

BASIS PEORIA SCIENCE BOWL

DOUBLE ELIMINATION ROUND 4

TOSS-UP

1) Biology – *Multiple Choice* This type of stain is used to identify bacteria with waxy material in their cell walls. It is primarily used to stain organisms in pathogenic genera of bacteria, the most famous of which are the Mycobacteria. Which of the following is the name of this stain?

W) Gram stain
X) Simple stain
Y) Acid - fast stain
Z) Endospore stain

ANSWER: Y) Acid - fast stain

BONUS

1) Biology – *Short Answer* The acid - fast stain is most commonly used on organisms of the genus Mycobacterium. Name the 2 most important pathogens from this genus.

ANSWER: Mycobacterium Tuberculosis, Mycobacterium Leprae

TOSS-UP

2) Chemistry – *Multiple Choice* Which of the following conditions will cause gases to deviate from ideal behavior?

W) High temperature
X) Low volume
Y) High pressure
Z) High molar mass

ANSWER: Y) High pressure

BONUS

2) Chemistry – *Multiple Choice* Which of the following gases is most ideal?

W) CO_2
X) XeF_2
Y) Cl_2
Z) H_2O

ANSWER: W) CO_2

TOSS-UP

3) Physics – *Short Answer* A ball of charge -50e lies at the center of a hollow spherical metal shell that has a net charge of -100e. What is the charge on the shell's inner surface?

ANSWER: +50E

BONUS

3) Physics – *Short Answer* A spherical nonconducting balloon has a uniform positive charge on its surface. If the balloon is expanded, does the magnitude of the electric field due to the charge increase, decrease, or remain the same at points that 1) are inside the balloon; 2) are on the balloon's surface; 3) were and still are outside?

ANSWER: 1) SAME; 2) DECREASE; 3) SAME

TOSS-UP

4) Math – *Multiple Choice* If a Pascal's triangle is left-justified, the diagonal bands sum to which of the following sequences of numbers?

W) Squares of the natural numbers
X) Fibonacci numbers
Y) Triangle numbers
Z) Prime numbers

ANSWER: X) FIBONACCI NUMBERS

BONUS

4) Math – *Short Answer* A bean machine with four rows of pegs has five boxes at the bottom. A bean is dropped into the top. Assuming the bean has an equal chance to bounce either direction at each peg, what is the chance it will land in the middlemost box as a fraction reduced to simplest terms?

ANSWER: ⅜

TOSS-UP

5) Earth and Space – *Multiple Choice* Approximately how old, in years, is Beringer Crater in Arizona?

W) 100
X) 20,000
Y) 50,000
Z) 65,000,000

ANSWER: Y) 50,000

BONUS

5) Earth and Space – *Short Answer* What type of rock makes up the floor of the Grand Canyon?

W) Schist
X) Slate
Y) Shale
Z) Sandstone

ANSWER: W) SCHIST

TOSS-UP

6) Energy – *Multiple Choice* In fluidized bed combustion, which of the following substances is added to coal to capture its carbon emissions?

W) Liquid Nitrogen
X) Limestone
Y) Water
Z) Ammonium

ANSWER: X) Limestone

BONUS

6) Energy – *Short Answer* Clean coal is a method of burning coal, in which it is considered "clean" because the carbon emissions are captured and stored where?

ANSWER: Underground

TOSS-UP

7) Biology – *Multiple Choice* What system of neurotransmitters are made up of decarboxylated amino acids? Two of the most famous and important neurotransmitters from this group are serotonin and dopamine.

W) Cholinergic
X) Biogenic
Y) Neuropeptide
Z) Amino acid

ANSWER: X) Biogenic

BONUS

7) Biology – *Short Answer* During the resting state of cell membranes, all ion channels are closed except for one specific type, which opens and closes at random intervals. Name this type of ion channel.

ANSWER: Leakage channel

TOSS-UP

8) Chemistry – *Short Answer* Only what 2 stable elements are liquid at room temperature?

ANSWER: Mercury and Bromine

BONUS

8) Chemistry – *Short Answer* Mercury is an extremely poisonous metal to humans. What form of mercury is formed when microorganisms convert the element from an inorganic form to an organic form through the addition of carbon? Additionally, this substance is the most common organic mercury compound in the environment.

ANSWER: Methylmercury

TOSS-UP

9) Physics – *Short Answer* What scientist received the 1907 Nobel Prize in physics for his creation of the first interferometer?

ANSWER: A. A. MICHELSON

BONUS

9) Physics – *Short Answer* Sunlight illuminates a thin film of oil that floats on water, which has a greater index of refraction than the oil. The edge of the film has thickness $L < 0.1\ \lambda$ ***[read: lam-duh]***. Is the edge dark or bright?

ANSWER: BRIGHT

TOSS-UP

10) Math – *Short Answer* What is the term for a generalization of the notion of a triangle or tetrahedron to arbitrary dimensions.?

ANSWER: SIMPLEX

BONUS

10) Math – *Short Answer* Find the surface volume of a tesseract with side length 2.

ANSWER: 64

TOSS-UP

11) Earth and Space – *Short Answer* What is the term for hard, densely compacted sand that has built up over time?

ANSWER: LOESS

BONUS

11) Earth and Space – *Short Answer* In which country did the most powerful recorded earthquake in history occur?

ANSWER: CHILE

TOSS-UP

12) Energy – *Short Answer* A fluorescence microscope is a microscope that absorbs the light energy from photons and re-emits that light as new photons to create an image. If the re-emitted photons have half the momentum of the original photons, how many times longer is the wavelength of the new photons than that of the old photons?

ANSWER: 2

BONUS

12) Energy – *Multiple Choice* Which of the following is NOT a component of a fluorescent microscope?

W) Light Source
X) Dichroic Mirror
Y) Photon Beamsplitter
Z) Emission Filter

ANSWER: Y) Photon Beamsplitter

TOSS-UP

13) Biology – *Multiple Choice* A series of membranes, called meninges, cover and protect the central nervous system. What is the innermost meninge called?

W) Arachnoid mater
X) Pia mater
Y) Dura mater
Z) Subarachnoid mater

ANSWER: X) Pia mater

BONUS

13) Biology – *Short Answer* The thalamus is an important structure in the brain that is responsible for relaying information. All sensory information, except for one sense, passes through the thalamus. Which sense does not pass through the thalamus and directly travels to the cerebral cortex, which explains why it can be a potent trigger of memories and emotion.

ANSWER: Olfaction (Accept: Sense of smell / smell)

TOSS-UP

14) Chemistry – *Multiple Choice* Which of the following is the chemical formula of nonyne?

W) C9H9
X) C9H16
Y) C9H18
Z) C9H20

ANSWER: X) C9H16

BONUS

14) Chemistry – *Short Answer* What is the name for a sequence of compounds with the same functional group and similar chemical properties? These sequences can be represented by a general formula.

ANSWER: Homologous series

TOSS-UP

15) Physics – *Short Answer* A horizontal force F pushes a block of mass m against a vertical wall. The coefficient of friction between the block and the wall is μ. What value of F is necessary to keep the block from slipping down the wall?
W) mg
X) μ mg
Y) mg/μ
Z) mg(1 - μ)

ANSWER: Y) mg/μ

BONUS

15) Physics – *Multiple Choice* A 5 kg object is propelled from rest at time t =0 by a net force F that always acts in the same direction. The
magnitude of F in newtons is given as a function of t in seconds by F = 0.5t. What is the speed of the object at t
= 4 s?
W) 0.2 m/s
X) 0.5 m/s
Y) 0.8 m/s
Z) 2.0 m/s

ANSWER: Y) 0.8 M/S

TOSS-UP

16) Math – *Short Answer* What proof technique did Euclid use to prove Euclid's theorem which states that there are an infinite number of primes?

ANSWER: PROOF BY CONTRADICTION

BONUS

16) Math – *Multiple Choice* Which of the following is true about the function sin(x)/x?

W) It is always concave upwards
X) It is never concave upwards
Y) It has a horizontal asymptote
Z) It has a vertical asymptote

ANSWER: Y) IT HAS A HORIZONTAL ASYMPTOTE

TOSS-UP

17) Earth and Space – *Short Answer* What is the term for the phenomenon in which a black hole slowly radiates away its mass over time?

ANSWER: HAWKING RADIATION

BONUS

17) Earth and Space – *Short Answer* Brown dwarfs are able to fuse what isotope of hydrogen?

ANSWER: DEUTERIUM (ACCEPT: HYDROGEN-2)

TOSS-UP

18) Energy – *Short Answer* In commercial fuel cells, what is the primary charge carrier in the sulfonated fluoropolymer ion-exchange membrane

ANSWER: Proton

BONUS

18) Energy – *Multiple Choice* Which of the following is NOT a component in fuel cells?

W) Anode
X) Heat sink
Y) Cathode
Z) Electrolyte

ANSWER: X) Heat sink

TOSS-UP

19) Biology – *Multiple Choice* PTH is an important hormone in maintaining calcium levels in the bloodstream. What hormone counteracts the effects of PTH and what does this hormone do to calcium levels?

W) Calcitonin, which decreases calcium levels in the bloodstream.
X) Calmodulin, which decreases calcium levels in the bloodstream.
Y) Calcitonin, which increases calcium levels in the bloodstream.
Z) Calmodulin, which increases calcium levels in the bloodstream.

ANSWER: W) Calcitonin, which decreases calcium levels in the bloodstream.

BONUS

19) Biology – *Short Answer* The release of PTH increases calcium levels in the bloodstream. One way in which PTH produces this effect is by stimulating the synthesis of a certain substance, which triggers calcium absorption from any digested food in the small intestine back into the bloodstream. Name this substance, which dissolves in the presence of fat.

ANSWER: Vitamin D

TOSS-UP

20) Chemistry – *Short Answer* What property is defined as the rate of change of internal energy with respect to temperature?

ANSWER: C_v(ACCEPT: CONSTANT VOLUME HEAT CAPACITY)

BONUS

20) Chemistry – *Short Answer* For adiabatic processes, the product of pressure and volume raised to a certain exponent is constant. This exponent is the ratio between what two properties?

ANSWER: Cp and Cv

TOSS-UP

21) Physics – *Short Answer* What is the term for a repetitive up-and-down or back-and-forth linear motion?

ANSWER: RECIPROCATING MOTION

BONUS

21) Physics – *Short Answer* What rule can be used to find the angular momentum vector of a system?

ANSWER: RIGHT-HAND RULE

TOSS-UP

22) Math – *Multiple Choice* Which of the following trigonometric identities is not correct?

W) $\sin(x - y) = \sin(x)\cos(y) - \cos(x)\sin(y)$
X) $\cos(-x) = \cos(x)$
Y) $\tan^2(x) + 1 = \sec^2(x)$
Z) $\cos(2x) = \cos^2(x) + \sin^2(x)$

ANSWER: Z) $\COS(2X) = \COS^2(X) + \SIN^2(X)$

BONUS

22) Math – *Short Answer* What is the limit as x approaches infinity of the sum of the first x integers divided by x squared?

ANSWER: 0.5

TOSS-UP

23) Earth and Space – *Short Answer* Which of the following stars is often nicknamed as the Garnet Star?

W) T Tauri

X) Alpha Centauri
Y) Alpha Cygni
Z) Mu Cephei

ANSWER: Z) MU CEPHEI

BONUS

16) Earth and Space – *Short Answer* The star Alpha Cygni is also given what name?

ANSWER: DENEB