

ROUND 7

TOSS-UP

1) EARTH AND SPACE *Short Answer* What is the general name of an instrument designed to observe the extremely faint emissions from the region around the Sun in the absence of a solar eclipse?

ANSWER: CORONAGRAPH (ACCEPT: SOLAR CORONAGRAPH)

BONUS

1) EARTH AND SPACE *Short Answer* What climate proxy can paleoclimate researchers use to provide an uninterrupted climate record extending back hundreds of thousands of years, including information such as temperature, precipitation, chemistry, volcanic eruptions, and other climate indicators?

ANSWER: ICE CORE

TOSS-UP

2) PHYSICS *Short Answer* The pressure of an ideal gas is kept constant while the volume of the gas is increased from 2 cubic meters to 6 cubic meters. If the initial temperature is 17° Celsius, find the final temperature in Kelvin to the nearest integer.

ANSWER: 870

BONUS

2) PHYSICS *Short Answer* By number, identify all of the following four groups of physical quantities that have the same units: 1) electric flux, electric field, and electric dipole moment; 2) heat, potential energy, and work; 3) pressure, stress, and Young's modulus; 4) electromotive force, potential difference, and electric voltage.

ANSWER: 2, 3, AND 4

TOSS-UP

3) EARTH AND SPACE *Short Answer* What is the name of unsorted sediment that is directly deposited by glaciers?

ANSWER: TILL

BONUS

3) EARTH AND SPACE *Short Answer* What is the name for hygroscopic atmospheric particles on which water vapor condenses to form clouds?

ANSWER: CLOUD CONDENSATION NUCLEI (ACCEPT: CCN, CONDENSATION NUCLEI, NUCLEI)

TOSS-UP

4) ENERGY *Multiple Choice* Which of the following is NOT an advantage of using liquefied petroleum gas in vehicles instead of conventional gasoline?

- W) It produces fewer toxic and smog-forming air pollutants
- X) Most liquefied petroleum gas comes from domestic sources
- Y) It is less expensive than gasoline
- Z) It gets more miles per tank of fuel than conventional gasoline

ANSWER: Z) IT GETS MORE MILES PER TANK OF FUEL THAN CONVENTIONAL GASOLINE

BONUS

4) ENERGY *Short Answer* Given the reaction $C_3H_{8(g)} + 5O_{2(g)} \rightarrow$ (read as: yields) $4H_2O_{(l)} + 3CO_{2(g)}$ occurs at room temperature with a change in enthalpy of -290,000 joules and change in entropy of -110 joules per Kelvin, what is the delta G in joules for this reaction and is the reaction spontaneous?

ANSWER: -277,500; SPONTANEOUS

[NOTE: read (g) as GASEOUS; (l) = LIQUID]

TOSS-UP

5) BIOLOGY *Multiple Choice* Which of the following BEST describes the syndrome that manifests itself in starving children as swollen distended abdomens, spindly arms, and edema in the face, hands, and feet resulting from the catabolism of muscle and blood proteins?

- W) Malnutrition primus
- X) Beri Beri
- Y) Kwashiorkor (read as; kwah-shee-OHR-kohr)
- Z) Emaciation

ANSWER: Y) KWASHIORKOR

BONUS

5) BIOLOGY *Multiple Choice* Which disease-causing agent is NOT correctly matched to the disease it causes?

- W) *Plasmodium falciparum* (read as: plahz-MÖE-dee-uhm fahl-SI-pah-ruh) – Dengue hemorrhagic fever
- X) *Rickettsia rickettsii* (read as: ri-KEHT-see-ah ri-KEHT-see) – Rocky Mountain spotted fever
- Y) *Borrelia burgdorferi* (read as: boh-REHL-ee-ah boorg-DOHR-feh-ree) – Lyme disease
- Z) *Trypanosoma brucei* (read as: try-pah-noh-SÖE-mah BROOH-sey) – Human African sleeping sickness

ANSWER: W) *PLASMODIUM FALCIPARUM* – DENGUE HEMORRHAGIC FEVER

TOSS-UP

6) MATH *Multiple Choice* Which of the following is NOT true about the function $y = |x|$ (read as: y equals the absolute value of x)?

- W) It is symmetric around the y -axis
- X) The derivative of the function does not exist at $x = 0$
- Y) It is monotonic
- Z) The integral of the function over the real line is unbounded

ANSWER: Y) IT IS MONOTONIC

BONUS

6) MATH *Short Answer* Suppose that g is the inverse function of f , $f(-1) = 2$ (read as: f of negative 1 equals 2), and $f'(-1) = -2$ (read as: f prime of negative 1 equals negative 2). Find $g'(2)$ (read as: g prime of 2).

ANSWER: $-1/2$

TOSS-UP

7) BIOLOGY *Multiple Choice* Aposematic coloration allows an organism to signal which of the following?

- W) Readiness to mate
- X) Territoriality
- Y) Noxious taste
- Z) Darwinian fitness

ANSWER: Y) NOXIOUS TASTE

BONUS

7) BIOLOGY *Multiple Choice* Which of the following is NOT true regarding human hemoglobin?

- W) It is a tetramer
- X) It exhibits binding cooperativity
- Y) It exhibits a sigmoidal saturation curve
- Z) It exhibits higher affinity for oxygen than myoglobin

ANSWER: Z) IT EXHIBITS HIGHER AFFINITY FOR OXYGEN THAN MYOGLOBIN

TOSS-UP

8) ENERGY *Multiple Choice* According to Betz's Law, wind turbines cannot capture more than what approximate percentage of the kinetic energy present in wind?

- W) 29
- X) 39
- Y) 49
- Z) 59

ANSWER: Z) 59

BONUS

8) ENERGY *Multiple Choice* Which of the following is NOT an advantage of vertical axis wind turbines as compared to horizontal axis wind turbines?

- W) They can catch the wind from all directions
- X) They can catch the wind at lower wind speeds
- Y) They are typically more efficient at converting wind energy into electricity
- Z) They are more suited to urban environments

ANSWER: Y) THEY ARE TYPICALLY MORE EFFICIENT AT CONVERTING WIND ENERGY INTO ELECTRICITY

TOSS-UP

9) PHYSICS *Short Answer* By name or number, identify how antimatter interacts gravitationally with ordinary matter: 1) it is attracted, 2) it is repelled, or 3) there is no interaction.

ANSWER: IT IS ATTRACTED (ACCEPT: 1)

BONUS

9) PHYSICS *Short Answer* A solid conducting sphere with a radius of 5 centimeters has a charge of 5 microcoulombs. Given Coulomb's constant as 9.0×10^9 newton meters squared per coulomb squared, what is the magnitude of the electric field in newtons per coulomb at a distance of 5 centimeters from the surface of the sphere?

ANSWER: 4,500,000

TOSS-UP

10) BIOLOGY *Short Answer* By name or number, identify all of the following four animals that are ectotherms: 1) turtles, 2) goldfish, 3) otters, 4) beetles.

ANSWER: TURTLES, GOLDFISH, AND BEETLES (ACCEPT: 1, 2, AND 4)

BONUS

10) BIOLOGY *Multiple Choice* Which of the following are NOT correctly matched to their function?

- W) Denitrifying bacteria: convert nitrates to gaseous nitrogen
- X) Nitrogen fixing bacteria: convert gaseous nitrogen to ammonia
- Y) Nitrosifying bacteria: convert ammonia to nitrates
- Z) Nitrifying bacteria: convert nitrites to nitrates

ANSWER: Y) NITROSIFYING BACTERIA: CONVERT AMMONIA TO NITRATES

TOSS-UP

11) MATH *Multiple Choice* Which of the following is NOT a property of the normal p.d.f.?

- W) The p.d.f. is symmetric
- X) The p.d.f. has two inflection points
- Y) The variance has to be positive
- Z) The domain of the p.d.f. is non-negative real numbers

ANSWER: Z) THE DOMAIN OF THE P.D.F. IS NON-NEGATIVE REAL NUMBERS

BONUS

11) MATH *Short Answer* If $f(x) = 2x - 1$ and $g(x) = 6 + 2x - x^2$, what is the standard polynomial form for $g(f(x))$ (read as: g of f of x)?

ANSWER: $-4x^2 + 8x + 3$

TOSS-UP

12) CHEMISTRY *Short Answer* In scientific notation, one attojoule is equal to how many joules?

ANSWER: 1×10^{-18}

BONUS

12) CHEMISTRY *Short Answer* What is the IUPAC name of the compound PbCO_3 ?

ANSWER: LEAD (II) CARBONATE (DO NOT ACCEPT: PLUMBOUS CARBONATE, LEAD CARBONATE)

TOSS-UP

13) EARTH AND SPACE *Multiple Choice* Which of the following is the number two killer among thunderstorm hazards?

- W) Large hail
- X) Lightning
- Y) Flash flooding
- Z) Tornadoes

ANSWER: X) LIGHTNING

BONUS

13) EARTH AND SPACE *Short Answer* According to records kept since 1897, the all-time record snow depth in the U.S. was 451 inches in 1911. In which state did this record occur?

ANSWER: CALIFORNIA

TOSS-UP

14) CHEMISTRY *Multiple Choice* Reduction involves which of the following?

- W) Gain of electrons and increase in oxidation number
- X) Loss of electrons and increase in oxidation number
- Y) Gain of electrons and decrease in oxidation number
- Z) Loss of electrons and decrease in oxidation number

ANSWER: Y) GAIN OF ELECTRONS AND DECREASE IN OXIDATION NUMBER

BONUS

14) CHEMISTRY *Short Answer* By number, identify all of the following four statements that are TRUE: 1) liquids with large intermolecular forces tend to have very low boiling points, 2) liquids with large intermolecular forces tend to have considerable surface tension, 3) ethanol has a higher boiling point than methanol, 4) the hardness of diamond is due to strong van der Waals forces.

ANSWER: 2 AND 3

TOSS-UP

15) BIOLOGY *Multiple Choice* Which of the following BEST describes how annelids use their hydrostatic skeleton for locomotion?

- W) Each body segment is walled off, allowing body fluids to be compressed or expanded by its muscles
- X) Each body segment has small holes allowing only small amounts of liquid to move at one time
- Y) All body segments are connected, and the muscles contract and release to move the fluid around the worm's body, creating aqueous motion
- Z) Anterior body segments are connected but walled off from posterior segments. Muscles control body fluid movement bilaterally

ANSWER: W) EACH BODY SEGMENT IS WALLED OFF, ALLOWING BODY FLUIDS TO BE COMPRESSED OR EXPANDED BY ITS MUSCLES

BONUS

15) BIOLOGY *Short Answer* How many pairs of chromosomes does a fruit fly have?

ANSWER: 4

TOSS-UP

16) CHEMISTRY *Multiple Choice* Which of the following is TRUE about the solubility of a gas in water?

- W) It increases as both temperature and partial pressure of the gas rise
- X) It increases as temperature rises but decreases as partial pressure of the gas rises
- Y) It decreases as temperature rises but increases as partial pressure of the gas rises
- Z) It decreases as both temperature and partial pressure of the gas rise

ANSWER: Y) IT DECREASES AS TEMPERATURE RISES BUT INCREASES AS PARTIAL PRESSURE OF THE GAS RISES

BONUS

16) CHEMISTRY *Short Answer* Plastics with the recycling symbols of 2 and 4, such as those used to make plastic bags, are produced from what monomer?

ANSWER: ETHYLENE (ACCEPT: ETHENE)

TOSS-UP

17) MATH *Short Answer* In how many different ways can a president, vice president, and secretary be elected in a club of 10 members if no one may hold more than one office?

ANSWER: 720

BONUS

17) MATH *Short Answer* Assuming that $\log 2 = 0.7$ and $\log 3 = 1.1$, find the value of $\log 72$ to the nearest tenth.

ANSWER: 4.3

TOSS-UP

18) PHYSICS *Multiple Choice* A person spearfishing from the shore sees a fish located 3 meters from the shore at an approximate depth of 1 meter. To spear the fish, the person should aim in which of the following directions?

- W) Directly at the fish's image
- X) Above the fish's image
- Y) Below the fish's image
- Z) Behind the fish's image

ANSWER: Y) BELOW THE FISH'S IMAGE

BONUS

18) PHYSICS *Short Answer* Once a rocket's fuel runs out, it coasts upwards for another 50 kilometers before falling back to Earth. Given g as 10 meters per second squared, what was the rocket's vertical velocity in meters per second the moment the fuel ran out?

ANSWER: 1000

TOSS-UP

19) BIOLOGY *Multiple Choice* Nematocysts (read as: NEHM-aht-oh-sists) are typically found in which of the following groups?

- W) Cnidarians (read as: ny-DEHR-ee-ahns (NO "C"))
- X) Flatworms
- Y) Roundworms
- Z) Echinoderms (read as: i-KY-noh-dehrms)

ANSWER: W) CNIDARIANS

BONUS

19) BIOLOGY *Multiple Choice* Which of the following does not occur in the tertiary structure of a protein?

- W) Glycosidic linkages
- X) Disulfide bridges
- Y) Hydrophobic interactions
- Z) Ionic bonds

ANSWER: W) GLYCOSIDIC LINKAGES

TOSS-UP

20) CHEMISTRY *Multiple Choice* Which of the following statements is usually TRUE about an unsaturated fatty acid?

- W) It is from vegetable sources and is solid at room temperature
- X) It is from vegetable sources and is liquid at room temperature
- Y) It is from animal sources and is solid at room temperature
- Z) It is from animal sources and is liquid at room temperature

ANSWER: X) IT IS FROM VEGETABLE SOURCES AND IS LIQUID AT ROOM TEMPERATURE

BONUS

20) CHEMISTRY *Multiple Choice* Making biodiesels is a transesterification reaction. Which of the following represents the product(s) of this reaction?

- W) Phosphodiester and glycerol
- X) Fatty acid esters and glycerol
- Y) Fatty acids and alcohol
- Z) Acetyl-ethyl ester

ANSWER: X) FATTY ACID ESTERS AND GLYCEROL

TOSS-UP

21) PHYSICS *Multiple Choice* A ball is thrown vertically upward. Assuming that up is positive, which of the following pairs best describes its velocity and acceleration, respectively, at its highest point?

- W) Negative, negative
- X) Zero, negative
- Y) Negative, zero
- Z) Zero, zero

ANSWER: X) ZERO, NEGATIVE

BONUS

21) PHYSICS *Short Answer* If an earplug decreases the sound level of sound waves by 20 decibels, providing your answer as a decimal to the nearest hundredth, what is the ratio of the final intensity of the waves to their initial intensity?

ANSWER: 0.01

TOSS-UP

22) EARTH AND SPACE *Multiple Choice* Evidence of past climate conditions is best reviewed by studying which of the following?

- W) Modern ocean chemistry
- X) Metal sulfides
- Y) Mid-ocean ridges
- Z) Deep sea sediments

ANSWER: Z) DEEP SEA SEDIMENTS

BONUS

22) EARTH AND SPACE *Short Answer* By number, identify all of the following five choices that will allow greater resolution for a radio telescope: 1) lower noise temperature, 2) larger diameter, 3) longer baseline, 4) adaptive optics system, 5) larger brightness temperature of the source.

ANSWER: 2 AND 3

TOSS-UP

23) PHYSICS *Short Answer* A worker pushes a crate across the floor with a force of 50 newtons for a distance of 10 meters. If a frictional force of 20 newtons acts on the crate, what is the net work, in joules, done on the crate?

ANSWER: 300

BONUS

23) PHYSICS *Short Answer* A horizontal force of 200 newtons is used to push a 50 kilogram box 10 meters across a floor at constant speed. Given $9.8 \text{ meters per second squared}$ as g and providing your answer as a decimal to the nearest hundredth, what is the coefficient of kinetic friction between the box and the floor?

ANSWER: 0.41

TOSS-UP

24) ENERGY *Multiple Choice* To reduce total energy consumption in the home, in which of the following locations should insulation with the highest R-value be installed?

- W) Walls
- X) Attic
- Y) Crawlspace
- Z) Kitchen

ANSWER: X) ATTIC

BONUS

24) ENERGY *Short Answer* An electronic device operates on a 1.5 volt battery with a resistance of 10 ohms. If the initial capacity of this battery is 1400 milliampere-hours, and providing your answer as a decimal to the nearest tenth, for how many hours of continuous use could this device operate?

ANSWER: 9.3

TOSS-UP

25) MATH *Short Answer* If a family has 5 children, what is the probability that there are 4 girls and 1 boy?

ANSWER: $5/32$

BONUS

25) MATH *Short Answer* Find the following quotient of complex numbers: $(4 + i)/(1 - 2i)$.

ANSWER: $2/5 + (9/5)i$ (ACCEPT: $0.4 + 1.8i$)