

2018 ASC ChemE Jeopardy Clues/Responses

Preliminary Round

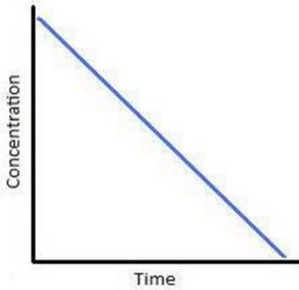
Single Jeopardy:

Chemical Reaction Engineering

100: This type of reactor has reactants loaded in the beginning. As the reaction proceeds, more reactant is added. Once the reaction is complete, the reactor is emptied.

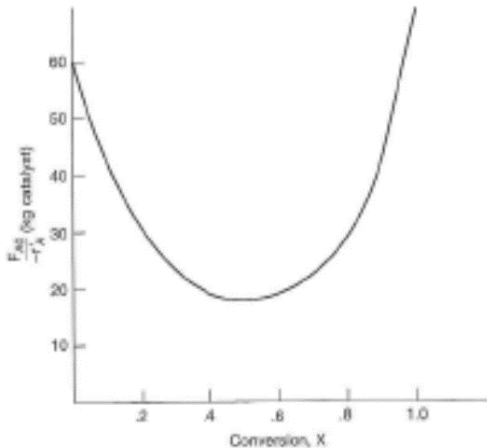
What is a semi-batch or fed-batch reactor?

200: This is the order of the reaction denoted by the following.



What is zeroth order?

300: This sequence of two ideal reactor types in series will minimize the total reactor volume needed to obtain 90% conversion for the following kinetics.



What is a CSTR followed by a PFR?

400: Enzyme kinetics described by the following equation.

$$-r_s = \frac{V_{\max} (S)}{K_M + (S)}$$

What are Michaelis-Menten kinetics?

500: This dimensionless number, given by τk for a first-order reaction, provides an estimate of the conversion in a CSTR.

What is the Damköhler number?

Mass Transfer

100: This parameter is the proportionality between a chemical's flux and its concentration gradient.

What is the diffusion coefficient?

200: In this mass transfer process, solute moves from one liquid into another immiscible liquid.

What is liquid-liquid extraction (LLE)?

300: This is the primary mass transfer mechanism in a laminar flow stream.

What is diffusion?

400: This type of diffusion happens in small pores where the diameter is smaller than the mean-free path of the gas molecules.

What is Knudsen Diffusion?

500: The following dimensionless number is commonly used in convective mass-transfer coefficient correlations and is sometimes referred to as the "mass transfer Nusselt number."

$$\frac{k_c L}{D_{AB}}$$

What is the Sherwood number?

Biochemical Engineering

100: Model used to describe the effect of substrate concentration on the specific growth rate as shown here.

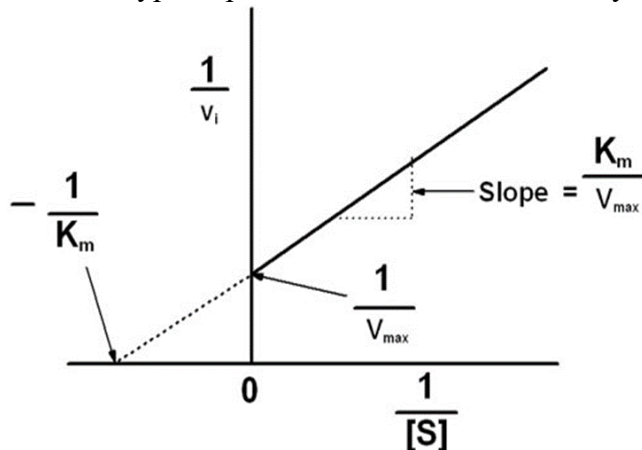
$$\mu_g = \frac{\mu_m S}{K_s + S}$$

What is the Monod equation?

200: This class of enzymes cut DNA at palindromic sequences.

What are restriction endonucleases?

300: The type of plot shown below is commonly used to determine enzyme kinetic parameters.



What is a Lineweaver-Burk plot?

400: This parameter can be found from the following equation that applies to a bioreactor operating at steady state:

$$\frac{Xq_{O_2}}{C_{O_2}^* - C_{L,O_2}}$$

What is the volumetric transfer coefficient (K_{La})?

500: This dimensionless number is used to determine mixer power in an aerated bioreactor:

$$\frac{Q}{ND_i^3}$$

What is the aeration number?

Polymers

100: This is the repeated unit for a polymer.

What is a Monomer or Repeat Unit?

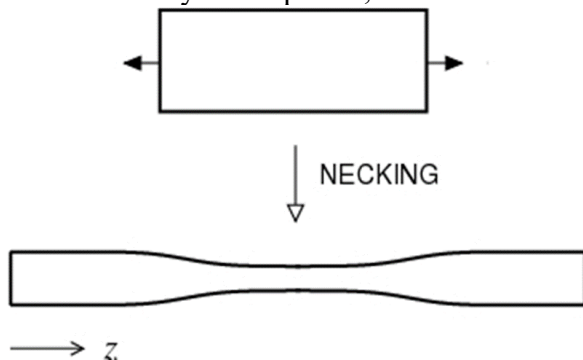
200: This common biopolymer or polynucleotide carries genetic material.

What is DNA?

300: This process, discovered by Charles Goodyear, converts rubber to a more durable form by heating in the presence of sulfur.

What is Vulcanization?

400: As a Polymer is pulled, the deformation shown below may occur.



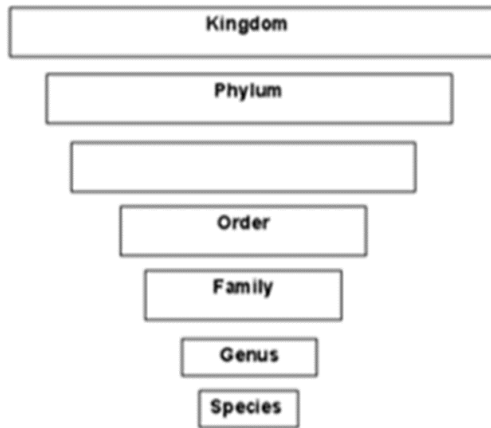
What is Necking or Yielding?

500: This natural polymer, first developed in Ancient China, is produced by certain insect larvae to form cocoons.

What is Silk?

Paleontology

100: This level is missing from the following Linnaean Taxonomy chart.



What is Class?

200: These reptiles dominated the Earth from the Triassic to the Jurassic periods, a span of nearly 135 million years.

What are the Dinosaurs?

300: The Argentinosaurus, which weighed nearly 200,000 lbs. was first discovered by Guillermo Heredia in this country.

What is Argentina?

400: The first dinosaurs, nearly 243 million years ago, walked on two legs, or this scientific term.

What is Bipedal?

500: The Paraceratherium was the largest land mammal at nearly 40,000 lbs. and is a hornless ancestor of this nosey animal.

What is the Rhinoceros?

Sports

100: In 2018 the Cleveland Cavaliers defeated this team to qualify for the NBA Playoff Finals.

Who are the Boston Celtics?

200: The Houston Astros defeated this team in the 2017 World Series.

Who are the Los Angeles Dodgers?

300: This team won the 2018 Stanley Cup Playoffs.

Who are the Washington Capitals?

400: This former Green Bay Packers quarterback holds the all-time NFL record for most interceptions thrown.

Who is Brett Favre?

500: These two countries played in the finals of the 2018 FIFA World Cup.

Who are France and Croatia?

Preliminary Round

Double Jeopardy:

Chemical Process Safety

200: This is given by:



What is the NFPA diamond?

400: The 3 sides of the fire triangle.

What are oxidizer, fuel and ignition source?

600: This type of flow is generally assumed when sizing a relief valve for a runaway reaction.

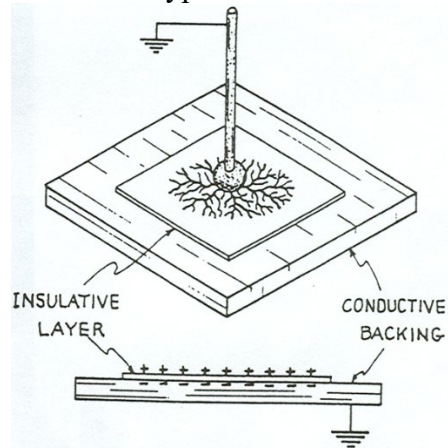
What is 2-phase flow?

800: This is the power to which the volume (V) is raised in the following equation when experimental explosion data are used to determine the explosive behavior of materials in process vessels.

$$\left(\frac{dP}{dt} \right)_{\max} V^a$$

What is 1/3?

1000: This type of electrostatic discharge can occur in the situation shown below.



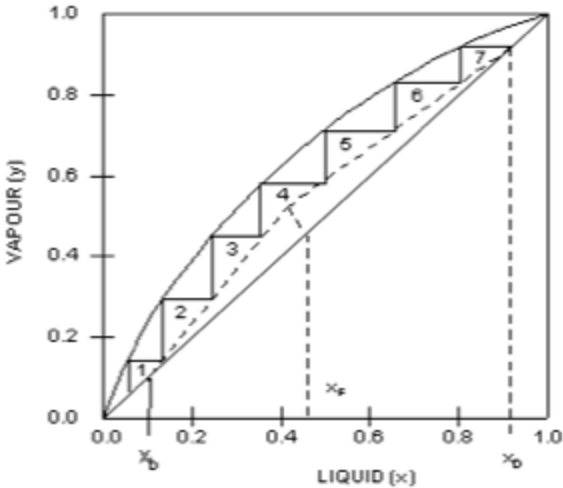
What is a propagating brush discharge or a Lichtenberg discharge?

Distillation

200: This is the ratio of the amount of material that returns to the distillation column to the amount of material that is collected in the distillate.

What is the Reflux Ratio?

400: The McCabe-Thiele Method and Diagram are used to determine the theoretical number of these.



What are Plates, Trays or Stages?

600: This is a mixture which when vaporized produces the same composition as the liquid and cannot be distilled past that composition.

What is an Azeotrope?

800: In this type of distillation, the column pressure is reduced causing evaporation of the most volatile component.

What is a Vacuum Distillation?

1000: These allow for easier and more controlled boiling due to the porous surface and cavitation sites.

What are Boiling Stones/Chips?

Industrial Processes

200: This process separates the components from a liquid mixture by selective evaporation and condensation.

What is Distillation?

400: The Haber-Bosch process is used to convert atmospheric nitrogen and hydrogen to this hazardous gas.

What is Ammonia?

600: This process transfers solute from a feed solution to an immiscible solvent and is common in nuclear reprocessing and the production of fine organic compounds.

What is Liquid-liquid Extraction or Solvent Extraction or Partitioning?

800: This process is designed to remove gas pollutants using a liquid solvent.

What is Scrubbing or Absorption?

1000: This process uses heat and a reducing agent to purify ore, removing gas or slag and leaving just the metal base behind.

What is Smelting?

Electricity and Circuits

200: This law states that the electric potential difference between two points is proportional to current flow.

What is Ohm's Law?

400: This circuit element resists changes in electric current

What is an Inductor (coil, reactor)?

600: Invented by Benjamin Franklin, this protects buildings from the discharge of atmospheric charge.

What is a Lightning Rod?

800: This type of material produces electricity when a mechanical stress is applied.

What is Piezoelectric?

1000: The equivalent resistance of four 100Ω resistors in parallel.

What is 25Ω ?

Geology

200: The rock cycle describes the transitions between magma and this many different types of rocks.

What is 3?

400: Radiocarbon dating determines the age of organic material by using the properties of this carbon isotope.

What is ^{14}C ?

600: This type of rock is generally formed through the cooling and solidification of magma or lava.

What is Igneous Rock?

800: This type of boundary commonly has tectonic plates that move toward one another and collide, forming mountain ranges.

What is Convergent Boundary?

1000: This peak, which is almost over 9,000 m tall, is still growing at nearly 2 cm/year.

What is Mt. Everest?

Company Slogans

200: "Eat Fresh."

What is Subway?

400: "Snap! Crackle! Pop!"

What is Rice Krispies?

600: "Taste the Rainbow."

What is Skittles?

800: "Because You're Worth It."

What is L'Oreal?

1000: "Don't Be Evil."

What is Google?

Preliminary Round

Final Jeopardy Category: Dimensionless Numbers

This dimensionless number represents the ratio of buoyant to viscous forces and is commonly used in calculations regarding natural convection.

What is the Grashof number?

Semi-Final Round

Single Jeopardy:

Heat Transfer

100: In this heat transfer equipment, a fluid in a tube bank is heated by a hotter fluid that makes multiple passes across the tube bank.

What is a shell and tube heat exchanger?

200: This type of heat transfer occurs without any contact between the surfaces.

What is radiation?

300: This is equal to

$$\frac{q}{A * \Delta T_{lm}}$$

What is U (Overall Heat Transfer Coefficient)?

400: This law describes the power radiated from a black body in terms of its temperature.

What is the Stefan-Boltzmann Law or Stefan's Law?

500: This law is expressed as

$$E_{b\lambda}(\lambda, T) = \frac{C_1}{\lambda^5 \left[\exp\left(\frac{C_2}{\lambda T}\right) - 1 \right]}$$

What is Planck's Law?

Catalysis

100: A heterogeneous catalyst is in a different _____ than that of the reactants.

What is Phase?

200: This is a general category of macromolecular, biological catalysts.

What are Enzymes?

300: This expensive catalyst is housed in the catalytic converter in most modern cars.

What is Platinum or Rhodium?

400: Catalysts effectively reduce this, resulting in a higher reaction rate at the same temperature and reactant concentrations.

What is Activation Energy?

500: The manufacturing of ammonia by the Haber Process is catalyzed using this metal, the most abundant in the Earth's core by mass.

What is iron?

Chemical Producers

100: This German-based chemical manufacturer is the largest chemical producer.

What is BASF?

200: This is the largest descendent of Standard Oil, formed in 1999 from the merger of two other petroleum companies.

What is Exxon-Mobil?

300: Best known for its aspirin, this German company recently has begun a merger with Monsanto.

What is Bayer?

400: The largest Korean chemical producer, this was originally founded as a cosmetics manufacturer named Lucky Chemical Industrial Corporation.

What is LG Chem?

500: This French company was formed in 1902 and is known primarily for its production of industrial gases.

What is Air Liquide?

Transport Phenomena

100: This dimensionless number is used as an indicator of turbulence in fluid flow.

What is the Reynolds number?

200: This law relates mass flux to a concentration gradient.

What is Fick's first law?

300: Free convection is primarily caused by a change in this fluid property, as a result of temperature gradients.

What is density?

400: In the case of laminar fluid flow in a stationary pipe, this is the most appropriate boundary condition.

What is the No Slip condition or zero fluid velocity at the wall?

500: This dimensionless number represents the ratio of momentum conduction to thermal conduction.

What is Prandtl number?

Biology

100: A cluster of bacterial genes encoding proteins with related activity that is often transcriptionally regulated as a single unit.

What is an Operon?

200: Regulatory protein that prevents a gene from being transcribed.

What is a Repressor?

300: This cellular process uses the electron transport chain to generate ATP from NADH and FADH₂.

What is oxidative phosphorylation?

400: Name for a class of compound composed of a nitrogenous base attached to a sugar without any phosphate group.

What is a Nucleoside?

500: Peptide hormone that is released from pancreatic Beta islet cells after food intake and serves to regulate glucose uptake by cells.

What is Insulin?

Supreme Court

100: She was appointed as the first female U.S. Supreme Court justice in 1981.

Who is Sandra Day O'Connor?

200: He is the only U.S. president who has also been a U.S. Supreme Court justice.

Who is William Howard Taft?

300: This president appointed the most justices (11) to the U.S. Supreme Court.

Who is George Washington?

400: He was appointed as the first African American U.S. Supreme Court Justice in 1967.

Who is Thurgood Marshall?

500: He was appointed as the first Jewish American U.S. Supreme Court Justice in 1916.

Who is Louis Brandeis?

Semi-Final Round

Double Jeopardy:

Chemical Process Safety

200: This is defined as the lowest temperature at which a vapor above a flammable liquid will ignite briefly.

What is the flash point?

400: These are the 3 steps involved in an accident.

What are initiation, propagation and termination?

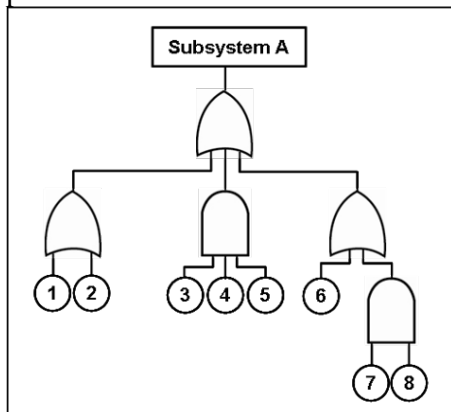
600: A dust explosion requires a fuel (dust), oxidizer, ignition source and these 2 conditions.

What are suspension and confinement?

800: This equipment, abbreviated ARSST, is commonly used to evaluate the reactive hazards.

What is the Advanced Reactive System Screening Tool?

1000: The method depicted here that is used to qualify and quantify the hazards and risks of a process.



What is a Fault Tree?

Material and Energy Balances

200: Input – Output = _____.

What is accumulation?

400: This is the number of moles (to 3 significant figures) of nitrogen per mole of oxygen in air that is used when conducting combustion reaction calculations.

What is 3.76?

600: When a vapor is cooled slowly at constant pressure, this is the temperature at which the first liquid droplet forms.

What is the dew-point temperature?

800: This type of stream is used to prevent the buildup of an inert substance within a reactive system.

What is a purge stream?

1000: This is the volume (in liters) of one mole of an ideal gas under STP conditions.

What is 22.4?

AICHE Ethics

200: Hold paramount the ____, ____ (2 words) and welfare of the public and protect the environment in performance of their professional duties.

What are safety and health?

400: Issue statements or present information only in an objective and ____ manner.

What is truthful?

600: Conduct themselves in a fair, _____, and respectful manner.

What is honorable?

800: Perform ____ ____ (2 words) only in areas of their competence.

What are Professional Services?

1000: Never tolerate _____.

What is Harassment?

Materials & Corrosion

200: Galvanized steel is a steel product coated with this.

What is Zinc?

400: The resistance of a material to breaking under tension.

What is Tensile Strength?

600: Steel in which the main alloying element is carbon, and whose properties chiefly depend on the percentage of carbon present.

What is Carbon Steel?

800: The localized attack on a metal surface at or immediately adjacent to, the gap or crevice between two joining surfaces

What is Crevice Corrosion?

1000: This technique is used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell, using a more easily corroded “sacrificial metal” to act as the anode.

What is Cathodic Protection?

Periodic Table

200: The electrons found in the outermost energy level of an atom.

What are Valence Electrons?

400: He is credited for the idea of the periodic table.

Who is Mendeleev?

600: Neon is a member of this family

What is Noble Gases?

800: Because these have characteristics of both metals and non-metals, they make good semi-conductors.

What are Metalloids?

1000: The Lanthanides and actinides found on the bottom two rows of the periodic table are also known as this.

What are the Rare Earth Metals?

Hamilton the Musical

200: She is the third sister named in song 'The Schuyler Sisters'.

Who is Peggy?

400: In the song 'Alexander Hamilton,' this is how many things Alexander says he hasn't done yet.

What is a million?

600: When King George III sings the song 'I Know Him,' this is to whom he is referring.

Who is John Adams?

800: This is who Philip Hamilton is seeking in the song 'Blow Us All Away,' for insulting Alexander Hamilton.

Who is George Eacker?

1000: Eliza Schuyler Hamilton responds to her husband's affair in this song

What is "Burn"?

Semi-Final Round

Final Jeopardy Category: Biochemical Engineering

The two criteria that need to be addressed during the FDA approval process for new drugs.

What are safety and efficacy?

Final Round

Single Jeopardy:

Fluid Flow

100: A pump characterized by approximately constant head, but with flowrates that increase or decrease depending on the system resistance.

What is a centrifugal pump?

200: The fluid type described by the following shear-velocity relationship.

$$\tau = \tau_o + \frac{\eta}{g_c} \left(\frac{du}{dy} \right)$$

What is Bingham plastic?

300: Equation used to determine the pressure drop across a packed bed.

What is the Ergun equation?

400: A situation where the drag force on a falling object is balanced by the gravitational and buoyant forces.

What is the terminal velocity?

500: This type of flow can occur when the gravitational driving force exceeds the full pipe friction loss, e.g., when a liquid is being pumped up and down over hilly terrain.

What is slack flow?

Chemical Process Safety

100: This Federal Agency is charged with enforcement of safety and health legislation.

What is OSHA (Occupational Safety and Health Administration)?

200: This is defined as a rapid expansion of gases resulting in a rapidly moving pressure or shock wave.

What is an explosion?

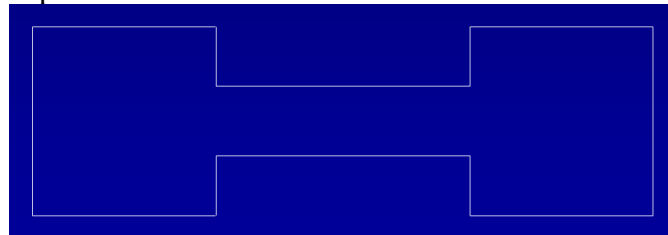
300: A Class D fire involves these materials.

What are metals?

400: A standard inerting procedure is to reduce the oxygen concentration to 4% below this value.

What is the limiting oxygen concentration (LOC)?

500: This phenomenon makes a geometry like the following particularly dangerous during an explosion.



What is pressure piling?

Process Control

100: This parameter is the time it takes for a first order system to reach 63% of the change in output.

What is the time constant?

200: This mode of the PID controller eliminates offset.

What is integral mode?

300: This type of controller makes adjustments to the manipulated variable based upon measured disturbances in an effort to absorb the effect of the disturbance before it affects the process.

What is feedforward control?

400: This is a control scheme in which a master loop controls a slave loop.

What is cascade control?

500: For a second order process, the range of values of the damping factor for which the process is stable and under damped (oscillatory).

What is 0 to 1?

Thermodynamics

100: The measure of disorder in a system.

What is entropy?

200: The molecules of an ideal gas are assumed to have no volume or _____.

What are intermolecular interactions?

300: The most efficient engine.

What is the Carnot engine?

400: This number of intrinsic properties needed to be determined to fully specify a two-phase single component system.

What is 1?

500: This law states that in a mixture of non-reacting gases, the total pressure exerted is equal to the sum of the partial pressures of the individual gases.

What is Dalton's Law?

-Ology

100: The study of interactions among organisms and their environment.

What is Ecology?

200: The study of insects.

What is Entomology?

300: The study of eyes.

What is Ophthalmology?

400: The study of animals.

What is Zoology?

500: The study of blood.

What is Hematology?

Big Bang Theory

100: He officiated Sheldon's and Amy's wedding.

Who is Mark Hamill?

200: The city in which Leonard and Penny got married.

What is Las Vegas?

300: This is Leonard's mom's profession.

What is a psychiatrist? (Neuroscientist also acceptable)

400: The filming of the *Big Bang Theory* will end during the 2018-19 season after this many years.

What is 12?

500: This is Raj's signature drink.

What is a grasshopper?

Final Round

Double Jeopardy:

Process Design

200: This diagram is used to represent the cash transactions that take place over the course of a project.

What is a cash-flow diagram?

400: The idea that money available at the present time is worth more than the same amount in the future.

What is the time value of money?

600: This represents the fixed capital investment of the plant, minus the value of the land, evaluated at the end of the plant life.

What is the salvage value?

800: This parameter is equal to

Number of days plant operates per year

365

What is the Stream Factor (SF)?

1000: Nickel-chromium alloys are known by this name, which is a trademark of the International Nickel Corporation.

What is Inconel?

AICHE Trivia

200: The year and city in which the first national AIChE meeting was held.

What is 1908 and Philadelphia?

400: This is the city in which the 2019 AIChE Annual Student Conference will be held.

What is Orlando, Florida?

600: She will be the 2019 AIChE President.

Who is Kim Ogden?

800: This is the city in which the 2020 AIChE Annual Student Conference will be held.

What is San Francisco?

1000: This AIChE group, whose acronym is DIERS, was founded in 1976 as a consortium of 29 companies.

What is the Design Institute for Emergency Relief Systems?

Equations

200: Describes the effect of temperature on reaction rates.

$$k = Ae^{-\frac{E_A}{RT}}$$

What is the Arrhenius Equation?

400: Describes the partial pressure of each component in an ideal mixture.

$$P_A = X_A P^{\circ}_A$$

What is Raoult's Law?

600: Dimensionless number that describes the ratio of inertial forces to viscous forces in a flowing fluid.

$$Re = \frac{\rho v D}{\mu}$$

What is Reynolds Number?

800: This Equation is used to calculate a pressure difference measured by the height of a fluid column.

$$P_1 + \rho_1 g h + \rho g h_1 = P_2 + \rho g h_2$$

What is the Manometer Equation?

1000: Describes the flow of a fluid through a porous media.

$$Q = \frac{-kA (\Delta P)}{\mu L}$$

What is Darcy's Law?

Separations

200: This is the basic thermodynamic principle behind flash and staged distillation.

What is Vapor liquid equilibrium?

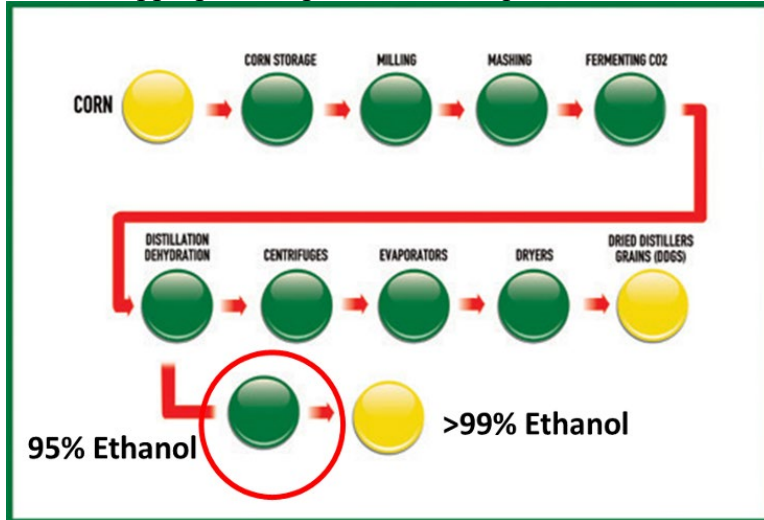
400: This common method of achieving separation in analytical equipment is based on selective affinity to a stationary or mobile phase.

What is Chromatography?

600: This is the phenomenon where an increase in fluid velocity in a packed bed results in a constant pressure drop and an increasing bed height.

What is fluidization?

800: The block flow diagram shows an ethanol production process known as dry milling. This is the most appropriate separation technique for the circled block.



What is Adsorption or Molecular Sieving?

1000: The sections above and below the feed stage in a distillation column as known as these. What are the Rectifying and Stripping sections?

Medical

200: An adult human has this many pairs of ribs.

What is 12?

400: This facial feature remains the same size from birth to adulthood.

What is the eyes?

600: The veins on each side of the neck, which drain blood from the head and neck to the larger veins passing to the heart are called this.

What is the Jugular?

800: Pyrosis is the technical term for which common complaint.

What is Heartburn?

1000: Leukemia is the cancer of this.

What is Blood Cells?

Disney Villains

200:



Who is Ursula in the Little Mermaid?

400:



Who is Captain Hook in Peter Pan?
600:



Who is the Wicked Stepmother in Cinderella?
800:



Who is Maleficent in Sleeping Beauty?
1000:



Who is Shere Khan in the Jungle Book?

Final Round

Final Jeopardy Category: Chemical Process Safety

These are the 4 concepts of inherently safer design.

What are Minimize (or Intensification), Substitute, Moderate (or Attenuation and Limitation of Effects), and Simplify (or Error Tolerance)?