metal may be broadly classified into three groups:

(*a*) pyrometallurgy (*b*) hydrometallurgy and (*c*) electrometallurgy.

Q. 22. Define pyrometallurgy.

Ans. Pyrometallurgy is the extractive process, which utilises thermal means for decomposition of feed material (*i.e.* ore, fuel, flux etc.) and then separation and consolidation of metal.

Q. 23. Define hydrometallurgy.

Ans. Hydrometallurgy is the extractive process, in which a solvent is used, to leach out the metal from its ore, followed by precipitation in metallic form.

Q. 24. Define electrometallurgy.

Ans. In electrometallurgy, electrical energy is used for electrolytic dissociation of metal from its aqueous solution or a salt bath.

Q. 25. Define bye-product.

Ans. During extraction of any metal from its ore, other metals are also obtained in appreciable amount, called bye-products. It happens because, some minerals occur in close association with principal minerals.

As for example — As, Bi, Sb, Cd, Co, Au, Ag etc. are obtained as bye-product, during Zn, Cu, Pb extraction.

In manufacture of coke by coke oven battery, tar, naphthalene, pitch are obtained as bye-product.

Q. 26. What are merits of vacuum treated metals?

Ans. Vacuum treated metals are clean and pure metals. These are free from any contamination of other metals blowhole, porosity, dirt, inclusion etc. This metal provides sufficient strength and requires specific property of that metal. Say, pure copper will have excellent thermal and electrical conductivities.

Q. 27. What are main metals, which can be extracted by pyrometallurgical process?

Ans. Copper, lead, nickel, zinc may be extracted pyrometallurgically, from their sulphide ores. Iron is extracted from its oxide ore by this method.

Q. 28. What are main metals, which can be extracted by hydrometallurgical process?

Ans. Copper from its oxide ore, magnesium from sea water, Zinc from sulphide ore, may be extracted by hydrometallurgical process.

Q. 29. What is difference in hydrometallurgy and pyrometallurgy of copper extraction?

Ans. In pyrometallurgy, copper sulphide ores are treated by thermal means *i.e.* (roasting, smelting) flash smelting, bessemerisation to get copper.

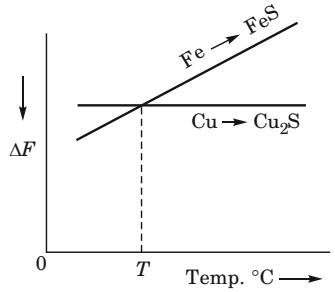
In hydrometallurgy, Copper sulphide ores are leached in a suitable solvent to precipitate, the metal. Recent development has been taken place in leaching technique, such as pressure leaching, bacteria leaching.

Q. 30. What are the main metals, which can be extracted by electrometallurgical process?

Ans. Aluminium, magnesium, sodium can be extracted by electrometallurgical process.

Q. 31. In mattle smelting, why FeS is removed first, and then followed by Cu_2S?

Ans. If we study metal sulphide system, it is evident that Cu_2S is more stable than FeS.



ΔF denotes free energy change.
Above temperature T, FeS is less stable, therefore FeS will be removed first.

Q. 32. If a mixture of lead sulphide and copper sulphide are heated above 280ºC, which will be first oxidised.

Ans. In Ellingham diagram of metal sulphide systems, curves of Cu_2S and PbS intersect at 280ºC. Above 280ºC, Cu_2S has more negative free energy change, so it is more stable. Thus PbS, being less stable, will be reduced first.

Q. 33. What are the metal sulphides, which can be decomposed simply on heating?

Ans. Bi_2S_3, HgS and CuS are very unstable and they decompose simply on heating.

Example: $$HgS \xrightarrow{\text{heat}} Hg + S$$

Q. 34. Why sulphide ores are first roasted?

Ans. In general, direct reduction of sulphide ores of metal are not possible. Thus, these are first roasted before smelting, to get in its oxide form.

Q. 35. What do we mean by drying operation?

Ans. Drying means removal of moisture or water from any material. Generally solid materials are dried by heating, so that water present in it, is evaporated.

Q. 36. How do we accomplish drying of gases?

Ans. If we require drying of gases or air, it may be performed by passing it, over suitable drying agents, such as calcium carbide, silica gel or sulphuric acid. These substances absorb water.

Q. 37. What is calcining?

Ans. Originally, Calcining was the term being used for burning of limestone. In Latin, calx means lime or limestone. But, now a days, calcining involves any reaction, in which solid material is heated below fusion point, to dry off volatile components—like carbon dioxide, organic matters and chemically combined water.

Q. 38. What is basic difference between calcining and roasting?

Ans. In calcination, heating is done to evaporate volatile components—like carbon dioxide, water etc., whereas roasting involves a chemical reaction between gas and a solid ore.

Q. 39. What do we call the reaction of heating magnesite to 1000°C?

Ans. It is a calcination reaction, where magnesite is decomposed to MgO and CO_2 as follows:

$$MgCO_3 \longrightarrow MgO + CO_2$$

Q. 40. What is displacement reaction?

Ans. Let us consider a reaction

$$M_1^+ A_1^- + M_2^+ B_2^- \longrightarrow M_1^+ B_2^- + M_2 A_1^-$$

This type of reaction is called a displacement reaction. A typical example of this reaction is the reaction of iron sulphide and calcium oxide.

$$FeS + CaO \longrightarrow FeO + CaS$$

Q. 41. Can the chlorides be decomposed by heating?

Ans. The chlorides cann't be decomposed by heating. Only carbon tetrachloride (CCl_4) decomposes at 750°C.

Q. 42. What is chloridising roasting process?

Ans. In this process, metallic oxide ores are converted to chlorides by heating with chlorine gas.

Example: $$2MnO + 2Cl_2 \longrightarrow 2MnCl_2 + O_2$$

Q. 43. Why Al, Mn, Si, Ti are used as deoxidisers?

Ans. These metals have very high affinities for oxygen and form stable oxides. Thus these serve the purpose of deoxidisers.

Q. 44. Do we get the idea of Kinetics of the reaction by Ellingham diagram?

Ans. No, it doesn't give such idea. It is only the plot of free-energy change of the reaction and temperature.

Q. 45. What is autogeneous roasting?

Ans. In common roasting process, some fuel is used in roasting furnace, to maintain the required temperature. But in the autogeneous roasting process, heat generated by roasting process is sufficient enough to continue or promote the reaction.

Q. 46. What are the various means, by which roasting is performed?

Ans. Roasting is performed by following means:

(*a*) heap roasting (*b*) reverberatory furnace

(*c*) mechanically raked furnace, *viz.* hearth roasting, suspension roasting, fluidised bed roasting and

(*d*) blast roasting.

Q. 47. Why do we prefer to remove harmful impurities of metal by oxidation?

Ans. Most of the oxides are insoluble in water or metal. Therefore, it is easy to remove the harmful impurities by oxidation and removing the oxides in the form of slag.

Q. 48. What type of atmosphere (oxidising or reducing) is present in L.D. process of steel making?

Ans. Oxidising atmosphere prevails in L.D. steel making process.

Q. 49. What is chemical formula of Faylite?

Ans. The chemical formula of Faylite is $2FeO, SiO_2$, which is present in slag.

Q. 50. Do we charge iron ore in Cupola furnace?

Ans. No, iron ore is not charged. Pig iron or iron scrap is charged, with coke and flux (limestone).

Q. 51. Mention few metallurgical furnaces.

Ans. Few Metallurgical furnaces are as follows: Crucible furnace, Bessemer converter, L.D. Converter, electric arc furnace, rocking arc furnace, blast furnace, cupola, reverberatory furnace, muffle furnace etc.

Q. 52. What are the main products, which can be produced by powder metallurgy technique?

Ans. Few main products of this process are babitted bearings for automobile, porous self-lubricating bearings, cemented carbides, metallic filters, motor brushes etc.

Q. 53. Why powder metallurgy technique is utilised for the manufacture of few products, even though it is a costly process?

Ans. Powder metallurgy technique is best suited for refractory or high melting point materials, which are very difficult to work with machines. By this process, metallic products are obtained by metallic powder of single metal or various metals or of a combination of metals and non-metals by applying pressure. Those metals cann't make solid solution, can be processed by powder metallurgy technique.

Q. 54. What is refining process?

Ans. After extraction of metals, refining is done to obtain it in more purer form. As for example, after electrolytic refining, we get 99.99% pure copper.

Q. 55. What are different refining processes?

Ans. Main refining processes are fire refining, liquation, drossing, sublimation, vacuum distillation, zone refining, electrolytic refining, electro-slay refining etc.

Q. 56. What is dross?

Ans. Dross is a term used for the oxides of metals.

Q. 57. What is drossing?

Ans. In drossing, addition of another metal is done, which combines with the impurities to form high melting point compounds. The latter can be easily separated leaving behind the pure metal. Commonly dross consists of oxides of impurities and other insoluble compounds.

Example: Copper is removed from tin and lead by stirring in sulphur.

In desilverisation of lead, zinc is used.

Q. 58. What is the principle of liquation?

Ans. Liquation refining is based on following two principles:

(*a*) molten metal immisicibility, and

(*b*) melting point difference.

Ex.: Molten lead and zinc are practically immiscible. If this mixture is heated to melting point of zinc, two liquids exist—one rich in zinc and other rich in lead. The former is lighter and floats on the top.

Q. 59. What is the principle of distillation?

Ans. This utilises the property of difference in boiling points of different metals. Metals, which vaporises first can be condensed to separate it from other metal.

In practice retort, reflux condenser or fractionating column is used for distillation purpose. Chemical separation of zinc from lead can be done and purity of zinc obtained is 99.99%.

Q. 60. What is main difference between vacuum distillation and common distillation technique?

Ans. In vacuum distillation, the reduction of surrounding pressure causes lowering of the temperature required for vaporisation. In this process, sublimations may occour *i.e.* vaporisation without melting which doesn't occur in ordinary distillation technique. Vacuum technique also serves the purpose of degassing.

Q. 61. What are different processes involved in leaching of hydrometallurgy process?

Ans. There are mainly three processes or principles involved in leaching such as ion exchange, solvent extraction, and pressure leaching.

Q. 62. What is main difference between hydrometallurgy and electrometallurgy?

Ans. Hydrometallurgy and electrometallurgy are closely related. In electrometallurgy, electrolysis is used to precipitate the metal from the solution, metal accumulates at cathode.

In hydrometallurgy, extraction is done by separation of metal from its suitable solution. Separation of a soluble substance from an insoluble one is done by means of a suitable solvent say water, acid, and alkali.

Q. 63. Mention few important leaching solvents.

Ans. Few important solvents are as follows:

Water, acid (sulphuric acid, hydrochloric acid) base (sodium hydroxide, ammonium hydroxide, Mixture of ammonium carbonate and ammonium hydroxide).

Salt (sodium cyanide, potassium cyanide ferric chloride, ferric sulphate).

Q. 64. What are different leaching processes?

Ans. Different leaching processes are — heap leaching, sand leaching, slime leaching, pressure leaching, bacteria leaching.

Q. 65. Can we use leaching technique for uranium extraction?

Ans. Yes, dissolution of oxides of uranium may be done by sulphuric acid (acid leaching) or sodium carbonate (alkaline leaching).

Q. 66. Can conversion of copper into copper ion be represented in the form of chemical formula?

Ans. Yes, it can be represented as follows: $Cu \Rightarrow Cu^{++} + 2e$

Q. 67. Define gangue materials.

Ans. Gangue materials are impurities or unwanted materials associated with the ore of any metal. Gangue materials are generally removed before going for the expensive process of metal extraction and few are removed in the form of slag during smelting.

Q. 68. Define flux.

Ans. Flux is used to react with the gangue materials and it also lowers down the operating temperature of the process.

Q. 69. Define slag.

Ans. Slag contains the impurities of ore minerals or other feed materials of the furnace. Slag is generally the product of flux and gangue materials present in the charge.

Q. 70. What are different type of fluxes? Give suitable examples.

Ans. There are mainly three type of fluxes, such as,

(*a*) acid flux – Example: silica (SiO_2)

(*b*) basic flux – Example: limestone ($CaCO_3$), dolomite ($CaCO_3$, $MgCO_3$)

(*c*) neutral flux – Example: fluorspar (CaF_2)

Q. 71. What is the use of slag?

Ans. Slag is used for the following purposes:

(*a*) manufacture of cement (*b*) as building materials

(*c*) as road materials (*d*) for insulating material

(*e*) basic slags (containing Phosphorus) for making fertilisers

(*f*) for roof covering.

Q. 72. What is the basicity of slag?

Ans. Basicity of slag is mainly the ratio of CaO and MgO to SiO_2 *i.e.* Basicity = $\frac{CaO + MgO}{SiO_2}$

If this ratio is more than one, the slag is called basic and if this ratio is less than one, the slag is acidic. Basicity ratio-one, makes the slag neutral.

Q. 73. Can we call electrometallurgy as thermo-electrolytic extraction process?

Ans. Yes, in electrometallurgy, electrolytic extraction of metal is done from its fused mineral or salt mixture. Once the bath has been melted, it is usually kept hot enough by the heating effect of the electrolytic current.

Q. 74. Is there any relation between viscosity and dimensions of the liquid melt?

Ans. Yes, the viscosity of the liquid melt is increased as the dimensions of the molecules are increased.

Q. 75. Which slag will be more fluid—slag having simple or complex structure.

Ans. The slag having simple structure will be more fluid. The viscosity of a liquid increases, if the structural complexity increases.

Molecular size of complex structure is more.

Q. 76. Do we prefer direct reduction in blast furnace operation?

Ans. No, indirect reduction is preferred in iron making by blast furnace operation.

Q. 77. What are the main Constituents of blast furnace slag?

Ans. Main Constituents of blast furnace slag are CaO, SiO_2, MgO, Al_2O_3, MnO, FeO and CaS.

Q. 78. What are the basic requirements for the formation of binary alloys?

Ans. Two metals will make an alloy, if they mix together to make a homogeneous solution. After solidification, it is obtained in crystalline form like a common metal. In special cases, alloying may also be accomplished, at temperatures below the melting point, by diffusion between contacting metals or reactive gases.

Examples: Carburisation, Cementation etc.

Q. 79. Do Copper-nickel, copper-zinc, copper-tin systems form solid solution in all proportions?

Ans. Yes.

Q. 80. What are the factors, which govern the mechanical properties of single atom and crystal?

Ans. A crystal is generally an aggregate of a tiny randomly positioned grains.

The behaviour of an aggregate differs from that of a single grain due to

(*a*) mutual reinforcement between the grains

(*b*) directional properties (*c*) uniformity of properties

(*d*) grain boundry strength (*e*) grain boundry segregation.

Q. 81. Why pure iron is not useful for engineering purposes?

Ans. Pure iron has almost no commercial use. But, when some elements are added, its properties change rapidly, resulting in its wide application, Example: Cast irons, wrought iron, plain carbon steel, alloy steels have extensive application.

Q. 82. How the quenching of plain carbon steels from 950°C, cause hardness?

Ans. Martensite sturcture is formed, which cause the steel hard.

Q. 83. What is free machining steel?

Ans. Free machining steels can be easily machined. Machinability property is influenced by its composition, heat treatment, inclusions (like sulphide) etc.

Q. 84. Define atom.

Ans. Under the proper conditions of treatment, all forms of matter may be decomposed to ultimate units called atom. Atoms are further composed of neutron, proton, electron, meson etc.

Q. 85. What is difference between electro-refining and electro-plating?

Ans. In electro-refining, metal after extraction from its ore is purified or refined in an electrolytic bath. But in electroplating, coating of some metal is done on some articles, such as galvanising, aluminising, chromising etc.

Q. 86. Define corrosion of metals.

Ans. It may be defined as deterioration, destruction, or loss of metal due to the chemical action of environment. Environment may include air, moisture steam, acid, alkali, gases etc.

Q. 87. How can we protect metals from corrosion?

Ans. Followings are the means to protect corrosion of metals by:

(*a*) coatings of paints, varnishes etc.

(*b*) metallic coatings *e.g.* galvanising, aluminising, chromising etc.

(*c*) the use in suitable alloy form or change in composition of metal, if possible.

(*d*) change in design of component.

Q. 88. What are the main constituents of brass and bronze?

Ans. In brass, copper and zinc are main constituents, whereas bronze contains mainly copper and tin.

Q. 89. What is the main use of Chromel? What is its composition?

Ans. Chromel is used mainly as thermocouple and it possesses 60 percent copper and 40 per cent nickel.

Q. 90. What does Ni-chrome contain?

Ans. Ni-chrome contains 80 percent nickel and 20 percent chromium.

Q. 91. What is 18 : 14 : 1 steel?

Ans. It is called high speed steel. It basically contains 18% tungsten, 4% Chromium and 1% Vanadium. It is widely used as cutting tool material.

Q. 92. What is miraging steel?

Ans. This steel has very high yield strength, good toughness and good ductility properties. Its typical composition is C $\rightarrow$ (0.003–0.03)%, Ni $\rightarrow$ (18–25)%, Co $\rightarrow$ (8–9)%, Mo $\rightarrow$ (3–5)%, Ti (0.2–0.6)% and Al $\rightarrow$ (0.1–0.2)%.

Practically it is free from carbon and is precipitation hardened. It may be used for making aeroplane landing gears, rocket, motor cases.

Q. 93. What is cartridge brass?

Ans. It is α-Brass *i.e.*, (70 : 30) brass. It can be cold-rolled to sheet, deep drawn and pressed for tube making and Cartridge for gun shots.

Q. 94. What are α-, β-, and α-β brasses?

Ans. Brass is mainly an alloy of copper and zinc.

Compositions of α-, β- and α-β brass are as follows:

α – Brass (Alpha, brass) $\rightarrow$ Zn(0–39)% and rest copper

β – Brass (Beta, brass) $\rightarrow$ Zn(39–50)% and rest copper

α – β Brass – Cu – 60%, Zn – 40%.

Q. 95. What is self-fluxing ore?

Ans. Generally in pyrometallurgical process of metal extraction, ore minerals are heated with flux. If the ore already contains flux and flux is not required to be added with ore, the ore is called self-fluxing ore.

Q. 96. How purification of lead bullion is done?

Ans. Lead bullion contains copper, arsenic, sulphur, antimony, tin and precious metals gold and silver as impurities. Cu, As, S, Sb, Sn are eliminated by "softening process", where lead bullion is heated in reverberatory furnace. Oxides of these impurities are formed. This operation is called "drossing".

Lead obtained after softening operation contains only silver and gold. This lead is further purified by "desilverisation process".

There are two main processes of desilverisation of lead *viz*. Pattinson's process and Parke's process.

Q. 97. What is Babbit metal?

Ans. It generally contains, tin (80–90)%, antimony (5–15)% and copper (2–5)%. It is used for cast lining in bronze, steel for internal combustion engines and making bearings.

Q. 98. What is transformer steel?

Ans. Silicon present in steel increases its electrical resistance and therefore it becomes suitable for transformer grade steel. It basically contains Si – (4.5–5)%, Mn – 0.1%, P – 0.02%, S – 0.02%, C – 0.05% and rest iron.

Q. 99. What is "Inconel"?

Ans. It contains Ni – 80%, Cr – 14%, Fe – 6% and traces of Ti, Al, Nb. This alloy has excellent resistance for high temperature corrosion, oxidation and creep property. It is used for insulating blanket in jet engines.

Q. 100. What is Hastelloy?

Ans. It contains Ni – (57–63)%, Mo – (18–30)%, Fe (5–19)%. Some iron is reflected by additions of Cr, W and Co. This alloy has excellent properties, at high temperature and possesses high corrosion, oxidation and creep-resistance.

Q. 101. What are different type of Cast irons?

Ans. Main Cast irons are white cast iron, gray cast iron, mottled cast iron, malleable cast iron, ductile cast iron, alloy cast iron. In alloy cast irons, various alloying elements are added to achieve desired properties and in other cast irons, carbon may be present in either elemental form (graphite nodules, graphite flaxes) or in combined form (cementite).

Q. 102. What are different type of plain carbon steels?

Ans. Plain carbon steels have distinctive properties, due to its variation in carbon content. Mainly there are three types as follows:

Plain carbon steels have distinctive properties due to its variation in carbon content. Mainly there are three types as follows:

low carbon steel	—	(0.08–0.3)% C
medium carbon steel	—	(0.3–0.6)% C
high carbon steel	—	(0.6–1.5)% C.

Q. 103. What is 18 : 8 steel?

Ans. It is a typical grade of stainless steel, which contains 18% Chromium and 8% Nickel as alloying elements. Stainless steel, in general, possesses high resistance to corrosion and oxidation.

Q. 104. What is the main alloying element, which imparts heat resistant properties to steel?

Ans. Addition of chromium from (12–30)% imparts heat-resistance to steel.

Q. 105. What is Y-alloy?

Ans. It possesses good casting quality and used for air-craft engines, cylinder heads and piston. Its typical composition is Cu – 4%, Ni – 2%, Mg – 1.5%, Si – (0.6)% Max., Fe – 0.6% and rest Al.

Q. 106. What is Duralumin alloy?

Ans. It owes special properties of high strength to weight property and is widely used for automobile and air-craft industries. Its other uses are for making electrical cable, castings, forged and stamped components.

Q. 107. What are spring steels?

Ans. For making springs, following grades of steel are commonly used:

(a) high carbon steel – C– (0.6–1.1)% uses for springs for locomotive wagons, road vehicles.

(*b*) chrome-vanadium steel C – (0.45–0.55)%, Cr – (0.9–1.2)%, V – (0.15–0.20)%, Si (0.3–0.5)%, Mn (0.5–0.8)% uses for laminated springs, automotive and air-craft engine value springs, coil springs.

(*c*) Silico-chrome steels TC – (0.55–0.65)%, Si (0.5–0.9)%, Cr – (0.5–0.8)%, Mn (0.4–08)% uses for suspension and compression helical spring motor, and rail leaf spring.

(*d*) Silico-manganese steel, C – (0.5–0.6)%, Si (1.8–2.0)%, Mn (0.8–1.0)% uses for springs of general engineering purposes.

Q. 108. What is Y-alloy?

Ans. It possesses good casting qualities and used for air-craft engines, cylinder heads and pistons. Its typical composition is Cu – 4%, Ni – 2%, Mg – 1.5%, Si – 0.6% max, Fe – 0.6% and rest Al.

Q. 109. What is Duralumin alloy?

Ans. It owes special quality of high strength to weight property and is widely used for automobile and air-craft industries. Its other uses are for making electrical cable, castings, forged and stamped components.

Q. 110. Define plastics.

Ans. Plastics are mouldable synthetic organic resins, characterised by plastic deformation, under stress. It is mainly of two types *viz.*

(*a*) thermosetting plastics and (*b*) thermoplastic plastics.

Q. 111. What are thermosetting plastics?

Ans. These plastics are shaped by the application of heat with or without pressure. It becomes permanently hard by polymerisation and cann't be resoftened by heat. Common thermosetting compounds are phenol formaldehyde, urea formaldehyde, phenol furfural, melamine.

Q. 112. What is Bakelite?

Ans. Bakelite is plastics of phenol formaldehyde group.

Q. 113. Define thermoplastics?

Ans. Thermoplastics don't undergo any chemical change during moulding. It doesn't become permanently hard with the application of pressure and heat. These particles may be remelted repeatedly for further moulding.

Examples: Cellulose derivatives and polystyrenes, polyethylene, vinyl resins, acrylic resins.

Q. 114. What are elastomers?

Ans. Elastomers are capable of extensive elastic properties. Rubbers and rubber-like materials are elastomers. Various type of rubbers, include natural rubber, butyl rubber, nitrile rubber, styrene-butadiene rubber (SBR), ethylene propylene rubber, (EPR), poly sulphide rubber (Thiokol), poly chloroprene rubber (Neoprene), Silicone rubber, polyurethanes.

Q. 115. What is P.V.C. plastics?

Ans. P.V.C. stands for poly-vinyl chloride, which is used for protective coatings for food and chemicals, cover of electric cables, gramophone records, water tubes.

Q. 116. What are heat insulating materials?

Ans. These materials resist the transmission of heat. Main heat resistant materials are glass, asbestos, cork, fibre board, reflecting paper, porcelain etc.

Q. 117. What are cermets?

Ans. Cermets are refractories having combination of ceramic and metals (say 80% ceramic and 20% metal). Few important cermets are tungsten carbide and cobalt zirconium carbide and iron, magnesium oxide and nickel.

Q. 118. What is glass?

Ans. Glass is a hard, brittle, transparent non-crystalline solid material. It has good corrosion resistance, acid, base and salt resistance and electrical current resistance.

Q. 119. What are common type of glasses?

Ans. Common glasses are classified on the basis of their compositions such as soda-lime glass, lead glass, borosilicate glass, flint glass, phosphate glass, leaded glass.

Q. 120. What is composition of typical soda lime glass?

Ans. A common glass contains, SiO_2 – (60–75)%, Na_2 Na_2O– 15%, CaO – 9%, MgO – 3% and Al_2O_3 – 2%.

Q. 121. What are the colouring argents used in glass-making?

Ans. To colour or decolour glasses, some colouring agents are used in small quantities. Main colouring agents are CoO (for blue), CuO(for red), Fe_2O_3 (for brown), Cr_2O_3 (for green), Cr_2O_3 (for yellow green).

Q. 122. What is epoxy cement?

Ans. It is used for joining plastics, wood and sheet metals. The surface to be joint is generally very small and makes a hard and tough joint.

Q. 123. What is glass wool?

Ans. It is glass (alumina boro-silicate) in fibrous form. It has good resistance to heat and sound.

Q. 124. What is Cork?

Ans. Cork is outer bark of the cork oak tree. This tree is found in Portugal, Spain and North Africa.

Q. 125. What are the sources of metals?

Ans. Metal occurs mainly in the form of ore minerals and sea/ocean water. Metals are also reclaimed and recycled from scrap.

Q. 126. What are metals/elements, which are not found (or found in little amount) in India?

Ans. The ores of gold, platinum, tin, antimony, bismuth, cobalt, mercury, molybdenum, strontium, niboium come under this group.

Q. 127. What are the factors, which determine the economical production of any metal from its ore?

Ans. The economical production of any metal depends upon many factors, which may be summarised as follows:

(*a*) amount/quality of ore deposits (*b*) percentage of metal content in ore

(*c*) type of extraction and refining processes of metal.

Q. 128. What do we mean by unit step?

Ans. Any process contains various sequential or individual step, which is called an unit step. Say, extraction of metal consists of several unit steps, such as concentration, roasting, smelting, refining etc.

Q. 129. What is difference between unit steps and unit operations?

Ans. An unit step may be classified into two classes *viz.* unit operations and unit processes. Unit operation consists of all physical operations, such as: communition, filteration, distillation, sieving, magnetic separation etc.

The term unit process refers to chemical operations or processes such as roasting, smelting, leaching, calcination etc.

Q. 130. What are Carbo-thermic and metallo-thermic reduction processes?

Ans. The reduction of any compound with carbon is called carbothermic reduction process, whereas in metallo-thermic reduction, the compound is reduced by metal, such as aluminium, silicon, manganese etc.

Q. 131. Do you agree with the following statement? "High temperature reactions are favoured by high pressure provided it involves, net decrease in volume of the system."

Ans. Yes, it is true.

Q. 132. Mention few refining processes, where oxidation reaction takes place.

Ans. Oxidation reactions, in the refining of the following metals, takes place:

(*a*) in the cupellation of lead process, oxidation of tin, zinc, antimony and arsenic takes place.

(*b*) in the fire refining of copper oxidation of aluminium, magnesium, iron, sulphur, arsenic, antimony, tin, lead take place.

(*c*) in the steel making, oxidation of copper, silicon, phosphorus and manganese take place.

Q. 133. Mention few processes, where chlorination reactions take place.

Ans. Chlorination takes place in the following processes:

(*a*) for the removal of zinc from lead.

(*b*) for the removal of zinc, lead and copper from bismuth.

Q. 134. What is the purpose of zone refining?

Ans. Zone refining provides purest metal. It is best suited for refining of metals used in semi-conductors, such as Silicon and Germanium.

Q. 135. What is a flow diagram of any process?

Ans. A flow diagram is a line diagram indicating successive steps of a process, with the equipments used for those processes.

Thus flow diagram indicates the unit processes operations involved in that system.

Q. 136. What is material balance in any process?

Ans. In any process one tries to find the yield with the difference of out put materials to input materials. We try to equalise on the basis of law of conservation of mass. In any chemical reactions few percentage of materials is lost in the form of vapours, fumes, dust, melting losses etc.

Q. 137. What is Kroll process?

Ans. The reduction of metallic halide by magnesium is termed as Kroll's process.

For example: $TiCl_4 + 2Mg = 2MgCl_2 + Ti$

Q. 138. What should be the basis of heat balance?

Ans. The simpler reaction for heat balance may be represented as

Heat input = Heat output + heat

or Heat input = Heat output

(If heat accumulation is negligible, which happens in most of the processes)

This holds good for batch type processes.

In continuous processes, the heat balance may be represented by rate of heat, such as

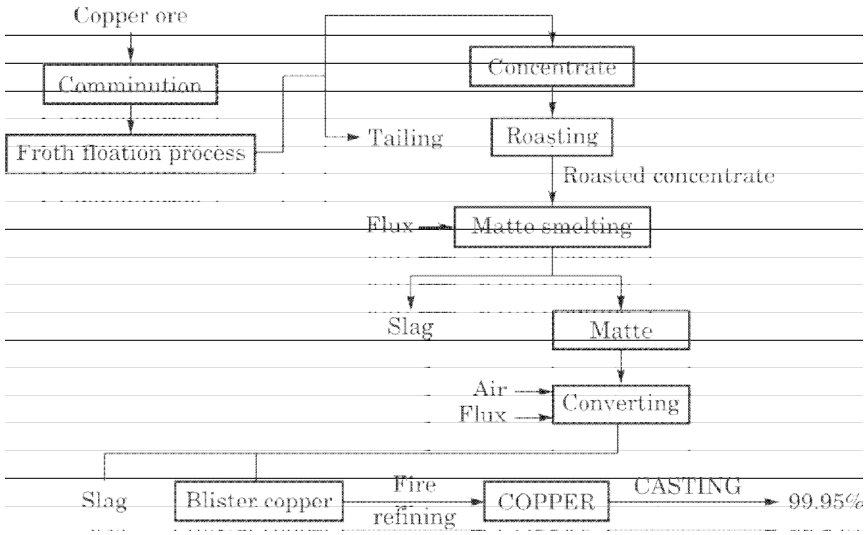
Rate of heat input = Rate of heat output

Q. 139. What is the reference temperature, which is considered for any type of reaction?

Ans. It is 25°C or (25 + 270) *i.e.*, 298° Kelvin

Q. 140. Draw a flow diagram for the extraction of copper?

Ans.



Q. 141. What is an adiabatic reaction?

Ans. In adiabatic reaction or system, no heat is put or taken out from the system. Here heat only comes with the reactants and goes out with the products.

Q. 142. What is an isothermal reaction?

Ans. In an isothermal reaction, temperature of the system is kept constant either by withdrawal or supply of heat.

Q. 143. Define pyrometer.

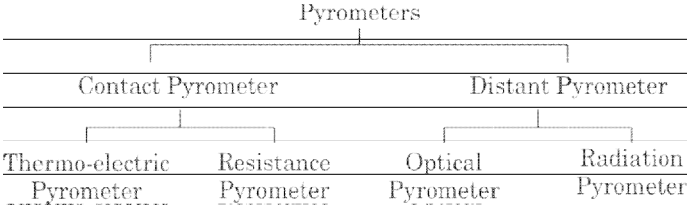
Ans. Pyrometer is a device or instrument to measure high temperatures.

Q. 144. What is difference between thermometry and pyrometry?

Ans. Both are techniques to measure temperature. Thermometry generally refers with the temperature measurement, with mercural thermometer upto 350°C. Pyrometry deals with the measurement of high temperature.

Q. 145. What are different type of pyrometers?

Ans. Pyrometers may be classified into different type as follows:



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4575/15, Onkar House, Opp. Happy School,
Ground Floor, Daryaganj, New Delhi-110002
Phones: 011-45033819, 9811541460
E-mail: contactus@khannapublishers.in

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