

DE1

TOSSUP

1) Biology - *Short Answer* Monish is studying malaria, and finds that the causative agent of the disease, *P. falciparum,* is part of what group of parasitic organisms characterized by the presence of an apicoplast?

ANSWER: apicomplexans [AD]

BONUS

1) Biology - *Multiple Choice* Birds and mice are both examples of endotherms, but their common ancestor, an early amniote, is an ectotherm. Based on the description, which of the following best characterizes endothermy in amniotes?

W) Pleisomorphy
X) Autapomorphy
Y) Synapomorphy
Z) Homoplasy

ANSWER: Z) Homoplasy [AD]

~~~~~~

TOSSUP

2) Chemistry - *Multiple Choice* Arjun is horsing around in the chemistry lab and accidentally spills some phenolphthalein in a beaker with a solution in it. The solution in the beaker immediately turns pink. Which of the following salts could have been in the solution?

W) NaF
X) NaCl
Y) KBr
Z) KI

ANSWER: W) NaF [SO]

BONUS

2) Chemistry - *Multiple Choice* Which of the following is the SI unit for activity when referring to a radioactive species?

W) Sievert
X) Reontgen
Y) Becquerel
Z) Gray
~~~~~~

ANSWER: Y) Becquerel [SO]

~~~~~~

TOSSUP

3) Earth and Space - *Multiple Choice* Streams can transport sediments in a variety of ways. Which of the following types of sediment load is primarily transported by saltation?

W) Dissolved load
X) Suspended load
Y) Bed load
Z) Channel load

ANSWER: Y) Bed load [JY]

BONUS

3) Earth and Space - *Short Answer* Calculate the discharge of a perfectly semicircular stream, in cubic meters per second, to the nearest ten, at a given point where the flow velocity is 7 m/s, and the depth of the channel is 2 meters?

ANSWER: 40 [JY]

~~~~~~

TOSSUP

4) Math - *Short Answer* How many of the regular polygons can tile the plane in a non-intersecting tiling?

ANSWER: 3

BONUS

4) Math - *Short Answer* What is the sum of the first 2025 terms of the arithmetic sequence with first three terms -2025, -2023, -2021?

ANSWER: -2025

~~~~~~
~~~~~~

TOSSUP

5) Physics - *Short Answer* Harshtha is listening to Taylor Swift on a spaceship traveling at 0.6 c. If Harshtha spends 4 minutes listening to the song in her frame, how long does she listen to the song for someone at rest?

ANSWER: 5 minutes

BONUS

5) Physics - *Short Answer* An object of mass 1 kg moves at 5 m/s and collides elastically with a 10,000 kg object. What is the speed of the 10,000 kg object after the collision to one significant figure?

ANSWER: 10^{-3} or 0.001 m/s

~~~~~~

TOSSUP

6) Biology - *Short Answer* - Identify all of the following three substances that are secreted by parietal cells in the stomach.

1) HCl
2) Pepsinogen
3) Intrinsic Factor

ANSWER: 1, 3 [AD]

BONUS

6) Biology - *Short Answer* After performing an experiment on the limb bud of a chick embryo, Sanjay discovers that the limb has several abnormalities. The first abnormality is that it is much shorter than a normal limb, and the second is that the digits of the limb display a mirror image pattern where they have two ends which resemble the posterior end of a normal limb. Identify all of the following three procedures did Sanjay likely perform in his experiment?

1) destroyed the limbs bud's apical ectodermal ridge
2) applied recombinant sonic hedgehog protein to both sides of the limb bud
3) destroyed the limb bud's zone of polarizing activity

ANSWER: 1, 2 [AD]

~~~~~~

TOSSUP

7) Chemistry- *Multiple Choice* When John Dalton was looking for evidence to convince him of the existence of atoms, he noted that elements like carbon and oxygen always combined

together in small whole number ratios to form compounds. What law of stoichiometry does this illustrate?

W) Law of conservation of mass
X) Law of conservation of energy
Y) Law of definite proportions
Z) Law of multiple proportions

ANSWER: Z) Law of multiple proportions [SO]

BONUS

7) Chemistry - *Short Answer* Carbon tetrachloride and hydrochloric acid are produced from the reaction between methane and chlorine gas. If the rate of formation of carbon tetrachloride is 0.80 M/min, then in M/min, what is the rate of disappearance of methane?

ANSWER: 0.80 M/min [SO]

~~~~~~

TOSSUP

8) Earth and Space - *Short Answer* Praneel looks outside as an earthquake is happening, and notices that the ground is rippling like water. What type of earthquake wave is he observing?

ANSWER: Rayleigh wave [JY]

BONUS

8) Earth and Space - *Short Answer* Order the following three stages of a coral reef in chronological order:

1) Atoll
2) Barrier
3) Fringing

ANSWER: 3, 2, 1 [JY]

~~~~~~

TOSSUP

9) Math - *Multiple Choice* For which of the following values of N does the last two digits of N^2 equal the last two digits of N?

W) 111
X) 120

Y) 125
Z) 132

ANSWER: Y) 125

BONUS

9) Math - *Short Answer* What is the minimum value of the function (x^2)/2 + 1/x over all positive real values of x?

ANSWER: 3/2.

~~~~~~

TOSSUP

10) Physics - *Short Answer* A tube closed on both ends has a length of 5 meters. What is the ratio of the frequency of the 2nd harmonic to the frequency of the 3rd harmonic?

ANSWER: ⅔

BONUS

10) Physics - *Short Answer* A disk has moment of inertia I and radius R. Keeping the density constant, what is the new moment of inertia if the disk has a radius of 2R?

ANSWER: 16 I

~~~~~~

TOSSUP

11) Biology - *Short Answer* What term refers to cell signalling pathways in which cells interact through direct contact, and is especially important for cell motility and embryonic development?

ANSWER: Juxtacrine Signalling [HL]

BONUS

11) Biology - *Short Answer* What term refers to an enzyme containing all components needed for active functioning, including an apoenzyme and its cofactors?

ANSWER: Holoenzyme (DO NOT ACCEPT: Conjugated Enzyme) [HL]

~~~~~~
~~~~~~

TOSSUP

12) Chemistry - *Multiple Choice* For a given reaction, the line formed from graphing $\ln(K_{eq})$ vs 1/T is linear with positive slope. Which of the following statements must be true regarding this reaction?

W) ΔH is less than 0
X) ΔS is less than 0
Y) ΔH is greater than 0
Z) ΔS is greater than 0

ANSWER: W) ΔH is less than 0 [SO]

BONUS

12) Chemistry - *Multiple Choice* Reactions 1 and 2 have the same reaction rate at 100 Kelvin. However, Reaction 1 has a much higher activation energy than Reaction 2. Which of the following statements best compares the rates of Reaction 1 to Reaction 2 at 50 and 150 Kelvin respectively?

W) Slower, Slower
X) Slower, Faster
Y) Faster, Slower
Z) Faster, Faster

ANSWER: X) Slower, Faster [SO]

~~~~~~

TOSSUP

13) Earth and Space - *Short Answer* Identify all of the following 4 options that contribute substantially to Mercury's atmosphere:

1) The Sun sublimates icy material off the surface of Mercury which then forms its atmosphere.
~~~~~~

2) Impact vaporization from meteoroids produces transient atmospheric gases.
3) Mercury's atmosphere is constantly replenished by outgassing from its interior.
4) Solar wind sputtering releases atoms from Mercury's surface into the exosphere.

ANSWER: 24

BONUS

13) Earth and Space - *Multiple Choice* Which of the following types of exoplanets are most likely to be discovered through the radial velocity?

W) Super Earths
X) Mini Neptunes
Y) Hot Jupiters
Z) Super Puff Planets

ANSWER: Y) Hot Jupiters

~~~~~~

TOSSUP

14) Math - *Multiple Choice* Which of the following is matched correctly with its intersection?

W) Angle Bisector, Orthocenter
X) Median, Incenter
Y) Altitude, Centroid
Z) Perpendicular Bisector, Circumcenter

ANSWER: Z) Perpendicular Bisector, Circumcenter

BONUS

14) Math - *Short Answer* The polynomial x^2+ax+b has roots at x = a and x = b. Find all possible ordered pairs (a, b).

ANSWER: (0, 0) and (1, -2)

~~~~~~

TOSSUP

15) Physics - *Short Answer* A blackbody is radiated with a wavelength of lambda. If the wavelength is halved, by what factor does the radiative flux of the black body change?

ANSWER: 16

BONUS:

15) Physics - *Short Answer* A table is pushed against a wall. Heidi attaches a rope with a mass of 1 kg and length of 4 meters to the wall with Gorilla Glue and strings it over a pulley. Then, she attaches a 2 kg block to the rope. Assuming the system is still in equilibrium, what is the speed of a transverse wave through the rope to the nearest integer? Use g=10 m/s2.

ANSWER: 9 m/s

~~~~~~

TOSSUP

16) Biology - *Short Answer* In puppies, brown fur color (capital B) is dominant over blonde fur color (lowercase b), a medium length tail (capital M) is dominant over a short tail (lowercase m), and a solid coat (capitol S) is dominant over a spotted coat (lowercase s). If an individual with genotype BbMmSs is bred with an individual with genotype BBmmSs, what is the probability that one of its offspring will have brown fur, a short tail, and a spotted coat?

ANSWER: ⅛ [HL]

BONUS

16) Biology - *Short Answer* Identify all of the following four taxa that are ecdysozoans:

1) Annelida
2) Tardigrada
3) Mollusca
4) Arthropoda

ANSWER: 2 and 4 (ACCEPT: tardigrada, arthropoda) [HL]

~~~~~~

TOSSUP

17) Chemistry - *Short Answer* Order the following three types of unit cells by increasing packing efficiency:

1) Simple Cubic
2) Body Centered Cubic
3) Face Centered Cubic

ANSWER: 123 [SO]

BONUS

17) Chemistry - *Multiple Choice* A given reaction is exothermic with an enthalpy change of -100 kJ/mol. If the activation energy for the forward reaction is 60 kJ/mol, then in kJ/mol, which of the following values is the activation energy for the reverse reaction?

W) -160
X) 160
Y) -40
Z) 40

ANSWER: X) 160 [SO]

~~~~~~

TOSSUP

18) Earth and Space - *Short Answer* The process of interstellar extinction describes how star light is reddened due to the scattering of blue light off dust grains. What type of scattering is most relevant to interstellar extinction?

ANSWER: Mie Scattering (ACCEPT Rayleigh)

BONUS

18) Earth and Space - *Short Answer* What element is most common in the core of a 1 solar mass asymptotic giant star?

ANSWER: Carbon

~~~~~~

TOSSUP

19) Math - *Short Answer* How many ways are there to reorganize the letters of BONANZA spelled, B-O-N-A-N-Z-A?

ANSWER: 1260

BONUS

19) Math - *Short Answer* How many solutions exist from the range 0 to 2pi for the equation. Sine of open parenthesis x close parenthesis squared is equal to cosine of open parenthesis x close parenthesis squared?

ANSWER: 4

~~~~~~
~~~~~~

TOSSUP

20) Physics - *Short Answer* A long, straight wire carries a current in the positive x-direction. A negatively charged particle is moving parallel to the wire, also in the +x direction, and is located 1 meter above it along the z-axis. In which direction does the particle experience a magnetic force?

ANSWER: +Z

BONUS

20) Physics - *Short Answer* A sphere is placed at the end of a long ramp with an angle of 30 degrees. The sphere is launched at a velocity of 100 m/s at an angle of 60 degrees. Calculate the time between collisions with the sphere and the ramp. Use g=10 m/s^2 and give your answer in terms of radicals.

ANSWER: 20/sqrt(3)