Round 14

TOSSUP

1) BIOLOGY *Multiple Choice* Which neurotransmitter has a D1-like receptor that activates adenylyl cyclase and a D2-like receptor that inhibits adenylyl cyclase

W) serotonin
X) GABA
Y) dopamine
Z) acetylcholine

ANSWER: Y) DOPAMINE

BONUS

1) BIOLOGY *Short Answer* When a male bird of one species performed a courtship display to a female of another species, she interpreted his behavior as aggressive rather than amorous. What type of reproductive isolating mechanism does this situation illustrate?

ANSWER: BEHAVIORAL ISOLATION

TOSSUP

2) CHEMISTRY *Short Answer* What colorless, pungent gas is often dissolved in water to yield a solution that is used as a biological preservative?

ANSWER: FORMALDEHYDE

BONUS

2) CHEMISTRY *Short Answer* Based on the Allred-Rochow electronegativity scale, what element is the most electronegative?

ANSWER: HELIUM

TOSSUP

3) MATH *Multiple Choice* What are the last three digits of 5^1,234,567?

W) 005
X) 025
Y) 125
Z) 625

ANSWER: Y) 125

BONUS

3) MATH *Multiple Choice* How many real roots does the equation $x^4 + 2x^2 - 8x + 3 = 0$ have?

W) 1
X) 2
Y) 3
Z) 4

ANSWER: X) 2

TOSSUP

4) ENERGY *Short Answer* As a result of Hawking radiation, what is the mathematical relationship between the temperature and mass of a blackhole?

ANSWER: INVERSE (ACCEPT EQUIVALENTS)

BONUS

4) ENERGY *Short Answer* This theorem states that all black hole solutions of the Einstein–Maxwell equations of gravitation and electromagnetism in general relativity can be completely characterized by only three externally observable classical parameters. Name this theorem and the three classical parameters.

ANSWER: NO-HAIR THEOREM AND MASS, (ELECTRIC) CHARGE, ANGULAR MOMENTUM

TOSSUP

5) PHYSICS *Multiple Choice* In joules, how much energy is stored in the magnetic field of an inductor with inductance 10 henrys and current 5 amperes?

W) 1000
X) 500
Y) 250
Z) 125

ANSWER: Z) 125

BONUS

5) PHYSICS *Short Answer* What kind of materials display a negative Poisson ratio?

ANSWER: AUXETICS

TOSSUP

6) EARTH AND SPACE *Short Answer* This nebula is made of the remnants of a supernova that was observed to explode in the year 1054. Of apparent magnitude 8.4 and found in the Taurus constellation what is the common name of this nebula?

ANSWER: CRAB NEBULA

BONUS

6) EARTH AND SPACE *Multiple Choice* A geological formation which looks like a small, streamlined hill and formed by glaciers acting on till or moraines is called what?

W) Pingo
X) Bergschrund
Y) Drumlin
Z) Tarn

ANSWER: Y) Drumlin

TOSSUP

7) BIOLOGY *Multiple Choice* What disease has a treatment that is not normally administered to children because of its potential to cause color blindness?

W) cholera
X) tuberculosis
Y) cystic fibrosis
Z) whooping cough

ANSWER: X) TUBERCULOSIS

BONUS

7) BIOLOGY *Short Answer* In a certain population, a disease is present at a rate of 5%. Studies regarding the disease have discovered that, on a molecular level, this disease occurs because of a mutation in the functional DNA inside of mitochondria. Calculate the probability, as a percentage, that the son of an affected mother has an affected daughter.

ANSWER: 5%

TOSSUP

8) CHEMISTRY *Multiple Choice* Which chemical reaction possesses the rare property that it is an oscillation reaction?

W) Meyers Briggs Reaction
X) Belousov-Zhabotinsky reaction
Y) Iodine Clock reaction
Z) Durermy-Farsch Reaction

ANSWER: X) BELOUSOV-ZHABOTINSKY REACTION

BONUS

8) CHEMISTRY *Multiple Choice* The nucleus of a carbon-13 atom can be classified as which of the following classes of particles?

W) Gluon
X) Meson
Y) Fermion
Z) Lepton

ANSWER: Y) FERMION

TOSSUP

9) EARTH AND SPACE *Multiple Choice* What element makes up the inside-most core of a type 2 supernova right before its core collapses?

W) Nickel
X) Gold
Y) Silver
Z) Iron

ANSWER: Z) IRON

BONUS

9) EARTH AND SPACE *Multiple Choice* What is the physical property of soil that is determined through the percentages or combinations of clay, silt, and sand?

W) Texture
X) Composition
Y) Permeability
Z) Cation Exchange Capacity

ANSWER: W) TEXTURE

TOSSUP

10) MATH *Multiple Choice* Which of the following functions is NOT a transcendental function?

W) trigonometric
X) algebraic
Y) logarithmic
Z) exponential

ANSWER: X) ALGEBRAIC

BONUS

10) MATH *Short Answer* The indefinite integral of (2x^3 - 1)/(x+x^4) (READ: quantity 2 x cubed minus 1 over quantity x plus x to the 4th) with respect to x can be represented as ln(x^(-a) + x^b)+C (READ: natural logarithm of open parentheses x to negative a plus x to the b close parentheses plus C). Find the absolute value of the sum a + b.

ANSWER: 3

TOSSUP

11) BIOLOGY *Multiple Choice* A certain species of plant is prone to herbivory by a variety of animals. Upon tissue wounding, growth of the plant is typically slowed down and metabolism is redirected towards producing defense molecules and repairing damage. These functions can be attributed towards which class of plant hormones?

W) Strigolactones
X) Brassinosteroids
Y) Jasmonates
Z) Benzoates

Answer: Y) Jasmonates

BONUS

11) BIOLOGY *Short Answer* What is the name of the primary brain cancer that develops from the insulating cells in the central nervous system?

ANSWER: OLIGODENDROGLIOMA

TOSSUP

12) PHYSICS *Multiple Choice* The exchange of what particles causes the residual strong force between nucleons?

W) Z Bosons
X) Gluons
Y) Neutrinos
Z) Photons

ANSWER: X) GLUONS

BONUS

12) PHYSICS *Short Answer* A transformer has a turns ratio of two to one. In ohms, what would be the resistance measured on the low side if a 100 ohm resistor is connected on the high side?

ANSWER: 25 OHMS

TOSSUP

13) ENERGY *Short Answer* What form of possible renewable energy early on had three main systems, being the Z-pinch, the Stellarator, and the Magnetic Mirror?

ANSWER: NUCLEAR FUSION

BONUS

13) ENERGY *Multiple Choice* The Princeton Plasma Physics Laboratory has recently used what type of device to create a fusion reaction mimicking the Big Bang and producing energy on the megawatt scale?

W) Energetic Laser
X) Maser
Y) Tevatron
Z) Quantum Reactor

ANSWER: W) ENERGETIC LASER

TOSSUP

14) EARTH AND SPACE *Short Answer* What cycles are partly caused by the eccentricity of Earth's orbit and are hypothesized to cause variations in Earth's climate?

ANSWER: MILANKOVITCH CYCLES

BONUS

14) EARTH AND SPACE *Multiple Choice* How much brighter does the sun appear to be compared to the full moon if the difference in their apparent magnitude is 14.00.

W) 120,500x
X) 2,000,000x
Y) 980,720,000x
Z) 400,000x

ANSWER: Z) 400,000X

TOSSUP

15) PHYSICS *Short Answer* What dimensionless constant, usually denoted with the letter alpha, describes how strongly electromagnetic waves affect charged particles?

ANSWER: FINE STRUCTURE CONSTANT (ACCEPT: SOMMERFIELD'S CONSTANT)

BONUS

15) PHYSICS *Short Answer* Order the following 4 bosons in terms of increasing mass. 1) Higgs Boson, 2) W Boson, 3) Gluon, 4) Z Boson.

ANSWER: 3, 2, 4, 1 (GLUON, W BOSON, Z BOSON, HIGGS BOSON)

TOSSUP

16) CHEMISTRY *Short Answer* Which of the following elements are doubly magic: 1) deuterium 2) calcium-40 3) calcium-48 4) lead-208

ANSWER: ALL

BONUS

16) CHEMISTRY *Short Answer* What is the only element observed to have phi bonding with itself?

ANSWER: URANIUM

TOSSUP

17) MATH *Short Answer* Find the quadratic equation that has 3-2i and its conjugate as its roots.

ANSWER: x^2 - 6x + 13 = 0 (DO NOT ACCEPT WITHOUT THE 0)

BONUS

17) MATH *Short Answer* Given that x = $\sqrt{7+4\sqrt{3}}$, find the value of x+1/x.

ANSWER: 4

TOSSUP

18) ENERGY *Short Answer* Scientists at Harvard University are researching the suction cups of octopi to learn about how they identify their prey. What term refers to the movement of an organism in response to a chemical stimulus?

ANSWER: CHEMOTAXIS

BONUS

18) ENERGY *Short Answer* The scientists at Harvard have found that the only odorant to which the octopi responded to was this group of molecules, which are generally produced by marine organisms as a defensive mechanism. What is this group of molecules, an example of which is eleutherobin?

ANSWER: TERPENOIDS (ACCEPT: ISOPRENOIDS)

TOSSUP

19) CHEMISTRY *Multiple Choice* Which of the following ligands is rightmost on the spectrochemical series, indicating stronger ligands?

W) OH-
X) H2O
Y) NH3
Z) CO

ANSWER: Z) CO

BONUS

19) CHEMISTRY *Multiple Choice* What is the baryon number of a pentaquark (A subatomic particle containing four quarks and one antiquark)?

W) 0
X) -0.5
Y) 1
Z) -1

ANSWER: Y) 1

TOSSUP

20) BIOLOGY *Short Answer* What is the name for the condition in which the tissue lining the uterus grows outside of the uterus?

ANSWER: ENDOMETRIOSIS

BONUS

20) BIOLOGY *Short Answer* What is the name of the mathematical model that describes action potentials, and was formulated from data taken from squid axons?

ANSWER: HODGKIN-HUXLEY MODEL

TOSSUP

21) PHYSICS What law is used in electromagnetism to calculate the magnetic field produced by a current and includes the displacement current?

ANSWER: BIOT-SAVART LAW

BONUS

21) PHYSICS *Short Answer* Assuming that the integral containing all the variables and excluding all the constants in the Biot-Savart law evaluates to 1, what is the value of the magnetic field in Teslas? Express your answer in terms of the constants in the equation.

ANSWER: MU NAUGHT / 4 PI (ACCEPT: PERMEABILITY OF FREE SPACE / 4 PI) (DO NO ACCEPT: MU / 4 PI)

TOSSUP

22) EARTH AND SPACE *Short Answer* The Deep Space Network consists of radio antennas around the world that can communicate with probes in space. Voyager 2 can only communicate with DSS43 in Australia because in 1989, it flew over this planet's north pole that deflected its trajectory and made it out of sight for the other radio antennas. What planet did Voyager 2 fly over?

ANSWER: NEPTUNE

BONUS

22) EARTH AND SPACE *Short Answer* What moon of Neptune was Voyager 2 trying to get a closer look at when it flew over Neptune's north pole?

ANSWER: TRITON

TOSSUP

23) MATH *Short Answer* If x is the conjugate of the complex number y,what is the argument of xy?

ANSWER: PI

BONUS

23) MATH *Multiple Choice* Given that y is the conjugate of the complex number z, if $z^2 + y = 0$, how many solutions are there for this equation?

W) 1
X) 2
Y) 3
Z) 4

ANSWER Z) 4