

ROUND 13

TOSS-UP

1) BIOLOGY *Multiple Choice* Which of the following is the form of highly condensed chromatin that is not transcribable in its present form and typical of the type of chromatin visible in the light microscope when the cell is in interphase:

- W) Z DNA
- X) euchromatin
- Y) heterochromatin
- Z) histochromatin

ANSWER: Y) HETEROCHROMATIN

BONUS

1) BIOLOGY *Multiple Choice* Which of the following is a primary consequence of histone acetylation:

- W) increased access of transcriptional factors to DNA
- X) decreased access of transcriptional factors to DNA
- Y) increased rate of cells entering mitosis
- Z) G-1 block

ANSWER: W) INCREASED ACCESS OF TRANSCRIPTIONAL FACTORS TO DNA

TOSS-UP

2) CHEMISTRY *Short Answer* What type of magnetism exists in substances in which electrons are unpaired and are very weakly attracted by magnetic fields?

ANSWER: PARAMAGNETISM (ACCEPT: PARAMAGNETIC)

BONUS

2) CHEMISTRY *Multiple Choice* Which of the following diatomic molecules will exhibit paramagnetism:

- W) B₂
- X) N₂
- Y) C₂
- Z) F₂

ANSWER: W) B₂

TOSS-UP

3) PHYSICS *Multiple Choice* What percent of energy in our Universe is believed to consist of dark matter and normal matter:

- W) 4.4%
- X) 16%
- Y) 27%
- Z) 73%

ANSWER: Y) 27%

BONUS

3) PHYSICS *Short Answer* Order the following 4 substances from the one with the LOWEST dielectric constant to the HIGHEST at 20°C: mica; paraffin; vacuum; pure water

ANSWER: VACUUM; PARAFFIN; MICA; PURE WATER

(Solution: vacuum = 1.00; paraffin = 2.2; mica = 7.0; water = 80.0)

TOSS-UP

4) MATH *Short Answer* Solve the following trigonometric equation for x , giving your answer in degrees such that $0^\circ \leq x < 360^\circ$: $2 \sin x - 1 = 0$

ANSWER: 30° AND 150°

BONUS

4) MATH *Short Answer* Solve the following logarithmic equation in base 10 for x over the real numbers:

$$\log(2x - 1) = \log(x + 2) + \log(x - 2)$$

ANSWER: 3 (DO NOT ACCEPT 3 and -1)

(Solution: $2x - 1 = (x + 2)(x - 2)$; $(x - 3)(x + 1) = 0$; $x = 3$, $x \neq -1$ – the $\log(-1)$ does not exist in the real number system)

TOSS-UP

5) EARTH SCIENCE *Multiple Choice* Which of the following BEST describes the largest size of sediment particle that can be transported by a particular flow in a river:

- W) discharge
- X) competency
- Y) capacity
- Z) bed load

ANSWER: X) COMPETENCY

BONUS

5) EARTH SCIENCE *Multiple Choice* A ship accidentally loses a cargo of floating rubber balls off the East coast of Japan. If they follow the prevailing currents, in which of the following locations will most of them likely FIRST wash on shore:

- W) the western coast of North America
- X) the eastern coast of Australia
- Y) the western coast of Australia
- Z) the south-central coast of Alaska

ANSWER: W) THE WESTERN COAST OF NORTH AMERICA

TOSS-UP

6) GENERAL SCIENCE *Multiple Choice* Which of the following is a mint-flavoring used in chewing gum, toothpaste, and mouthwashes produced naturally in fruits and vegetables:

- W) wintergreen
- X) xylitol
- Y) winterol
- Z) arabinose

ANSWER: X) XYLITOL

BONUS

6) GENERAL SCIENCE *Multiple Choice* The separation of proteins using SDS polyacrylamide gel electrophoresis is primarily based on:

- W) charge only
- X) charge and shape
- Y) molecular mass
- Z) shape only

ANSWER: Y) MOLECULAR MASS

TOSS-UP

7) ASTRONOMY *Multiple Choice* Which of the following is LEAST accurate:

- W) magnetic fields can be strongly amplified when 2 neutron stars merge
- X) Saturn's moon Titan has been found to have large dunes
- Y) hydrogen and nitrogen isotopes have been found in organic matter of primitive meteorites
- Z) interplanetary dust particles are typically nitrogen-rich and carbon-poor

ANSWER: Z) INTERPLANETARY DUST PARTICLES ARE TYPICALLY NITROGEN-RICH AND CARBON-POOR

BONUS

7) ASTRONOMY *Multiple Choice* Which of the following is LEAST accurate:

- W) the imaginary north-south line that passes through the zenith on the celestial sphere is the meridian
- X) Kirkwood gaps are gaps in the main asteroid belt caused by the gravitational effects of Mars
- Y) Population TWO stars are composed mostly of hydrogen and helium
- Z) a negative sign indicates the celestial coordinate is in the southern hemisphere

ANSWER: X) KIRKWOOD GAPS ARE GAPS IN THE MAIN ASTEROID BELT CAUSED BY THE GRAVITATIONAL EFFECTS OF MARS

TOSS-UP

8) BIOLOGY *Multiple Choice* Which of the following is a primary target of certain HIV drugs, such as AZT, specifically because HIV is a retrovirus:

- W) reverse transcriptase
- X) HIV receptors
- Y) CD 4 cells
- Z) CD 8 cells

ANSWER: W) REVERSE TRANSCRIPTASE

BONUS

8) BIOLOGY *Short Answer* Name all of the following 5 products that are NOT produced by the adult human liver: clotting factors; glycogen; erythropoietin; bile; corticotropin (read as: core-tick-oh-TRO-pin)

ANSWER: ERYTHROPOIETIN AND CORTICOTROPIN
(Solution: erythropoietin = kidney; corticotropin = pituitary)

TOSS-UP

9) CHEMISTRY *Multiple Choice* Which of the following is a term used to describe the electronic geometry around a central atom that has 5 regions of high electron density:

- W) tetrahedral
- X) trigonal pyramidal
- Y) trigonal bipyramidal
- Z) octahedral

ANSWER: Y) TRIGONAL BIPYRAMIDAL

BONUS

9) CHEMISTRY *Multiple Choice* Which of the following is NOT an aromatic amino acid:

- W) glutamine
- X) tryptophan
- Y) phenylalanine
- Z) tyrosine

ANSWER: W) GLUTAMINE

TOSS-UP

10) PHYSICS *Short Answer* Giving your answer in hertz, what is the lowest frequency possible for a string that is 90-centimeters long and whose wave speed is 360 meters per second?

ANSWER: 200

(Solution: $f = v/\lambda; = 360/1.8\text{m} = 200$)

BONUS

10) PHYSICS *Multiple Choice* Current accounting of the composition of the universe suggests that dark energy and dark matter together make up about what percent of the energy in the universe:

- W) 65%
- X) 75%
- Y) 85%
- Z) 95%

ANSWER: Z) 95%

TOSS-UP

11) MATH *Short Answer* Simplify the following radical expression, giving your answer in standard *bi* form: $\sqrt{\frac{-144}{49}}$

ANSWER: $\frac{12}{7}i$

BONUS

11) MATH *Short Answer* Multiply the following complex numbers, giving your answer in standard form: $(2 + i\sqrt{2})(3 - i\sqrt{2})$

ANSWER: $8 + \sqrt{2}i$ (ACCEPT: $8 + i\sqrt{2}$)

TOSS-UP

12) ASTRONOMY *Multiple Choice* Which of the following was the primary instrument used to gather 5 to 35 micrometer spectra data from the Deep Impact mission:

- W) Chandra X-ray observatory
- X) Arecibo radio telescope
- Y) Hubble gamma-ray telescope
- Z) Spitzer infrared spectrograph

ANSWER: Z) SPITZER INFRARED SPECTROGRAPH

BONUS

12) ASTRONOMY *Multiple choice* By what multiple does the brightness of two stars differ with apparent magnitudes of -3 and $+4$:

- W) 2.5
- X) 25
- Y) 250
- Z) 625

ANSWER: Z) 625

TOSS-UP

13) EARTH SCIENCE *Multiple Choice* Which of the following glacial features are deposited in annual layers and can be used by geologists to determine seasonal variations during past ice ages:

- W) drumlins
- X) moraines
- Y) varves
- Z) eskers

ANSWER: Y) VARVES

BONUS

13) EARTH SCIENCE *Multiple Choice* Which of the following is a geothermal process that has mostly led to concentrated stores of copper and zinc in the Earth's crust:

- W) soil leaching
- X) hydrothermal precipitation
- Y) igneous cooling
- Z) evaporation of water

ANSWER: X) HYDROTHERMAL PRECIPITATION

TOSS-UP

14) ASTRONOMY *Short Answer* If the temperature of an object is doubled, and all other things remain the same, how many times as fast will it radiate energy?

ANSWER: 16 (ACCEPT: 2^4)

BONUS

14) ASTRONOMY *Short Answer* How many sidereal minutes are in 4 sidereal hours?

ANSWER: 240

TOSS-UP

15) BIOLOGY *Multiple Choice* During the electron transport system, a store of potential energy is created that will be converted into high energy phosphates. The potential energy is best described as:

- W) ADP
- X) ATP
- Y) the hydrogen ion gradient
- Z) the sodium differential

ANSWER: Y) THE HYDROGEN ION GRADIENT

BONUS

15) BIOLOGY *Multiple Choice* What is the first place in the breakdown of glucose, starting in glycolysis and through the Krebs cycle, where CO₂ is released:

- W) pyruvate yielding Acetyl Co-A
- X) 3-phosphoglycerate (read as: 3-foss-foe-GLISS-err-ate) yielding 2-phosphoglycerate
- Y) isocitrate yielding alpha ketogluterate
- Z) oxaloacetate (read as: ox-AL-oh-ACETATE) yielding citrate

ANSWER: W) PYRUVATE YIELDING ACETYL Co-A

TOSS-UP

16) CHEMISTRY *Multiple Choice* Which of the following molecules has the highest bond enthalpy, or energy it would take to break apart the bond:

- W) F₂
- X) H₂
- Y) HCl
- Z) CO

ANSWER: Z) CO

BONUS

16) CHEMISTRY *Multiple Choice* Silver iodide, or AgI, is LEAST soluble in which of the following aqueous solutions:

- W) NaOH
- X) distilled water
- Y) HNO₃
- Z) KI

ANSWER: Z) KI
(Solution: common ion effect)

TOSS-UP

17) PHYSICS *Multiple Choice* In using a frequency of light that causes the photoelectric effect, which of the following will occur when there is an increase in the intensity of the incident light beam on a metal surface:

- W) the maximum kinetic energy of ejected electrons will increase exponentially
- X) the maximum kinetic energy of ejected electrons will increase linearly
- Y) it will increase the work function
- Z) more electrons will be ejected from the metal

ANSWER: Z) MORE ELECTRONS WILL BE EJECTED FROM THE METAL

BONUS

17) PHYSICS *Multiple Choice* Which of the following is NOT true according to the Standard Model of Particle Physics:

- W) quarks carry color charge
- X) hadrons are color-neutral particles
- Y) quarks can be isolated from their hadrons
- Z) the carrier particle for the electromagnetic interaction has zero charge

ANSWER: Y) QUARKS CAN BE ISOLATED FROM THEIR HADRONS

TOSS-UP

18) MATH *Short Answer* In degrees, what is the least positive angle that is coterminal with 650° ?

ANSWER: 290°

(Solution: $650^\circ - 360^\circ = 290^\circ$)

BONUS

18) MATH *Short Answer* Given the function $f(x) = x^3 + 3x - k$ and $f(3) = 31$, solve for k :

ANSWER: 5

(Solution: $31 = 3^3 + 3(3) - k$; $k = 5$)

TOSS-UP

19) EARTH SCIENCE *Multiple Choice* It is estimated that the supercontinent Pangaea began to break up at the end of the Triassic Period about how many years ago:

- W) 2.5 billion years
- X) 225 million years
- Y) 5 million years
- Z) 150,000 years

ANSWER: X) 225 MILLION YEARS

BONUS

19) EARTH SCIENCE *Multiple Choice* A group of small volcanoes, called the petit spot volcanoes, was recently found. What makes this find so unusual is they are believed to be formed:

- W) from asthenosphere material squeezing through cracks caused by bending in Earth's crust
- X) from plumes rising rapidly from the boundary between Earth's core and mantle
- Y) at a convergent plate boundary
- Z) at a mid-ocean ridge

ANSWER: W) FROM ASTHENOSPHERE MATERIAL SQUEEZING THROUGH CRACKS CAUSED BY BENDING IN EARTH'S CRUST

TOSS-UP

20) GENERAL SCIENCE *Multiple Choice* Which of the following is NOT true:

- W) long-term variation in Earth's insolation is partially caused by precession
- X) there has yet to be any scientifically well-documented case of a human whose immune system has eradicated HIV from their body
- Y) *Candida albicans* is a common fungal infective agent in humans
- Z) most scientific evidence supports the belief that C3 plants evolved from C4 plants

ANSWER: Z) MOST SCIENTIFIC EVIDENCE SUPPORTS THE BELIEF THAT C3 PLANTS EVOLVED FROM C4 PLANTS

BONUS

20) GENERAL SCIENCE *Short Answer* By number or name, identify all of the following blood measures that would suggest a woman is deficient in iron: 1) low hematocrit; 2) larger than average size of erythrocytes; 3) high levels of TSH; 4) increased transferrin level

ANSWER: 1 AND 4 (ACCEPT: 1 - LOW HEMATOCRIT; 4 - INCREASED TRANSFERRIN LEVEL

TOSS-UP

21) ASTRONOMY *Short Answer* Name all of the following 4 objects that would NOT be found on Earth: meteors; craters; asteroid impact remnants; bolides

ANSWER: METEORS; BOLIDES

BONUS

21) ASTRONOMY *Short Answer* For someone standing at 22° North latitude, how many degrees above the horizon will the north celestial pole be?

ANSWER: 22

TOSS-UP

22) BIOLOGY *Short Answer* How many codons in the entire genetic code call for amino acids?

ANSWER: 61

BONUS

22) BIOLOGY *Short Answer* Name all of the following organelles that are bounded by a double membrane: nucleus; mitochondrion; chloroplast; lysosome

ANSWER: NUCLEUS; MITOCHONDRION; CHLOROPLAST
(ACCEPT: ALL BUT LYSOSOME)

TOSS-UP

23) CHEMISTRY *Short Answer* Order the following 3 ionic solids in terms of their lattice energies or enthalpies, going from the HIGHEST to the LOWEST: LiBr; KBr; NaBr

ANSWER: LiBr; NaBr; KBr

BONUS

23) CHEMISTRY *Short Answer* Arrange the following 3 oxoacids or oxyacids in order of INCREASING acid strength: HBrO₃; HBrO₂; HBrO

ANSWER: HBrO; HBrO₂; HBrO₃

TOSS-UP

24) PHYSICS *Short Answer* If a rock is spun on a sling with a frequency of 100 revolutions per minute, what is the rock's period, in seconds?

ANSWER: 0.6

(Solution: $T = 1/f = 0.6 \text{ sec}$)

BONUS

24) PHYSICS *Short Answer* A 3-kilogram model airplane has velocity components of 5 meters per second due east and 8 meters per second due north. What is the plane's kinetic energy, in joules to the nearest whole number?

ANSWER: 134

(Solution: $v^2 = v_E^2 + v_N^2$; $KE = \frac{1}{2} m(v_E^2 + v_N^2) = \frac{1}{2} (3\text{kg})[(5\text{m/s})^2 + (8 \text{ m/s})^2] = 133.5\text{J}$)

TOSS-UP

25) BIOLOGY *Short Answer* What part of the human brain releases the most corticotropin?

ANSWER: PITUITARY

BONUS

25) BIOLOGY *Short Answer* What is the average yield of ATP for every NADH and for every FADH₂, respectively, that pass through the electron transport system?

ANSWER: NADH = 3; FADH₂ = 2