

ROUND ROBIN – ROUND 7

TOSS-UP

1) Earth & Space – *Short Answer* What line separates the dark and light hemispheres of the moon?

ANSWER: TERMINATOR

BONUS

1) Earth & Space – *Multiple Choice* Which of the following combinations of gases best describes Earth's primordial atmosphere?

- W) Carbon dioxide, nitrogen, and water vapor
- X) Hydrogen, helium, and methane
- Y) Nitrogen, oxygen, and argon
- Z) Helium, argon, and xenon [**ZEE-non**]

ANSWER: X) HYDROGEN, HELIUM, AND METHANE

TOSS-UP

2) Biology – *Multiple Choice* MRSA [**mirsa**] is an infection-causing bacteria. Which of the following best describes why MRSA is especially difficult to treat relative to many other human pathogens?

- W) It reproduces very quickly
- X) It can evade the immune system
- Y) It is resistant to many antibiotics
- Z) It secretes harmful toxins

ANSWER: Y) IT IS RESISTANT TO MANY ANTIBIOTICS

BONUS

2) Biology – *Multiple Choice* Which of the following percentages is the closest to the fraction of the human genome that codes for proteins?

- W) 99
- X) 50
- Y) 10
- Z) 1

ANSWER: Z) 1

TOSS-UP

3) Math – *Short Answer* The end of a pendulum swings through an arc 12 feet long when the string swings through an angle of 1.5 radians. In feet, what is the length of the pendulum?

ANSWER: 8

BONUS

3) Math – *Short Answer* What is the y -coordinate of the solution of the following system of 2 equations: $9x + 8y = 4$ and $7x + 3y = 5$.

ANSWER: $-17/29$

TOSS-UP

4) Chemistry – *Multiple Choice* Andrew has a 1-kilogram test weight that he places on a scale and measures five observations, which he records in kilograms as 1.31, 1.33, 1.32, 1.33, and 1.31. Which of the following best describes the scale?

- W) Precise and accurate
- X) Neither precise nor accurate
- Y) Precise, but not accurate
- Z) Accurate, but not precise

ANSWER: Y) PRECISE, BUT NOT ACCURATE

BONUS

4) Chemistry – *Short Answer* Rank the following three diatomic molecules in order of increasing bond dissociation energy: 1) Nitrogen; 2) Oxygen; 3) Fluorine.

ANSWER: 3, 2, 1

TOSS-UP

5) Energy – *Short Answer* Researchers at Princeton Plasma Physics Lab are studying the flow of infalling matter in stellar accretion disks. The resistance of these flows to falling directly into the star is most related to the conservation of what quantity?

ANSWER: ANGULAR MOMENTUM

BONUS

5) Energy – *Short Answer* Researchers at Lawrence Berkeley National Lab are studying how the immune system detects viruses. Identify all of the following three conditions that can be caused by autoimmunity: 1) Transplant rejection; 2) Type I diabetes; 3) Hay fever.

ANSWER: ALL

TOSS-UP

6) Physics – *Short Answer* According to Coulomb's law, the electric force between two point charges is directly proportional to what power of the distance between the charges?

ANSWER: NEGATIVE TWO

BONUS

6) Physics – *Short Answer* A car is driving around a circular track with a radius of 250 meters. It begins at a speed of thirty meters per second, and accelerates tangentially [*tan-JEN-chul-ee*] at five meters per second squared for four seconds. In meters per second squared, what is the centripetal acceleration of the car afterwards?

ANSWER: 10

TOSS-UP

7) Biology – *Short Answer* Antibodies are secreted forms of proteins similar in structure to surface receptors found on what type of immune cell?

ANSWER: B CELL (ACCEPT: B LYMPHOCYTE)

BONUS

7) Biology – *Short Answer* You want to sequence eukaryotic mRNA by using a DNA primer that will bind to the 3-prime end of transcripts with high affinity. This primer should be primarily composed of what base?

ANSWER: THYMINE (ACCEPT: T)

TOSS-UP

8) Earth & Space – *Multiple Choice* Which of the following best describes the structure of the mid-Atlantic ridge?

- W) One long continuous ridge
- X) Many spreading ridges offset by normal faults
- Y) Many spreading ridges offset by horsts and grabens [*GRAH-bens*]
- Z) Many spreading ridges offset by transform faults

ANSWER: Z) MANY SPREADING RIDGES OFFSET BY TRANSFORM FAULTS

BONUS

8) Earth & Space – *Multiple Choice* A molecule of carbon dioxide in the atmosphere is most likely to leave the atmosphere through which of the following processes?

- W) Dissolution into seawater
- X) Atmospheric escape
- Y) Photosynthesis
- Z) Respiration

ANSWER: W) DISSOLUTION INTO SEAWATER

TOSS-UP

9) Energy – *Short Answer* Argonne National Lab scientists are developing materials for use in spintronic storage, which exploits the spin quantum number as a way to store information. In particular, spintronics is concerned with the spin quantum number of what subatomic particle?

ANSWER: ELECTRON

BONUS

9) Energy – *Short Answer* Researchers at Princeton Plasma Physics Lab are studying plasma processes which are believed to lead to planet formation in disks around young stars. What is the term for newly formed, very luminous stars on the Hayashi [*high-YAH-shee*] track?

ANSWER: T TAURI STARS

TOSS-UP

10) Math – *Short Answer* A special coin has a $\frac{3}{5}$ probability of landing on heads, and a $\frac{2}{5}$ probability of landing on tails. In a series of three coin flips, what is the probability of the outcome sequence heads, tails, heads?

ANSWER: 18/125 (ACCEPT: 0.144, 14.4%)

BONUS

10) Math – *Short Answer* Find the y -intercept of the line passing through the point $(-7, 8)$ that is perpendicular to the line $3x + 5y = 14$.

ANSWER: $\frac{59}{3}$ (ACCEPT: $19 \frac{2}{3}$)

TOSS-UP

11) Chemistry – *Short Answer* What is the point on a phase diagram that represents the temperature and pressure at which three phases of a substance can coexist?

ANSWER: TRIPLE POINT

BONUS

11) Chemistry – *Short Answer* Assume that the pKa of ammonium ions is 10. The molar concentration of hydroxide ions in a one-molar solution of ammonia is closest to 10 raised to what integer?

ANSWER: -2

TOSS-UP

12) Physics – *Short Answer* A 12-volt battery with an internal resistance of one ohm is connected to a 5-ohm resistor. In watts, what is the power dissipated by the battery itself?

ANSWER: 4

BONUS

12) Physics – *Short Answer* Identify all of the following three statements that are true of a block sliding down a ramp: 1) The normal force is pointing directly upward; 2) The frictional force is pointing opposite to the direction of motion; 3) The gravitational force is pointing directly downward.

ANSWER: 2, 3

TOSS-UP

13) Earth & Space – *Multiple Choice* A layer of sedimentary *[sed-ih-MEN-taree]* strata contains many diverse fossils, while an older layer just below it contains very few fossils. Which of the following evolutionary events might have occurred and would explain this observation?

- W) Radiation
- X) Regression
- Y) Convergence
- Z) Extinction

ANSWER: W) RADIATION

BONUS

13) Earth & Space – *Multiple Choice* Half Dome in Yosemite National Park is an example of an exfoliation dome created by what type of mechanical weathering?

- W) Frost wedging
- X) Sheet jointing
- Y) Salt crystal growth
- Z) Water erosion

ANSWER: X) SHEET JOINTING

TOSS-UP

14) Math – *Short Answer* Giving your answer in standard form, what is the equation of the circle with center at (0, 0) and diameter 32?

ANSWER: $x^2 + y^2 = 256$

BONUS

14) Math – *Short Answer* If the third derivative of a position function can be described by the function $12t^4 + 7t^3 - 10$, what is the coefficient of the highest-order term in the position function?

ANSWER: 2/35

TOSS-UP

15) Energy – *Short Answer* Scientists at the National Renewable Energy Laboratory are using computational methods to predict the energies of atomic orbitals. What subatomic particles do orbitals contain?

ANSWER: ELECTRONS

BONUS

15) Energy – *Short Answer* Scientists at the Joint Genome Institute are studying organisms that communicate with cyclic di-GMP. This is a second messenger used primarily in what domain of life?

ANSWER: BACTERIA (ACCEPT: EUBACTERIA; DO NOT ACCEPT: ARCHAEA)

TOSS-UP

16) Biology – *Multiple Choice* In which of the following environments would a plant exhibiting CAM photosynthesis most likely be found?

- W) Wet and warm
- X) Cold and dark
- Y) Dry and arid
- Z) Mountainous and windy

ANSWER: Y) DRY AND ARID

BONUS

16) Biology – *Short Answer* Neuronal depolarization [*dee-poh-lah-riz-AY-shun*] during an action potential is mediated through channels that allow entry of what cation [*CAT-eye-on*]?

ANSWER: SODIUM (ACCEPT: SODIUM ION, SODIUM PLUS, Na⁺)

TOSS-UP

17) Physics – *Short Answer* Two equal point charges are located inside a sphere with radius six meters. If the sphere's radius is tripled, by what factor is the net electric flux through the sphere multiplied?

ANSWER: 1 (DO NOT ACCEPT: IT IS UNCHANGED, THERE IS NO CHANGE)

BONUS

17) Physics – *Short Answer* A one-meter string is fixed at both ends, and a standing wave with wavelength 40 centimeters is generated on the string. How many nodes will the string have?

ANSWER: 6

TOSS-UP

18) Chemistry – *Multiple Choice* Which of the following compounds contains bonds with the most ionic character?

- W) Magnesium oxide
- X) Lithium chloride
- Y) Ferrous chloride
- Z) Aluminum bromide

ANSWER: X) LITHIUM CHLORIDE

BONUS

18) Chemistry – *Short Answer* The specific heat of ice is half that of liquid water. Given that value, then, to the nearest tenth of a kilojoule, how much energy would have to be transferred to 25 grams of ice to raise its temperature by from -50 degrees Celsius to -25 degrees Celsius?

ANSWER: 1.3

TOSS-UP

19) Earth & Space – *Short Answer* What type of comet tail is formed by radiation pressure?

ANSWER: DUST TAIL

BONUS

19) Earth & Space – *Multiple Choice* When William Herschel first observed Uranus through a telescope, he thought it was a comet. What observation convinced him it was a planet?

- W) It was too massive to be a comet
- X) Its orbit had low eccentricity
- Y) It had natural satellites, unlike most comets
- Z) It had rings, much like the other gas giants

ANSWER: X) ITS ORBIT HAD LOW ECCENTRICITY

TOSS-UP

20) Math – *Short Answer* The complex number 6 lies on the boundary between what two quadrants in the complex plane?

ANSWER: FIRST AND FOURTH (ACCEPT: ONE AND FOUR)

BONUS

20) Math – *Short Answer* What is the cosine of the smallest angle in a triangle with side lengths of 5, 10, and 11?

ANSWER: 49/55

TOSS-UP

21) Biology – *Multiple Choice* Which of the following animals does not possess an amniotic [*am-nee-AW-tic*] membrane at any stage of development?

- W) Salamander
- X) Lizard
- Y) Gorilla
- Z) Tiger

ANSWER: W) SALAMANDER

BONUS

21) Biology – *Short Answer* Identify all of the following three substances that contribute to the osmolarity [*oz-mow-LAIR-it-ee*] of blood: 1) Chloride ion; 2) Glucose; 3) Albumin.

ANSWER: ALL

TOSS-UP

22) Physics – *Multiple Choice* A fully-charged capacitor is connected to a circuit with a resistor. Which of the following describes how the charge in the capacitor will change with time?

- W) Linearly decreases to zero
- X) Exponentially decreases to zero
- Y) Immediately discharges to zero
- Z) Stays constant

ANSWER: X) EXPONENTIALLY DECREASES TO ZERO

BONUS

22) Physics – *Short Answer* Identify all of the following three statements that are always true of fluid pressure: 1) Pressure is linearly proportional to fluid depth; 2) Pressure originates due to the fluid's weight; 3) In an enclosed incompressible fluid, an applied pressure is felt at all points in the fluid.

ANSWER: 3

TOSS-UP

23) Chemistry – *Short Answer* Identify all of the following three solvents that are polar. 1) Acetone; 2) DMSO; 3) Benzene.

ANSWER: 1, 2

BONUS

23) Chemistry – *Short Answer* Rank the following three ionic compounds in order of increasing solubility in water: 1) MgSO_4 ; 2) BaSO_4 ; 3) $\text{Ba}(\text{OH})_2$.

ANSWER: 2, 3, 1