Chemical Engineering

1. Which law states that the total pressure of a mixture of ideal gases is the sum of the partial pressures of the individual gases?

A) Henry's Law

B) Dalton's Law

C) Raoult's Law

D) Boyle's Law

Answer: B) Dalton's Law

Explanation: Dalton's Law of Partial Pressures is a fundamental principle for gas mixtures, stating that each gas in a mixture exerts pressure independently.

2. The Hagen-Poiseuille equation is used to calculate the pressure drop for:

A) Laminar flow through a circular pipe.

B) Turbulent flow through a circular pipe.

C) Flow over a flat plate.

D) Flow through a packed bed.

Answer: A) Laminar flow through a circular pipe.

Explanation: This equation provides an exact analytical solution for the pressure drop of a Newtonian fluid in fully developed, steady laminar flow.

3. The Stefan-Boltzmann law is related to heat transfer by:

A) Conduction

B) Convection

C) Radiation

D) Advection

Answer: C) Radiation

Explanation: The Stefan-Boltzmann law states that the total radiant heat energy emitted from a surface is proportional to the fourth power of its absolute temperature.

4. 'Jigging' is a mechanical separation process that separates particles based on their:

A) Size

B) Density

C) Shape

D) Surface properties

Answer: B) Density

Explanation: Jigging uses a pulsating fluid stream to stratify particles, causing denser particles to settle to the bottom layer and lighter particles to rise to the top.

5. 'Humidification' is a mass transfer operation that involves the transfer of:

A) A liquid from a gas phase to a liquid phase.

B) A solid from a liquid phase to a gas phase.

C) Water vapor from a liquid phase to a gas phase.

D) A gas from a gas phase to a solid phase.

Answer: C) Water vapor from a liquid phase to a gas phase.

Explanation: This process involves enriching a gas stream (like air) with water vapor by bringing it into contact with liquid water.

6. 'Delayed coking' is a severe thermal cracking process in a refinery used to:

A) Produce high-octane gasoline.

B) Remove sulfur from diesel.

C) Upgrade heavy residual oils into lighter products and petroleum coke.

D) Produce lubricating oils.

Answer: C) Upgrade heavy residual oils into lighter products and petroleum coke.

Explanation: It is a carbon-rejection process that converts the heaviest, lowest-value part of crude oil into more valuable liquid and gas products, leaving solid coke as a byproduct.

7. The main component of phosphatic fertilisers is typically reported in terms of its equivalent content of:

A) P (Phosphorus)

B) PO4 (Phosphate)

C) P2O5 (Phosphorus pentoxide)

D) H3PO4 (Phosphoric acid)

Answer: C) P2O5 (Phosphorus pentoxide)

Explanation: By convention, the phosphorus content or "grade" of fertilizers is expressed as the mass percentage of P2O5, even though the compound itself is not present.

8. 'Drying' is a process that removes a volatile liquid (usually water) from a solid material by:

A) Mechanical pressing.

B) Adsorption.

C) Evaporation.

D) Absorption.

Answer: C) Evaporation.

Explanation: Drying is a mass transfer process where heat is supplied to the wet solid, causing the liquid to vaporize and be carried away by a drying medium like air.

9. The 'selectivity' of a reaction is a measure of:

A) How fast the reaction proceeds.

B) The fraction of the limiting reactant that is converted.

C) The ratio of the moles of desired product formed to the moles of undesired product formed.

D) The heat released by the reaction.

Answer: C) The ratio of the moles of desired product formed to the moles of undesired product formed.

Explanation: In reactions with multiple possible products, selectivity is crucial for maximizing the yield of the valuable product while minimizing the formation of by-products.

10. A 'cascade control' system is a control strategy that uses:

A) A single controller and a single sensor.

B) Two or more controllers where the output of a primary (master) controller adjusts the setpoint of a secondary (slave) controller.

C) A controller that predicts the future behavior of the process.

D) A controller that only takes action when the process variable exceeds a certain limit.

Answer: B) Two or more controllers where the output of a primary (master) controller adjusts the setpoint of a secondary (slave) controller.

Explanation: Cascade control is used to improve the response to disturbances in the secondary loop before they can affect the primary process variable.

11. 'Gibbs free energy' is a thermodynamic potential that can be used to determine the:

A) Total heat content of a system.

B) Spontaneity of a process at constant temperature and pressure.

C) Internal energy of a system.

D) Rate of a reaction.

Answer: B) Spontaneity of a process at constant temperature and pressure.

Explanation: A process will be spontaneous if the change in Gibbs free energy is negative. If it is zero, the system is at equilibrium.

12. A 'batch reactor' is a type of reactor where:

A) Reactants are continuously fed and products are continuously removed.

B) The composition is uniform throughout the reactor.

C) Reactants are charged into the vessel, allowed to react for a specific time, and then the products are removed.

D) The fluid flows through a tube without any mixing.

Answer: C) Reactants are charged into the vessel, allowed to react for a specific time, and then the products are removed.

Explanation: Batch reactors are commonly used for small-scale production, for testing new processes, and for manufacturing high-value products.

13. The main components of natural gas are:

A) Hydrogen and carbon monoxide.

B) Methane, with smaller amounts of ethane, propane, and butane.

C) Long-chain hydrocarbons (C20+).

D) Aromatic compounds like benzene and toluene.

Answer: B) Methane, with smaller amounts of ethane, propane, and butane.

Explanation: Methane (CH4) is typically the most abundant component, often making up over 85% of natural gas.

14. 'Stress corrosion cracking' is a material failure mechanism caused by the combined action of:

A) A tensile stress and a specific corrosive environment.

B) A cyclic stress and a corrosive environment.

C) A high temperature and a high pressure.

D) Erosion and corrosion.

Answer: A) A tensile stress and a specific corrosive environment.

Explanation: This is a dangerous form of failure because it can occur at stress levels well below the material's yield strength and with little visible sign of corrosion.

15. A 'rupture disc' is a safety device used to:

A) Regulate the pressure in a vessel.

B) Prevent a pump from running dry.

C) Protect a pressurized vessel from overpressure by bursting at a predetermined pressure.

D) Measure the pressure in a vessel.

Answer: C) Protect a pressurized vessel from overpressure by bursting at a predetermined pressure.

Explanation: A rupture disc is a one-time-use, fail-safe device that provides an instant and unobstructed opening to relieve excess pressure.

16. The 'time value of money' is a fundamental concept in economics which states that:

A) The value of money is constant over time.

B) A sum of money is worth more now than the same sum will be at a future date due to its potential earning capacity.

C) Inflation always decreases the value of money.

D) The cost of a project is the most important factor.

Answer: B) A sum of money is worth more now than the same sum will be at a future date due to its potential earning capacity.

Explanation: This principle is the basis for all discounted cash flow analyses, such as Net Present Value (NPV), used to evaluate the profitability of projects.

17. The 'coolant' in a nuclear reactor is the fluid used to:

A) Slow down neutrons.

B) Absorb excess neutrons.

C) Transfer heat from the reactor core to the steam generator or turbine.

D) Provide fuel for the reaction.

Answer: C) Transfer heat from the reactor core to the steam generator or turbine.

Explanation: The coolant (e.g., water, heavy water, liquid sodium, or gas) is essential for removing the intense heat generated by nuclear fission and converting it into useful energy.

18. 'Tempering' is a heat treatment process applied to hardened steel to:

A) Make it even harder.

B) Increase its ductility and toughness, while reducing its brittleness.

C) Make it softer.

D) Improve its corrosion resistance.

Answer: B) Increase its ductility and toughness, while reducing its brittleness.

Explanation: Tempering involves heating the quenched (hardened) steel to a temperature below its critical point, which relieves internal stresses and results in a more serviceable and less brittle material.

19. 'Thermal conductivity' is a material property that indicates its ability to:

A) Store heat.

B) Conduct heat.

C) Resist deformation at high temperatures.

D) Withstand rapid temperature changes.

Answer: B) Conduct heat.

Explanation: Materials with high thermal conductivity (like metals) transfer heat quickly, while materials with low thermal conductivity (like insulators and refractories) transfer heat slowly.

20. A 'Venturi scrubber' is an air pollution control device that uses:

A) A packed bed of catalyst to destroy pollutants.

B) A high-velocity gas stream to atomize a scrubbing liquid, which captures pollutants.

C) High voltage to charge and collect particles.

D) A fabric bag to filter out dust.

Answer: B) A high-velocity gas stream to atomize a scrubbing liquid, which captures pollutants.

Explanation: The high turbulence and large contact area created in the Venturi throat make it very efficient for removing fine particulate matter and some gaseous pollutants.

21. 'Blow molding' is a polymer manufacturing process used to create:

A) Flat sheets and films.

B) Long continuous profiles like pipes.

C) Complex, solid parts.

D) Hollow objects like bottles and containers.

Answer: D) Hollow objects like bottles and containers.

Explanation: The process involves inflating a heated plastic tube (a parison) inside a mold, forcing it to take the shape of the mold cavity.

22. 'Water hammer' is a phenomenon in fluid mechanics that occurs when:

A) A fluid flows very slowly through a pipe.

B) Air bubbles form in a pump.

C) The flow of a fluid in a pipe is suddenly stopped, causing a high-pressure shock wave.

D) A pipe is not properly supported.

Answer: C) The flow of a fluid in a pipe is suddenly stopped, causing a high-pressure shock wave.

Explanation: The rapid closure of a valve converts the kinetic energy of the moving fluid into pressure energy, creating a shock wave that can cause loud noises and damage the piping system.

23. The 'Prandtl number' (Pr) is a dimensionless group that relates:

A) Momentum diffusivity (kinematic viscosity) to thermal diffusivity.

B) Inertial forces to viscous forces.

C) Thermal diffusivity to mass diffusivity.

D) Buoyant forces to viscous forces.

Answer: A) Momentum diffusivity (kinematic viscosity) to thermal diffusivity.

Explanation: The Prandtl number compares the thickness of the momentum boundary layer to the thermal boundary layer and is a key property of the fluid itself, independent of the flow.

24. A 'filter press' is a piece of equipment used for:

A) Liquid-liquid extraction.

B) Gas absorption.

C) Solid-liquid separation by filtration under pressure.

D) Size reduction.

Answer: C) Solid-liquid separation by filtration under pressure.

Explanation: A filter press consists of a series of plates and frames or recessed plates that are pressed together. Slurry is pumped in, and the liquid (filtrate) passes through the filter cloth while the solids (filter cake) are retained.

25. 'Gas absorption' is a mass transfer operation where a:

A) Soluble component is transferred from a gas phase to a liquid solvent.

B) Liquid is vaporized into a gas stream.

C) Component is transferred from one liquid phase to another.

D) Solid is dissolved in a liquid.

Answer: A) A soluble component is transferred from a gas phase to a liquid solvent.

Explanation: This process, also known as scrubbing, is used for removing pollutants from gas streams (e.g., removing SO_2 with a limestone slurry) or for producing chemical products.

26. 'Isomerization' in a refinery is a process that:

A) Combines small molecules into larger ones.

B) Breaks large molecules into smaller ones.

C) Rearranges the structure of molecules to form isomers with more desirable properties.

D) Removes sulfur from hydrocarbons.

Answer: C) Rearranges the structure of molecules to form isomers with more desirable properties.

Explanation: A common application is the conversion of straight-chain, low-octane alkanes like n-butane into their branched-chain, high-octane isomers like isobutane.

27. The three numbers on a fertilizer bag (e.g., 10-20-10) represent the percentage by weight of:

A) Nitrogen, Phosphorus, and Potassium.

B) Nitrogen, Phosphate (P_2O_5), and Potash (K_2O).

C) Nitrate, Phosphate, and Potash.

D) Nitrogen, Sulfur, and Potassium.

Answer: B) Nitrogen, Phosphate (P_2O_5), and Potash (K_2O).

Explanation: These numbers represent the N-P-K grade of the fertilizer, indicating the available content of the three primary macronutrients.

28. 'Raoult's Law' relates the partial pressure of a component in the vapor phase above an ideal liquid mixture to its:

A) Mole fraction in the vapor phase.

B) Mole fraction in the liquid phase and its vapor pressure as a pure substance.

C) Temperature.

D) Molecular weight.

Answer: B) Mole fraction in the liquid phase and its vapor pressure as a pure substance.

Explanation: Raoult's Law is fundamental to understanding the vapor-liquid equilibrium of ideal solutions, which is the basis for distillation.

29. The 'conversion' of a reactant in a chemical process is the:

A) Fraction or percentage of that reactant that has been consumed by the reaction.

B) Rate at which the reactant is consumed.

C) Total amount of the reactant fed to the process.

D) Amount of desired product formed.

Answer: A) The fraction or percentage of that reactant that has been consumed by the reaction.

Explanation: Conversion is a measure of how far a reaction has progressed with respect to a particular reactant.

30. 'Ratio control' is a control strategy used to:

A) Maintain a process variable at a constant value.

B) Maintain the flow rate of one stream in a fixed ratio to the flow of another, uncontrolled stream.

C) Select between two different measurements to control a process.

D) Control the level in a tank.

Answer: B) Maintain the flow rate of one stream in a fixed ratio to the flow of another, uncontrolled stream.

Explanation: This is commonly used for blending operations or for maintaining the correct air-to-fuel ratio in a combustion process.

31. An 'isobaric' process is a thermodynamic process that occurs at constant:

A) Temperature.

B) Volume.

C) Pressure.

D) Entropy.

Answer: C) Pressure.

Explanation: The heating of water in an open container is an example of an isobaric process, as it occurs at a constant atmospheric pressure.

32. The 'half-life' of a first-order reaction is:

A) Directly proportional to the initial concentration.

B) Inversely proportional to the initial concentration.

C) Independent of the initial concentration.

D) Equal to the rate constant.

Answer: C) Independent of the initial concentration.

Explanation: For a first-order reaction, the time it takes for the concentration of the reactant to decrease by half is a constant, regardless of how much you start with.

33. 'Gasification' is a process that converts a solid or liquid carbonaceous fuel into:

A) Only carbon dioxide and water.

B) A gaseous fuel mixture called syngas (synthesis gas).

C) Elemental carbon (coke).

D) A higher-quality liquid fuel.

Answer: B) A gaseous fuel mixture called syngas (synthesis gas).

Explanation: Gasification involves reacting the fuel at high temperatures with a controlled amount of oxygen and/or steam. The resulting syngas (primarily H2 and CO) can be burned to generate power or used as a chemical feedstock.

34. 'Passivation' is the process of treating a metal to:

A) Make it more reactive.

B) Make it softer.

C) Make it less susceptible to corrosion by forming a protective oxide layer.

D) Remove an existing oxide layer.

Answer: C) Make it less susceptible to corrosion by forming a protective oxide layer.

Explanation: Stainless steel is naturally passivating due to its chromium content, but the process can also be induced on other metals using specific acid treatments.

35. A 'globe valve' is primarily designed for:

A) On/off service with low pressure drop.

B) Preventing reverse flow.

C) Throttling or regulating the flow of a fluid.

D) Handling slurries.

Answer: C) Throttling or regulating the flow of a fluid.

Explanation: The S-shaped flow path through a globe valve causes a significant pressure drop but allows for precise control over the flow rate, making it ideal for regulation.

36. 'Fixed costs' in an economic analysis are costs that:

A) Vary directly with the level of production.

B) Are incurred only once at the beginning of a project.

C) Do not change with the level of production, such as rent, insurance, and salaries.

D) Are the same as the raw material costs.

Answer: C) Do not change with the level of production, such as rent, insurance, and salaries.

Explanation: Fixed costs must be paid regardless of whether the plant is producing at 10% or 100% capacity.

37. The 'chain reaction' in a nuclear reactor is sustained by which particles?

A) Protons.

B) Alpha particles.

C) Electrons.

D) Neutrons.

Answer: D) Neutrons.

Explanation: The fission of a uranium or plutonium nucleus releases several high-energy neutrons. For a self-sustaining chain reaction, at least one of these neutrons, after being slowed down, must go on to cause the fission of another nucleus.

38. 'Draft' in a furnace system refers to the:

A) Rate at which fuel is burned.

B) Small pressure difference that causes the flow of hot gases through the furnace and up the stack.

C) Temperature of the flue gas.

D) Efficiency of the combustion.

Answer: B) The small pressure difference that causes the flow of hot gases through the furnace and up the stack.

Explanation: Draft can be natural (due to the buoyancy of hot gases in a tall stack) or forced/induced (using fans).

39. The property of a refractory to resist abrasion and erosion is known as its:

A) Refractoriness.

B) Porosity.

C) Cold crushing strength.

D) Thermal conductivity.

Answer: C) Cold crushing strength.

Explanation: Cold crushing strength (CCS) is a measure of the mechanical strength of a refractory at room temperature and is an important indicator of its durability and ability to withstand mechanical stresses during operation.

40. 'Acid rain' is caused primarily by the emission of which pollutants into the atmosphere?

A) Carbon dioxide and carbon monoxide.

B) Methane and ozone.

C) Sulfur dioxide and nitrogen oxides.

D) Particulate matter and heavy metals.

Answer: C) Sulfur dioxide and nitrogen oxides.

Explanation: These gases react with water, oxygen, and other chemicals in the atmosphere to form sulfuric acid and nitric acid, which then fall to the earth with precipitation.

41. 'Injection molding' is a polymer processing technique where:

A) A molten polymer is forced through a die to create a continuous shape.

B) A hollow object is formed by inflating a heated tube of polymer.

C) A molten polymer is injected under high pressure into a closed mold cavity.

D) A sheet of polymer is heated and pulled down by a vacuum into a mold.

Answer: C) A molten polymer is injected under high pressure into a closed mold cavity.

Explanation: This process is used to mass-produce complex, solid parts with high precision, such as car parts, electronic housings, and toys.

42. The 'Moody chart' is a graph used in fluid mechanics to determine the:

A) Drag coefficient for flow over a sphere.

B) Friction factor for flow in a pipe.

C) Pump efficiency.

D) Heat transfer coefficient.

Answer: B) The friction factor for flow in a pipe.

Explanation: The Moody chart plots the Darcy friction factor as a function of the Reynolds number and the relative roughness of the pipe, covering both laminar and turbulent flow regimes.

43. 'Kirchhoff's law of thermal radiation' states that for a body in thermal equilibrium, its:

A) Emissivity is equal to its absorptivity.

B) Emissivity is equal to its reflectivity.

C) Absorptivity is equal to its transmissivity.

D) Emissivity, absorptivity, and reflectivity sum to one.

Answer: A) Emissivity is equal to its absorptivity.

Explanation: This law implies that a good absorber of radiation is also a good emitter of radiation, and a poor absorber is a poor emitter.

44. 'Rittinger's Law' of crushing states that the energy required for size reduction is proportional to the:

A) Initial size of the particles.

B) Reduction ratio.

C) New surface area created.

D) Volume of the particles.

Answer: C) New surface area created.

Explanation: This is one of the classical laws of comminution, and it is generally considered to be most applicable for the fine grinding of brittle materials.

45. 'Liquid-liquid extraction' is a mass transfer operation used to separate components of a liquid mixture by:

A) Boiling the mixture.

B) Adding a solid adsorbent.

C) Using an immiscible liquid solvent that has a preferential affinity for one of the components.

D) Freezing the mixture.

Answer: C) Using an immiscible liquid solvent that has a preferential affinity for one of the components.

Explanation: The component to be separated is transferred from the original feed solvent to the new extracting solvent, allowing for its separation and recovery.

46. 'Crude oil' is first processed in a refinery in which unit?

A) Catalytic cracker.

B) Hydrotreater.

C) Atmospheric distillation unit.

D) Coker.

Answer: C) Atmospheric distillation unit.

Explanation: The first step in refining is to separate the crude oil into broad fractions (or "cuts") based on their boiling points, such as naphtha, kerosene, and gas oil, in a large distillation column.

47. 'Potash' is a common name for fertilisers that contain the nutrient:

A) Nitrogen.

B) Phosphorus.

C) Potassium.

D) Sulfur.

Answer: C) Potassium.

Explanation: The term "potash" refers to a variety of potassium-containing salts, with potassium chloride (muriate of potash) being the most common.

48. A 'process flow diagram' (PFD) is a schematic representation of a process that shows:

A) The detailed layout of all the piping and instrumentation.

B) The major pieces of equipment and their interconnections, along with key process streams and their conditions.

C) Only the electrical wiring for the plant.

D) Only the foundation and structural details of the plant.

Answer: B) The major pieces of equipment and their interconnections, along with key process streams and their conditions.

Explanation: A PFD provides a high-level overview of a process, showing the main flow paths and major unit operations.

49. If a reaction goes to completion and the reactants are fed in stoichiometric proportions, then at the end of the reaction:

A) Only the limiting reactant will be consumed.

B) All reactants will be consumed, leaving only products.

C) There will be an excess of one reactant.

D) Only products and inert substances will be present.

Answer: B) All reactants will be consumed, leaving only products.

Explanation: Feeding in stoichiometric proportions means there is exactly the right amount of each reactant to react completely with the others, leaving no excess.

50. 'Feedforward control' is a strategy where the controller takes action based on:

A) The value of the controlled variable.

B) The value of a disturbance variable before it affects the process.

C) The output of another controller.

D) The time of day.

Answer: B) The value of a disturbance variable before it affects the process.

Explanation: Feedforward control is proactive. It measures a potential disturbance (like a change in feed flow rate) and makes a corrective change to a manipulated variable to cancel out the disturbance's effect before it can cause an error in the controlled variable.

51. An 'isothermal' process is a thermodynamic process that occurs at constant:

A) Pressure.

B) Volume.

C) Temperature.

D) Enthalpy.

Answer: C) Temperature.

Explanation: For an isothermal process to occur, any heat generated or consumed by the system must be transferred to or from the surroundings to keep the temperature constant.

52. The 'effectiveness factor' for a catalyst pellet is the ratio of the:

A) Actual overall reaction rate to the rate that would occur if the entire interior of the pellet were exposed to the external reactant concentration.

B) Rate of the forward reaction to the rate of the reverse reaction.

C) Surface area of the catalyst to its volume.

D) Rate of the catalyzed reaction to the rate of the uncatalyzed reaction.

Answer: A) The actual overall reaction rate to the rate that would occur if the entire interior of the pellet were exposed to the external reactant concentration.

Explanation: This factor accounts for the limitations on the reaction rate caused by the diffusion of reactants into the pores of the catalyst pellet. An effectiveness factor less than 1 indicates pore diffusion limitations.

53. The 'flash point' of a combustible liquid is the:

A) Temperature at which it will spontaneously ignite without an external ignition source.

B) Temperature at which it boils.

C) Lowest temperature at which it can vaporize to form an ignitable mixture in air.

D) Temperature at which it freezes.

Answer: C) The lowest temperature at which it can vaporize to form an ignitable mixture in air.

Explanation: The flash point is a key safety parameter. A liquid with a low flash point is considered a greater fire hazard.

54. 'Weld decay' is a form of intergranular corrosion that can occur in:

A) Carbon steels.

B) Austenitic stainless steels.

C) Copper alloys.

D) Titanium.

Answer: B) Austenitic stainless steels.

Explanation: It occurs in a heat-affected zone near a weld, where chromium carbides can precipitate at grain boundaries, depleting the adjacent regions of chromium and making them susceptible to corrosion.

55. A 'baffle' in a shell and tube heat exchanger is used to:

A) Support the tubes and direct the flow of the shell-side fluid across the tube bundle.

B) Prevent the tubes from vibrating.

C) Clean the inside of the tubes.

D) Increase the pressure drop on the tube side.

Answer: A) Support the tubes and direct the flow of the shell-side fluid across the tube bundle.

Explanation: By forcing the shell-side fluid to flow in a serpentine path across the tubes, baffles increase the fluid velocity and the heat transfer coefficient, leading to a more efficient heat exchange.

56. The 'six-tenths factor' rule is a rule of thumb used in preliminary cost estimation which states that the cost of an equipment unit is proportional to:

A) Its capacity raised to the power of 0.6.

B) Its capacity.

C) The square of its capacity.

D) The logarithm of its capacity.

Answer: A) Its capacity raised to the power of 0.6.

Explanation: This cost-capacity relationship reflects the economy of scale; doubling the capacity of a piece of equipment typically does not double its cost.

57. The most common fuel used in commercial nuclear power reactors in the world today is:

A) Plutonium-239.

B) Enriched uranium dioxide (UO_2).

C) Natural uranium metal.

D) Thorium-232.

Answer: B) Enriched uranium dioxide (UO_2).

Explanation: Uranium dioxide is a ceramic material with a high melting point and good stability, making it a safe and reliable fuel form for the high-temperature environment of a reactor core.

58. A 'soaking pit' is a type of furnace used in the steel industry to:

A) Melt scrap steel.

B) Reheat steel ingots to a uniform temperature before they are hot-rolled.

C) Heat treat finished steel products.

D) Dry the refractory lining of a ladle.

Answer: B) Reheat steel ingots to a uniform temperature before they are hot-rolled.

Explanation: Soaking ensures that the large ingots have a consistent temperature from surface to center, which is necessary for successful rolling into slabs, blooms, or billets.

59. 'Permeability' of a refractory refers to its:

A) Ability to withstand high temperatures.

B) Ability to allow gases or liquids to pass through it under a pressure gradient.

C) Mechanical strength.

D) Resistance to chemical attack.

Answer: B) The ability to allow gases or liquids to pass through it under a pressure gradient.

Explanation: Permeability is related to the interconnectedness of the pores within the refractory and is an important property when considering penetration by molten metals, slags, or gases.

60. 'Bioremediation' is an environmental engineering technology that uses:

A) Chemical reactions to neutralize pollutants.

B) Physical filters to remove contaminants.

C) Microorganisms to break down and consume environmental pollutants.

D) High temperatures to incinerate waste.

Answer: C) Microorganisms to break down and consume environmental pollutants.

Explanation: This process leverages natural biological degradation to clean up contaminated sites, such as oil spills or soil contaminated with industrial solvents.