

## 2015 ChemE Jeopardy Clues & Responses

### Preliminary Round

#### *Single Jeopardy*

#### Chemical Process Safety

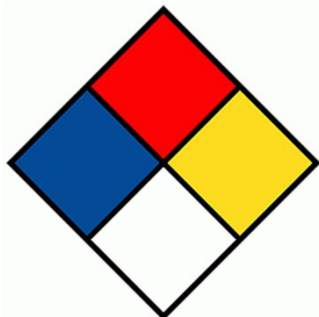
100: These are the 3 major types of chemical plant accidents.

What are fires, explosions, and toxic releases?

200: This is the OSHA equivalent of the Threshold Limit Value – Ceiling (TLV-C).

What is Immediately Dangerous to Life and Health (IDLH)?

300: The red area on the NFPA diamond given here represents the level of this hazard.



What is fire? or What is flammability?

400: This 1976 legislation regulates the introduction of new or already existing chemical in the United States.

What is the Toxic Substances Control Act (TSCA) of 1976?

500: For industrial operations where flammable vapors may be present, any charge accumulation exceeding this energy level is considered dangerous.

What is 0.1 mJ?

#### Biological Sciences

100: This is the number of naturally occurring amino acids.

What is 20?

200: The strict definition of this is “an anaerobic process used for producing products.”

What is a fermentation?

300: This cellular metabolic pathway converts glucose to pyruvate.

What is the glycolytic pathway?

400: These eukaryotic organelles are basically membranous bags of hydrolytic enzymes.

What are Lysosomes?

500: This type of immunity is also known as antibody-mediated immunity.

What is Humoral Immunity?

#### Transport Phenomena

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

What is distillation?

200: This analog to Newton’s law of viscosity relates the diffusive flux to the concentration under the assumption of steady state.

What is Fick’s Law?

300: This accumulation of unwanted material on solid surfaces of a heat exchanger is detrimental to its function.

What is fouling?

400: This dimensionless number, also called the mass transfer Nusselt number, represents the ratio of the convective mass transfer rate to the diffusive mass transport rate.

What is the Sherwood Number?

500: This dimensionless number is defined as the ratio of the advective transport rate of a physical quantity to the diffusive transport rate of the same quantity.

What is the Péclet number?

### Thermodynamics

100: The transfer of energy from one object to a cooler object.

What is heat?

200: This is given by the following

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

What is the Van der Waal's Equation of State?

300: The temperature at which a vapor mixture begins to condense at a fixed pressure.

What is the Dew Point Temperature?

400: This is given by

$$\left( \frac{\partial T}{\partial P} \right)_H$$

What is the Joule-Thomson Coefficient?

500: A cycle which consists of the following steps: adiabatic/isobaric/adiabatic/isochoric.

What is the Diesel Cycle?

### Chemical Reaction Engineering

100: The design equation for this type of reactor is given by

$$V = \frac{F_{A_0} X}{-r_A}$$

What is a continuous stirred tank reactor (CSTR)?

200: This reactor type is essentially a heat exchanger.

What is a plug flow reactor (PFR)?

300: This reactor type has no inflow or outflow.

What is a batch reactor?

400: A reaction follows this when the reaction orders are identical to the stoichiometric coefficients.

What is an elementary rate law?

500: This dimensionless number is the ratio of the reaction rate of A to the convective transport rate of A.

What is the Damköhler number?

### U.S. Presidents

100: This president signed the Indian Removal Act into law.

Who was Andrew Jackson?

200: First President to win the Nobel Peace Prize.

Who was Theodore Roosevelt?

300: The first President to appoint an African American to the Supreme Court.

Who was Lyndon Baines Johnson (LBJ)?

400: He was the only president to serve 2 non-consecutive terms.

Who was Grover Cleveland?

500: This president signed the treaty for the purchase of Alaska from Russia.

Who was Andrew Johnson?

## **Final Round**

### *Single Jeopardy*

#### Jeopardy Science

100: Organic chemistry focuses specifically on this element's compounds & their reactions.

What is carbon?

200: The first object in our solar system discovered by telescope was not a planet, but one of these.

What is a moon?

300: His "Galvanic Circuit Investigated Mathematically" received so much "resistance," he resigned his post at Cologne.

Who was Georg Ohm?

400: The word for this disease comes from the same Latin root as "rage."

What is rabies?

500: It's the square root of a gross.

What is 12?

#### Physics

100: This famous equation is known as the mass-energy equivalence.

What is  $E = mc^2$ ?

200: This Nobel Prize winning Austrian physicist, who developed a number of fundamental results in the field of quantum theory, may be best remembered for his thought experiment of a cat.

Who is Erwin Schrödinger?

300: He received the 1921 Nobel Prize for his "services to theoretical physics," in particular his discovery of the law of the photoelectric effect, a pivotal step in the evolution of quantum theory.

Who is Albert Einstein?

400: Although Alfred Nobel established the Nobel Prize in his will in 1833, during his life he was best known for this groundbreaking invention.

What is dynamite?

500: "Laser" is an acronym for this.

What is light amplification by stimulated emission of radiation?

#### Dimensionless Groups

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

What is the Reynolds (Re) number?

200: This dimensionless number is used to determine the relative thickness of thermal and momentum boundary layers.

What is the Prandtl (Pr) number?

300: This dimensionless number is the ratio of convective to conductive heat transfer.

What is the Nusselt (Nu) number?

400: This dimensionless number represents the ratio of fluid velocity to the velocity of sound in that medium.

What is the Mach (Ma) number?

500: This dimensionless number is the ratio between inertial and gravitational forces, and is used to determine the resistance of an object moving through a fluid.

What is the Froude (Fr) number?

### Heat Transfer

100: This is equal to

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

What is the Overall Heat Transfer Coefficient (U)?

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

What is a shell and tube heat exchanger?

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

What is radiation?

400: This type of heat transfer happens due to density variations of the fluid.

What is natural convection? or What is free convection?

500: This number is the ratio of heat transfer resistances inside the body to the resistances at the surface.

What is the Biot number?

### Process Control

100: This parameter represents the time for a first order process to reach 63% of the change in output in response to a step change in input.

What is the time constant?

200: The Laplace transform of the function  $e^{-at}$ .

What is  $1/(s+a)$ ?

300: 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 device receives signals from the controller and makes changes to one of the inputs to the process.

What is an actuator?

500: These are the roots of the polynomial in the denominator of the closed-loop transfer function.

What are the poles?

### U.S. Geography Extremes

100: This is the deepest freshwater lake in the United States.

What is Crater Lake?

200: This is the tallest waterfall in the United States.

What is Yosemite Falls?

300: The northern most point in the contiguous 48 states is located in this state.

What is Minnesota?

400: The highest point in the contiguous 48 states is located at the summit of this mountain.

What is Mt. Whitney?

500: This was the most widely visited National Park in 2014 with over 10 million visitors.

What is the Great Smoky Mountains National Park?

### **Final Round**

#### *Double Jeopardy*

#### Chemical Process Safety

200: This is the OSHA equivalent of the Threshold Limit Value – Time Weighted Average (TLV-TWA).

What is the Permissible Exposure Limit (PEL)?

400: This chemical was released in large quantities and caused 1000's of deaths on December 3, 1984, in Bhopal, India.

What is methyl isocyanate (MIC)?

600: The 1974 accident that occurred at Flixborough, England depicted here could have been prevented through the use of this procedure commonly abbreviated by MOC.

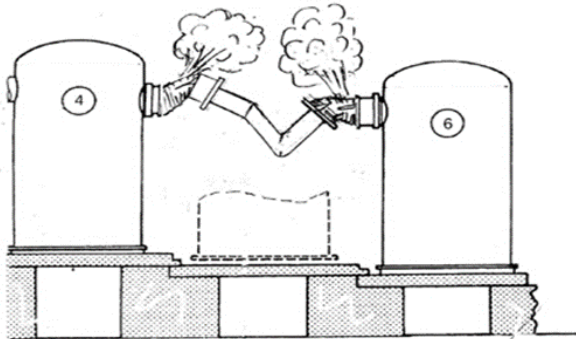


Fig 2 View of fractured temporary pipe

What is Management of Change (MOC)?

800: The Risk Management Plan (RPM) Rule implements Section 112(r) of this 1990 federal legislation.

What is the 1990 Clean Air Act Amendments?

1000: This instrument, abbreviated ARSST, is used to determine properties of runaway reactions.

What is the Advanced Reactive System Screening Tool?

#### Biochemical Engineering

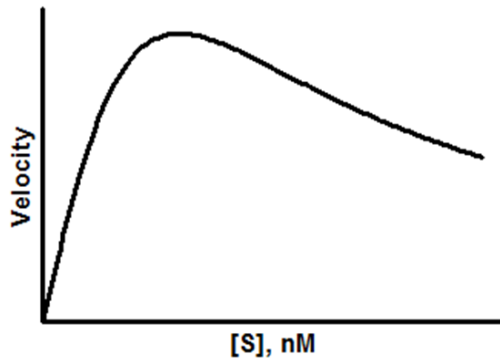
200: This enzyme is used to convert glucose to fructose in High Fructose Corn Syrup (HFCS) production.

What is glucose isomerase?

400: These small circular double-stranded DNA molecules are commonly used to introduce genes into bacteria.

What are plasmids?

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



What is Substrate Inhibition?

800: During exponential growth, this is defined by

$$\frac{1}{X} \frac{dX}{dt}$$

What is the specific growth rate,  $\mu$ ?

1000: This is the most commonly used mammalian cell line in the commercial production of recombinant proteins.

What are Chinese Hamster Ovary (CHO) cells?

### Math

200: This shape is an ellipse with an eccentricity of zero.

What is a circle?

400: This type of scalar product is geometrically used to find the projection of one vector onto another.

What is the dot product?

600: A Maclaurin series is a power series centered at zero and a specific type of this more famous power series.

What is a Taylor Series?

800: This differential operator is given by the divergence of the gradient of a function on Euclidean space.

What is the Laplacian?

1000: The Laplacian operator is given by this set of differential operators of a function in Euclidean space.

What is the divergence of the gradient?

### Mass Transfer

200: This law states that

$$J_A = -D_{AB} \Delta C_A$$

What is Fick's First Law?

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

What is liquid-liquid extraction?

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

What is diffusion?

800: This process involves the extraction of a solute from a solid into a liquid.

What is leaching?

1000: This type of diffusion happens in small pores where the diameter is smaller than the mean-free path of gas molecules.

What is Knudsen Diffusion?

### Dog Breeds

200: Scooby Doo.

What is a Great Dane?

400: Comet from *Full House*.

What is a Golden Retriever?

600: Snoopy.

What is a Beagle?

800: Lady from *Lady and the Tramp*.

What is a Cocker Spaniel?

1000: Rin Tin Tin.

What is a German Shepherd?

### Fluid Flow

200: At sufficiently low Reynolds numbers, this type of flow lacks lateral mixing.

What is Laminar Flow?

400: This boundary property allows insects to walk on water.

What is surface tension? or What is Interfacial tension?

600: This phenomenon forms damaging bubbles or voids on impellers.

What is cavitation?

800: This layer of fluid in the immediate vicinity of a surface has significant viscosity effects.

What is a boundary layer?

1000: This nonlinear constitutive model describes a viscoelastic material with a yield stress and a linear relationship between the viscous stress tensor and the velocity gradient.

What is a Bingham Plastic?

## **Final Round**

Final Jeopardy Category: Thermodynamics

This thermodynamic variable is given by  $U - TS$ .

What is the Helmholtz Free Energy (A)?