2020 ChemE Jeopardy Clues/Responses

Preliminary Round

Single Jeopardy:

Fluid Flow

100: This variable is the ratio of the fluid density to the density of water.
What is specific gravity?
200: The fanning friction factor is a function of this in fully turbulent flow.
What is the relative surface roughness (Ɛ/D)?
300: These are the SI units for viscosity.
What is kg/(m-s)?
400: Mayonnaise is commonly modeled as this type of fluid (not Newtonian).
What is Bingham plastic?
500: In a pump this is a measure of how close the fluid at a given point is to boiling and thus to cavitation.
What is the Available Net Positive Suction Head ($NPSH_A$)?

Heat Transfer

100: This type of heat transfer involves higher energy molecules transferring energy to lower energy molecules.
What is conduction?
200: The law describes the power radiated from a black body in terms of its temperature.
What is the Stefan-Boltzmann Law? (Stefan's Law)
300: In this heat transfer equipment, steam is used to concentrate the liquid feed via evaporation.
What is an evaporator?
400: This dimensionless number is the product of the Grashof number and Prandtl number.
What is the Rayleigh number?
500: This parameter, given by F_{12}, is commonly used is radiative heat transfer.
What is the view factor?

Biochemical Engineering

100: This equation is commonly used to model the effect of substrate concentration on the specific growth rate.
What is the Monod equation?
200: This is the complete name of the most commonly used bacterial species in the commercial production of recombinant proteins.
What is *Escherichia coli*? (*E. coli* is acceptable)
300: This was the first commercially produced recombinant protein product.
What is insulin?
400: This plot of V vs. V/S is commonly used to determine Michaelis-Menton enzyme kinetic parameters.
What is an Eadie-Hofstee plot?
500: This dimensionless number is used to determine the overall rate limiting step (i.e., reaction or diffusion) when an enzyme is immobilized on the surface of a particle.
What is the Damköhler number?

Chemistry
100: This is the number of moles of solute present in 1 kg of solvent.
What is Molality?
200: This is the most electronegative element.
What is Flourine?
300: This is the Uranium isotope that is the most important for use in nuclear reactors.
What is U^{235}?
400: This is the second most abundant element in the Universe.
What is helium?
500: This is the second most abundant metal in the Earth's crust.
What is iron? (Aluminum is the most abundant)

Chemical Reaction Engineering
100: This model described the rate constant $k = \exp(-E_a/RT)$.
What is the Arrhenius equation?
200: The Ergun equation is used to calculate this in a packed bed reactor.
What is pressure drop?
300: This equation is used to describe the most common type of enzyme kinetics.
What is the Michaelis-Menten Equation?
400: This is the time necessary to process one reactor volume of fluid based on entrance conditions.
What is Space Time?
500: As the upward gas flowrate through a packed bed reactor increases the bed will become fluidized when the drag forces equal this.
What is the downward gravitational force (weight)?

World Leaders
100: She will come vice-president of the United States on January 20th, 2021.
Who is Kamala Harris?
200: He is the current Prime Minister of the United Kingdom.
Who is Boris Johnson?
300: He is the current Canadian Prime Minister.
Who is Justin Trudeau?
400: She is the current Federal Chancellor of Germany.
Who is Angela Merkel?
500: She is the current Prime Minister of New Zealand.
Who is Jacinda Ardern?

Preliminary Round
Double Jeopardy:
Biological Science
200: This disaccharide is comprised of a glucose and fructose.
What is sucrose?
400: He is considered to be the first person to prove that living microorganisms are responsible for fermentations.
Who is Louis Pasteur?

600: These are the 3 primary types of RNA that are involved in protein synthesis.
What are messenger RNA (mRNA), transfer RNA (tRNA) and ribosomal RNA (rRNA)?
800: This eukaryotic organelle consists of flattened sacs studded with ribosomes and is involved in protein synthesis.
What is the Rough Endoplasmic Reticulum (ER)?
1000: This is the mechanism of Penicillin's antibiotic effect.
What is inhibit cell wall synthesis?

Chemical Process Safety
200: This organization is abbreviated by NFPA.
What is the National Fire Protection Association?
400: This type of gas or vapor flow is commonly assumed in source model calculations to provide a worst-case scenario.
What is choked flow?
600: This is the type of electrostatic discharge from a person that occurs following walking on a carpet.
What is a spark discharge?
800: The pressure at the outlet of a relief device during the relief process resulting from the pressure of the discharge system.
What is the Backpressure?
1000: A passive device placed in pipes and other locations that stops fuel combustion by cooling the flame.
What is a flame arrestor?

Mass Transfer
200: This mass transfer process creates a vapor phase concentrated in the more volatile components.
What is distillation?
400: This dimensionless number is the ratio of mass transfer rate to mass diffusivity.
What is the Sherwood Number?
600: This dimensionless number is the ratio of momentum diffusivity to mass diffusivity.
What is the Schmidt Number?
800: The diffusion coefficient (D_{AB}) is approximately proportional to the absolute temperature raised to this power (T^a).
What is 1.5?
1000: Transient diffusion in a semi-infinite medium results in a solution that contains this function.
What is an Error Function?

Process Control
200: The Laplace function that represents the Laplace transform of f(t) = t.
What is $1/s^2$?
400: This parameter is the ratio of the change in output to the change in input at steady state.
What is the gain?
600: 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?
800: This mode of a PID controller is also called the reset mode.
What is the integral mode?
1000: A control scheme in which an outer control loop controls an inner control loop.
What is Cascade Control?

Thermodynamics
200: The temperature at which the first bubble of vapor is formed when heating a liquid at a fixed pressure.
What is the bubble point temperature?
400: This is given by the following: $PV = a + bP + cP^2 + ...$
What is the Virial Equation of State?
600: A cycle that consists of the following steps: adiabatic/isothermal/adiabatic/isothermal
What is the Carnot Cycle?
800: A process in which volume is held constant.
What is an Isochoric Process?
1000: This is given by $(1/V)(\partial V/\partial T)_p$.
What is the volume expansivity (β)?

International Food
200: Stroopwafel (a wafer cookie) originated in this European country.
What is the Netherlands?
400: When used in the kitchen, sodium bicarbonate is commonly known as this.
What is baking soda?
600: Halloumi is a semi-hard, unripened, brined cheese that originates from this Mediterranean Island country.
What is Cyprus?
800: The mojito is a traditional rum cocktail from this country.
What is Cuba?
1000: The traditional Peruvian dish cuy is made with this animal.
What is Guinea Pig?

Preliminary Round
Final Jeopardy Category: Chemical Process Design
This diagram is used to represent the cash transactions that take place over the course of a project.
What is a cash flow diagram?

Semi-Final Round

Single Jeopardy:

Biochemical Engineering

100: Organisms in this class use CO_2 as their primary carbon source.
What is an autotroph?
200: This class of organisms guard their chromosomal DNA separate from the rest of the cell using a nuclear membrane.
What are Eukaryotes?
300: Enzymes in this class are often found in detergents.
What are proteases?
400: Between 20 and 80 volunteers are used to determine this characteristic of a drug during Phase 1 clinical trials.
What is safety?
500: The cellular specific growth rate is equal to this parameter in a chemostat.
What is the Dilution Rate?

Chemical Process Design

100: 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?
200: These are the 3 main factors that determine the capital cost of a specific piece of equipment at a given time.
What are size/capacity, material of construction, and operating pressure?
300: 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?
400: This is defined as (Average Annual Net Profit)/(Fixed Capital Investment).
What is rate of return?
500: This transitional metal is added to low-alloy steels to increase the strength of the steel at high temperatures.
What is molybdenum?

Environmental Engineering

100: This is the study of living organisms and their environment or habitat.
What is ecology?
200: This is defined as a legal and controlled area for the placement of wastes into the ground.
What is a landfill?
300: This is defined as the controlled aerobic degradation of organic wastes into a material which can be used for landscaping, landfill cover, or soil conditioning.
What is composting?
400: This is defined as "of, made, or caused by human activity or actions."
What is anthropogenic?
500: This is the sum of the divalent cation concentrations expressed as meq/L or mg calcium carbonate per liter.
What is hardness?

Microbiology
100: The color of Gram-positive bacteria resulting from the Gram stain.
What is purple?
200: The major type of compound in a virus capsid.
What is a protein?
300: Okazaki fragments are associated with this essential process.
What is DNA replication?
400: This is the function of a bacterial flagellum.
What is movement?
500: Retroviruses are equipped with this enzyme that transcribes DNA from an RNA template.
What is reverse transcriptase?

Material and Energy Balances
100: The moles (batch) or molar flow rate (continuous) of O_2 needed for the complete combustion of all the fuel fed to the reactor, assuming that all the carbon and hydrogen in the fuel are oxidized to CO_2 and H_2O, respectively.
What is Theoretical Oxygen?
200: This chart contains (i) dry-bulb temperature, (ii) wet-bulb temperature, (iii) relative humidity, (iv) absolute humidity and many other properties.
What is a psychrometric or humidity chart?
300: This value (to 3 significant figures) is added to the temperature in °F to obtain °R.
What is 460?
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?
500: This "law" states that the volume of gas mixture is the sum of the pure component volumes.
What is Amagat's Law?

Also Known As
100: Norma Jeane Mortenson is better known by this name.
Who is Marilyn Monroe?
200: Lew Alcindor is better known by this name.
Who is Kareem-Abdul Jabbar?
300: Cassius Clay is better known by this name.
Who is Muhammad Ali?
400: Richard Starkey is better known by this name.
Who is Ringo Starr?
500: Reginald Kenneth Dwight is better known by this name.
Who is Elton John?

Semi-Final Round
Double Jeopardy:
Chemical Process Safety
200: The OSHA equivalent to the Threshold Limit Value-Ceiling (TLV-C).
What is Immediately Dangerous to Life and Health (IDLH)?
400: This type of spring-loaded relief valve should be used when a large back pressure is present.

What is a balanced bellows?
600: This type of explosion is characterized by a shock wave that moves faster than the speed of sound.
What is a detonation?
800: This is the exposure time for the Threshold Limit Value for Short Term Exposure (TLV-STEL).
What is 15 minutes?
1000: This can be determined by finding the intersection of the LFL and fuel vapor pressure lines.
What is the flash point?

Conversions and Units
200: This is the number (to 3 significant figures) of feet in a meter.
What is 3.28?
400: This is the SI unit for sound.
What is a decibel (dB)?
600: This is the number of liters in a gallon (to 3 significant figures).
What is 3.78?
800: This is the SI unit for light intensity.
What is a Candela?
1000: This is the number (to 3 significant figures) of ft-lb_f in a BTU.
What is 778?

Organic Chemistry
200: These are the monomers of proteins.
What are amino acids?
400: This is used to describe when a structure and its mirror image are not superimposable on one another.
What is chirality?
600: This is the mechanism type of a nucleophilic substitution reaction that involves the synchronous breaking and formation of bonds in one step.
What is a S_N2 reaction?
800: This is the name of the experimental test in which an aldehyde is distinguished from a ketone due to the oxidation of the aldehyde into a carboxylic acid.
What is the Tollens' Test?
1000: This is a class of water-insoluble compounds that will dissolve in aqueous sodium hydroxide, but not in aqueous sodium bicarbonate.
What are phenols?

Physics
200: This is defined as the force multiplied by the perpendicular distance from a point.
What is a moment?
400: This physicist became more famous for his cat than for his equation.
Who is Edwin Schrödinger?
600: The filament of an incandescent light bulb is made of this material.
What is Tungsten?

800: Albert Einstein's first Nobel prize was about this phenomenon.
What is the photoelectric effect?
1000: The basic principle for generating electric current was the work of this scientist
Who is Michael Faraday?

Heat Transfer

200: Assumption made when the Biot Number is less than 0.1.
What is the lumped solution assumption? (Uniform temperature throughout body during transient heat transfer).
400: A physical constant used in radiation heat transfer calculations, with dimensions of power per area per temperature raised to the 4^{th} power.
What is the Stefan-Boltzmann constant?
600: In most heat transfer coefficient (h) correlations for turbulent flow in pipes, h is proportional to the Reynolds number raised to this power.
What is 0.8?
800: This is the boundary condition at a perfectly insulated surface.
What is $dT/dx = 0$?
1000: This dimensionless parameter is the ratio of the heat conduction rate to the rate of thermal energy storage.
What is the Fourier Modulus?

Fun Presidential Trivia

200: This president, who served as Abraham Lincoln's second vice-president, was an accomplished tailor and made his own suits while president.
Who is Andrew Johnson?
400: This president, who served as Richard Nixon's vice-president, was a fashion model during college.
Who is Gerald Ford?
600: This one-term president, who lost his reelection bid in 1980, reported a UFO sighting in 1973.
Who is Jimmy Carter?
800: This president, who was known for the New Deal, was married to his fifth cousin.
Who is Franklin Roosevelt (FDR)?
1000: The only Ph.D. president whose face is on the $100,000 bill.
Who is Woodrow Wilson?

Semi-Final Round

Final Jeopardy Category: Chemical Process Safety

This is the minimum energy of an electrostatic discharge that is considered hazardous in industrial operations where flammable vapors are present.
What is 0.1 mJ?

Final Round

Single Jeopardy:

General Chemistry

100: This is the point during a titration at which stoichiometrically equivalent quantities are brough together.
What is the equivalence point?
200: Discovery of the wave properties of the electron led to the uncertainty principal name for this German Physicist.
Who is Werner Heisenberg?
300: h represents this in the following equation that is used to calculate the energy of a photon: $E = h\nu$.
What is Planck's Constant?
400: For water this occurs at 0.0098°C and 0.00603 atm.
What is the triple point?
500: This is the value of the characteristic bond angle in a tetrahedral molecule.
What is 109.5°?

Nuclear Physics

100: This process creates energy through the process of splitting large atoms.
What is fission?
200: This is emitted during beta radiation.
What are high-energy electrons?
300: The penetrating power of alpha, beta, and gamma radioactive sources in increasing order.
What is alpha, beta, and gamma?
400: The ionizing power of alpha, beta, and gamma, radioactive sources from largest to smallest.
What is alpha, beta, and gamma?
500: This is the form of radiation used in a smoke detector.
What is alpha radiation?

Biochemistry

100: The process in which proteins are made using an mRNA template.
What is translation?
200: This technical term is used to describe high blood glucose levels.
What is hyperglycemia?
300: This is the simplest amino acid with a hydrogen as the side chain.
What is glycine?
400: This 5-carbon sugar is a major component of RNA.
What is ribose?
500: Thomas Cech won the 1989 Nobel Prize in Chemistry for the discovery that these compounds can have catalytic properties.
What is RNA?

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 type of function in the Laplace domain related the output to the input.
What is a transfer function?
300: This type of control measures disturbances and compensates for them before the output changes.
What is the feedforward control?
400: This type of behavior results when a process transfer function has negative real poles with no imaginary component.
What is exponential decay?
500: This type of control valve automatically opens when its output signal is lost.
What is air-to-close or fail-open?

Dimensionless Numbers
100: This dimensionless number is the ratio of the fluid velocity to the velocity of the sound in the medium.
What is the Mach Number?
200: This dimensionless number in the ratio of the kinematic viscosity to the thermal diffusivity.
What is the Prandtl Number?
300: This dimensionless particle relates diffusion within catalyst particles with the reaction rate.
What is the Thiele Modulus?
400: This dimensionless number is the ratio of convection to conductive heat transfer across a boundary.
What is the Nusselt Number?
500: This dimensionless number measures the ratio of the inertial and gravitational forces.
What is the Froude Number?

State Capitals
100: This is the most populous state capital city.
What is Phoenix, Arizona?
200: This is the largest capital city by area.
What is Juneau, Alaska?
300: These two capital cities are located near the 45^{th} parallel (latitude).
What are Salem, Oregon, and St. Paul, Minnesota?
400: This state capital is located at the highest elevation above sea level.
What is Santa Fe, New Mexico?
500: A 2.3 million gallon molasses flood occurred in this capital city in 1919.
What is Boston, Massachusetts?

Final Round
Double Jeopardy:
Chemical Process Safety
200: These are the 5 sides of the dust explosion pentagon.
What are fuel (dust), oxidizer (air), ignition source, suspension, and confinement?
400: This process can be used in enclosed areas to reduce static charge accumulation, especially in the wintertime.
What is humidification?
600: The year that the OSHact was signed into law by President Richard Nixon.

What is 1970?
800: These are the 3 steps involved in an accident.
What are initiation, propagation, and termination?
1000: The overpressure from explosions is commonly estimated by using an equivalent mass of this substance.
What is TNT?

Algebra
200: The denominator in the quadratic formula when the numerator is $-b \pm (b^2 - 4ac)^{1/2}$.
What is 2a?
400: This is the kind of matrix that has an inverse matrix.
What is a nonsingular matrix?
600: Factoring of $x^2 - 6x + 9$ results in this.
What is $(x - 3)^2$?
800: The inverse of a matrix can be obtained by multiplying the reciprocal of the matrix's determinant by this.
What is the adjoint (or adjuvant) of the matrix?
1000: Factoring of $x^2 + x - 30$ results in this.
What is $(x + 6)(x - 5)$?

Separations
200: Method used to separate solids from fluids by interposing a medium through which only fluid can pass.
What is filtration?
400: The amount of condensed distillate returned to the top of a distillation column, relative to the amount removed as a product.
What is the reflux ratio?
600: The process by which a volatile solute is removed from a liquid by passing a gas through the liquid.
What is stripping?
800: In liquid extraction, the two phases are commonly called the extract phase and this.
What is the Raffinate phase?
1000: A relationship between absorbed and non-absorbed solute in which the absorbent may become completely saturated.
What is a Langmuir isotherm?

Thermodynamics
200: Static condition in which no changes occur in the macroscopic properties of a system with time.
What is equilibrium?
400: The third law of thermodynamics specifies this property as zero for perfect crystalline substances at absolute zero temperature.
What is entropy?
600: $C_p - C_v$ equals this for an ideal gas.
What is R (the gas constant)?

800: This, according to the Gibbs' Phase Rule, is the degrees of freedom for pure liquid water (1 phase).
What is 2? ($F = 2 - \pi + N = 2 - 1 + 1 = 2$)
1000: An enthalpy-entopy diagram is commonly called this in recognition of its creator.
What is a Mollier diagram?

Imaginary Engineering
200: In Statics, these two parameters are zero on every part of the system
What are forces and moments?
400: The fundamental principles of this law, which is used in circuit analysis, are (i) the summation of potential differences around a closed loop must be zero and (ii) the summation of the currents at a junction must be zero.
What is Kirchoff's Law?
600: This is the branch of mechanics concerned with the motion of bodies under the action of forces.
What is dynamics?
800: This is the potential energy of a 1 kg sphere at an elevation of 100 m above the ground.
What is
1000: This is the resistance of a system containing resistor A (5 Ω) and resistor B (5 Ω) in parallel.
What is 2.5 Ω? ($1/R_{system} = 1/5 + 1/5 = 0.4\ \Omega$; $R_{system} = 2.5\ \Omega$)

Cartoon Characters
200: He is Fred Flintstone's best friend.
Who is Barney Rubble?
400: This is the Simpsons' dog's name.
What is Santa's Little Helper?
600: This is Shaggy's last name from the Scooby-Doo cartoon.
What is Rogers?
800: This is Bullwinkle's sidekick.
Who is Rocky (the Flying Squirrel)?
1000: These are the names of the 3 Powerpuff Girls.
Who are Blossom, Bubbles, and Buttercup?

Final Round
Final Jeopardy Category: Biochemical Engineering
This phenomenon occurs when the chemostat's dilution rate is higher than the cells' maximum growth rate.
What is washout?