

ROUND 1

TOSS-UP

1) CHEMISTRY *Short Answer* When chemists do flame tests, they often view the flame through a colored transparent piece of glass to filter out any sodium contamination. What color glass do they use?

ANSWER: COBALT BLUE (ACCEPT: BLUE, COBALT)

BONUS

1) CHEMISTRY *Short Answer* Specifying the sign, what is the oxidation state of phosphorus in $\text{Na}_2\text{P}_2\text{O}_6$?

ANSWER: +5 (DO NOT ACCEPT: 5)

TOSS-UP

2) MATH *Short Answer* What is magnitude of the phase shift of the function $y = \sin x$ to $y = 2\sin(3x - \pi) - 4$ (read as: 2 sine of open parenthesis 3x minus pi close parenthesis minus 4)?

ANSWER: $\pi/3$

BONUS

2) MATH *Short Answer* An isosceles triangle has a base of 30 feet and height of 15 feet. In feet, how far apart are the legs 10 feet above the base?

ANSWER: 10

TOSS-UP

3) PHYSICS *Multiple Choice* A charged particle moves through an area of space at a constant speed and direction. Which of the following statements is TRUE?

- W) There is no magnetic field
- X) There could be magnetic and electric fields oriented in the same direction
- Y) There could be magnetic and electric fields oriented perpendicularly to one another
- Z) There could be magnetic and electric fields oriented opposite to one another

ANSWER: Y) THERE COULD BE MAGNETIC AND ELECTRIC FIELDS ORIENTED PERPENDICULARLY TO ONE ANOTHER

BONUS

3) PHYSICS *Short Answer* A household appliance runs on 120 volts and has an internal resistance of 100 ohms. Providing your answer to the nearest integer, how much power, in watts, does this appliance use?

ANSWER: 144

TOSS-UP

4) BIOLOGY *Short Answer* What is the name of the hormone that controls metamorphosis in amphibians?

ANSWER: THYROXINE (ACCEPT: T4)

BONUS

4) BIOLOGY *Short Answer* In glycolysis (read as: gly-KOH-li-sis), what is the net yield of ATP molecules generated per glucose molecule?

ANSWER: 2

TOSS-UP

5) CHEMISTRY *Short Answer* What element has the lowest boiling point?

ANSWER: HELIUM

BONUS

5) CHEMISTRY *Multiple Choice* Which of the following bonds is the MOST polar?

- W) B-C
- X) B-N
- Y) B-O
- Z) B-F

ANSWER: Z) B-F

TOSS-UP

6) PHYSICS *Multiple Choice* Which of the following is TRUE of beta particles?

- W) They have a charge equal and opposite to alpha particles
- X) They are more penetrating than gamma particles of the same energy
- Y) They are common decay products of alpha particles
- Z) They can be electrons or positrons

ANSWER: Z) THEY CAN BE ELECTRONS OR POSITRONS

BONUS

6) PHYSICS *Short Answer* The resistance of a certain wire is 10 ohms. What would be the resistance in ohms if the radius of the wire were doubled?

ANSWER: 2.5

TOSS-UP

7) EARTH AND SPACE *Multiple Choice* America's first satellite, Explorer I, had all of the following technology aboard, EXCEPT:

- W) Internal and external temperature sensors
- X) Data transmitting antennas
- Y) Solar panels
- Z) Micrometeorite impact microphone

ANSWER: Y) SOLAR PANELS

BONUS

7) EARTH AND SPACE *Short Answer* Lightning is most likely to occur at what time of day: morning, afternoon, evening, or night?

ANSWER: AFTERNOON

TOSS-UP

8) PHYSICS *Short Answer* Given g as 10 meters per second squared, if a ball is tossed upward at an initial velocity of 20 meters per second, what will be its velocity in meters per second at 2.5 seconds?

ANSWER: -5 (ACCEPT: 5 DOWN; DO NOT ACCEPT: 5)

BONUS

8) PHYSICS *Short Answer* The frequency of light from a laser radiation source is 6×10^{14} hertz. Using 3×10^8 meters per second as the speed of light, what is the wavelength of this light in nanometers?

ANSWER: 500

TOSS-UP

9) ENERGY *Multiple Choice* In terms of energy, which of the following happens after a skydiver reaches terminal velocity?

- W) Kinetic energy increases exponentially with distance
- X) Gravitational potential energy ceases to be present
- Y) Gravitational potential energy is converted into thermal energy
- Z) Kinetic energy increases linearly with distance

ANSWER: Y) GRAVITATIONAL POTENTIAL ENERGY IS CONVERTED INTO THERMAL ENERGY

BONUS

9) ENERGY *Short Answer* Non-hydraulic elevators typically use very small motors and block and tackle pulleys. What system component helps reduce the amount of the car's weight that the motor has to lift?

ANSWER: COUNTERBALANCE (ACCEPT: COUNTERWEIGHT)

TOSS-UP

10) MATH *Short Answer* If $f(x) = x^2 - 3$ and $g(x) = 6 - \sqrt{x}$, what is the value of $f(g(16))$ (read as: f of g of 16)?

ANSWER: 1

BONUS

10) MATH *Short Answer* According to Descartes's Rule of Signs, what are the possible numbers of positive real roots that the following equation might have: $x^5 - 7x^3 + 15x^2 + 3 = 10$?

ANSWER: 1 OR 3 (MUST GIVE BOTH ANSWERS)

TOSS-UP

11) EARTH AND SPACE *Multiple Choice* Which of the following will NOT result from variations in the Moon's orbital plane with respect to the Earth?

- W) The Moon will continue to cause solar eclipses
- X) The Moon will pass over the Earth's North Pole
- Y) There will continue to be lunar eclipses
- Z) The apparent path of the Moon in the sky will vary

ANSWER: X) THE MOON WILL PASS OVER THE EARTH'S NORTH POLE

BONUS

11) EARTH AND SPACE *Multiple Choice* What is the approximate average impact speed, in miles per hour, of a piece of orbital debris that strikes the Earth?

- W) 5,000
- X) 10,000
- Y) 20,000
- Z) 30,000

ANSWER: Y) 20,000

TOSS-UP

12) PHYSICS *Short Answer* Applying Bernoulli's principle to vortices, where in a vortex should the pressure be highest?

ANSWER: CENTER (ACCEPT: MIDDLE)

BONUS

12) PHYSICS *Short Answer* Providing your answer as a decimal rounded to the nearest tenth, if a normal force of 1 newton is applied to the end of a fixed cylinder with a radius of 1 meter, what pressure, in pascals, is induced in the cylinder?

ANSWER: 0.3

TOSS-UP

13) EARTH AND SPACE *Short Answer* In the atmosphere, what ion is formed by the oxidation of sulfur oxides?

ANSWER: SULFATE (ACCEPT: SO_4^{2-})

BONUS

13) EARTH AND SPACE *Short Answer* What do we call the transfer of a property of the atmosphere, such as heat, cold, or humidity, by the horizontal movement of an air mass?

ANSWER: ADVECTION

TOSS-UP

14) ENERGY *Multiple Choice* Absorption refrigeration is commonly used in co-generation facilities. It differs from traditional compressor refrigeration by which of the following key characteristics?

- W) Size
- X) It is heat-sourced
- Y) It is electrically-sourced
- Z) Temperature

ANSWER: X) IT IS HEAT-SOURCED

BONUS

14) ENERGY *Short Answer* By name or number, order the following four fuels from least to greatest amount of carbon dioxide produced annually from stationary combustion in the United States: 1) wood, 2) coal, 3) natural gas, 4) kerosene.

ANSWER: NATURAL GAS, KEROSENE, WOOD, COAL (ACCEPT: 3, 4, 1, 2)

TOSS-UP

15) BIOLOGY *Multiple Choice* Members of the order Gymnophiona (read as: jim-noh-FYOH-nah), otherwise known as Caecilians (read as: si-SIL-yahns), do NOT have which of the following?

- W) Poison glands
- X) Teeth
- Y) Elongated organs
- Z) Legs

ANSWER: Z) LEGS

BONUS

15) BIOLOGY *Short Answer* What group of hormones is responsible for both phototropism and gravitropism?

ANSWER: AUXINS

TOSS-UP

16) MATH *Short Answer* What is the measure in radians of an interior angle of a regular pentagon?

ANSWER: $3\pi/5$

BONUS

16) MATH *Multiple Choice* Suppose, in a certain part of the world, in any 50-year period, the probability of a major plague is 39%, the probability of a major famine is 52%, and the probability of both a plague and a famine is 15%. Given that there is a plague, which of the following is the probability of a famine?

- W) 0.240
- X) 0.288
- Y) 0.370
- Z) 0.385

ANSWER: Z) 0.385

TOSS-UP

17) BIOLOGY *Short Answer* Submandibular, parotid, and lingual are adjectives referring to which type of gland?

ANSWER: SALIVARY

BONUS

17) BIOLOGY *Short Answer* By name or number, identify all of the following five events that could trigger secondary succession: 1) forest fire, 2) hurricane, 3) lava flow, 4) flood, 5) tsunami.

ANSWER: FOREST FIRE, HURRICANE, FLOOD, AND TSUNAMI (ACCEPT: 1, 2, 4, AND 5 OR ALL BUT 3)

TOSS-UP

18) ENERGY *Multiple Choice* Which of the following BEST describes the process of coal liquefaction?

- W) It converts coal into synthetic fuels
- X) It reduces carbon dioxide emissions in coal plants
- Y) It removes sulfur from coal in coal plants
- Z) It converts coal into an easily transportable form

ANSWER: W) IT CONVERTS COAL INTO SYNTHETIC FUELS

BONUS

18) ENERGY *Multiple Choice* Which of the following is a disadvantage of flexible fuel vehicles?

- W) They get about 25% fewer miles per gallon when fueled with E85
- X) They experience significant loss in power when operating on E85
- Y) They are very different than gasoline-only models
- Z) The technology is untested

ANSWER: W) THEY GET ABOUT 25% FEWER MILES PER GALLON WHEN FUELED WITH E85

TOSS-UP

19) PHYSICS *Multiple Choice* An elephant steps on an electrical extension cord that is connected to a lit lamp. Assuming that the lamp remains plugged in and the cord unbroken, which of the following happens to the light intensity coming from the lamp?

- W) It goes out
- X) It becomes dimmer
- Y) It becomes brighter
- Z) It is unchanged

ANSWER: Z) IT IS UNCHANGED

BONUS

19) PHYSICS *Short Answer* If a fuse can dissipate 600 watts of power without blowing, how much current, in amperes, can it pass at 120 volts without melting?

ANSWER: 5

TOSS-UP

20) BIOLOGY *Multiple Choice* Which of the following BEST explains why water molds are NOT classified as fungi?

- W) They have cell walls of cellulose and produce motile spores
- X) They are decomposers
- Y) They are multinucleate
- Z) They have cell walls of chitin (read as: KY-tin) and when aggregated function like a multicellular organism

ANSWER: W) THEY HAVE CELL WALLS OF CELLULOSE AND PRODUCE MOTILE SPORES

BONUS

20) BIOLOGY *Short Answer* By name or number, identify all of the following five choices that are considered embryophyta (read as: ehm-bree-ah-FY-tah): 1) gymnosperms (read as: JIM-noh-spehrms), 2) diatoms, 3) mosses, 4) dinoflagellates, 5) ferns.

ANSWER: GYNOSPERMS, MOSSES, FERNS (ACCEPT: 1, 3, AND 5)

TOSS-UP

21) MATH *Short Answer* If the median of the five numbers 1, 7, 14, 28, and x is 10, what is x ?

ANSWER: 10

BONUS

21) MATH *Short Answer* To what value does the geometric series that starts $1/3 + 1/9 + 1/27 + \dots$ converge?

ANSWER: $1/2$

TOSS-UP

22) CHEMISTRY *Multiple Choice* Which of the following substances has the highest boiling point?

- W) Water
- X) Methanol
- Y) Ethyl alcohol
- Z) Diethyl ether

ANSWER: W) WATER

BONUS

22) CHEMISTRY *Short Answer* The pressure of 2 moles of an ideal gas at 27° Celsius is 1.2 atmospheres. Providing your answer to the nearest tenth, if the temperature is increased by 100° Celsius and the volume of the gas doubles, what is the new pressure of the gas in atmospheres?

ANSWER: 0.8

TOSS-UP

23) EARTH AND SPACE *Short Answer* What geologic features of Io are responsible for loading Jupiter's atmosphere with heavy ionized particles?

ANSWER: VOLCANOES

BONUS

23) EARTH AND SPACE *Short Answer* On Mars, how do the ages of the higher elevation and heavily cratered southern highlands compare to the ages of the lower elevation and flat northern lowlands?

ANSWER: SOUTHERN HIGHLANDS ARE OLDER (ACCEPT: NORTHERN LOWLANDS ARE YOUNGER)

TOSS-UP

24) CHEMISTRY *Short Answer* What is the common name given to the industrial reaction in which nitrogen and hydrogen are reacted with a catalyst, forming ammonia?

ANSWER: HABER PROCESS

BONUS

24) CHEMISTRY *Short Answer* What is the molecular formula for strontium nitrite?

ANSWER: $\text{Sr}(\text{NO}_2)_2$

TOSS-UP

25) BIOLOGY *Multiple Choice* The drug Digoxin from the *Digitalis* plant slows the reuptake of calcium by the sarcoplasmic reticulum (read as: ri-TI-kyuh-luhm). What is the effect of this on the strength and rate of heart contractions?

- W) Strengthens and slows the heartbeat
- X) Strengthens and speeds the heartbeat
- Y) Weakens and slows the heartbeat
- Z) Weakens and speeds the heartbeat

ANSWER: W) STRENGTHENS AND SLOWS THE HEARTBEAT

BONUS

25) BIOLOGY *Short Answer* In eudicots (read as: yuh-DY-kohts), lateral roots arise from the mitotic activity of which tissue layer?

ANSWER: PERICYCLE