2017 ASC ChemE Jeopardy Clues/Responses

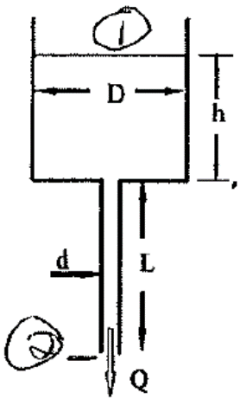
Preliminary Round

Single Jeopardy:

Fluid Flow

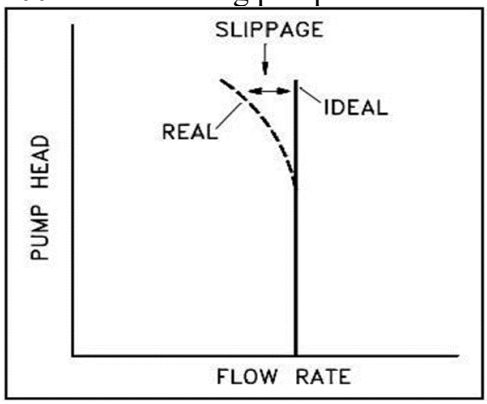
100: The parameters of the Mechanical Energy Balance that can be set ~0 for the following scenario.

$$\frac{-\dot{W}_s}{\dot{m}} = \frac{P_2 - P_1}{\rho} + \frac{g(z_2 - z_1)}{g_c} + \frac{v_2^2 - v_1^2}{2g_c} + F$$



What are W_s, the ΔP term, and v_1?

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



What is a positive displacement pump?

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 phenomenon occurs when the pressure drop across a bed of solid particles exceeds the total weight of particles in the bed during the upward flow of a fluid.

What is fluidization?

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?

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 diagram is used to represent the cash transactions that take place over the course of a project.
What is a cash-flow diagram?
300: 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?
400: Adverse vapor conditions in a distillation column will cause weeping, foaming, flooding, and this.
What is entrainment?
500: This transition metal is added to low-alloy steels to increase the strength of the steel at high temperatures.
What is molybdenum?

Chemical Reaction Engineering

100: This reactor type has no inflow or outflow.
What is a batch reactor?
200: A reaction follows this when the reaction orders are identical to the stoichiometric coefficients.
What is an elementary rate law?
300: The Ergun equation is used to calculate this in a packed bed reactor.
What is pressure drop?
400: This is defined as

$$\frac{\text{Exit molar flow rate of desired product}}{\text{Exit molar flow rate of undesired product}}$$

What is overall selectivity?
500: This happens when a catalyst is chemically deactivated.
What is poisoned? (Poisoning, catalytic poisoning)

Process Control

100: This type of function in the Laplace domain relates the output to the input.
What is a transfer function?
200: This is the most common control loop in the Chemical Process Industry.
What is a flow controller?
300: The Laplace transform of the function e^{-at}.

What is 1/(s+a)?
400: This type of valve has a spherically shaped element with a hole in it that rotates to control flow.
What is a ball valve?
500: A controller that does not have enough of this type of control action will exhibit slow offset elimination.
What is integral control action?

Biological Sciences
100: This is the synthesis of RNA under the direction of DNA.
What is transcription?
200: He is considered to be the first person to prove that living microorganisms are responsible for fermentations.
Who was Louis Pasteur?
300: These two molecules containing high reducing power are produced during the TCA cycle.
What are NADH and $FADH_2$?
400: These glycoprotein molecules are produced in the body in response to the introduction of an antigen.
What are antibodies?
500: This eukaryotic organelle consists of a meshwork of fine tubules and is involved with lipid metabolism.
What is the Smooth Endoplasmic Reticulum (ER)?

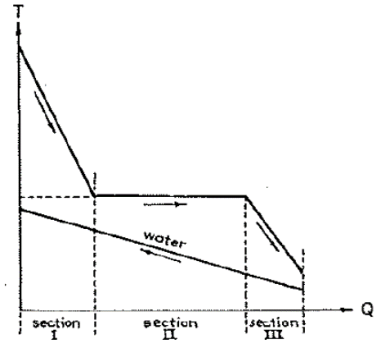
Citizenship Test
100: This is the number of justices on the U.S. Supreme Court.
What is 9?
200: This is the number of voting members in the U.S. House of Representatives.
What is 435?
300: The U.S. Constitution was written in this year.
What is 1787?
400: This is the minimum age to be elected to the U.S. House of Representatives.
What is 25?
500: This is the current number of amendments to the U.S. Constitution.
What is 27?

Preliminary Round

Double Jeopardy:

Heat and Mass Transfer

200: This process is occurring in section II of the hot stream in the countercurrent heat exchanger whose T vs. Q plot is given below.



What is condensing steam (or condensing vapor)?

400: He proposed the rate equation for convection heat transfer in 1701.

Who is Sir Isaac Newton?

600: This dimensionless parameter is given by

$$\frac{hV/A}{k}$$

What is the Biot Number?

800: The ratio of convective mass transport to diffusive mass transport.

What is the Sherwood Number?

1000: The ratio of thermal diffusivity and mass diffusivity is designated by this dimensionless number.

What is the Lewis number?

Thermodynamics

200: A variable that is independent of the path between two states.

What is a state variable?

400: This is given by the following: $F = 2 - \pi + N$.

What is Gibb's Phase Rule?

600: The third law of thermodynamics specifies this property as zero for perfect crystalline substances at absolute zero temperature.

What is entropy?

800: A cycle which consists of the following steps:
Adiabatic/isochoric/adiabatic/
isochoric.

What is the Otto cycle?

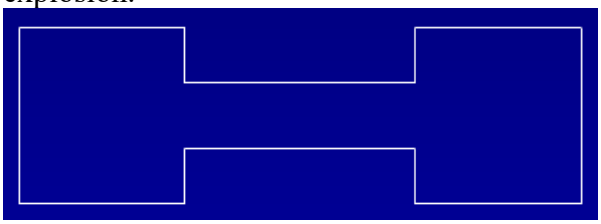
1000: This parameter is given by

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

What is the Joule/Thompson coefficient?

Chemical Process Safety

200: These are the minimum voltage and energy of an electrostatic discharge that are considered hazardous in industrial operations where flammable vapors are present.
What are 350 V and 0.1 mJ?
400: This federal government regulation covers operations involving hazardous wastes that are conducted at treatment, storage, and disposal facilities.
What is the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER)?
600: The deflagration index for gases and dusts is calculated by multiplying $(dP/dt)_{max}$ by the volume (V) raised to this power.
What is 1/3?
800: This type of spring-loaded relief valve is used when high backpressures are present.
What is a balanced bellows?
1000: This phenomenon makes a geometry like the following particularly dangerous during an explosion.



What is pressure piling?

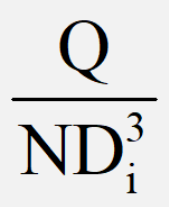
Biochemical Engineering

200: This occurs in a chemostat when the dilution rate (D) exceeds the maximum specific growth rate (μ_m).
What is washout?
400: This was the first commercially produced recombinant protein product.
What is insulin?
600: This dimensionless number, represented here, is used to determine the required power in a mixing operation involving Newtonian fluids.

$$\frac{P}{\rho N^3 D_i^5}$$

What is the Power number?

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



What is the Aeration number?
1000: 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
200: 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?
400: These are radioactive decay particles that are identical to helium-4 nuclei.
What are alpha particles?
600: This describes an equal mixture of two enantiomers.
What is a racemic mixture?
800: The average distance traveled by a gas molecule between collisions.
What is the mean free path?
1000: Charge contained in 1 mole of electrons, equivalent to 96,487 coulombs.
What is a Faraday?

Disney Animals
200: Sebastian from *The Little Mermaid*.
What is a crab?
400: Bruno from *Cinderella*.
What is a dog?
600: Timon from the *Lion King*.
What is a meerkat?
800: Kaa from the *Jungle Book*.
What is a python (snake)?
1000: Flit from *Pocahontas*.
What is a hummingbird?

Preliminary Round
Final Jeopardy Category: Infamous Accidents
The location (i.e., city) and type of explosion(s) for the 1984 accident at a liquid petroleum gas tank farm that resulted in over 500 deaths.
What are Mexico City (San Juanico) and BLEVEs?

Final Round

Single Jeopardy:

Industrial Microbiology

100: This antibiotic was discovered by Alexander Fleming in 1929.
What is Penicillin?
200: The full name of the "E" in *E. coli*.
What is Escherichia?
300: This byproduct of the sugar processing industry is a common carbon source in industrial growth media.
What is Molasses?
400: *Aspergillus niger* is commonly used to mass produce this TCA cycle intermediate that is widely used in the food and beverage industry.
What is Citric Acid?
500: These are the three major products produced in an ABE fermentation process.
What are Acetone (A), Butanol (B) and Ethanol (E)?

Separations

100: The ratio of the partial pressure of the vapor to the vapor pressure of the liquid at the gas temperature.
What is Relative Humidity?
200: This separation process utilizes the formation of solid particles within a homogeneous phase.
What is Crystallization?
300: This happens when liquid collects into small rivulets and flows along localized baths in a packed column.
What is Channeling?
400:
In liquid extraction, this is the intersection of the raffinate-phase and extract-phase boundary curves.
What is the Plait Point?
500: This process is used to dry foods, vitamins and other heat sensitive products at temperatures below 0ºC.
What is Lyophilization (or freeze drying)?

Units and Conversions

100: The ratio of degrees Rankine (ºR) to degrees Kelvin (K).
What is 1.8?
200: The number of pounds in a short ton.
What is 2000?
300: The number of kilopascals (kPa) in a bar.
What is 100?
400: The number of pints in a gallon.
What is 8?
500: The number of acres in a square mile.
What is 640?

Material and Energy Balances

100: If any of the process variables change with time, this is said to exist.
What is Transient or Unsteady State?

200: This is a material or energy stream that leaves a downstream process unit and is returned to the same process unit or upstream unit.
What is a Recycle Stream?

300: A plot of one system variable against another that shows the conditions at which the substance exists as a solid, a liquid, and a gas.
What is a Phase Diagram?

400: The temperature at which Fahrenheit and Celsius scales are equal.
What is -40º?

500: This laboratory apparatus is used to analyze gas samples for its oxygen, carbon monoxide and carbon dioxide content and has been largely replaced by instrumental techniques.
What is an Orsat Gas Analyzer?

Physics

100: This is the ratio of the object's speed to the speed of sound in the medium that the object is traveling.
What is the Mach Number?

200: This is the ratio of the velocity of light in a specified medium to its velocity in a vacuum.
What is the Refractive Index?

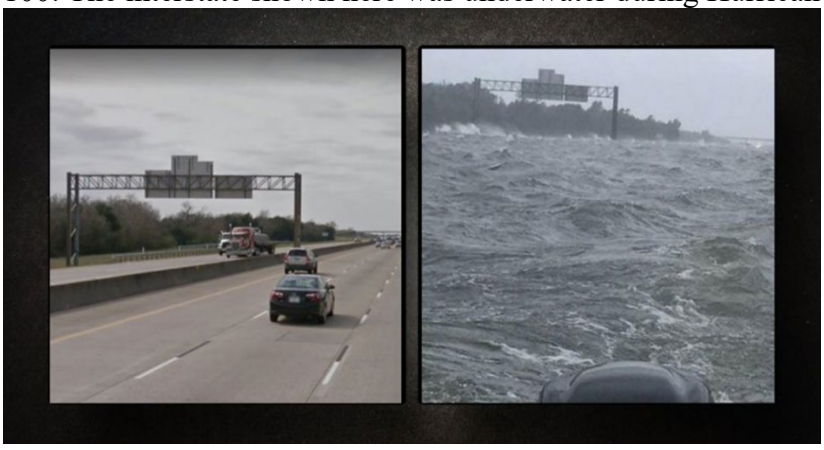
300: This law relates the attenuation of light to the properties of the material through which the light is traveling.
What is the Beer-Lambert Law?

400: This is the science and engineering of interacting surfaces in relative motion, which includes the study of friction, wear, lubrication, and the design of bearings.
What is Tribology?

500: A complex number representing a sinusoidal function whose amplitude (A), angular frequency (ω), and initial phase (θ) are time-invariant.
What is a Phasor?

Eisenhower Interstate System

100: The interstate shown here was underwater during Hurricane Harvey.

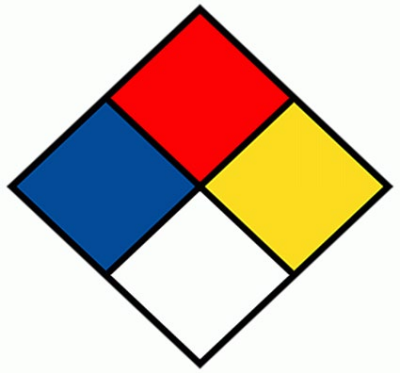


What is I-10?

200: This is the major interstate on the west coast of the U.S., running largely parallel to the Pacific Ocean.
What is I-5?
300: At 4860.2 km this east-west interstate is the longest in the Eisenhower Interstate system.
What is I-90?
400: At 3089.5 km this is the longest north-south interstate in the Eisenhower Interstate system.
What is I-95?
500: This interstate runs only in Texas and Arkansas.
What is I-30?

Final Round
Double Jeopardy:
AIChE Trivia
200: The 2018 AIChE Annual Meeting will be held in this city.
What is Pittsburgh?
400: The current (2017) AIChE President.
Who is T. Bond Calloway?
600: The location and year of the first National AIChE Meeting.
What are Philadelphia and 1908?
800: This was established in 1985 to focus on engineering and management practices that help prevent and mitigate catastrophic process safety accidents.
What is the CCPS (Center for Chemical Process Safety)?
1000: This was formed in 1976 as a consortium of 29 companies to develop methods for the design of emergency relief systems to handle runaway reactions.
What is DIERS (Design Institute for Emergency Relief Systems)?

Chemical Process Safety
200: The red area on the NFPA diamond given here represents the level of this hazard.



What is Fire (or Flamability)?
400: These are used instead of spring-operated relief valves when it is desired to keep the relief line open following the relieving event.
What are rupture discs?
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.

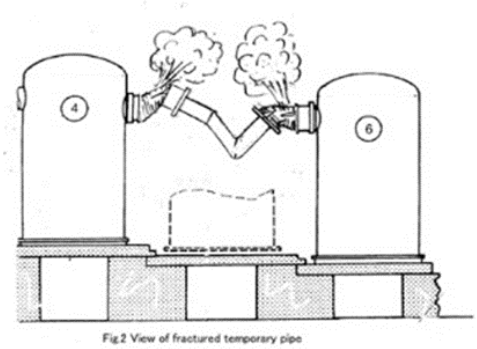
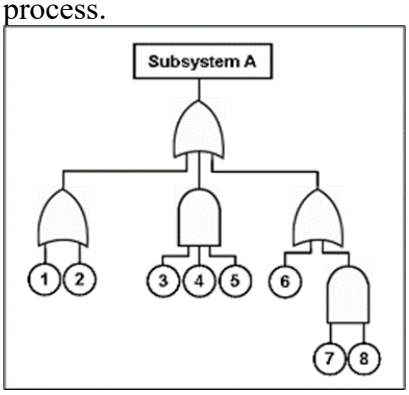


Fig.2 View of fractured temporary pipe

What is Management of Change?

800: The method depicted here that is used to qualify and quantify the hazards and risks of a process.



What is a Fault Tree?

1000: From the Greek word meaning “fire-bearing,” this is the term for a compound that is capable of igniting spontaneously in air.

What is Pyrophoric?

Imaginary Engineering

200: The sums of money recorded as receipts or disbursements in a project’s financial records.

What is the Cash Flow?

400: This is the ratio of the flow area and the wetted perimeter.

What is the Hydraulic Radius?

600: This is the study of a body’s motion independent of the forces acting on the body.

What is Kinematics?

800: Modern gas turbine engines follow this thermodynamic cycle.

What is the Brayton Cycle?

1000: The electrical device that transfer electrical energy between two or more circuits through electromagnetic induction.

What is a Transformer?

Dimensionless Numbers

200: This dimensionless number is the ratio of the inertial to viscous forces.

What is the Reynolds Number (Re)?

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

What is the Nusselt Number (Nu)?

600: This dimensionless number is the ratio of buoyancy to viscous forces.

What it the Grashof Number (Gr)?
800: This dimensionless number is the ratio of the heat conduction rate to the rate of thermal energy storage in a solid.
What is the Fourier Number (Fo)?
1000: This dimensionless number if the ratio of inertial and gravitational forces.
What is the Froude Number (Fr)?

Math
200: This law is of the form:
$a + b = b + a$
or
$a \times b = b \times a$.
What is the Commutative Law?
400: This law is of the form:
$(a + b) + c = a + (b + c)$
or
$(a \times b) \times c = a \times (b \times c)$.
What is the Associative Law?
600: This law is of the form: $a \times (b + c) = a \times b + a \times c$.
What is the Distributive Law?
800: An analysis that establishes the relation between trigonometric functions and the complex exponential functions.
What is the Euler's Formula?
1000: This sequence goes as 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, and so forth.
What is the Fibonacci Sequence?

TV Show Characters
200: Spock.
What is *Star Trek*?
400: Amy Farrah Fowler.
What is *The Big Bang Theory*?
600: Sheldon J. Plankton.
What is *SpongeBob SquarePants*?
800: Santa's Little Helper.
What is *The Simpsons*?
1000: Elaine Benes.
What is *Seinfeld*?

Final Round
Final Jeopardy Category: Transport Phenomena
This is a viscoplastic material that behaves as a rigid body at low stresses but flows as a viscous fluid at high stress. It is used as a common mathematical model of mud flow in drilling operations, and in the handling of slurries.
What is a Bingham Plastic?