

ROUND 15

TOSS-UP

- 1) **PHYSICS** *Short Answer* Recent evidence contradicts Wolfgang Pauli's belief that neutrino's have none of what?

ANSWER: MASS

BONUS

- 1) **PHYSICS** *Short Answer* If the cost of electricity is 2 cents per kilowatt-hour, how much will it cost to run an electrical heater with a resistance of 10 ohms running on 110 volts for 1 hour, rounded to the nearest whole cent?

ANSWER: 2 CENTS

(Solution: $110/10 = 11$ amps, $P = I^2R = (11 \text{ A})^2 \times (10) \text{ ohms} = 1210 \text{ w} = 1.21 \text{ kilowatt-hours}$, $1.21 \times 2 = 2.42 \text{ cents /hr}$)

TOSS-UP

- 2) **BIOLOGY** *Short Answer* The transfer RNA charged with an amino acid on the three prime terminus of the adenosine residue is most commonly referred to as:

ANSWER: AMINOACYL-tRNA

BONUS

- 2) **BIOLOGY** *Short Answer* Using electrophoresis at a pH of 6.0, which one of the following 5 amino acids would move towards the anode the fastest? arginine, glutamic acid, glycine, alanine, lysine

ANSWER: GLUTAMIC ACID

TOSS-UP

- 3) CHEMISTRY *Multiple Choice* A molecule which has an octahedral molecular geometry will have how many atoms attached to its central atom:

W) 4
X) 6
Y) 8
Z) 10

ANSWER: X) 6

BONUS

- 3) CHEMISTRY *Short Answer* Calculate the pH of a buffer solution that is 0.5 molar in an acid with a pK_a of 7.00 and its salt which is at a concentration of 5.0 molar:

ANSWER: 8.00 (ACCEPT: 8)

(Solution: $pH = pK_a + \log([base] / [acid]); = 5 + \log (5 / 0.5); = 7 + \log 10; = 8.00$)

TOSS-UP

- 4) ASTRONOMY *Short Answer* The great Homer mentions in the Iliad that the Bear constellation is never plunged into the ocean. What do astronomers most commonly call such motion?

ANSWER: CIRCUMPOLAR

BONUS

- 4) ASTRONOMY *Multiple Choice* A person in Texas observes a waxing first quarter moon rising at 4:00 PM. At which of the following times will the moon most likely rise two days later:

W) 2:02 PM
X) 3:12 PM
Y) 4:52 PM
Z) 5:42 PM

ANSWER: Z) 5:42 PM

(Solution: The moon rises about 50 minutes later each night)

TOSS-UP

5) MATH *Multiple Choice* Solve the following: $\tan 45^\circ - \cos 45^\circ \sin 45^\circ$

- W) 0
- X) 1
- Y) $\frac{1}{2}$
- Z) $\frac{1}{4}$

ANSWER: Y) $\frac{1}{2}$

BONUS

5) MATH *Short Answer* Calculate the following indefinite integral: $I = \int e^{2x} dx$

ANSWER: $\frac{1}{2} e^{2x} + \text{Constant}$ (OR $\frac{1}{2} e^{2x} + C$)

TOSS-UP

6) EARTH SCIENCE *Multiple Choice* Which of the following organisms eventually sediments onto the ocean seafloor as a siliceous ooze:

- W) coccolithophores
- X) foraminifera
- Y) diatoms
- Z) fish scales

ANSWER: Y) DIATOMS

BONUS

6) EARTH SCIENCE *Short Answer* In which period in the geological timescale did fish evolve jaws and later became the top predators by the end of this Period?

ANSWER: DEVONIAN

TOSS-UP

7) GENERAL SCIENCE *Multiple Choice* Citrus canker is caused by an Asian strain of:

- W) bacterium
- X) virus
- Y) aphid
- Z) fungus

ANSWER: W) BACTERIUM

BONUS

7) GENERAL SCIENCE *Multiple choice* On average, equatorial areas of the Earth receive approximately 2.4 times as much insolation as polar areas because:

- W) the North Pole is ice covered
- X) the air at the Equator contains more moisture
- Y) there is greater heating at the Equator
- Z) the Earth is a sphere

ANSWER: Z) THE EARTH IS A SPHERE

TOSS-UP

8) COMPUTER SCIENCE *Multiple Choice* MIME is a protocol that:

- W) determines a server's IP address from a domain name
- X) translates binary files to text-based email messaging
- Y) coordinates packet information for the many IP packets and addresses in an online transmission
- Z) sets a specification for digital transmission of data over an analog phone line

ANSWER: X) TRANSLATES BINARY FILES TO TEXT-BASED EMAIL MESSAGING

BONUS

8) COMPUTER SCIENCE *Multiple Choice* What is the total number of devices that can be connected to a USB host:

- W) 15
- X) 63
- Y) 127
- Z) unlimited

ANSWER: Y) 127

TOSS-UP

- 9) PHYSICS *Multiple Choice* Which of the following laws was most directly employed by Robert Milliken to calculate the radius of a charged particle falling through air, for which he was awarded the 1928 Nobel prize:
- W) Fick's law
 - X) Bernoullis' law
 - Y) Hooke's law
 - Z) Stoke's law

ANSWER: Z) STOKES' LAW

BONUS

- 9) PHYSICS *Short Answer* If an object were to fall in each of the following 3 locations, in which location would it have the slowest acceleration due to gravity and in which would it have the fastest acceleration due to gravity: Pikes Peak; North Pole; and Denver, Colorado

ANSWER: SLOWEST = PIKES PEAK; FASTEST = NORTH POLE

TOSS-UP

- 10) BIOLOGY *Short Answer* What is the term, coined by Francis Crick, that accounts for the freedom in pairing in the third base of the codon with its anticodon?

ANSWER: WOBBLE

BONUS

- 10) BIOLOGY *Short Answer* Which 2 of the following 5 molecules of the citric acid cycle are considered 4 carbon intermediates: citric acid, oxaloacetic acid, succinic acid, alpha ketogluteric acid, isocitric acid

ANSWER: SUCCINIC ACID, OXALOACETIC ACID

TOSS-UP

- 11) CHEMISTRY *Multiple Choice* In the equation for Gibbs-free energy, if ΔH (Pron: delta H) is negative and ΔS (Pron: delta S) is positive, then the outcome for the reaction is:
- W) spontaneous at all temperatures
 - X) nonspontaneous at all temperatures
 - Y) spontaneous only at high temperatures
 - Z) spontaneous only at low temperatures

ANSWER: W) SPONTANEOUS AT ALL TEMPERATURES

BONUS

- 11) CHEMISTRY *Short Answer* Order the following from the shortest to the longest carbon chain fatty acid: lauric, palmitic, arachadonic

ANSWER: LAURIC, PALMITIC, ARACHADONIC

TOSS-UP

- 12) ASTRONOMY *Short Answer* Because of its considerable influence on astronomy from the time of its creation in the 2nd century AD until the 16th century, what book is often mentioned as one of the greatest books in the entire history of science?

ANSWER: ALMAGEST

BONUS

- 12) ASTRONOMY *Short Answer* Compute the estimated temperature, in Kelvin to the nearest one-thousand, of a stellar body's surface that emits light of 290 nanometers:

ANSWER: 10,000K

(Solution: Wien's Law $T = 2.9 \times 10^{-3} \text{ m.k}/\lambda \rightarrow 2.9 \times 10^{-3} \text{ m.k} / 290 \times 10^{-9} \text{ m} = .01 \times 10^6 = 10,000 \text{ K}$)

TOSS-UP

13) MATH *Short Answer* Find the derivative of the following equation: $y = x^{-12}$

ANSWER: $-12x^{-13}$

BONUS

13) MATH *Short Answer* Use the Binomial Theorem to expand and simplify the following equation: $(x + 2)^4$

ANSWER: $x^4 + 8x^3 + 24x^2 + 32x + 16$

TOSS-UP

14) EARTH SCIENCE *Multiple Choice* Which of the following is NOT true about the Earth's stratosphere:

- W) it contains most of the ozone
- X) it is bordered on the bottom by the stratopause
- Y) it sits below the mesosphere
- Z) within the layer, temperature increases with altitude

ANSWER: X) IT IS BORDERED ON THE BOTTOM BY THE STRATOPAUSE

BONUS

14) EARTH SCIENCE *Short Answer* In some regions of the central U.S., wind-blown deposits of dust are thick enough that it forms a rugged topography with steep slopes consisting largely of silt which exhibits little stratification and is known as:

ANSWER: LOESS (Pron: lurss)

TOSS-UP

15) GENERAL SCIENCE *Multiple Choice* Ethologists are scientists who study:

- W) Earth's ecosystems
- X) animal behavior
- Y) racial groups
- Z) countries of origin

ANSWER: X) ANIMAL BEHAVIOR

BONUS

15) GENERAL SCIENCE *Multiple Choice* The carcinogenic effects of sunlight on skin are primarily caused by which of the following bands of light:

- W) infrared
- X) UV-A
- Y) UV-B
- Z) UV-C

ANSWER: Y) UV-B

TOSS-UP

16) COMPUTER SCIENCE *Multiple Choice* Spooling occurs when:

- W) a document is loaded into a buffer for printing
- X) the operating system copies a certain number of pages from the hard disk to main memory
- Y) data being sent over secure networks is encrypted
- Z) analog data is converted into digital data

ANSWER: W) A DOCUMENT IS LOADED INTO A BUFFER FOR PRINTING

BONUS

16) COMPUTER SCIENCE *Multiple Choice* In the Java implementation, vectors are created using arrays. The default array size for a vector in Java 1.2 is:

- W) 5
- X) 10
- Y) 20
- Z) 25

ANSWER: X) 10

TOSS-UP

- 17) PHYSICS *Short Answer* Considering air resistance is negligible and that gravitational acceleration is 9.8 meters per second squared, rounded to the first decimal place, what is the speed acquired by a body in free fall, starting from rest, after 5 seconds?

ANSWER: 49 METERS/SECOND

(Solution: $v = gt$; $= 9.8 \times 5 = 49$)

BONUS

- 17) PHYSICS *Short Answer* Order the following elements from the one with the LEAST resistivity to the GREATEST resistivity at 20°C: aluminum, mercury, iron, glass

ANSWER: ALUMINUM, IRON, MERCURY, GLASS

TOSS-UP

- 18) BIOLOGY *Multiple Choice* Proteins of which of the following will typically have the shortest half-life:

- W) ovary
- X) kidney
- Y) liver
- Z) smooth muscle

ANSWER: Y) LIVER

BONUS

- 18) BIOLOGY *Short Answer* Order the following three lipids from those with the lowest to highest melting points: n-octadecanoic acid, n-eicosanoic acid, n-dodecanoic acid (Pron: n-octa-deck-a-noic acid, n-EYE-cos-so-noic acid, n-doe-decka-noic acid)

ANSWER: N-DODECANOIC ACID, N-OCTADECANOIC ACID, N-EICOSANOIC ACID

TOSS-UP

- 19) CHEMISTRY *Multiple Choice* In general, which of the following isomers are the most similar in terms of their physical and chemical properties:

W) conformational
X) geometric
Y) structural
Z) diastereomers

ANSWER: W) CONFORMATIONAL

BONUS

- 19) CHEMISTRY *Short Answer* To the second decimal place and in the proper units, what is the specific heat of a substance, which weighs 20 grams, if it takes 80 Joules to raise the temperature by 10°C:

ANSWER: 0.40 JOULES/GRAM°C

(Solution: specific heat = $q/(\text{mass})(\Delta T)$; = $80\text{J}/(20\text{g})(10^\circ\text{C})$; = $0.40\text{J/g}^\circ\text{C}$)

TOSS-UP

- 20) ASTRONOMY *Multiple Choice* Which of the following is probably the most ancient astronomic instrument:

W) dioptera
X) gnomon
Y) astrolabe
Z) compass

ANSWER: X) GNOMON

BONUS

- 20) ASTRONOMY *Short Answer* How many degrees of arc are in 1 hour and 20 minutes of right ascension?

ANSWER: 20

(Solution: 1 hr = 15°, 60 minutes = 1 hr, $15^\circ + 20 \times .25 = 20^\circ$)

TOSS-UP

- 21) EARTH SCIENCE *Multiple Choice* Named in honor of the English Mathematician who explained them, what is the name for the thermal circulation consisting of rising air near the equator and sinking air near 30° latitude:

W) Rossby wave
X) Ferrel cell
Y) Hadley cell
Z) Christopher cell

ANSWER: Y) HADLEY CELL

BONUS

- 21) EARTH SCIENCE *Short Answer* Which geological time period existed between approximately 500 and 570 million years ago:

ANSWER: CAMBRIAN

TOSS-UP

- 22) GENERAL SCIENCE *Multiple Choice* What type of microscope usually has a binocular eyepiece tube, a long working distance, and a range of magnifications typically from 5x to 35x or 40x:

W) light field
X) dark field
Y) dissecting
Z) phase contrast

ANSWER: Y) DISSECTING

BONUS

- 22) GENERAL SCIENCE *Multiple Choice* Radioactive dating of the Tyrolean Ice Man has shown he lived during which of the following ages:

W) stone age
X) copper age
Y) bronze age
Z) iron age

ANSWER: X) COPPER AGE

TOSS-UP

- 23) PHYSICS *Short Answer* How many neutrons and how many protons are present in a single tritium nucleus?

ANSWER: TWO NEUTRONS AND ONE PROTON

BONUS

- 23) PHYSICS *Short Answer* What is the average acceleration in meters/sec² of a seagull traveling in a straight path from rest to 36 km/hr in 10 sec?

ANSWER: 1

(Solution: $36 \text{ km/hr} \times 1000 \text{ m} \times 1/3600 \text{ s} = 10 \text{ m/s}$, $10 \text{ m/s} \div 10 = 1 \text{ m/s}^2$)

TOSS-UP

- 24) BIOLOGY *Multiple Choice* In plant tissue culture, one of the most effective ways to prepare sterile solutions of heat-labile hormones is to do which of the following:

- W) pasteurize the sample
- X) freeze and thaw the sample multiple times
- Y) dissolve the sample in 95% ethanol
- Z) autoclave the sample

ANSWER: Y) DISSOLVE THE SAMPLE IN 95% ETHANOL

BONUS

- 24) BIOLOGY *Short Answer* As Acetyl Coenzyme-A and oxaloacetate enter the tricarboxylic acid cycle in the presence of water, they will yield what two products?

ANSWER: CITRIC ACID AND COENZYME A (ACCEPT: CITRATE AND Co A)

TOSS-UP

25) CHEMISTRY *Multiple Choice* Which of the following properties is best used and most accurate for the determination of molecular weights of an unknown substance:

- W) vapor-pressure lowering
- X) freezing-point depression
- Y) boiling-point elevation
- Z) osmotic pressure

ANSWER: Z) OSMOTIC PRESSURE

(Solution: it has the largest colligative property change per mole of solute)

BONUS

25) CHEMISTRY *Short Answer* How much work, in kilojoules and to 2 decimal places, is expended during a chemical reaction in which the system volume expands from 10.0 liters to 12.0 liters against an external pressure of 5 atmospheres?

ANSWER: -1.01

(Solution: $w = -P\Delta V$; $= (-5\text{atm})(2\text{L}) = -10\text{L}\cdot\text{atm}$; $(-10\text{ L}\cdot\text{atm})(101\text{J/L}\cdot\text{atm}) = -1010\text{J} = -1.01\text{kJ}$)