

2013 ASC ChemE Jeopardy Clues & Responses

Preliminary Round

Single Jeopardy:

Thermodynamics

100: Static condition in which no changes occur in the macroscopic properties of a system with time.

What is equilibrium?

200: Condition when a boiling liquid mixture produces a vapor of exactly the same composition as it evaporates.

What is an azeotrope?

300: An enthalpy-entropy diagram is also call this

What is a Mollier diagram?

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

What is entropy?

500: A constant volume process is also called this

What is an isochoric process?

Chemical Process Safety

100: This Federal Agency is charged with enforcement of safety and health legislation

What is OSHA (Occupational Safety and Health Administration)?

200: Device that limits the pressure increase in a system or vessel

What is a relief valve?

300: The 3 sides of the fire triangle.

What are oxidizer, fuel and ignition source?

400: This is the temperature above which adequate energy is available in the environment to provide an ignition source

What is the Autoignition Temperature (AIT)?

500: These are the 4 major methods for achieving Inherently Safer Design

What are minimize, substitute, moderate and simplify?

Biochemical Engineering

100: This plot of $1/v$ vs. $1/S$ is used to determine the maximum reaction rate from enzyme kinetic data.

What is a Lineweaver-Burk plot?

200: Glucose isomerase is used to produce this industrially-important product.

What is high-fructose corn syrup (HFCS)?

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

What are proteases?

400: The process to develop large-scale production of this compound has been described as a paradigm for bioprocess development and biochemical engineering.

What is penicillin?

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

What is the dilution rate?

Energy

100: Over the last 5 years the worldwide electricity generating capacity from this renewable source increased by over 25% annually, its growth blowing away all other renewables.

What is wind energy?

200: Nearly all fuel ethanol produced in the United States comes from yeast fermentation of glucose obtained from the hydrolysis of this polysaccharide.

What is starch?

300: This type of device converts chemical energy directly to electrical energy for use in a work-producing motor.

What is a fuel cell?

400: Energy efficient lamps can be constructed from these low power semiconductor devices commonly referred to as LEDs.

What are light emitting diodes?

500: This is the common term referring to fatty acid methyl esters that are used to fuel compression-ignition engines.

What is biodiesel?

Chemistry

100: The third most common gas in air.

What is argon?

200: Class of compounds characterized by C_nH_{2n+2} .

What are alkanes?

300: Full name of TNT.

What is trinitrotoluene?

400: Organometallic chemical reaction in which alkyl- or aryl-magnesium halides are added to a carbonyl group in an aldehyde or ketone.

What is the Grignard reaction?

500: Volume, in liters (within 1 liter) occupied by 8 grams of O_2 at STP.

What is 5.6 L? (4.6 to 6.6. is acceptable)

State Nicknames

100: The First State

What is Delaware?

200: The Gem State.

What is Idaho?

300: The Peace Garden State

What is North Dakota?

400: The Pine Tree State

What is Maine?

500: Yellowhammer State

What is Alabama?

Preliminary Round

Final Jeopardy Category: Process Control

The four components to consider when troubleshooting a process control problem.

What are sensor, controller, actuator, and process?

Final Round

Single Jeopardy:

Fluid Flow

100: This equation used to calculate the fanning friction factor for laminar flow.

What is $16/RE$?

200: A pump characterized by approximately constant head, but with flowrates that increase or decrease depending on the system resistance.

What is a centrifugal pump?

300: Equation used to determine the pressure drop across a packed bed.

What is the Ergun equation?

400: A situation where the drag force on a falling object is balanced by the gravity and buoyant forces.

What is terminal velocity?

500: The assumption that the fluid velocity at a stationary surface is equal to zero is called this.

What is the no slip condition?

Separations

100: This separation technique accounts for 90-95% of all separations in the chemical process industry.

What is Distillation?

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

What is filtration?

300: A simplified version of this separation process is seen in a coffee or tea maker.

What is Leaching?

400: The amount of condensed distillate returned to the top of a distillation column, relative to the amount removed as a product.

What is the reflux ratio?

500: A relationship between adsorbed and non-adsorbed solute in which the adsorbent may become completely saturated.

What is a Langmuir isotherm?

Equations

100: $q = -k \frac{dT}{dx}$

What is Fourier's Law?

200: $J_A = -D * \frac{dC_A}{dx}$

What is Fick's 1st Law?

300: $\frac{1}{2}\rho v^2 + \rho gz + P = \text{Constant}$

What is Bernoulli's Equation?

400: $\Delta U = Q - W$

What is the 1st Law of Thermodynamics?

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

What is the Continuity Equation?

Material and Energy Balances

100: Input – Output = this

What is accumulation?

200: Enthalpy change required for a solid to become a liquid at a specific temperature and pressure

What is the latent heat of fusion?

300: When a vapor is cooled slowly at constant pressure, this is the temperature at which the first liquid droplet forms.

What is the dew-point temperature?

400: This chart contains the wet-bulb temperature, dry-bulb temperature, relative humidity and other parameters.

What is a psychrometric chart? or What is a humidity chart?

500: The process of contacting a stream of warm gas with a stream of cold liquid that results in gas cooling and liquid evaporation

What is adiabatic cooling?

AIChE

100: The number of student chapter regions in the United States.

What is 9?

200: This city hosted the first AIChE National Meeting?

What is Philadelphia, PA?

300: The year of the first AIChE National Meeting.

What is 1908?

400: He is the current AIChE President.

Who is Phillip R. Westmoreland?

500: Location of the 2014 AIChE Annual Meeting.

What is Atlanta?

Pop Culture

100: Neil deGrasse Tyson took to Twitter to question the science in this movie released in October 2013.

What is Gravity?

200: These 2 elements are part of the logo to a popular AMC drama that ended in September 2013.

What are Bromine and Barium?

300: This upcoming movie currently holds the record for the highest number of Kickstarter backers.

What is the Veronica Mars movie?

400: This token was added to the Monopoly game earlier this year.

What is the cat token?

500: This South American political leader passed away in March 2013.

Who is Hugo Chavez?

Final Round

Double Jeopardy

Heat Transfer

200: These are the three fundamental mechanisms of heat transfer.

What are conduction, convection, and radiation?

400: This type of temperature difference is commonly used in heat exchanger design.

What is the log-mean temperature difference?

600: The dimensionless ratio of convective heat transfer to conductive heat transfer.

What is the Nusselt number?

800: A physical constant used in radiation heat transfer calculations, with dimensions of power per area per temperature raised to the 4th power.

What is the Stefan-Boltzmann constant?

1000: 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).

Mass Transfer

200: The proportionality between a chemical's flux and its concentration gradient.

What is the diffusion coefficient?

400: During steady-state diffusion into a sphere, the location where the concentration gradient is the steepest.

Where is the center?

600: His second law stipulates that the rate of local concentration change is proportional to the concentration's second spatial derivative.

Who is Adolf Fick?

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

What is the Sherwood Number?

1000: 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 $-1/2$?

Process Control

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

What is the time constant?

400: This mode of the PID controller eliminates offset

What is integral mode?

600: This type of function in the Laplace domain relates the output to the input

What is a transfer function?

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

What is feedforward control?

1000: This type of plot is a graph of amplitude ratio and phase angle versus input frequency

What is a Bode plot?

Safety

200: This is given by (picture given)

What is the NFPA diamond?

400: These are the 5 sides of the dust explosion pentagon

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

600: A device placed in pipes and other locations that stops fuel combustion by cooling the flame

What is a flame arrestor?

800: 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)?

1000: Uses OR and AND logic functions to evaluate risks in a process.

What is a fault tree?

Biological Science

200: This cellular process uses the electron transport chain to generate ATP from NADH and FADH₂.

What is oxidative phosphorylation?

400: This class of organisms guard their chromosomal DNA separate from the rest of the cell using a nuclear membrane.

What are eukaryotes?

600: This circular piece of DNA is often used to introduce foreign DNA into a host cell.

What is a plasmid?

800: Organisms in this class use CO₂ as their primary carbon source.

What is an autotroph?

1000: This process involves the addition of sugars to a protein for cellular recognition.

What is glycosylation?

U.S. Government Firsts

200: First Vice-President

Who was John Adams?

400: First Secretary of the Treasury

Who was Alexander Hamilton?

600: First Secretary of War (Defense)

Who was Henry Knox?

800: First Chief Justice of the Supreme Court

Who was John Jay?

1000: First (and only) Chemical Engineer to serve as the EPA Administrator

Who was Lisa Jackson?

Final Round

Final Jeopardy Category: Design

This is the annual cash flow for the following situation. Annual sales (s_j): \$100,000; Annual expenses (c_{oj}): \$20,000. Annual Depreciation (d_j): \$10,000; Tax Rate (Φ): 50%

What is \$45,000?

Gross Profit (G_j) = $s_j - c_{oj} - d_j = \$100,000 - \$20,000 - \$10,000 = \$70,000$

Net Profit (N_p) = $G_j(1 - \Phi) = \$70,000(1 - 0.5) = \$35,000$

Cash Flow (A_j) = $N_p + d_j = \$35,000 + \$10,000 = \$45,000$