

BASIS PEORIA SCIENCE BOWL

DOUBLE ELIMINATION ROUND 8

TOSS-UP

1) Biology – *Multiple Choice* Which of the following tactile mechanoreceptors function to detect deep pressure and high - frequency vibration in the skin?

W) Merkel cells
X) Meissner's corpuscles
Y) Ruffini endings
Z) Pacinian corpuscles

ANSWER: Z) Pacinian corpuscles

BONUS

1) Biology – *Short Answer* Identify all of the following mechanoreceptors that are encapsulated: (1) Merkel cells; (2) Meissner's corpuscles; (3) Ruffini endings; (4) Pacinian corpuscles.

ANSWER: 2, 3, 4

TOSS-UP

2) Chemistry – *Short Answer* EDTA can form multiple bonds with ions such as Ca2+ or Fe2+, preventing them from continuing reactivity in solution. What is the term for a compound such as EDTA that exhibits this property?

ANSWER: CHELATING AGENT

BONUS

2) Chemistry – *Short Answer* What is the denticity of EDTA?

ANSWER: 6

TOSS-UP

3) Physics – *Multiple Choice* Which of the following is true of fictitious forces?

W) Fictitious forces are present in all references frames.
X) Fictitious forces are only present in non-inertial reference frames.
Y) Fictitious forces are only present in inertial reference frames.
Z) Fictitious forces are not real.

ANSWER: X

BONUS

3) Physics – *Short Answer* Find the critical speed for an object to remain in circular motion in a vertical loop with radius 10m, assuming g=10.

ANSWER: 10

TOSS-UP

4) Math – *Short Answer* What famous theorem of probability gives the chance of an event occurring if another event has occurred?

ANSWER: BAYES THEOREM

BONUS

4) Math – *Short Answer* Use Bayes Theorem to answer the following scenario. The Art Competition has entries from three painters: Pam, Pia and Pablo. Pam put in 15 paintings, 4% of her works have won First Prize. Pia put in 5 paintings, 6% of her works have won First Prize. Pablo put in 10 paintings, 3% of his works have won First Prize. What is the chance that Pam wins first place?

ANSWER: 50%

TOSS-UP

5) ESS– *Short Answer* What is the chemical formula of the tetrahedral silicate anions in olivine?

ANSWER: SiO4 4-

BONUS

5) ESS– *Short Answer* What class of silicates that includes Benitoite arranges silicate tetrahedra in a ring structure?

ANSWER: CYCLOSILICATES

TOSS-UP

6) Energy – *Short Answer* What is the capacitor that is used to deliver charge from an electrolytic capacitor to a battery because it is significantly faster in short-term energy storage?

ANSWER: Supercapacitor

BONUS

6) Energy – *Short Answer* Which of the following is NOT a disadvantage of using supercapacitors over batteries?

W) Supercapacitors have significantly lower energy density
X) Supercapacitors have a lower breakdown voltage
Y) Supercapacitors have a higher self-discharge rate
Z) Supercapacitors have a shorter lifespan

ANSWER: Z) Supercapacitors have a shorter lifespan

TOSS-UP

7) Biology – *Short Answer* There are two types of nephrons in the renal cortex. The first type is the juxtamedullary nephron. Provide the name for the second type of nephron, which is much more common in the kidney.

ANSWER: Cortical nephron

BONUS

7) Biology – *Short Answer* The primary difference between juxtamedullary and cortical nephrons is the length of what structure, which functions to reabsorb certain substances and create a concentration gradient?

ANSWER: Loop of Henle

TOSS-UP

8) Chemistry – *Short Answer* Hexaaquia complexes contain six of what ligands bound to a metal center?

ANSWER: WATER

BONUS

8) Chemistry – *Short Answer* What is the simplest pnictogen hydride?

ANSWER: AMMONIA

TOSS-UP

9) Physics – *Short Answer* Find the fluidic pressure at a depth of 10m, in a fluid of density 1000 kg/m^3, assuming g=9.8. Give your answer in kilopascals.

ANSWER: 98

BONUS

9) Physics – *Short Answer* Name all of the following three statements which describe ideal fluids?

1) Fluids are inviscid
2) Fluids are compressible
3) Fluids experience laminar flow

ANSWER: 1 AND 3

TOSS-UP

10) Math – *Short Answer* What paradox in geometry states that given a finite 3d solid ball, there exists a decomposition of the ball into disjoint sets from which two identical balls can be constructed.

ANSWER: BANACH-TARSKI PARADOX

BONUS

10) Math – *Short Answer* What famous theorem in math, whose proof was published in 1995, states that no distinct positive integers a, b, c can satisfy $a^n + b^n = c^n$ for n>2.

ANSWER: FERMAT'S LAST THEOREM

TOSS-UP

11) ESS– *Short Answer* What are the two main types of local metamorphism caused by an igneous intrusion?

ANSWER: CONTACT AND THERMAL

BONUS

11) ESS– *Multiple Choice* Which of the following minerals is the highest grade index minerals?

W) Orthoclase
X) Garnet
Y) Chlorite
Z) Kyanite

ANSWER: W

TOSS-UP

12) Energy – *Multiple Choice* Which of the following methods for nuclear fusion is the most well-developed and will most likely be used in the future?

W) Magnetic confinement
X) Electric pinch
Y) Inertial electrostatic confinement
Z) Inertial confinement

ANSWER: W) Magnetic confinement

BONUS

12) Energy – *Short Answer* What is the name of the device that uses magnetic fields to confine hot plasma into a toroidal shape in the magnetic confinement nuclear fusion method?

ANSWER: Tokamak

TOSS-UP

13) Biology – *Short Answer* Protein kinases catalyze the transfer of phosphate from ATP to a protein. What enzyme functions to oppose the action of kinases by catalysing the removal of phosphate from a protein to a water molecule?

ANSWER: Protein Phosphatase (Accept: Phosphatase)

BONUS

13) Biology – *Short Answer* Phosphofructokinase is a major regulatory enzyme in glycolysis. This enzyme functions by transferring a phosphate group from molecule A to molecule B. What are molecules A and B?

ANSWER: Molecule A: ATP, Molecule B: Fructose - 6 - phosphate

TOSS-UP

14) Chemistry – *Short Answer* How many different shapes of d orbitals exist?

ANSWER: 5

BONUS

14) Chemistry – *Short Answer* What are the quantum numbers n and l of a 4f electron, respectively?

ANSWER: 4 and 3

TOSS-UP

15) Physics – *Short Answer* Calculate the buoyant force on an object that displaces 3 cubic meters in a fluid of density 1200 kg/m^3 assuming g=10. Give your answer in kiloNewtons.

ANSWER: 36

BONUS

15) Physics – *Short Answer* Which of the following is not an example of turbulent flow?

W) Flow of honey from a bottle.
X) Terrestrial atmospheric circulation.
Y) Air flow over a stationary golf ball.
Z) Smoke rising from cigarettes.

ANSWER: W

TOSS-UP

16) Math – *Short Answer* What is the supremum of the following set over the real numbers {2, 4, 6, 8, 9, 11}

ANSWER: 11

BONUS

16) Math – *Short Answer* Which of the following sets obeys the axiom of completeness?

W) The Natural Numbers
X) The Real Numbers
Y) The Rational Numbers
Z) The Integers

ANSWER: X

TOSS-UP

17) ESS– *Short Answer* What is the name for the type of sand, found in Venezuela and Alberta, containing high concentrations of bitumen?

ANSWER: TAR SAND

BONUS

17) ESS– *Short Answer* What two compounds make up gas hydrate?

ANSWER: METHANE AND WATER

TOSS-UP

18) Energy – *Multiple Choice* What is the chemical by-product of biodiesel production that is commonly used to make antifreeze?

ANSWER: Glycerol (ACCEPT: Glycerin)

BONUS

18) Energy – *Short Answer* Glycerol can be reacted with concentrated nitric acid to produce nitroglycerin. What acid is used to catalyze this reaction?

ANSWER: Sulfuric

TOSS-UP

19) Biology – *Multiple Choice* The human skull consists of mostly irregular bones. Which of the following pairs of irregular bones forms the hard palate of the mouth?

W) Ethmoid and Vomer
X) Maxillary and Palatine
Y) Zygomatic and Sphenoid
Z) Mandible and Nasal

ANSWER: X) Maxillary and Palatine

BONUS

19) Biology – *Short Answer* What 3 paired bones fuse during adolescence to form the pelvis?

ANSWER: Ilium, Ischium, and Pubis

TOSS-UP

20) Chemistry – *Multiple Choice* Which of the following is NOT one of the five shapes of d orbitals?

W) d-x^2
X) d-xy
Y) d-yz
Z) d-z^2

ANSWER: W

BONUS

20) Chemistry – *Short Answer* What unique third type of covalent bond (after sigma and pi) is found by the overlap of four lobes of d orbitals?

ANSWER: DELTA BOND

TOSS-UP

21) Physics – *Short Answer* The wave speed on a string with linear density 12 kg/m is 10m/s. What is the wave speed in a similar string with equal tension and a linear density of 6 kg/m?

ANSWER: 40

BONUS

21) Physics – *Short Answer* Find the sound intensity level in decibels of a sound of intensity. 10 W/m^2

ANSWER: 130 dB

TOSS-UP

22) Math – *Short Answer* What fundamental theorem states that for any continuous function f over the closed interval from a to b, f takes on every value between f(a) and f(b) over the interval?

ANSWER: INTERMEDIATE VALUE THEOREM

BONUS

22) Math – *Short Answer* What theorem states that if $g(x) \leq f(x) \leq h(x)$ and the limit as x goes to c of g(x) is equal to the limit as x goes to c of h(x) then f(x) must have the same limit as x goes to c.

ANSWER: SQUEEZE THEOREM

TOSS-UP

23) ESS– *Short Answer* The equations of motion cannot be solved analytically for a system that has more than how many bodies?

ANSWER: TWO

BONUS

23) ESS– *Short Answer* What theorem provides a general equation that relates the average over time of the total kinetic energy of a stable system of discrete bodies, bound by potential forces, with that of the total potential energy of the system?

ANSWER: VIRIAL THEOREM