2024 ASC North American ChemE Jeopardy Clues/Responses

Preliminary Round

Single Jeopardy:

Chemical Reaction Engineering

100: The Damköhler number (Da) is the ratio of reaction rate to this.

$$\mathrm{Da} = \frac{\text{reaction rate}}{?}$$

What is the mass transfer rate? (convective or diffusive)

200: E_a in the Arrhenius equation.

$$A \exp(-\frac{E_a}{RT})$$

What is the activation energy?

300: Order of the reaction that results in the following solution of the rate equation.

$$\frac{1}{C_A} - \frac{1}{C_{Ao}} = kt$$

What is second order?

400: The probability distribution function describing the time a fluid element spends in a reactor.

What is the residence time distribution?

500: Methylcyclopentadienyl manganese tricarbonyl (MCMT) produced during the 2007 T2 Laboratories explosion in Jacksonville, Florida is used as an additive to this widely used material.

What is gasoline?

Thermodynamics

100: A process in which volume is held constant.

What is Isochoric?

200: An enthalpy-entropy diagram is commonly called this in recognition of its creator.

What is a Mollier diagram?

300: Equation of state given by

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

What is the Peng-Robinson Equation of State?

400: A cycle which consists of the following steps: isothermal/isochoric/isothermal/isochoric.

What is the Stirling cycle?

500: Parameter given by $\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$

What is the (isothermal) compressibility (κ)?

Global Top 50 Chemical Firms

100: This German company is the world's largest chemical producer with $74.5 billion in 2023 chemical sales.

What is BASF?

200: This company is the United States' largest chemical maker with $44.6 billion in 2023 chemical sales.

What is Dow?
300: This company is China's largest chemical maker with $58.1 billion in 2023 chemical sales.
What is Sinopec?
400: This company is South Korea's largest chemical maker with $42.4 billion in 2023 chemical sales.
What is LG Chem?
500: This company is the world's largest industrial gas producer with $30.7 billion in 2023 chemical sales.
What is Linde?

Spectacular Solubility
100: A rise in this measurement of average molecular velocity often results in a rise in solubility.
What is the temperature?
200: A solvent will dissolve no more solute once the solution has reached this point.
What is saturation?
300: This law is used to quantify the solubility of gases in solvents.
What is Henry's Law?
400: This rule that rhymes with earring states that a linear relationship exists between the temperatures at which two solutions exert the same vapor pressure.
What is Dühring's rule?
500: This parameter provides a numerical estimate of the degree of interaction between molecules and can be a good indication of solubility, particularly for many polymers.
What is the Hildebrand Solubility Parameter?

Odds and Ends
100: This thermodynamic quantity that is related to chemical potential and activity has units of pressure.
What is fugacity?
200: The laboratory handling of volatile compounds should be done inside one of these ventilation devices.
What is a fume hood?
300: Yeast and mushrooms are inhabitants of this kingdom of eukaryotes.
What are fungi?
400: This aromatic five-membered ring has the molecular formula C_4H_4O.
What is furan?
500: A buckyball is a spherical one of these hollow carbon molecules.
What is a fullerene?

Geography
100: This mountain range runs along the western coast of South America.
What are the Andes mountains?
200: This is the highest mountain in Africa.
What is Kilimanjaro?
300: This is the northernmost national capital in the world.
What is Reykjavik, Iceland?
400: This country is known as the "Land of a Thousand Lakes."
What is Finland?

500: This is the second-largest island in the world and part of it is politically part of Indonesia. What is New Guinea?

Preliminary Round

Double Jeopardy:

Equipment Anagrams

200: Once Cly (1 word)
What is a Cyclone?
400: Get Fun Eric (1 word)
What is a Centrifuge?
600: Bad De Peck (2 words).
What is a Packed Bed?
800: Reboot Rico (1 word).
What is bioreactor?
1000: Camel Turf Upping (2 words).
What is a Centrifugal Pump?

Mass Transfer

200: This dimensionless number is given by $\frac{\mu}{\rho * D} \equiv \frac{viscous\ diffusion\ rate}{molecular\ diffusion\ rate}$
What is the Schmidt Number?
400: This process involves the extraction of a solute from a solid into a liquid.
What is leaching?
600: The ratio of thermal diffusivity and mass diffusivity is designated by this dimensionless number.
What is the Lewis number?
800: The Wilke-Chang equation for diffusion is valid for this phase.
What is liquid?
1000: This is the type of diffusion that describes mass transport in porous solids with pores smaller than gas molecules' mean free path.
What is Knudsen diffusion?

Valve Types:

200:

What is a ball valve?

400:

What is a butterfly valve?

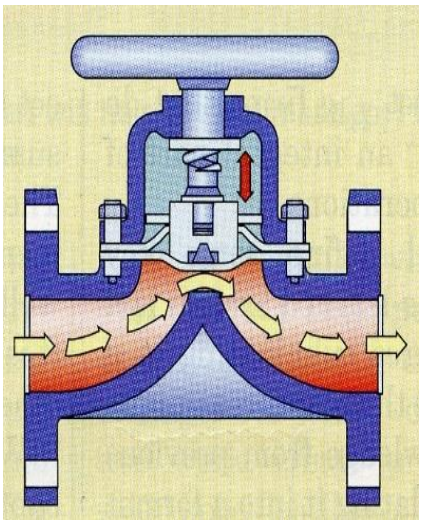
600:

What is a check valve? (non-return valve also acceptable).

800:

What is a gate valve?

1000:



What is a diaphragm valve?

General Chemistry

200: 6.022×10^{23}.

What is Avogadro's number?

400: A substance that can donate electrons to another substance.

What is a reducing agent?

600: Properties of solutions that depend on the number of solute particles in solution and not on the nature of the solute properties.

What are colligative properties?

800: This law states that "the volume of a fixed amount of gas maintained at constant pressure is directly proportional to the absolute temperature of the gas."

What is Charles' Law?

1000: Charge contained in 1 mole of electrons, equivalent to 96,487 coulombs.

What is a Faraday?

Biology

200: Organelle responsible for packaging cellular exports.

What is the Golgi Apparatus?

400: These two molecules containing high reducing power are produced during the TCA cycle.

What are NADH and $FADH_2$?

600: This is the number of photosystems in typical plant cell chloroplasts.

What is two?

800: This eukaryotic protein helps to roll double-helix DNA into more complex structures.

What are histones?

1000: In mammals mitochondrial DNA is inherited according to this mechanism.

What is maternal inheritance?

Dog Breeds

200:

What is a Beagle?

400:

What is a Boxer?

600:

What is a Bernese Mountain Dog?

800:

What is a Cavalier King Charles Spaniel?

1000:

What is a Shiba Inu?

Preliminary Round

Final Jeopardy Category: Chemical Process Design

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?

Semi-Final Round

Single Jeopardy:

Safety Anagrams

100: In Half Tops (2 words).
What is Flash Point?
200: Fuel Treat (2 words).
What is Fault Tree?
300: Pine Sol Ox (1 word).
What is Explosion?
400: Tiger Inn (1 word).
What is Inerting?
500: Dupe Risk Rut (2 words).
What is Rupture Disk?

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: This happens when vapor enters the suction of a pump.
What is cavitation?
300: This is the typical temperature approach used in the design of shell and tube heat exchangers.
What is 10ºF?
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?

Separations

100: Method used to separate solids from fluids by interposing a medium through which only the fluid can pass.
What is filtration?
200: In liquid extraction the two phases are commonly called the extract phase and this.
What is the Raffinate phase?
300: A simplified version of this separation process is seen in a coffee or tea maker.
What is Leaching?
400: 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?
500: This plot, used in chromatography, shows the effect of velocity on plate height.
What is the van Deemter Plot?

GHS Pictograms
100:

What is Explosive?
200:

What is Health Hazard (or Toxicity Hazard)?
300:

What is Acute Toxicity?

400:

What is oxidizer?
500:

What is compressed gas?

Physics
100: This popular astrophysicist, author of “Death By Black Hole” and host of TV’s “Cosmos,” earned a BA in Physics from Harvard University in 1980.
Who is Neil DeGrasse Tyson?
200: Word that describes a theory in theoretical physics, a family of instruments in an orchestra, and cheese that you can easily pull apart.
What is string?
300: Subatomic particle (varieties include strange and charmed) whose name was taken from the James Joyce work "Finnegans Wake.”
What is a Quark?
400: Full name of the British scientist (died on April 8th, 2024) who discovered the Higgs Boson.
Who is Peter Higgs?
500: Howard Aiken received a PhD in Physics from Harvard in 1939, and in 1944 he installed the Harvard Mark I, a computer designed for this giant computer company.
What is IBM (International Business Machines)?

History

100: The United States purchased Alaska from this country.
What is Russia?
200: This leader came to power in Cuba after the Cuban Revolution.
Who was Fidel Castro?
300: He was the first democratically elected president of South Africa.
Who was Nelson Mandela?
400: This country was ruled by Pol Pot until he was overthrown by the Vietnamese army in 1979.
What is Cambodia?
500: The Titanic sank this year.
What is 1912?

Semi-Final Round

Double Jeopardy:

Heat Transfer

200: This parameter is defined as the rate of heat transfer through a unit thickness of material per unit area per temperature difference.

What is thermal conductivity?

400: This parameter is defined as the following.

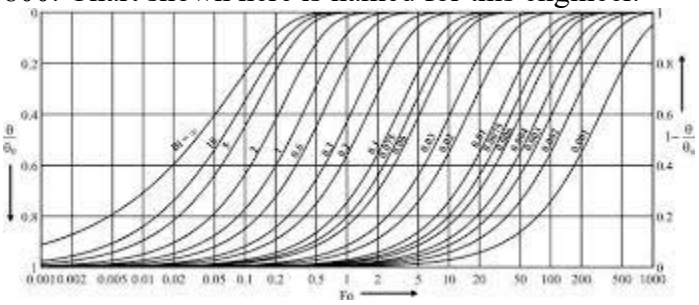
$$\propto = \frac{k}{\rho C_p}$$

What is thermal diffusivity?

600: This law of radiation states that the emissivity and the absorptivity of a surface at a given temperature and wavelength are equal.

What is Kirchhoff's Law?

800: Chart shown here is named for this engineer.



Who is Charles Heisler?

1000: Dimensionless number denoted by the following.

$$\frac{h}{\rho C_p V} = \frac{Nu}{Re_L Pr}$$

What is the Stanton number?

Fires and Explosions

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

What is a detonation?

400: The overpressure from explosions is commonly estimated by using an equivalent mass of this substance.

What is TNT?

600: A Class D fire involves these materials.

What are metals?

800: This is defined as the lowest temperature at which a vapor above a flammable liquid will ignite and remain ignited.

What is the fire point?

1000: From the Greek word meaning "fire-bearing," this is the term for a compound that can ignite spontaneously in air.

What is pyrophoric?

Process Control

200: A control scheme that uses measured disturbances to calculate the control action.
What is feed forward control?

400: 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 between 0 to 1?

600: This type of diagram (full name) provides a detailed description of the process equipment with all the valves, pumps, piping specifications and sensors located on the diagram.
What is a piping and instrumentation diagram?

800: The maximum positive and negative change in the signal to the final control element that does not produce a measurable change to the flow rate in question.
What is valve deadband?

1000: This is the build-up of the integral term in a PID controller caused by reaching constraints in the system.
What is reset windup? (Integral windup also acceptable)

Hydrogen

200: The NFPA flammability rating (i.e., given on NFPA diamond) for hydrogen.
What is 4?

400: Common names of the hydrogen isotopes (^{2}H and ^{3}H) used in nuclear fusion to produce ^{4}He.
What are deuterium and tritium?

600: The "color" of hydrogen produced by natural gas, currently the most common production method.
What is grey?

800: The minimum ignition energy of hydrogen in air.
What is 0.018 mJ (0.01 to 0.03 mJ acceptable)?

1000: Hydrogen was discovered (i.e., recognized as an element) in 1766 by this English physicist.
Who was Henry Cavendish?

Molecular Biology

200: They proposed the double-helical structure of DNA in 1953.
Who were James Watson and Francis Crick?

400: These enzymes are widely used in genetic engineering and cut DNA at palindromic sequences.
What are restriction endonucleases?

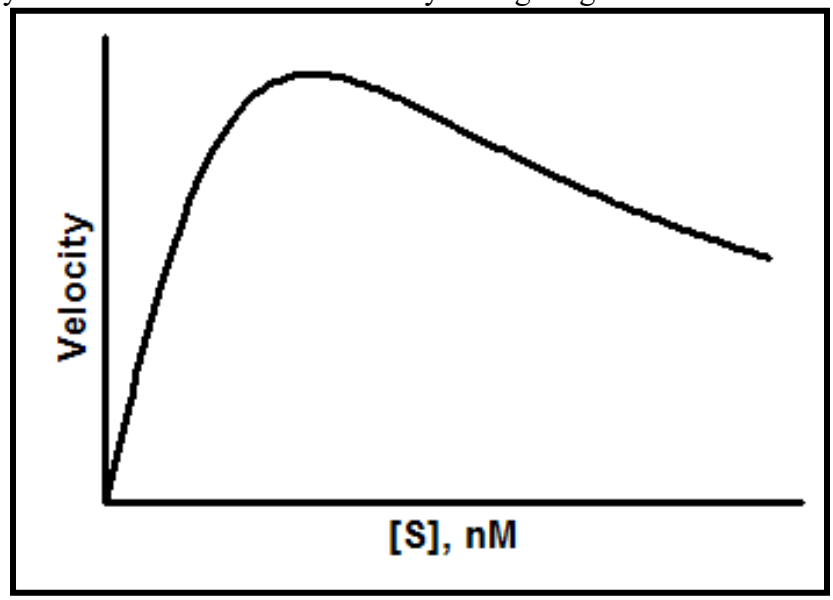
600: This method uses primers, DNA polymerase and other molecules to amplify a DNA segment.
What is the Polymerase Chain Reaction (PCR)?

800: This enzyme is used to prepare a complementary DNA (cNDA) library from messenger RNA (mRNA).
What is Reverse (RNA) Transcriptase?

1000: These are the short segments of newly synthesized DNA along the trailing or discontinuous strand that are then linked by a ligase to form the completed DNA.
What are Okazaki fragments?

Sports Playoff History
200: This team has won 3 of the last 5 super bowls.
Who are the Kansas City Chiefs?
400: This team came back from a 3-1 deficit to win the 2016 NBA championship.
Who are the Cleveland Cavaliers?
600: This is the only MLB team to come back from a 3-0 deficit to win a playoff series.
Who are the Boston Red Sox?
800: This is the only NFL team to have an undefeated season.
Who are the Miami Dolphins (1972)?
1000: This is the last Canadian team to win the Stanley Cup (1993).
Who are the Montreal Canadiens?

Semi-Final Round
Final Jeopardy Category: Biochemical Engineering
This type of enzyme inhibition is demonstrated by the figure given here:



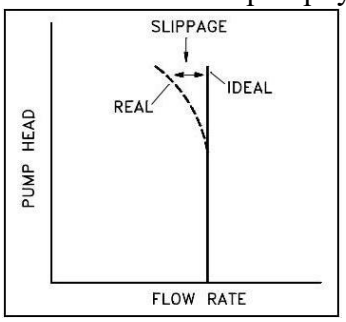
What is Substrate Inhibition?

Final Round

Single Jeopardy:

Fluid Flow

100: The following pump curve is consistent with this pump type.



What is a positive displacement pump?

200: The fanning friction factor is usually a function of these two dimensionless parameters.

What are the Reynolds number and the relative roughness?

300: This is a limiting condition for gas flow in a pipe in which the mass flow rate will not increase with a further decrease in the downstream pressure when the upstream pressure is fixed.

What is choked flow?

400: This type of fluid flow, also known as creeping flow or creeping motion, where inertial forces are small compared to viscous forces, bears the same name as the CGS unit of kinematic viscosity.

What is Stokes flow?

500: The dimensionless number given by the following equation is commonly used in problems involving falling particles.

$$\frac{d^3 \rho g \Delta \rho}{\mu^2}$$

What is the Archimedes number?

Material and Energy Balances

100: This is a temperature-measurement device that consists of two dissimilar metal wires joined at one end.

What is a thermocouple?

200: This type of stream is used to send unused raw material emerging from a process unit back to the unit.

What is a recycle stream?

300: This "law" states that the volume of a gas mixture is the sum of the pure component volumes.

What is Amagat's Law?

400: The specific gravity of a liquid or solid is based on the density of water at this temperature.

What is 4ºC (39ºF)?

500: This is the volume (in ft^3) of one lb-mole of an ideal gas under STP conditions (3 significant figures).

What is 359?

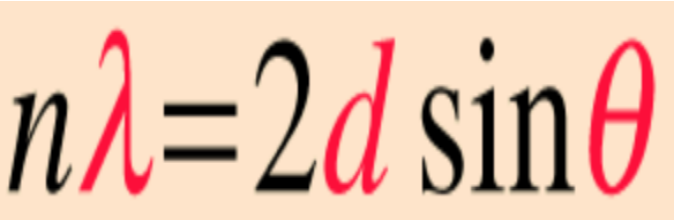
Materials Science

100: This term is used for a material that is not crystalline.
What is amorphous?

200: This is a measure of the stiffness of a solid material.
What is Young's modulus (elastic modulus)?

300: Of the following, two have the closest packing of atoms: Simple cubic, BCC, HCP, FCC.
What are HCP and FCC?

400:



$$n\lambda = 2d\sin\theta$$

What is Bragg's law?

500: This technique involves strengthening metals by alloying it with impurity atoms.
What is solid solution strengthening?

Energy

100: This state in the United States was the largest coal producer in 2023.
What is Wyoming?

200: This state in the United States currently produces the most electricity from nuclear energy.
What is Illinois?

300: This country currently produces the most electricity from geothermal energy.
What is the United States?

400: This country currently produces the most hydroelectric power.
What is China?

500: At ~43% this was the top method of electricity production in the United States in 2023.
What is natural gas?

Nuclear Engineering

100: Isotope used for dating many archeological artifacts.
What is C-14?

200: The key Uranium isotope that is fissile (i.e., the "fuel" in nuclear reactions).
What is Uranium-235?

300: The number of neutrons in Cl-37.
What is 20?

400: Unit of area commonly used for expressing the cross-sectional area of a nuclei, equal to 10^{-24} cm^2.
What is a Barn?

500: Byproduct of nuclear decay that cannot pass through the skin.
What is an Alpha Particle?

Literature

100: She wrote “To Kill a Mockingbird.”
Who was Harper Lee?

200: He wrote “The Little Mermaid.”
Who was Hans Christian Andersen?

300: Name of Washington Irving’s 1819 short story about a man that fell asleep in the woods for 20 years.
Who is Rip Van Winkle?

400: Sherlock Holmes played this instrument.
What is the violin?

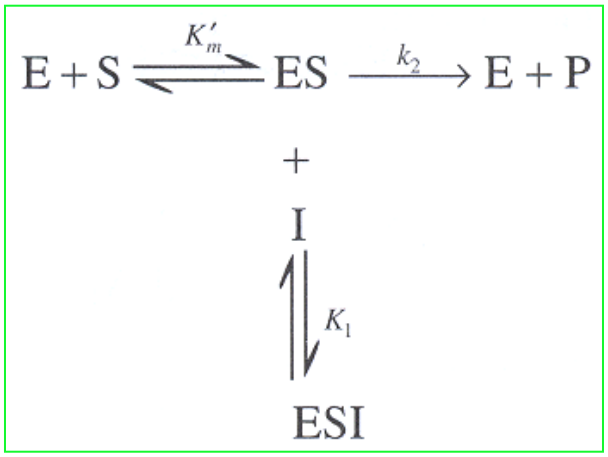
500: This musician and songwriter won the Nobel Prize in Literature in 2016 for his songwriting.
Who was Bob Dylan?

Final Round

Double Jeopardy:

Biochemical Engineering

200: Type of enzyme inhibition represented here.



What is uncompetitive inhibition?

400: Enzymes in this class are often found in detergents.

What are proteases?

600: This dimensionless parameter is used for enzymes inside particles.

$$\frac{R}{3}\left[\frac{v_{max}/K_M}{D_{eff}}\right]^{0.5}$$

What is the Thiele Modulus?

800 This product, which is produced in *Escherichia coli*, became the first commercial recombinant DNA product in 1982.

What is insulin?

1000: This product, which is produced by Genentech, became the first commercial recombinant DNA product produced in mammalian cells in 1988.

What is tissue plasminogen activator (t-PA)?

Chemical Process Safety

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

What are initiation, propagation and termination?

400: This is defined as a chemical or physical condition that has the potential for causing damage to people, property, or the environment.

What is a hazard?

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

What is 15 minutes?

800: This is the OHHA equivalent of the Threshold Limit Value – Time Weighted Average (TLV-TWA)

What is the Permissible Exposure Limit (PEL)?

1000: The 1970 OSHAct created the Occupational Safety and Health Administration (OSHA) and this related organization.
What is the National Institute for Occupational Safety and Health (NIOSH)?

Named Equations

200:

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

What is the Fenske Equation?

400: $v_t = \frac{d_p^2 g(\rho_p - \rho_f)}{18\mu_f}$

What is Stoke's Law?

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

What is the Monod Equation?

800: $\frac{\partial P}{\partial t} + \nabla \cdot (\rho u) = 0$

What is the Continuity Equation?

1000:

$$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} + V(x)\psi = E\psi$$

What is the Schrodinger equation?

Flixborough Accident 50th Anniversary

200: Country in which accident occurred.
What is England? (United Kingdom is also acceptable)
400: Type of accident.
What is a vapor cloud explosion? (explosion acceptable).
600: Application of this procedure, commonly abbreviated by MOC, would probably have prevented the accident.
What is Management of Change?
800: Major chemical released during accident.
What is cyclohexane?
1000: The facility at which this accident occurred was owned by this company?
What is Nypro UK?

Quick Math
200: $(8^{2/3})^3$
What is 64?
400: 5! – 3!
What is 114?
600: Volume of right regular pyramid with a base area of 6 m^2 and a height of 10 m.
What is 20 m^3?
800: $\int_2^4 x^3\,dx$
What is 60?
1000: Final score for a bowler who has a spare in the first frame followed by 11 consecutive strikes.
What is 290?

Taylor Swift
200: This is Taylor Swift's signature lipstick color.
What is red?
400: State in which Taylor Swift was born.
What is Pennsylvania?
600: The song "Bad Blood" is believed to be about this female pop star.
Who is Katy Perry?
800: Taylor Swift is named after this famous singer-songwriter.
Who is James Taylor?
1000: Taylor Swift grew up on this type of farm.
What is a Christmas Tree Farm?

Final Round
Final Jeopardy Category: Dimensionless Numbers
These are the 3 dimensionless numbers used to determine the mixing power in an agitated and aerated (i.e., sparged) fermenter.
What are the Reynolds, Power and Aeration number/