2021 NA ASC ChemE Jeopardy Clues/Responses

Preliminary Round

Single Jeopardy:

Safety Acronyms

100: FP

What is the flash point?

200: AIT

What is the autoignition temperature?

300: NFPA

What is the National Fire Protection Association?

400: LOPA

What is layer of protection analysis?

500: IDLH

Immediately Dangerous to Life and Health?

Fluid Flow

100: The equation given by the following:

$$P_1 + \frac{1}{2}\rho V_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho V_2^2 + \rho g h_2$$

What is the Bernoulli Equation?

200: A fluid with a linear relationship between stress and strain, but which also has a yield stress associated with it.

What is a Bingham Plastic?

300: The force (F) given by the following equation:

$$F = -\rho_f g V_f$$

What is buoyancy?

400: This parameter is given by the following equation and is equal to RT/M for an ideal gas:

$$\left(\frac{\partial P}{\partial \rho}\right)_T^{1/2}$$

What is the speed of sound?

500: This equation, given by $f''' + ff'' = 0$, is used to describe the stream function in a steady 2-dimensional boundary layer.

What is the Blasius Equation?

Chemical Reaction Engineering

100: This enzyme-catalyzed reaction kinetics follows this rate equation

$$V = \frac{V_{max} S}{K_M + S}$$

What is Michaelis-Menten kinetics?
200: This is a reaction type for which the overall standard enthalpy change ΔH° is positive.
What is an endothermic reaction?
300: This parameter is defined as

$$-R \frac{\partial \ln(k)}{\partial \left(1/T \right)}$$

What is the activation energy (E_a)?
400: Emission of radiation resulting from a chemical reaction that does not produce significant heat.
What is chemiluminescence?
500: Substance introduced into a reaction system to cause chain initiation upon irradiation of the system by visible or ultraviolet light.
What is a photoinitiator?

General Chemistry
100: For a molecule to be considered organic, it must contain this element.
What is Carbon?
200: This is typically the bond angle between tetrahedral, sp^3 hybridized carbon compounds.
What is 109.5°?
300: According to Boyle's Law, this parameter will increase at constant temperature when volume is decreased.
What is pressure?
400: Elements number 98 and 99 (Bk and Cf) were discovered at UCRL, which is associated with this university.
What is the University of California, Berkeley?
500: This word is spelled using the periodic table abbreviations for elements 5, 8, and 10.
What is bone (B-O-Ne)?

General Chemistry
100: This small ring of DNA is independent from the bacterium's main genome and is commonly used in genetic engineering.
What is a plasmid?
200: This is the function of a flagellum.
What is locomotion (movement)?
300: Okazaki fragments are associated with this essential process.
What is DNA replication?
400: Retroviruses are equipped with this enzyme that allows DNA to be transcribed from an RNA template.
What is reverse transcriptase?

500: These structures are necessary for conjugation.
What are pili?

In The News 2021
100: Joe Biden's Electoral College win was certified by Congress on this date, which was also the day that the U.S. Capital was attacked.
When is January 6th?
200: This former Minneapolis police officer was sentenced to 22.5 years in prison for murdering George Floyd.
Who is Derek Chauvin?
300: These two senators were elected from Georgia resulting in a 50-50 senate.
Who are Jon Ossoff and Raphael Warnock?
400: The primary profession of Pedro Castillo prior to being elected Peru's president.
What is a teacher?
500: She stepped down as the German Chancellor, a position she has held since 2005.
Who is Angela Merkel?

Preliminary Round
Double Jeopardy:
Globally Harmonized System (GHS) Pictograms
200:

What is acute toxicity? (Toxicity acceptable)
400:

What is an explosive?
600:

What is environmental?
800:

What is a compressed gas?
1000:

What is an oxidizer?

Material and Energy Balances

200: This type of stream is used to prevent the buildup of an inert substance within a reactive system.
What is a purge stream?
400: This is the volume (in liters) of one mole of an ideal gas under STP conditions (3 significant figures).
What is 22.4?
600: This U-shaped tube partially filled with a fluid of known density is commonly used to determine pressure differences.
What is a manometer?
800: The specific gravity of a liquid or solid is based on the density of water at this temperature.
What is 4°C?
1000: This “law” states that the volume of a gas mixture is the sum of the pure component volumes.
What is Amagat’s Law?

Process Control

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

What is the time constant?

400: This dynamic behavior model has the acronym FOPDT.

What is first order plus dead time?

600: This mode of the PID controller eliminates offset.

What is integral?

800: An electro-mechanical device that converts a 4-20 mA electrical signal to a 3-15 psig pneumatic signal.

What is an I/P converter? (current to pressure converter)

1000: This controller performance criterion has the abbreviation ISE.

What is integral of the squared error?

Physics

200: This scalar quantity is defined as the total distance traveled divided by the total time interval required to travel that distance.

What is average speed?

400: This type of collision between two objects occurs when the total kinetic energy of the system is not the same after the collision happens.

What is an inelastic collision?

600: This rule states that the sum of currents going into and out of a junction must equal 0.

What is Kirchhoff's (junction) rule?

800: This type of mirror image of an object is always seen in a flat mirror.

What is a virtual image?

1000: This law states that an induced electromotive force (emf) always gives rise to a current whose magnetic field opposes the change in original magnetic flux.

What is Lenz's Law?

Nuclear Engineering

200: Isotope used for the dating of many archeological artifacts.

What is C-14?

400: The Uranium isotope that is fissile, i.e., the "fuel" in nuclear reactions.

What is Uranium-235?

600: The number of neutrons in Cl-37.

What is 20?

800: Unit of area commonly used for expressing the cross-sectional area of nuclei, equal to 10^{-24} cm^2.

What is a barn?

1000: Byproduct of nuclear decay that cannot pass through the skin.

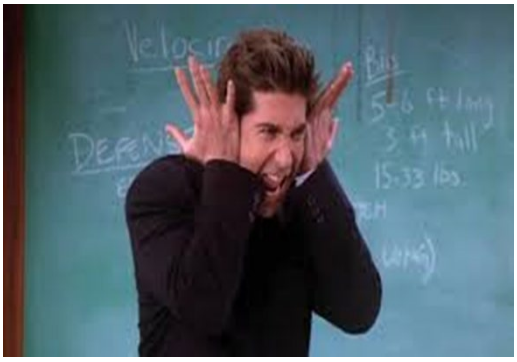
What are alpha particles?

Character Names

200: The first and last name of this character from Breaking Bad:

Who is Walter White?

400: The first and last name of this character from Friends:



Who is Ross Geller?

600: The first and last name of this character from The Flintstones:

Who is Betty Rubble?

800: The first and last name of this character from Scooby Doo:

Who is Velma Dinkley?

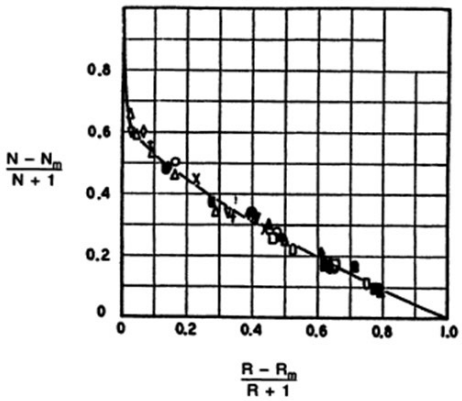
1000: The first and last name of this character from M*A*S*H:

Who is Margaret (“Hot Lips”) Houlihan?

Preliminary Round

Final Jeopardy Category: Unit Operations

The name of the correlation represented by this graph.



What is the Gilliland correlation?

Semi-Final Round

Single Jeopardy:

Chemical Process Safety

100: This type of explosion is characterized by a shock wave that moves faster than the speed of sound.

What is a detonation?

200: These are the 5 sides of the dust explosion pentagon that are required for a dust explosion.

What are fuel, oxidizer, ignition source, dispersion and confinement?

300: This type of spring-loaded relief valve should be used when a large back pressure is present.

What is a balanced bellows?

400: This is the exposure time for the Threshold Limit Value for Short Term Exposure (TLV-STEL).

What is 15 minutes?

500: This parameter is defined as the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing effects other than mild transient adverse health effects.

What are Emergency Response Planning Guidelines -1 (ERPG-1)?

Heat Transfer

100: 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)

200: The equation $Q = hA(T_\infty - T_w)$ is named after this scientist.

Who is Sir Isaac Newton?

300: The σ in the following black body radiation equation:

$$q = \sigma T^4$$

What is the Stefan-Boltzmann constant?

400: The type of heat transfer and geometry for which the following equation applies.

$$q = -\frac{4\pi}{\frac{r_2 - r_1}{k_A r_1 r_2} + \frac{r_3 - r_2}{k_B r_2 r_3}}\left(T_3 - T_1\right)$$

What is conduction in concentric spheres?

500: The radiation heat transfer parameter given by the following.

$$\frac{1}{A_1}\iint_{A_1,A_2}\frac{\mathrm{Cos}\left(\theta_1\right)\mathrm{Cos}\left(\theta_2\right)dA_2 dA_1}{\pi r^2}$$

What is the view factor (F_{12})?

Chemical Process Design

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

What is a cash flow diagram?

200: This parameter is equal to:

$$\frac{\text{Number of days plant operates per year}}{365}.$$

What is the stream factor (SF)?

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

What is the salvage value?

400: This transition metal is added to low-alloy steels to increase the strength of the steel at high temperatures.

What is molybdenum?

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

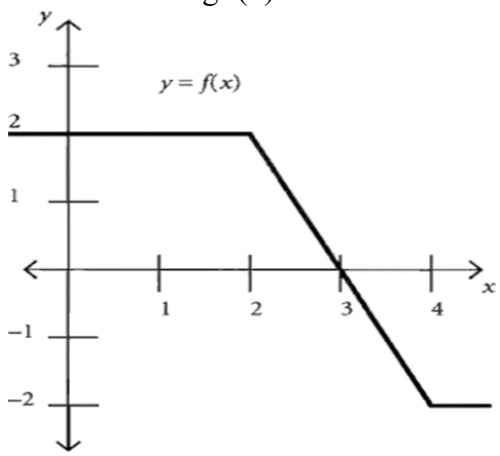
What is Monel?

Math

100:

$$\int_0^4 f(x)dx$$

for the following f(x):



What is 4?

200:

$$\lim_{x \to 3} \left(\frac{x^2 - 5x + 6}{x^2 - 2x - 3} \right)$$

What is 1/4?

(through use of L-Hospital's rule)
300: Given the lengths of two sides of a triangle and the corresponding angle between them, this law will provide the length of the third side.
What is the law of cosines?
400: This is defined by

$$\int_0^\infty f(t)e^{-st}dt$$

What is the Laplace Transform of f(t)?
500: This is defined as

$$\int_0^\infty e^{-t}t^{x-1}dt$$

What is the gamma function? or What is the generalized factorial function?

Disease Cause and Prevention
100: This disease is usually caused by the bacterium *Borrelia burgdorferi* that is transmitted to humans through the bite of infected ticks.
What is Lyme Disease?
200: This disease is caused by the Plasmodium parasite that is usually spread to humans through the bites of infected mosquitoes.
What is malaria?
300: The world's first vaccine, developed in 1796 by Edward Jenner, prevented this disease.
What is smallpox?
400: *Helicobacter pylori* causes this condition.
What is (stomach) ulcers?
500: The inactivated and attenuated polio vaccines that came into commercial use in 1955 and 1961, respectively, were developed by these 2 scientists.
Who are Jonas Salk and Albert Sabin, respectively? (correct order not required)

State Trivia
100: On December 7, 1787, this became the first U.S. state admitted to the Union.
What is Delaware?
200: This state is the largest producer of maple syrup.
What is Vermont?
300: In 1912 these were the 47th and 48th states admitted to the Union.
What were New Mexico and Arizona? (correct order not required)
400: According to the 2020 U.S. Census, this was the fastest growing state (by percentage) between 2010 and 2020.
What is Utah?
500: According to the 2020 U.S. Census, this state had the largest decrease in population (by percentage) between 2010 and 2020.

What was West Virginia?

Semi-Final Round

Double Jeopardy:

Safety Acronyms

200: OSHA

What is the Occupational Safety and Health Administration?

400: MOC

What is management of change? (minimum oxygen concentration is also acceptable)

600: TLV-TWA

What is the threshold limit value – time weighted average?

800: PEL

What is the permissible exposure limit?

1000: DIERS

What is the Design Institute for Emergency Relief Systems?

Biochemical Engineering

200: Between 20 and 80 volunteers are used to determine this characteristic of a drug during Phase I clinical trials.

What is safety?

400: The cellular growth rate is equal to this parameter in a chemostat.

What is the dilution rate (D)?

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

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

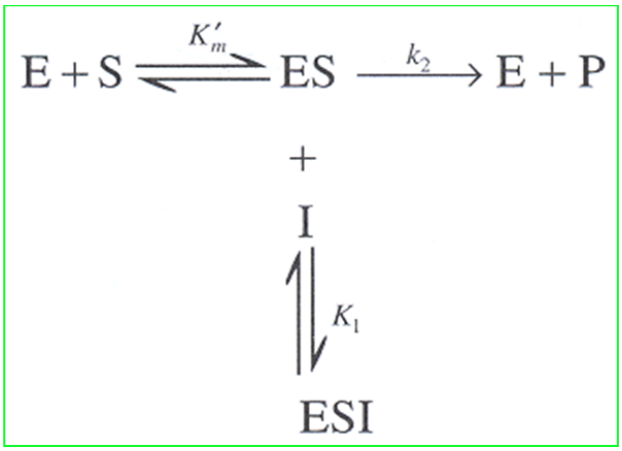
What is the aeration number?

800: 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 K_La? (volumetric transfer coefficient)

1000: Type of enzyme inhibition represented here



What is uncompetitive inhibition?

Dimensionless Numbers

200: This dimensionless number is the ratio of the fluid velocity to the velocity of sound in the medium.
What is the Mach number?
400: This dimensionless number is the ratio of convective to conductive heat transfer across a boundary.
What is the Nusselt number?
600: This dimensionless number is the ratio of the kinematic viscosity to the thermal diffusivity.
What is the Prandtl number?
800: This dimensionless number is the ratio of kinematic viscosity to the diffusivity.
What is the Schmidt number?
1000: This dimensionless number is the ratio of the inertial and gravitational forces.
What is the Froude number?

Uncommon Units

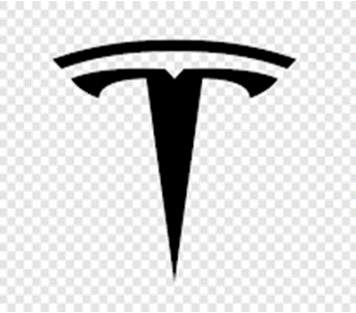
200: The number of fluid ounces in a pint.
What is 16?
400: Number of feet in a fathom.
What is 6?
600: Number of years in a score.
What is 20?
800: Number of acres in a square mile.
What is 640?
1000: U.S. currency equal to two bits.
What is 25 cents?

Common Chemical Names

200: Common name of glyphosate-based herbicide.
What is Roundup?
400: Common name of iron pyrites.
What is fool's gold?
600: Common name of hydrated iron oxide ($Fe_2O_3 \cdot xH_2O$)

What is rust?
800: Common name of sodium tetraborate decahydrate.
What is borax?
1000: Common name of 2, 4, 6-trinitrophenol.
What is picric acid?

Automobile Logos
200:



What is Tesla?
400:

What is Hyundai?
600:

What is Lexus?
800:

What is Audi?
1000:

What is Porsche?

Semi-Final Round

Final Jeopardy Category: Fluid Flow

This type of pump requires a relief valve on its discharge side.

What is a positive displacement pump?

Final Round

Single Jeopardy:

AIChE Trivia

100: The city and year of the first AIChE Annual Conference.
What are Philadelphia and 1908?
200: The current (2021) AIChE president.
Who is Deborah L. Grubbe?
300: City in which the 2022 AIChE Annual Student Conference will be held.
What is Phoenix, Arizona?
400: AIChE's Center for Chemical Process Safety (CCPS) was founded in this year.
What is 1985?
500: She will be the 2022 AIChE president.
Who is Christine S. Grant?

Mass Transfer

100: The proportionality between a chemical's flux and its concentration gradient.
What is the diffusion coefficient (D_{AB})?
200: During steady-state diffusion into a sphere, the location where the concentration gradient is the steepest.
What is the center?
300: This dimensionless number is the ratio of convective mass transfer to diffusive mass transfer.
What is the Sherwood number?
400: This type of diffusion occurs in small pores where the diameter is smaller than the mean free path of the gas molecules.
What is Knudsen diffusion?
500: The equation shown here that is used calculate the minimum number of theoretical plates in binary continuous distillation.

$$N = \frac{\log\left[\left(\frac{X_d}{1-X_d}\right)\left(\frac{1-X_b}{X_b}\right)\right]}{\log \alpha_{avg}}$$

What is the Fenske?

Thermodynamics

100: This third law of thermodynamics specifies this property as zero for perfect crystalline substances at absolute zero temperature.
What is entropy?
200: Condition when a boiling liquid mixture produces a vapor of the same composition as it evaporates.
What is an azeotrope?
300: $C_P - C_v$ equals this for an ideal gas.
What is R (gas constant)?
400: An enthalpy-entropy diagram is commonly called this in recognition of its creator.
What is a Mollier diagram?

500: This equation, which follows directly from the Gibbs-Duhem equation of a binary system, is given by the following.

$$\frac{dP}{dy_1} = \frac{P(y_1 - x_1)}{y_1(1 - y_1)}$$

What is the coexistence equation?

Organic Chemistry

100: This is a reaction where a bond is broken and formed synchronously in one step.
What is an SN2 reaction?

200: This is an organometallic reaction where halides are added to a carbonyl group in an aldehyde or ketone.
What is a Grignard reaction?
300: The degrees of unsaturation of $C_{10}H_{13}BrO_2$.
What is 4 degrees of unsaturation?
400: Name of the R-S-H functional group.
What is a thiol?
500: This molecule contains 6 carbon atoms, 6 pi bonds (all delocalized), and all carbons are sp^2.
What is benzene?

Earth Science

100: This is the zero degree line of latitude.
What is the equator?
200: Earthquakes occur along these cracks in the earth's surface.
What are faults?
300: When shale is exposed to heat and pressure without melting, this type of rock is formed.
What is slate?
400: A curve in a river is known as this.
What is a meander?
500: This type of weather front brings a short period of heavy precipitation.
What is a cold front?

U.S. National Parks

100: This was the first National Park.

What is Yellowstone National Park?

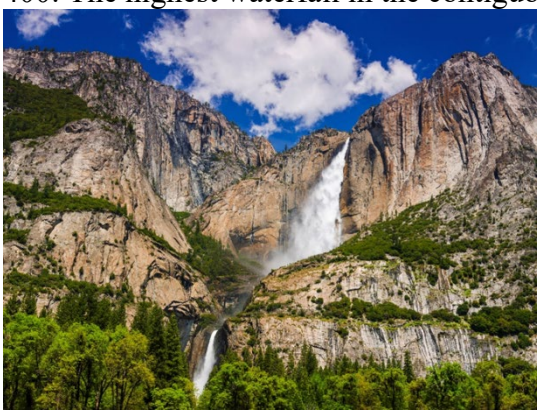
200: This national park is in Oregon.

What is Crater Lake National Park?

300: The most widely visited national park.

What is Great Smoky Mountains National Park?

400: The highest waterfall in the contiguous United States is located within this national park.



What is Yosemite National Park?

500: This is the largest national park.

What is the Wrangell-St. Elias National Park? (located in Alaska)

Final Round

Double Jeopardy:

Safety-Regulated Legislation

200: The 1970 OSHA Act was signed into law by this U.S. president.
Who was Richard Nixon?
400: In addition to creating OSHA, the 1970 OSHAct also created this organization whose mission is "to develop new knowledge in the field of occupational safety and health and to transfer that knowledge into practice."
What is NIOSH? (National Institute for Occupational Safety and Health)
600: This legislation provides guidelines maintained by OSHA that regulates hazardous waste operations and emergency services in the United States and its territories.
What is HAZWOPER? (Hazardous Waste Operations and Emergency Response)
800: Creation of the U.S. Chemical Safety and Hazard Investigation Board was authorized by this 1990 federal legislation.
What is the 1990 Clean Air Act Amendments?
1000: The 2016 update of the 1976 Toxic Substance Control Act (TSCA) was named after this former New Jersey Senator.
Who was Frank R. Lautenberg?

Separations

200: This is used to separate components based on differences in their volatility.
What is distillation?
400: A simplified version of this separation process is seen in a coffee or tea maker.
What is leaching?
600: This equipment uses centrifugal force to separate solids from a gas stream.
What is a cyclone?
800: In distillation, this is the ratio of the amount of vapor in the lowest stage to the amount of bottoms product.
What is the boilup ratio?
1000: This plot, used in chromatography, shows the effect of velocity on plate height.
What is the van Deemter Plot?

Equations

200: $k = Ae^{-Ea/RT}$)
What is the Arrhenius equation?
400:

$$P = \frac{RT}{V - b} - \frac{a}{V^2}$$

What is the van der Waals equation of state?
600:

$$\Delta P = \frac{8\mu LQ}{\pi r^4}$$

What is the Hagen-Poiseuille equation? (Poiseuille equation acceptable)

800:

$$\ln\left(\frac{P_2^{sat}}{P_1^{sat}}\right) = \frac{-\Delta H^{vap}}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

What is the Clausius-Clapeyron equation?

1000:

$$T_g = T_{g,\infty} + \frac{K}{M_n}$$

What is the Flory-Fox equation?

Biological Science

200: The equation that describes the Central Dogma of Molecular Biology.
What is DNA → RNA → Protein?

400: Organisms in this class use CO_2 as their primary carbon source.
What are autotrophs?
600: These are the 3 types of RNA used in protein synthesis.
What are mRNA, tRNA and rRNA? (messenger, transfer, and ribosomal RNAs)
800: This is the primary pathway for carbon dioxide fixation in photoautotrophs and chemolithotrophs.
What is the Calvin Cycle?
1000: This eukaryotic cell structure is involved in maintaining cell shape, cell movement, and cell contraction.
What is the cytoskeleton?

COVID-19

200: The "D" in COVID-19 is an acronym for this.
What is disease?
400: The form of the nucleic acid in SARS-CoV-2.
What is single-stranded RNA?
600: The first human case of SARS-CoV-2 infection was identified in this city in December 2019.
Where is Wuhan, China?

800: The Pfizer COVID-19 vaccine consists of this material inside lipid nanoparticles.
What is mRNA?
1000: This is the name given to the human cell surface receptor to which the SARS-CoV-2 spike protein binds to initiate the virus infection process.
What is ACE2?

TV Show Locations
200: *The Simpsons* live in this city.
What is Springfield?
400: *Friends* was set in this city.
What is New York City, New York?
600: *Grey's Anatomy* is set in this city.
What is Seattle, Washington?
800: *The Flintstones* lived in this city.
What is Bedrock?
1000: *The Mary Tyler Moore Show* was set in this city.
What is Minneapolis, Minnesota?

Final Round
Final Jeopardy Category: Chemical Process Safety
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?