

## 2023 ASC North American ChemE Jeopardy Clues/Responses

### Preliminary Round

#### *Single Jeopardy:*

#### Industrial Accidents

100: The February 3, 2023 train derailment in East Palestine, Ohio resulted in the release of this hazardous chemical.



What is vinyl chloride?

200: Location (city and state/country) of an accident described as “an ammonium nitrate explosion that occurred at a storage facility in April 2013.”

What is West, Texas?

300: The company at which an accident described as “a refinery fire in Richmond, California in August 2013 triggered by a leaking old pipe” occurred.

What is Chevron?

400: Location (city and state/country) of an accident described as “a huge explosion at a sugar refinery in February 2008 that resulted in 14 deaths.”

What is Port Wentworth, Georgia?

500: Release and ignition of this chemical was involved in the June 1974 Flixborough, England disaster.

What is cyclohexane?

#### Electricity

100: This German physicist introduced the concept of electrical resistance in 1827.

Who is Georg Ohm?

200: This famous U.S. inventor developed the first thermal power station in the United States in 1882.

Who is Thomas Edison?

300: The United States electric grid system delivers AC power at 110-120 volts at this many Hertz.

What is 60 Hz?

400: This Italian physicist invented the battery in 1800.

Who is Alessandro Volta?

500: This English physicist published the law of induction in 1831 (Joseph Henry developed the same law independently).

Who is Michael Faraday?

#### Mass Transfer

100: This dimensionless number represents the ratio of convective mass transfer to diffusive mass transport.

What is the Sherwood Number?

200: Process where  $N_a = -N_b$ .

What is equimolar counterdiffusion?

300: This is the average distance traveled by a gas molecule or other particle between collisions with other particles.

What is the mean free path?

400: A chemical's concentration during non-steady state diffusion from a constant source has the same dependence on distance as it has on this power of time.

What is  $-1/2$ ?

500: At low Reynolds number, the diffusion coefficient of spherical particles in a liquid can be determined from this equation, as derived by hydrodynamic theory.

What is the Stokes-Einstein Equation?

### Material & Energy Balances

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

What is 22.4?

200: This equation of state is given by

$$\frac{P\hat{V}}{RT} = 1 + \frac{B}{\hat{V}} + \frac{C}{\hat{V}^2} + \dots$$

What is the virial equation of state?

300: This equation is given by the following:

$$\ln(P^*) = -\frac{\Delta\hat{H}_v}{RT} + B$$

What is the Clausius-Clapeyron Equation?

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 a gas mixture is the sum of the pure component volumes.

What is Amagat's Law?

### Separations

100: Method used to separate solids from fluids by interposing a medium through which only the fluid can pass.

What is filtration?

200: This is used to separate components from a rising gas with the use of a falling liquid to trap the gas.

What is absorption? Or What is a scrubber?

300: This equipment uses centrifugal force to separate solids from a gas stream.

What is a cyclone?

400: In liquid extraction the two phases are commonly called the extract phase and the \_\_\_\_\_.

What is the raffinate phase?

500: This plot, used in chromatography, shows the effect of velocity on plate height.

What is the van Deemter Plot?

## Simpsons

100: Name of the bar that Homer Simpson frequents.

What is Moe's Tavern?

200: This was the name of Ned Flander's first wife.

Who is Maude Flanders?

300: During the 2-part episode "Who Shot Mr. Burns?" Mr. Burns was shot and hospitalized.

This person shot Mr. Burns.

Who was Maggie Simpson?

400: The name of the annual series of special Halloween-themed anthology episodes, formerly known as The Simpsons Halloween Specials.

What is the Treehouse of Horror?

500: This was Homer's high school yearbook quote.

What is "I can't believe I ate the whole thing?"

## Preliminary Round

### Double Jeopardy:

#### Gone Nuclear!

200: A high-speed electron emitted in the decay of a radioactive isotope.

What is a beta particle?

400: Hydrogen isotope that contains 2 neutrons.

What is tritium?

600: The title character's name in the 1964 Stanley Kubric film in which the bomb was dropped.



Who is Dr. Strangelove?

800: C-14 becomes this when it undergoes beta decay.

What is N-14?

1000: Discovered radioactivity accidentally from the effect of uranium salts on photographic plates.

Who is Henri Becquerel?

### Anagrams

200: AFTER MENTION (clue: anaerobic)

What is fermentation?

400: DUTY HIMI (clue: weather)

What is humidity?

600: DORIAN SPOT (clue: separation)

What is adsorption?

800: APE TO ZERO (clue: thermodynamics)

What is azeotrope?

1000: FLEE REVIVAL (clue: safety)

What is relief valve?

### Chemical Process Safety

200: This is defined as the lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture with air.

What is the flash point?

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

What is an explosion?

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

What is TNT?

800: This is the most common type of electrostatic discharge in industry.

What is a spark discharge?

1000: This equipment, abbreviated ARSST, is commonly used to evaluate the reactive hazards.

What is the Advanced Reactive System Screening Tool?

### Thermodynamics

200: This law is an expression of the fact that the enthalpy of a chemical process is independent of the path taken.

What is Hess's law?

400: Name of this equation:  $\ln(P_{\text{sat}}) = A - B/(T+C)$

What is Antoine's Equation?

600: Temperature at which a vapor mixture begins to condense at a fixed pressure.

What is the dew point temperature?

800: This parameter is given by  $-\left(\frac{\partial G}{\partial T}\right)_p$ .

What is entropy (S)?

1000: This, according to the Gibbs' Phase Rule, is the degrees of freedom for pure liquid water (1 phase).

What is 2? ( $F = 2 - \Pi + N = 2 - 1 + 1 = 2$ )?

### Process Control

200: The name of the function that is the ratio of the output to the input in the Laplace domain.

What is a transfer function?

400: This type of diagram 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 (P & ID)?

600: A control element designed to reduce loop interaction.

What is a decoupler?

800: This type of control uses the sensor reading and the setpoint to set the value of the manipulated variable for a process.

What is feedback control?

1000: The characteristic of a second-order process that determines the general shape of the dynamic response.

What is the damping factor?

### U.S. Geography

200: Smallest US state by land mass.

What is Rhode Island?

400: This state has the largest number of endangered species.

What is Hawaii?

600: Number of US states bordering Mexico.

What is 4? (Texas, New Mexico, Arizona & California)

800: This is the lowest point in the United States.

What is Death Valley?

1000: The Niagara River that contains Niagara Falls connects these two great lakes.  
What are Erie and Ontario?

**Preliminary Round**

Final Jeopardy Category: Thermodynamics

The Legendre transform of the internal energy ( $U$ ) in which temperature ( $T$ ) replaces entropy ( $S$ ) as the independent variable.

What is the Helmholtz Free Energy ( $A$ )?

## **Semi-Final Round**

### *Single Jeopardy:*

#### AIChE Trivia

100: Current (2023) AIChE president.

Who is Billy B. Barton?

200: Location (City and State) of the 2024 AIChE Annual Student Conference.

What is San Diego, California?

300: The 2024 AIChE president (current president elect).

Who is Alan E. Nelson?

400: In 2003 she became the first woman to be AIChE president.

Who is Diane Dorland?

500: This AIChE organization, denoted by the acronym DIERS, was formed in 1976 as a consortium of 29 companies.

What is the Design Institute for Emergency Relief Systems?

#### Household Chemicals

100: The active ingredient in Drano.

What is sodium hydroxide?

200: Chemical name for baking soda.

What is sodium bicarbonate?

300: In 1945 Grand Rapids, Michigan was the first community to add this compound to tap water to reduce tooth decay in children.

What is sodium fluoride? (sodium hexafluorosilicate or hexafluorosilicic acid are also acceptable responses).

400: Mothballs are commonly made of paradichlorobenzene or this chemical.

What is naphthalene?

500: Mixing bleach and this compound commonly found in kitchens produces toxic chlorine gas.

What is vinegar?

#### Microbiology

100: The Gram stain is used to classify cells based on differences in their \_\_\_\_\_.

What is cell wall?

200: A small ring of DNA independent from the bacterium's main genome that can be taken in and expressed by bacteria is called a(n) \_\_\_\_\_.

What is a plasmid?

300: In 1892 this became the first virus to be discovered.

What is the tobacco mosaic virus?

400: PCR is the abbreviation for this.

What is the polymerase chain reaction?

500: This bacterium is the causative agent of bubonic plague?

What is *Yersinia pestis*?

#### Dimensionless Numbers

100: This dimensionless number is used as the criterion for determining whether pipe flow is laminar or turbulent.

What is the Reynolds number?

200: This dimensionless number is the ratio of the fluid velocity to the velocity of sound in the medium.

What is the Mach number?

300: This dimensionless number is the ratio of convection to conductive heat transfer across a boundary.

What is the Nusselt number?

400: This dimensionless number is the ratio of the kinematic viscosity to the thermal diffusivity.

What is the Prandtl number?

500: This dimensionless number measures the ratio of the inertial and gravitational forces.

What is the Froude number?

### Safety Legislation

100: This organization, denoted by the abbreviation CSB, was formed in the 1990 Clean Air Act Amendments legislation.

What is the Chemical Safety Board?

200: The Risk Management Plan (RMP) implements Section 112(r) of this federal legislation.

What is the 1990 Clean Air Act Amendments?

300: On June 22, 2016, the Frank R. Lautenberg Chemical Safety for the 21<sup>st</sup> Century Act (Lautenberg Chemical Safety Act) was signed into law, which was an update of this 1976 legislation.

What is the Toxic Substances Control Act (TSCA)?

400: This federal government legislation covers operations involving hazardous wastes that are conducted at treatment, storage, and disposal facilities.

What is HAZWOPER (OSHA Hazardous Waste Operations and Emergency Response)?

500: The 1970 OSHA Act created the Occupational Safety and Health Administration (OSHA) and this related organization.

What is NIOSH (National Institute for Occupational Safety and Health)?

### SpongeBob

100: The first name of Mr. Krabs, the owner of the Krusty Krab.

What is Eugene?

200: State that Sandy Cheeks is originally from.

What is Texas?

300: Complete the lyrics to the F.U.N. Song: "F is for friends who do stuff together. U is for you and me. N is for \_\_\_\_\_."

What is "Anywhere and anytime at all."

400: This day of the year is "Annoy Squidward Day."

What is February 15<sup>th</sup>?

500: This is the only way to prevent a sea bear attack.

What is draw a circle in the dirt? (anti-sea bear circle)



## Semi-Final Round

### Double Jeopardy:

#### Famous Scientists/Engineers (Fill in the Blanks)

200: (clue: radiation) \_\_\_ ie C \_\_\_\_\_

Who is Marie Curie?

400: (clue: reactions) O \_\_\_ ve \_\_\_\_\_ iel

Who is Octave Levenspiel?

600: (clue: fermentation) L \_\_\_\_\_ P \_\_\_\_\_

Who is Louis Pasteur?

800: (clue: safety) T \_\_\_\_\_ K \_\_\_\_\_ z

Who is Trevor Kletz?

1000: (clue:  $S = k \log W$ ) L \_\_\_ wig B \_\_\_\_\_ ann

Who is Ludwig Boltzmann?

### Physics

200: The relationship between voltage, current, and resistance is represented by this law:  $V = IR$ .

What is Ohm's Law?

400: These are the most abundant particles that have mass in the universe.

What are neutrinos?

600: This British physicist discovered the existence of electrons.

Who is J.J. Thomson?

800: This is the smallest known particle in the universe.

What is a quark?

1000:  $\frac{1}{f} = \frac{1}{o} + \frac{1}{i}$ , where "o" is the object, "i" is the image distance, and "f" is the focal length.

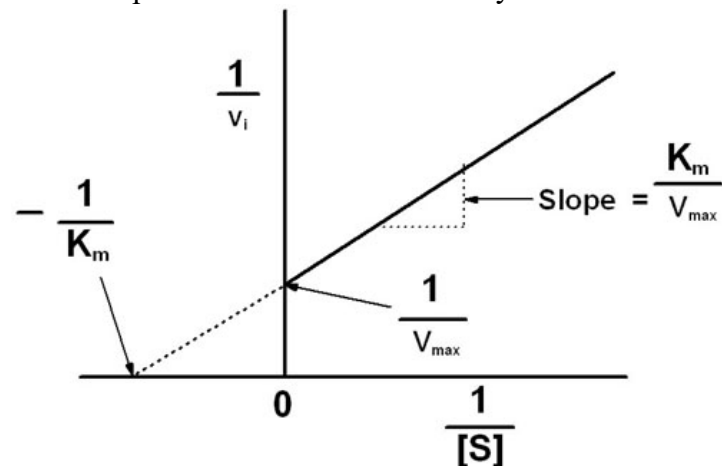
What is the thin lens equation?

### Enzyme Kinetics

200: A common type of enzyme kinetics given by  $V = \frac{V_{\max} S}{K_M + S}$ .

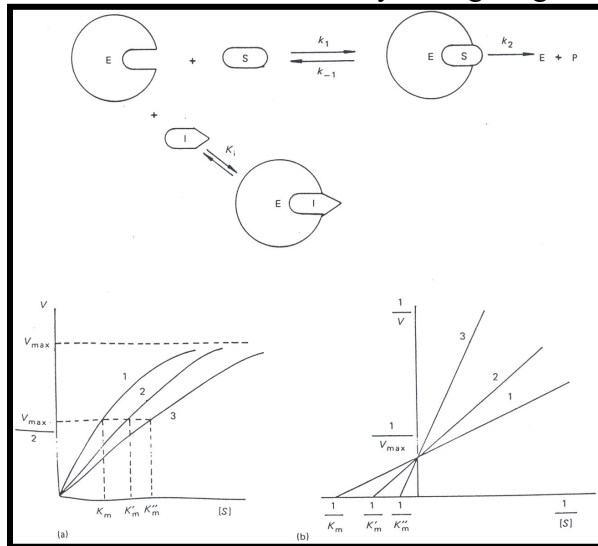
What is Michaelis-Menten kinetics?

400: The plot shown here is commonly used to determine enzyme kinetic parameters.



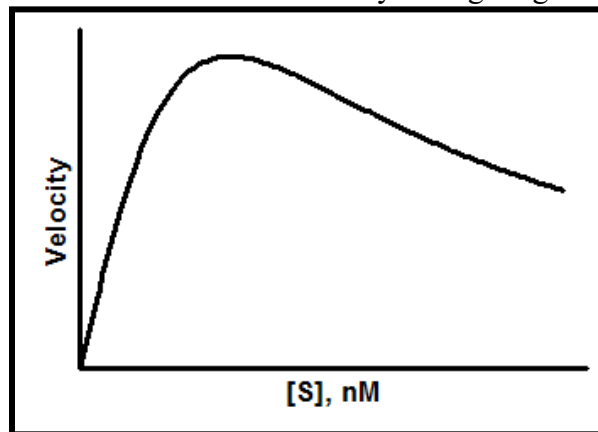
What is a Lineweaver-Burk plot?

600: This type of enzyme inhibition is demonstrated by the figure given here:



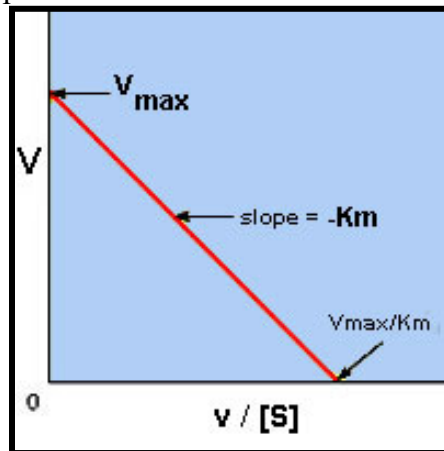
What is Competitive Inhibition?

800: This type of enzyme inhibition is demonstrated by the figure given here:



What is Substrate Inhibition?

1000: The plot shown here is commonly used to determine the parameters in Michaelis-Menton enzyme kinetics and generally provides more accurate  $K_M$  values than other types of plots.



What is an Eadie-Hofstee Plot?

### It's a Gas!

200: This gas was used to provide buoyancy in the Hindenburg airship.

What is hydrogen?

400: This is the 3<sup>rd</sup> most abundant gas (by volume) in air.

What is Argon?

600: This is the 4<sup>th</sup> most abundant gas (by volume) in air.

What is carbon dioxide?

800: This is the heaviest gas element.

What is Radon?

1000: He discovered oxygen in 1774.

Who is Joseph Priestley?

### Thermodynamics

200: A cycle consisting of the following steps: adiabatic/isobaric/adiabatic/isochoric.

What is the Diesel cycle?

400: Parameter defined as  $\left(\frac{\partial T}{\partial P}\right)_H$ .

What is the Joule-Thomson coefficient?

600: This branch of thermodynamics applies microscopic analysis based on probability to evaluate macroscopic properties.

What is statistical thermodynamics?

800: This equation of state is given by the following equation:

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

What is the Peng-Robinson Equation of State?

1000: A set of equations derived by application of Euler's reciprocity relation to the thermodynamic characteristic functions.

What are the Maxwell Equations?

### Law Category

200: The rights a police officer must inform you when you are arrested.

What are the Miranda Rights/Warnings?

400: This legal principle states that a person cannot be tried twice for the same crime.

What is double jeopardy?

600: The only person to have served as both President and Chief Justice of the Supreme Court.

Who is William Howard Taft?

800: This is a government grant of the right to exclude others from making, using, or selling an invention for a limited period of time.

What is a patent?

1000: This amendment grants people the right to be free from unreasonable searches and seizures by the government.

What is the 4<sup>th</sup> amendment?

## **Semi-Final Round**

Final Jeopardy Category: Infamous Accidents

The location (i.e., city and state/country) and hazardous gas that was leaked on December 3, 1984 at a pesticide plant that resulted in more than 2000 civilian casualties.

What is Bhopal, India and MIC (methyl isocyanate)?

## **Final Round**

### *Single Jeopardy:*

#### 2023 Science in the News

100: In June an international team of astronomers detected a low hum of gravitational waves echoing across the universe. This is suspected to be the source of the waves.

What is the merging of black holes?

200: The World Health Organization announced in early July that this artificial sweetener is a possible carcinogen.

What is aspartame?

300: This NASA telescope orbits the sun, sits ~1 million miles from Earth (in its shadow), and has been described as “it can peek 13 billion years back in time at ancient galaxies ...”

What is the James Webb Space Telescope?

400: In July the FDA approved a shot, consisting of this type of compound, to protect infants and vulnerable toddlers against respiratory syncytial virus (RSV).

What is a monoclonal antibody?

500: A late July article in *The NY Times* describes research of this type of organism (species name *Panagrolaimus kolymaensis*) that was revived and produced offspring after spending ~46,000 years in the Siberian permafrost.

What is a roundworm? (Worm or Nematode are also acceptable)

#### Anagrams II

100: ADDER BELLS (clue: packing)

What is Berl saddle?

200: AUNTIE PORTION (clue: equipment)

What is unit operation?

300: LITTON PIPER (clue: thermodynamics)

What is triple point?

400: FOXIER ULTRA (clue: distillation)

What is reflux ratio?

500: BUMPER OWNER (clue: mixing)

What is power number?

#### Process Design

100: Future value of \$1 in 3 years assuming an annual interest rate of 100% and annual compounding.

What is \$8?

200: This type of interest is represented by  $F = Pe^{rt}$ .

What is continuously compounded interest?

300: This parameter is equal to  $\frac{\text{Number of days plant operates per year}}{365}$ .

What is the Stream Factor (SF)?

400: This depreciation system is commonly denoted by its acronym MACRS.

What is the Modified Accelerated Cost Recovery System?

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

What is Monel?

## Fluid Flow

100: A Bingham plastic acts as a solid until this threshold is reached.

What is the yield stress?

200: This general pump type requires a relief valve on its discharge side.

What is a positive displacement pump?

300: This device is used to measure fluid velocity, consists of a narrow tube, one end of which is open and faces upstream, the other end is connected to a manometer.

What is a Pitot tube?

400: The sudden closing of a valve leads to this undesirable phenomenon.

What is water hammer?

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 Reaction Engineering

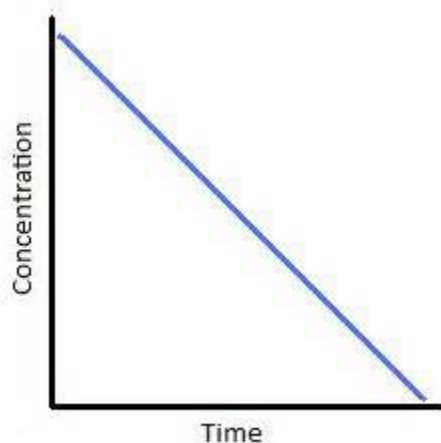
100: This is defined as  $\frac{\text{Reactor Volume}}{\text{Volumetric Flowrate Entering Reactor}}$ .

What is the space time ( $\tau$ )?

200: Ratio of the rate of reaction to the rate of mass transfer.

What is the Damköhler number?

300: This is the order of the reaction denoted by the following



What is zeroth order?

400: Add enough of this to a plug-flow reactor (PFR) and a continuously stirred tank reactor (CSTR) is obtained.

What is recycle?

500: Although sounding like terminology from a cooking oil commercial, this behavior is characteristic of many catalytic reactions.

What is saturation kinetics?

## Simpsons II

100: This is Homer Simpson's job title at the nuclear power plant.

What is nuclear safety inspector?

200: This is the only character in the Simpsons with 5 fingers. (The other characters only have 4 fingers)

Who is God?

300: The Simpsons relocate to this state in *The Simpsons Movie*.

What is Alaska?

400: This is the Simpsons' street address.

What is 742 Evergreen Terrace?

500: The Simpsons is the longest running TV series in history. The 2023-24 season will be the \_\_\_\_\_ (number) season of the show.

What is the 35th season?

## Final Round

*Double Jeopardy:*

Water

200: The combined force of cohesion and adhesion that results in the following:



What is capillary action?

400: The bond angle (1 decimal place and within 1° of the accepted value) between the central oxygen and the hydrogen atoms.

What is 104.5°? (any value between 103.5 and 105.5° is acceptable).

600: Thumper describes the water on this frozen lake by this word in *Bambi*.



What is the water is “stiff?”

800: The tightness on the top layer of water due to cohesion.

What is surface tension?

1000: The density of water is equal to 1 gm/mL at this temperature (°C).

What is 4°C?

## Medical

200: This antibiotic was discovered in 1928 by Sir Alexander Fleming because of a laboratory contaminant.

What is penicillin?

400: Bayer modified salicylic acid (a compound found in willow bark) to create this medication that was the first medication marketed in a tablet form.

What is aspirin?

600: Mammalian cells commonly used in recombinant DNA technology for producing monoclonal antibody medications.

What are Chinese Hamster Ovary (CHO) cells?

800: Anthelmintics treat this medical condition.

What are parasitic worms?



1000: This pharmaceutical abbreviation means “as needed.”  
What is PRN? (Abbreviation for Latin term “pro re nata”).

### Quick Math

200: 5!

What is 120?

400:  $(625)^{1/4}$

What is 5?

600:  $\int \sin(x)dx$

What is  $-\cos(x) + C$ ?

800:  $\frac{d}{dx}(\ln(x))$

What is  $\frac{1}{x}$ ?

1000:  $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$

What is e? (Euler’s Number also acceptable)

### Process Control

200: This type of control measures disturbances and compensates for them before the output changes.

What is feedforward control?

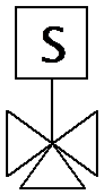
400: This is the most widely controlled parameter in the chemical process industry.

What is the flow rate?

600: A variable that we have no control over in the process but affects the material or heat flow of a process.

What is a disturbance variable?

800: Name of the control valve depicted here.



What is a 3-way solenoid valve?

1000: Too much of this type of control action will result in a closed-loop response that has a staircase shape.

What is derivative control action?

### Heat Transfer

200:  $\dot{Q} = hA(T_{\infty} - T_w)$  is named after this Scientist.

Who is Sir Isaac Newton?

400: These are the SI units for Thermal Conductivity.

What is  $W/(m\cdot K)$  or  $J/(m\cdot s\cdot K)$ ?  $[(kg\cdot m)/(t^3\cdot K)]$  also acceptable]

600: This dimensionless parameter is given by  $\frac{hV/A}{k}$ .

What is the Biot Number?

800: This dimensionless number is given by  $\frac{g\beta(T_w - T_\infty)D^3}{\nu^2}$ .

What is the Grashof number?

1000: This radiation heat transfer parameter is given by  $\frac{1}{A_1} \iint_{A_1, A_2} \frac{\cos(\theta_1)\cos(\theta_2)dA_2dA_1}{\pi r^2}$ .

What is the view factor  $F_{12}$ ?

### U.S. History

200: This was the first permanent English settlement in what is now the United States.

What was Jamestown?

400: This Native American woman met explorers Meriwether Lewis and William Clark and became the translator during their famous exploration of the Louisiana Territory.

Who was Sacagawea?

600: This famous nurse during the Civil War later founded the Red Cross.

Who was Clara Barton?

800: He was Abraham Lincoln's first vice-president from 1861-1865.

Who was Hannibal Hamlin?

1000: This famous novel, written in the 1920s by Upton Sinclair, highlighted the horrific conditions of the meatpacking industry in the United States.

What is *The Jungle*?

### Final Round

Final Jeopardy Category: Chemical Process Safety

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

What are fuel (dust), oxidizer (air), ignition source, confinement and dispersion (of dust)?