2022 NA ChemE Jeopardy Clues/Responses

Preliminary Round

Single Jeopardy:

Unit Conversions

100: 1 atm in units of mm Hg
What is 760 (mm Hg)?
200: 2 inches in units of cm (3 significant figures).
What is 5.08 (cm)?
300: 1 slug in lb_f - ft/s^2 (3 significant figures).
What is 32.2 (lb_f - ft/s^2)?
400: 10-7 of the meridian through Paris between the North Pole and the Equator.
What is a meter? (original definition)
500: Base SI unit for a Farad.
What is $Kg^{-1}m^{-2}s^4A^2$?

Material and Energy Balances

100: In this type of chemical process, no mass crosses the system boundaries between the times at which feed is provided and the product is removed.
What is a batch process?
200: In the general balance equation, this term is always equal to zero at steady state operation.
What is accumulation?
300: This type of energy balance is typically written when heat flows and internal energy changes are secondary in importance to changes in kinetic energy, potential energy, and shaft work.
What is a mechanical energy balance?
400: In vapor-liquid equilibrium, this relationship is generally valid for describing dilute solutions of a component A in a specific solvent: $y_AP=x_AH_A(T)$.
What is Henry's Law?
500: Named for the 1932 Nobel Prize winner in Chemistry, this the term for the following expression describing the adsorption of a species as a function of its partial pressure:

$$X_i^* = \frac{aK_Lp_i}{1+K_Lp_i}$$

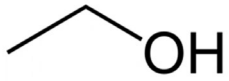
What is the Langmuir isotherm?

It's a Gas

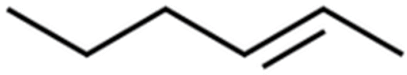
100: This gas is used to fill balloons.
What is helium?
200: Law that states the volume of a gas at constant temperature varies inversely with the pressure exerted on it.
What is Boyle's Law?
300: A corrections factor which describes the deviation of a real gas from ideal behavior.
What is compressibility factor (Z)?

400: Dry air contains approximately 0.93 mol percent of this gas at STP.
What is Argon?
500: Formerly used in refrigerators and air conditioners, the EPA banned production of this gas to help protect the ozone layer.
What is Freon?

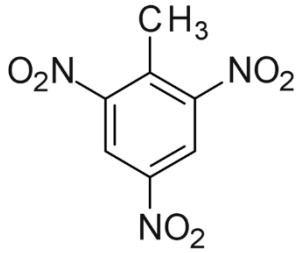
Chemical Structures
100:



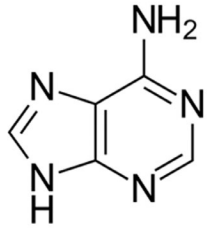
What is ethanol?
200:



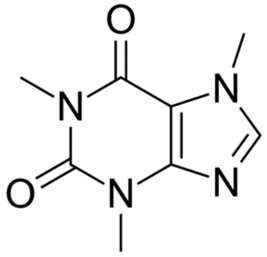
What is 2-hexene?
300:



What is trinitrotoluene (TNT)?
400:



What is adenine?
500:



What is caffeine?

Math and Statistics

100: A fundamental operation of calculus, this operation is defined by the following limit for a given function f, assuming the limit exists.

$$\lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

What is differentiation?

200: The sequence of numbers 0, 1, 1, 2, 3, 5, 8, … has close ties to the Golden Ratio and bears the name of this Italian mathematician.

Who is Fibonacci?

300: Equal to the square of standard deviation, this term measures the spread of a set relative to its mean value.

What is variance?

400: Named for a French scholar, this is the term for the following conversion of a real-variable function f to the complex domain.

$$F(s) = \int_0^\infty f(t)e^{-st}\,dt$$

What is a Laplace Transform?

500: In linear algebra, this is the term for a scalar λ for matrix A and vector X such that $AX = \lambda X$.

What is eigenvalue?

Stage Names

100: Robyn Fenty

Who is Rihanna?

200: Aubrey Graham

Who is Drake?

300: Childish Gambino

Who is Donald Glover?

400: Christopher Breaux

Who is Frank Ocean?

500: Stefani Germanotta

Who is Lady Gaga?

Preliminary Round

Double Jeopardy:

Name that Reactor

200: A reactor that consists of a hollow pipe or tube where the feed is continuously introduced at one end and the products continuously removed from the other end.

What is a plug flow reactor?

400: This idealized continuous reactor assumes perfect mixing.

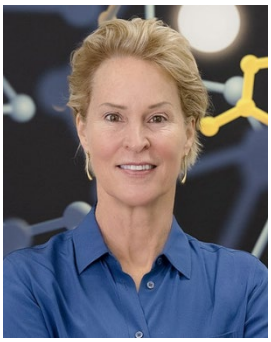
What is a CSTR? (Continuous Stirred Tank Reactor)

600: Industrial production of ethanol begins as a batch process in these large stainless-steel tanks.
What is a fermenter? (or bioreactor)
800: Industrial production of high fructose corn syrup is made in this type of reactor, which is designed to conserve the catalyst.
What are immobilized enzyme reactors? (or packed bed reactor)
1000: In this type of reactor, a fluid (gas or liquid) is passed through a solid granular material (usually a catalyst) at high enough speeds to suspend the solid and cause it to behave as though it were a fluid.
What is a fluidized bed reactor?

Bio-Chem
200: This porphyrin contains iron and binds oxygen to hemoglobin.
What is heme?
400: The net number of ATP molecules produced in glycolysis from one glucose molecule.
What is two?
600: The protein that catalyzes the conversion of adenosine diphosphate and inorganic phosphate into adenosine triphosphate.
What is ATP Synthase?
800: The rapid change in cell membrane potential that is essential for cell-to-cell communication.
What is the action potential?
1000: A condition at death in which a lack of ATP in the body leads to no breakage of actin-myosin cross bridges leading to muscle stiffness.
What is Rigor Mortis?

CHE Around the Globe
200: This country is home to the world's largest oil refinery producing 1.24 million barrels of oil per day.
What is India?
400: While the United States produces the most chemicals in the world, this country is a close second.
What is Germany?
600: The most produced industrial chemical in the world.
What is sulfuric acid?
800: The first university to offer chemical engineering as a degree starting in 1887.
What is the University of Manchester?
1000: This organization oversees awarding some of the best chemical engineers around the world with their yearly Global Awards.
What is IChemE (Institution of Chemical Engineering)?

Famous Chemical Engineers
200: This Caltech Professor won the Nobel Prize in Chemistry in 2018 for her work on directed evolution.
Who is Frances Arnold?

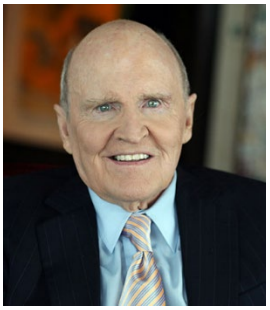


400: This MIT professor is a widely recognized and cited researcher in medical biotechnology, as well as a highly prolific entrepreneur, having participated in the founding of over 40 biotechnology companies including Moderna.

Who is Robert Langer?

600: As CEO of General Electric, his management practices sought to streamline GE, increasing its market value from $12 billion in 1981 to $410 billion in 2001. He was dubbed “Neutron Jack” for “eliminating employees while leaving buildings intact”

Who is Jack Welch?



800: Among his many achievements, he introduced the thermodynamic concept of activity and coined the term fugacity. He also formulated the electron-pair theory of acid–base reactions. Interestingly, he flunked organic chemistry at Harvard.

Who is Gilbert N. Lewis?

1000: A former NASA astronaut, he worked on the STS-129 mission as a Mission Specialist, spent over 259 hours in space, and participated in two of the three spacewalks.
Who is Robert Lee "Bobby" Satcher Jr.?

Process Equipment

200: This device increases the pressure of a liquid to transport it from one place to the other.
What is a pump?
400: A vessel that contains the distillate after it passes through the condenser.
What is a reflux drum?
600: A device used to convert an electrical signal into a pressure signal.
What is an I/P transducer?
800: Decreasing the pressure of a fluid while harvesting energy from the fluid is the main goal of this device.
What is a turbine?
1000: A device consisting of two dissimilar conductors forming an electrical junction resulting in a temperature measurement.
What is thermocouple?

Children's TV

200: This fox is always attempting to steal items from Dora the Explorer and Boots.
Who is Swiper?
400: Mermaid Man and Barnacle Boy are retired superheroes in this animated classic.
What is SpongeBob SquarePants?
600: This show features three kids who travel across space and use math and science to defeat Hacker.
What is Cyber Chase?

800: Tinky-Winky, Dipsy, Laa Laa and Po were stars of this children's TV show.
What is Teletubbies?
1000: This show was the launching point for Wild Kratts hosted by two brothers and a friendly lemur whose name bears the name of the show.
What is Zoboomafoo?

Preliminary Round

Final Jeopardy Category: Chemical Process Safety

This class of substances are known to have the capability to cause malformations to an embryo or fetus.
What are Teratogens?

Semi-Final Round

Single Jeopardy:

Heat Transfer

100: He first proposed the heat conduction equation in 1822.
Who is Joseph Fourier?

200: He proposed the rate equation for convective heat transfer in 1701.
Who is Sir Isaac Newton?

300: The heat transfer coefficient (h) for turbulent flow in pipes is generally found to be proportional to the Reynold's number raised to this power.
What is 0.8?

400: This is the boundary condition at a perfectly insulated surface.
What is

$$\frac{\partial T}{\partial x} = 0?$$

500: This law is expressed as

$$E_{b\lambda}(\lambda, T) = \frac{C_1}{\lambda^5\left[\exp\left(\frac{C_2}{\lambda T}\right) - 1\right]}$$

What is Planck's Law?

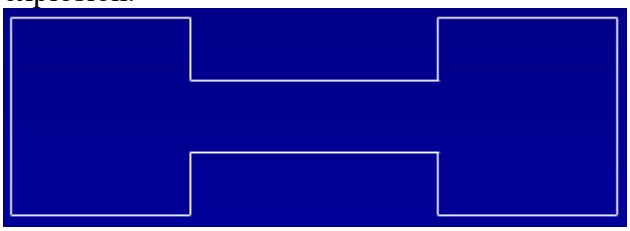
Chemical Process Safety

100: The OSHA equivalent to the Threshold Limit Value – Ceiling (TLV-C).
What is Immediately Dangerous to Life and Health (IDLH)?

200: Uses OR and AND logic functions to evaluate risks in a process.
What is a fault tree?

300: A balanced bellows spring loaded device is used when this occurs.
What are systems with a large backpressure?

400: This phenomenon makes a geometry like the following particularly dangerous during an explosion.



What is pressure piling?

500: These data, abbreviated as ERPG, are commonly used when developing evacuation strategies following the release of toxic substances.
What are Emergency Response Planning Guidelines?

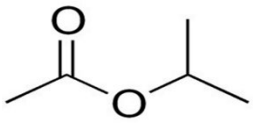
Separations

100: This separation method consumes approximately 40% of the total energy used in the chemical and petroleum refining industries.

What is distillation?
200: The two options for packing a column.
What are structured packing and random packing?
300: A dialysis machine is an example of this type of separation.
What is membrane separation?
400: This is the measure of how close an irregularly shaped object is to a sphere.
What is sphericity?
500: The point on a phase diagram where the maximum number of allowable phases are in equilibrium.
What is the eutectic point?

Biochemical Engineering
100: These are the 4 major phases of a cell growth curve.
What are lag, exponential (or log), stationary, and decline (or death)?
200: This is the first recombinant DNA drug product (protein) approved by the FDA.
What is insulin?
300: This is the ratio of the moles of CO_2 produced to moles of O_2 utilized.
What is the respiratory quotient (RQ)?
400: These are the 3 compounds produced in an ABE fermentation (i.e., represented by the A, B and E).
What are acetone, butanol and ethanol?
500: N-linked glycans are linked to this amino acid in naturally occurring glycoproteins.
What is asparagine?

Chemistry
100: Reaction type characterized by the loss of electrons.
What is oxidation?
200: This rule is used to determine the ground state of an atom.
What is Hund's rule?
300: Chemical compound represented by the following structure:



What is isopropyl acetate?
400: The only two elements to exist in a liquid state at standard temperature and pressure.
What are bromine and mercury?
500: The metallic element extracted using the Kroll Process.
What is titanium (or zirconium)?

Disney
100: This is what "Hakuna Matata" means as mentioned in *The Lion King*.
What are "no worries"?
200: This female celebrity was the voice of Dory in Finding Nemo.
Who is Ellen DeGeneres?
300: This is the experiment number of Stitch in Lilo & Stitch.

What is 626?
400: This is the city that 101 Dalmatians takes place in.
What is London, England?
500: These are the names of Hades' two minions in Hercules.
Who are Pain and Panic?

Semi-Final Round
Double Jeopardy:
Mass Transfer
200: Mass flow rate per unit area.
What is mass flux?
400: Dimensionless number defined as the ratio of convective mass transport to diffusive mass transport.
What is the Sherwood Number?
600: This type of diffusion happens in small pores where the diameter is smaller than the mean-free path of the gas molecules.
What is Knudsen Diffusion?
800: Dimensionless number defined as the ratio of momentum diffusivity to mass diffusivity.
What is the Schmidt Number?
1000: This is A(x,t) in the chemical concentration equation given below for non-steady state diffusion from a constant source:

$$\frac{C(x,t)-C}{C_s-C_o}=1-\mathrm{erf}[A(x,t)]$$

What is

$$\frac{x}{2\sqrt{Dt}}?$$

The Diamond
200: These are the hazards represented by blue, red and yellow on the NFPA diamond.
What are Health, Flammability and Stability (or Reactivity), respectively?
400: This is the number range given for the hazards on the NFPA diamond.
What is 0 to 4?
600: NFPA is an abbreviation for this.
What is National Fire Protection Association.
800: The flammability rating on the NFPA diamond is based solely on the value of this parameter.
What is the flash point?
1000: Specific hazards on the NFPA diamond are given in this color.
What is white?

Thermodynamics:
200: Static condition in which no changes occur in the macroscopic properties of a system with time.
What is equilibrium?
400: An enthalpy-entropy diagram is commonly called this in recognition of its creator.
What is a Mollier diagram?
600: A cycle which consists of the following steps: isothermal/isochoric/ isothermal /isochoric.
What is the Stirling cycle?
800: A constant volume process is also called this.
What is an isochoric process?
1000: This equation, which follows directly from the Gibbs–Duhem equation of a binary system, is given by

$$\frac{dP}{dy_1} = \frac{P(y_1 - x_1)}{y_1(1 - y_1)}$$

What is the coexistence equation?

Physics
200: This law states that the force needed to extend or compress a spring by some distance is proportional to that distance.
What is Hooke's Law?
400: This Nobel Prize-winning Austrian physicist, who developed several fundamental results in the field of quantum theory, may be best remembered for his thought experiment of a cat.
Who is Erwin Schrödinger?
600: This force is proportional to the normal force but independent of the magnitude of the area of contact.
What is friction?
800: This mass property of a rigid body determines the torque needed for a desired angular acceleration.
What is the moment of inertia?
1000: Laser is an acronym for this phase.
What is light amplification by stimulated emission of radiation?

Insects
200: Insects have these many legs.
What is 6?
400: This insect was the first living creature sent into space.
What is a fruit fly?
600: This insect eats its mate after mating.
What is a praying mantis?
800: Lepidopterophobia is a fear of this.
What are butterflies (or moths)?
1000: This insect is responsible for the spread of African Trypanosomiasis (sleeping sickness).
What is the tsetse fly?

Better Call Saul
200: Saul Goodman's name prior to becoming Saul.
What is Jimmy (James) McGill?
400: City in which Saul Goodman (as Gene Takavic) is managing a Cinnabon.
What is Omaha, Nebraska?
600: University at which Saul Goodman received his law degree.
What is the University of American Samoa?
800: Where Mike Ehrmantraut is working when Saul Goodman first meets him.
What is in a parking booth?
1000: Last name of couple Saul Goodman pursues as clients in season 1.
What are the Kettlemans (Craig and Betsy)?

Semi-Final Round
Final Jeopardy Category: Dimensionless Numbers
The ratio of thermal diffusivity and mass diffusivity is designated by this dimensionless number.
What is the Lewis Number?

Final Round

Single Jeopardy:

Fluid Flow

100: This principle states that the weight of the fluid displaced by an object is equal to the buoyant force.
What is the Archimedes' Principle?

200: 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?

300: This layer of fluid in the immediate vicinity of a surface has significant viscosity effects.
What is the boundary layer?

400: The Fanning friction factor is usually a function of these two dimensionless parameters.
What are the Reynolds number and the relative roughness?

500: These additional restraints provide closure to differential equations describing a finite domain.
What are boundary conditions?

Process Design

100: This diagram is used to represent the cash transactions that take place over the course of a project.
What is a cash-flow diagram?

200: This represents the fixed capital investment of the plant, minus the value of the land, evaluated at the end of the plant life.
What is the salvage value?

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: This transition metal is added to stainless steels to significantly increase the corrosion resistance.
What is chromium?

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 dimensionless number is the ratio of the rate of reaction of A to the rate of convective transport of A, evaluated at the entrance.
What is the Damköhler Number?

200: This plot is $F_{A0}/-r_A$ vs X.
What is a Levenspiel plot?

300: A reaction follows this when the reaction orders are identical to the stoichiometric coefficients.
What is an elementary rate law?

400: This modulus (as shown below) is useful in predicting reactor behavior when solid catalyst particles are used.

$$L\sqrt{\frac{k'''}{D_{eff}}}$$

What is the Thiele Modulus?

500: This metal, the second most common in the Earth's crust, is used in catalyzing the Haber process.

What is iron?

Math

100: Famous theorem given by $a^2 + b^2 = c^2$.

What is the Pythagorean Theorem?

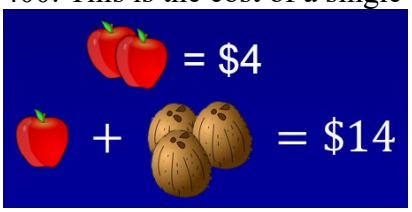
200: The answer to this: 4!

What is 24?

300: This is the probability of choosing the Daily Double this round, assuming it is equally likely to appear in any question.

What is 1/30 or 3.33%?

400: This is the cost of a single coconut.



What is $4?

500: This is how many times the minute and hour hand on a clock overlap in one full day. [12:00 am to 11:59 pm]

What is 22?

Microbiology

100: This is the most used species of yeast used in commercial ethanol production.

What is *Saccharomyces cerevisiae*?

200: This is the complete name of the most used bacterial species used in the production of recombinant proteins.

What is *Escherichia coli*?

300: An inactive (dormant) form of bacteria that enables bacteria to survive adverse environmental conditions.

What are spores?

400: These are long, thin filaments that protrude from the cell surface and enable bacteria to move.

What are flagella?

500: The genus of the bacteria that causes anthrax.

What is *Bacillus*? (*Bacillus anthracis*)

Marvel

100: This movie started the Marvel Cinematic Universe.

What is Iron Man?

200: Captain America's shield and the Winter Soldier's arm are made with the material.
What is vibranium?
300: The number of infinity stones and the infinity stone that requires a sacrifice to obtain.
What are 6 and the soul stone?
400: The town that Wanda hexed.
What is Westview, New Jersey?
500: The name of Dr. Strange's love interest.
Who is Christine Palmer?

Final Round

Double Jeopardy:

Material and Energy Balances

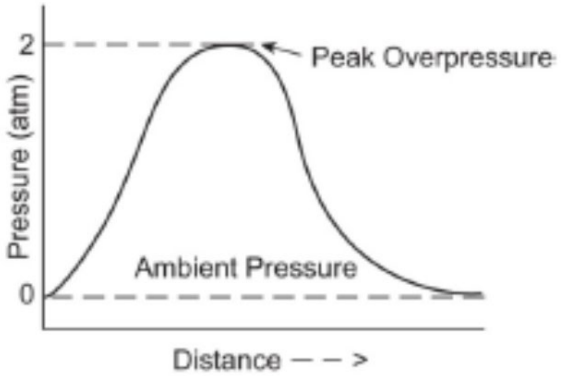
200: When a vapor is cooled slowly at constant pressure, this is the temperature at which the first liquid droplet forms.
What is the dew-point temperature?
400: This value (to 3 significant figures) is added to the temperature in °F to obtain °R.
What is 460?
600: The specific gravity of a liquid or solid is based on the density of water at this temperature.
What is 4ºC (39ºF)?
800: 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?
1000: This "law" states that the volume of a gas mixture is the sum of the pure component volumes.
What is Amagat's Law?

Process Control

200: This type of device is indicated by the abbreviation TIC on a P&ID.
What is temperature indicator and controller?
400: This mode of the PID controller eliminates offset.
What is integral mode?
600: This is a control scheme in which a primary loop controls a secondary loop.
What is cascade control?
800: This dynamic behavior model has the abbreviation FOPDT.
What is first order plus dead time?
1000: These types of poles of a transfer function lead to underdamped behavior.
What are complex poles?

Fire and Explosions

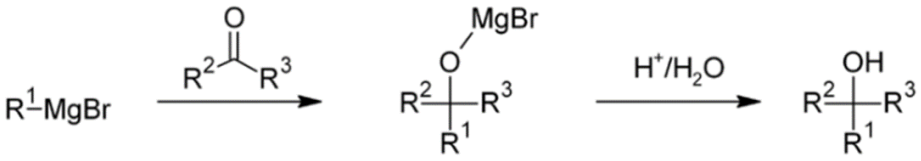
200: A Hartmann Tube is used to investigate these.
What are dust explosions?
400: BLEVE is an acronym for this.
What is a Boiling Liquid Expanding Vapor Explosion?
600: NFPA fire class D is used for this type of fire.
What is a metal fire?
800: The type of explosion depicted by the pressure− distance curve given here.



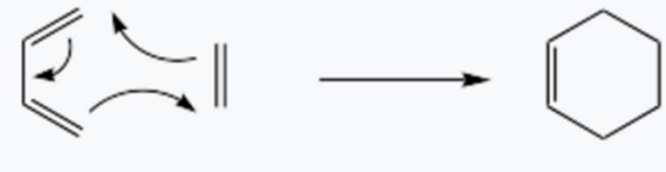
What is a deflagration?
1000: These passive devices function by absorbing heat from a flame and thereby prevent flame transmission.
What are flame arresters?

Botany
200: This is the process by which the microspores of a seed plant are transferred to another compatible plant of the same type.
What is pollination?
400: This is the botanical name for the male reproductive organ in flowering plants.
What is the stamen?
600: The name of the structure that is formed for the ovule of a plant after fertilization has taken place.
What is the seed?
800: These vessels transport water and minerals from the roots and help support the plant.
What are xylem vessels?
1000: This term is used to describe a naked seed.
What is a gymnosperm?

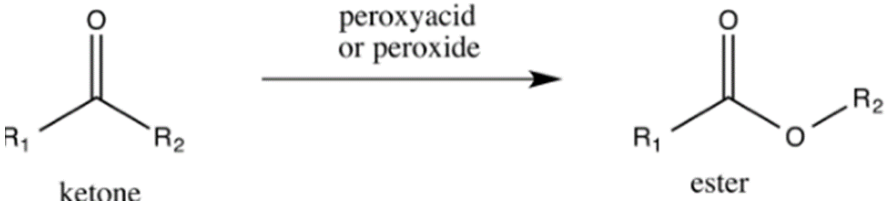
Organic Chemistry Reactions
200:



What is a Grignard reaction?
400:

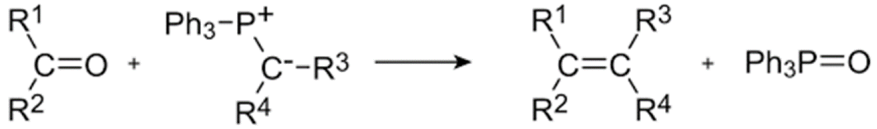


What is a Diels-Alder reaction?
600:



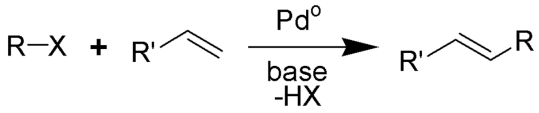
What is a Baeyer-Villiger oxidation?

800:



What is a Wittig reaction?

1000:



What is a Heck reaction?

Disney

200: This is the name of the high school that the characters of *High School Musical* attended.
What is East High School?

400: This is the character that sings "Kiss the Girl" in *The Little Mermaid*.
Who is Sebastian?

600: This is the name that Princess Aurora goes by to protect her identity in *Sleeping Beauty*.
Who is Briar Rose?

800: This is the number of kittens that Duchess is a mother to in *The Aristocats*.
What is three?

1000: This is the name of the main antagonist in *The Princess and the Frog*, also known as the Shadow Man.
Who is Dr. Facilier?

Final Round

Final Jeopardy Category: Biochemical Engineering

This thermally-resistant bacterium is the model organism used to design systems for the heat sterilization of growth media.
What is *Bacillus stearothermophilus*?