

BASIS PEORIA SCIENCE BOWL

DOUBLE ELIMINATION ROUND 3

TOSS-UP

1) Biology – *Short Answer* What is the longest muscle in the human body?

ANSWER: Sartorius

BONUS

1) Biology – *Short Answer* What is the main muscle that allows us to sit cross - legged? This muscle also acts as a synergist for many other movements in the thigh and hips.

ANSWER: Sartorius

TOSS-UP

2) Chemistry – *Multiple Choice* Which of the following will give a green flame test?

W) Strontium
X) Calcium
Y) Lithium
Z) Barium

ANSWER: Z

BONUS

2) Chemistry – *Short Answer* Give the color of the flame produced in a flame test by each of the following three elements.

1) Lithium
2) Potassium
3) Sodium

ANSWER: RED, VIOLET, YELLOW

TOSS-UP

3) Physics – *Multiple Choice* Which of the following constants is not included in the equation of capacitance of a sphere?

W) Pi
X) Vacuum permeability
Y) Vacuum permittivity
Z) 4

ANSWER: X) VACUUM PERMEABILITY

BONUS

3) Physics – *Multiple Choice* Which of the following is closest to the self-capacitance of the Earth?

W) 1x10^3 farads
X) 1 farad
Y) 1x10^-3 farads
Z) 1x10^-6 farads

ANSWER: Y) 1x10^-3 FARADS

TOSS-UP

4) Math – *Short Answer* Find the area of a regular hexagon with a side length of 2. Give your answer in simplest radical form.

ANSWER: $6\sqrt{3}$

BONUS

4) Math – *Multiple Choice* What is the equation of the line tangent to the unit circle at $(\frac{\sqrt{3}}{2}, \frac{1}{2})$?

W) $y = -\frac{\sqrt{3}}{3}x + 2$
X) $y = -\frac{1}{2}x + \sqrt{3}$
Y) $y = -\sqrt{3}x + 2$
Z) $y = -2x + \frac{\sqrt{3}}{3}$

ANSWER: Y) $Y = -\sqrt{3}X + 2$

TOSS-UP

5) Earth and Space – *Multiple Choice* Partial melting of subducted lithospheric material gives rise to what phenomenon common at subduction zones?

W) EARTHQUAKES
X) VOLCANISM
Y) LIQUEFACTION
Z) FORMATION OF MOUNTAIN RANGES

ANSWER: X) VOLCANISM

BONUS

5) Earth and Space – *Short Answer* In Mexico in 1943, a volcanic vent started erupting from a small, otherwise boring depression in a small corn field. The volcano was powerful enough to throw rock fragments as high as 20, 000 feet into the air. The volcano erupted for the next nine years, and the mountain soon engulfed the entirety of the nearby village of Paricutin. A lava flow also covered much of the village of San Juan Parangaricutiro. Then, however, the eruptions abruptly ended. What type of volcano was Paricutin?

ANSWER: CINDER CONE

TOSS-UP

6) Energy – *Multiple Choice* Ivanpah, one of the largest solar power plants in the United States converts sunlight into electricity via what method?

W) Heating up and melting salts, which, by the Thermoelectric effect, turn heat into electricity
X) Photovoltaic Effect
Y) Photoelectrolysis
Z) Heating up water to produce steam which pushes a turbine

ANSWER: Z) Heating up water to produce steam which pushes a turbine

BONUS

6) Energy – *Short Answer* Solar Power plants are usually not dedicated to producing only solar energy. Name the other energy source that is most commonly converted into energy alongside solar power?

ANSWER: Natural Gas

TOSS-UP

7) Biology – *Multiple Choice* This glial cell is only present in the CNS and is responsible for producing cerebrospinal fluid. Name this type of cell, which appear similar to epithelial cells and possess cilia to distribute cerebrospinal fluid.

W) Astrocyte
X) Microglia
Y) Satellite cell
Z) Ependymal cell

ANSWER: Z) Ependymal cell

BONUS

7) Biology – *Multiple Choice* Oligodendrocytes and Schwann cells both perform very similar functions in different parts of the nervous system. Which of the following is an accurate comparison of the structures of these two cells.

W) Schwann cells possess many processes that myelinate multiple axon segments whereas Oligodendrocytes wrap around and myelinate only one axon segment.
X) Oligodendrocytes possess many processes that myelinate multiple axon segments whereas Schwann cells wrap around and myelinate only one axon segment.
Y) Both Schwann cells and Oligodendrocytes wrap around and myelinate only one axon segment.
Z) Both Schwann cells and Oligodendrocytes possess many processes that myelinate multiple axon segments.

ANSWER: X) Oligodendrocytes possess many processes that myelinate multiple axon segments whereas Schwann cells wrap around and myelinate only one axon segment.

TOSS-UP

8) Chemistry – *Short Answer* What law relates the volume of a gas to the number of molecules in a gas under constant temperature and pressure?

ANSWER: Avogadro's Law

BONUS

8) Chemistry – *Short Answer* What is the volume of a 6 mol sample of Argon at STP?

ANSWER: 134.4 L

TOSS-UP

9) Physics – *Short Answer* What are the SI units for wavenumber?

ANSWER: RADIANS PER METER

BONUS

9) Physics – *Short Answer* A 45kg mass attached to a spring is oscillating. Find the angular frequency in radians per second if the spring constant is 5 N/m.

ANSWER: 3

TOSS-UP

10) Math – *Multiple Choice* Give the derivative of tan(x).

W) $\cos^2(x) - \sin^2(x)$
X) $\sin(x)\cos(x)$
Y) $\cot^2(x)$
Z) $\sec^2(x)$

ANSWER: Z) $SEC^2(X)$

BONUS

10) Math – *Short Answer* Give an antiderivative of tan(x).

ANSWER: F(X) = -LN(COS(X)) (ACCEPT: GIVEN ANSWER PLUS ANY CONSTANT)

TOSS-UP

11) Earth and Space – *Multiple Choice* The star Sirius has an apparent magnitude of-1.47, while Barnard's Star has an apparent magnitude of 9.53. In scientific notation to the nearest tenth, how many times brighter is Sirius than Barnard's Star?

W) 1.1*10^1
X) 9.1*10^-2
Y) 2.5*10^5
Z) 4.0*10^-4

ANSWER: Y) 2.5*10^5

BONUS

11) Earth and Space – *Short Answer* A certain star lies 326 light years away, and has an apparent magnitude of 6. What is its absolute magnitude?

ANSWER: 1

TOSS-UP

12) Energy – *Short Answer* Physicist Thomas Johann Seebeck discovered that there is a buildup of electric potential, which created a magnetic field, across a temperature gradient in a wire. Not noticing the electric current in the wire, he named it the "thermomagnetic effect" Later, Hans Ørsted recognized and corrected Seebeck's mistake, renaming the effect to what?

ANSWER: Thermoelectric Effect

BONUS

12) Energy – *Multiple Choice* Which of the following scientists did NOT contribute to the discovery and testing of Thermoelectricity

W) Thomas Johann Seebeck
X) Alexandre Edmond Becquerel
Y) Jean Charles Athanase Peltier
Z) Lord Kelvin

ANSWER: X) Alexandre Edmond Becquerel

TOSS-UP

13) Biology – *Short Answer* A recent respiratory disease has caused over 24 million cases worldwide. Thought to originate from Wuhan, China, this disease is primarily spread through respiratory and oral droplets, and it has quickly reached the status of a worldwide pandemic. Name the virus that is responsible for this disease.

ANSWER: SARS Coronavirus 2

BONUS

13) Biology – *Short Answer* Identify all of the following that are direct symptoms of COVID - 19. (1) Muscle fatigue. (2) Back pain. (3) Diarrhea. (4) Shortness of breath. (5) Blurred vision.

ANSWER: (1), (3), (4)

TOSS-UP

14) Chemistry – *Multiple Choice* Which of the following is not a state function?

W) Entropy
X) Specific Heat
Y) Internal energy
Z) Enthalpy

ANSWER: X) Specific Heat

BONUS

14) Chemistry – *Short Answer* This law exists because enthalpy is a state function, and it states that the total change in enthalpy of a reaction is the sum of all the enthalpy changes within the intermediate stages of the reaction. Name this law.

ANSWER: Hess's Law

TOSS-UP

15) Physics – *Multiple Choice* Which of the following is a statement of Pascal's Principle?

W) A change in the pressure applied to an enclosed incompressible fluid is transmitted undiminished to every portion of the fluid and to the walls of the containing vessel
X) A body fully or partially immersed in a fluid is buoyed up by a force equal to the weight of the fluid that the body displaces
Y) If the speed of a fluid particle increases as it travels along a horizontal streamline, the pressure of the fluid must decrease, and conversely.
Z) In laminar flow the velocity of the moving fluid at any fixed point does not change with time, either in magnitude or in direction.

ANSWER: W) A CHANGE IN THE PRESSURE APPLIED TO AN ENCLOSED INCOMPRESSIBLE FLUID IS TRANSMITTED UNDIMINISHED TO EVERY PORTION OF THE FLUID AND TO THE WALLS OF THE CONTAINING VESSEL

BONUS

15) Physics – *Multiple Choice* A block of wood floats at a certain level in a pail of water in a stationary elevator. Which of the following is not true about the block?

W) It would sink lower in the water if the elevator accelerated upward
X) It would float higher in the water if the elevator accelerated downward
Y) It is acted on by a force equal and opposite to the weight of the displaced water
Z) It would float higher in the water if the elevator began to move at a constant speed upward

ANSWER: Z) IT WOULD FLOAT HIGHER IN THE WATER IF THE ELEVATOR BEGAN TO MOVE AT A CONSTANT SPEED UPWARD

TOSS-UP

16) Math – *Short Answer* What is the term for the parallelogram that is created by joining the midpoints of the four sides of a quadrilateral?

ANSWER: VARIGNON PARALLELOGRAM

BONUS

16) Math – *Short Answer* Find the area of a simple quadrilateral whose Varignon parallelogram has a base of 17 and a height of 13.

ANSWER: 442

TOSS-UP

17) Earth and Space – *Short Answer* To one decimal place and in kelvins, what is the temperature of the Cosmic Microwave Background?

ANSWER: 2.7

BONUS

17) Earth and Space – *Short Answer* What is the term for a large collection of stars of the same age that is gravitationally bound and roughly spherical?

ANSWER: GLOBULAR CLUSTER

TOSS-UP

18) Energy – *Short Answer* In the United States the average price you pay for electricity is about 12 cents per kilowatt hour. Assuming I live in the US, how much would it cost to turn on a 100 Watt LED light bulb for 5 hours?

ANSWER: 3.036 cents (~3 cents)

BONUS

18) Energy – *Multiple Choice* Answer the following two questions about light bulbs

A. Rank the following light bulb types from most energy-efficient to least energy-efficient: 1) CFL, 2) Halogen, 3) LED, 4) Incandescent
B. Electricity is passed through the gas-filled tube in a CFL bulb, which produces UV light. A coating, then, absorbs this UV light and produces visible light. What is this coating made from?

ANSWER: A. 3), 1), 2), 4) B. Phosphors

TOSS-UP

19) Biology – *Multiple Choice* Which of the following is not one of Koch's postulates?

W) The organism can be isolated from diseased tissues and grown on artificial media.
X) The organism is found in every instance of the disease.
Y) When the organism is introduced into a healthy host, it causes the same disease.
Z) When antibiotics specific to the organism are introduced into a diseased host, then the organism will die.

ANSWER: Z) When antibiotics specific to the organism are introduced into a diseased host, then the organism will die.

BONUS

19) Biology – *Short Answer* In the 1860s, this English surgeon applied the germ theory of disease to medical procedures. His use of phenol to treat surgical wounds dramatically reduced the number of infections and deaths. Provide the name of this surgeon and the name of the technique that he pioneered, respectively.

ANSWER: Joseph Lister and aseptic surgery

TOSS-UP

20) Chemistry – *Short Answer* What is the densest naturally - occurring element of the periodic table?

ANSWER: Osmium

BONUS

20) Chemistry – *Short Answer* Powdered osmium will react with oxygen in the air to form what volatile compound?

ANSWER: OsO4 (Accept: Osmium tetroxide)

TOSS-UP

21) Physics – *Multiple Choice* Which of the following relationships between the force F on a particle and the particle's position x implies simple harmonic oscillation?

W) $F = -400x^2$
X) $F = -5x$
Y) $F = 10x$
Z) $F = 3x^2$

ANSWER: X) F = -5X

BONUS

21) Physics – *Short Answer* When mass A is hung from spring A and a smaller mass B is hung from spring B, the springs are stretched by the same distance. If the two spring-mass systems are put into simple harmonic motion with the same amplitude, which system, A or B, will have more energy?

ANSWER: A

TOSS-UP

22) Math – *Short Answer* What theorem of calculus can be best summarized as, "At some instant, a function must take on its average rate of change"?

ANSWER: MEAN VALUE THEOREM

BONUS

22) Math – *Short Answer* Find the derivative of the function $f(x) = \sin^3(x)$.

ANSWER: $3\text{SIN}^2(\text{X})\text{COS}(\text{X})$

TOSS-UP

23) Earth and Space – *Short Answer* What is the term for a place where a river directly meets the sea without slowing down, forming a single channel?

ANSWER: ESTUARY

BONUS

23) Earth and Space – *Short Answer* What type of glacier starts in a mountainous region and then reaches a low-lying plain, where it spreads out?

ANSWER: PIEDMONT GLACIER