

TOSS-UP

1) CHEMISTRY *Short Answer* What principle states that if a system in equilibrium is disturbed by changes in determining factors, the system will tend to shift its equilibrium position so as to counteract the effect of the disturbance?

ANSWER: Le Châtelier's Principle

BONUS

1) CHEMISTRY *Short Answer* In a phase diagram of a compound, the point at which a solid, liquid and gas phases can co-exist is called the _____, and the point at which the liquid and gas phases becomes indistinguishable is called the _____.

ANSWER: Triple point, critical point

TOSS-UP

2) EARTH & SPACE *Multiple Choice* Which of the following igneous rocks floats on water?

W. Basalt

X. Obsidian

Y. Granite

Z. Pumice

ANSWER: Z. Pumice

BONUS

2) EARTH & SPACE *Short Answer* Breccia is an example of what type of sedimentary rock?

ANSWER: Detrital

TOSS-UP

3) PHYSICS *Short Answer* What particle mediates the electromagnetic force?

ANSWER: Photon

BONUS

3) PHYSICS *Short Answer* By name or number, list all of the following that is not a conservative force

I. Static friction

II. Spring force

III. Gravitational force

IV. Drag

ANSWER: 1, 4

TOSS-UP

4) MATH *Multiple Choice* Which of the following is equal to the tangent of 180 degrees?

W) -1

X) $-\sqrt{2}/2$ [read: negative root 2 over 2]

Y) 0

Z) 1

ANSWER: Y) 0

BONUS

4) MATH *Short Answer* What is the second derivative with respect to x of the polynomial $x^4 - 3x^2 + 1$?

ANSWER: $12x^2 - 6$

TOSS-UP

5) BIOLOGY *Short Answer* By name or number, which of the following are taste types?

I. Umami

II. Sour

III. Salty

ANSWER: I, II, III

BONUS

5) BIOLOGY *Short Answer* What is the specialized junction between cardiac muscle cells called? This region also directly provides electric coupling between cells.

ANSWER: Intercalated Disk

TOSS-UP

6) CHEMISTRY *Multiple Choice* Which of the following is not an example of a colloid?

W) Blood

X) Milk

Y) Plaster

Z) Saltwater

ANSWER: Z) Saltwater

BONUS

6) CHEMISTRY *Short Answer* By name or number, identify the following colloids that are classified as emulsions

1. Smoke

2. Mayonnaise

3. Gelatin

4. Blood

5. Pearl

ANSWER: 2, 4

TOSS-UP

7) EARTH & SPACE *Short Answer* How many Jovian planets are in our solar system?

ANSWER: 4

BONUS

7) EARTH AND SPACE *Multiple Choice* By the Richter Magnitude Scale, what Richter magnitudes are felt by *some* people near the epicenter?

W) 2.0-2.9

X) 3.0-3.9

Y) 4.0-4.9

Z) 5.0-5.9

ANSWER: X) 3.0-3.9

TOSS-UP

8) PHYSICS *Multiple Choice* If a truck and an apple were dropped at the same height in the moon, which of the following will happen?

W) The truck will fall faster

X) The apple will fall faster

Y) They will land at the same time

Z) They do not fall as the effects of gravity is negligible.

ANSWER: Y) They will land at the same time

BONUS

8) PHYSICS *Multiple Choice* An adult and a child are standing on ice, where friction is negligible. If the child pushed the adult with a force of 10 Newtons, which of the following will happen?

W) They will both remain stationary

X) They will both move apart at the same speed

Y) They will both move apart, and the child will be slower than the adult

Z) They will both move apart, and the child will be faster than the adult

ANSWER: Z) They will both move apart, and the child will be faster than the adult

TOSS-UP

9) MATH *Short Answer* Convert the base-3 number 1111 to base 10.

ANSWER: 40

BONUS

9) MATH *Short Answer* Farmer Chanseo owns both chickens, which have two feet, and cows, which have four feet. If Chanseo has 17 total animals and 62 total feet among those animals, how many cows does he own?

ANSWER: 14

TOSS-UP

10) BIOLOGY *Multiple Choice* Which of the following bones is NOT found in the human ear? (Raghav)

W) Hammer

X) Scapula

Y) Anvil

Z) Incus

ANSWER: X) Scapula

BONUS

10) BIOLOGY *Short Answer* Who won the Nobel Prize for Physiology or Medicine in 2016 for their discoveries of mechanisms of for autophagy?(Raghav)

ANSWER: Yoshinori Ohsumi (ACCEPT: Ohsumi)

TOSS-UP

11) CHEMISTRY *Short Answer* Of the following elements, the strongest reducing agent is

1. Na

2. Mg

3. Li

4. Al

ANSWER: 3. Li

BONUS

11) CHEMISTRY *Short Answer* How many moles of copper are plated out when a current of 1000.0 amperes is passed for 30 seconds through a solution containing Cu^{2+} , using the estimation that one Faraday is 96,000 Coulombs per mole of electrons? Report your answer to three decimal points.

ANSWER: 0.156 mol Cu

TOSS-UP

12) EARTH & SPACE *Multiple Choice* The distance from the Earth to the Sun in astronomical units is:

W) 10.5 au

X) 6.0 au

Y) 3.7 au

Z) 1.0 au

ANSWER: Z) 1.0 au

BONUS

12) EARTH & SPACE *Short Answer* What term describes air holding the maximum possible quantity of water vapor that it can hold at a given temperature and pressure?

ANSWER: Saturated

TOSS-UP

13) PHYSICS *Multiple Choice* As a figure skater is spinning around, he notices that when he draws his legs towards himself, he spins faster. This is an example of: (Jinwoo)

W) Conservation of energy

X) Conservation of angular momentum

Y) Conservation of linear momentum

Z) Conservation of mass

ANSWER: X) Conservation of angular momentum

BONUS

13) PHYSICS *Short Answer* One of the electrons in an orbital is known to have a spin of $\frac{1}{2}$. What spin number must the other electron in the orbital have?

ANSWER: $-\frac{1}{2}$

TOSS-UP

14) MATH *Short Answer* How many ways are there to fully tile a 3x1 [read: 3 by 1] grid using only 2x1 and 1x1 pieces? (DL)

ANSWER: 3

BONUS

14) MATH *Short Answer* Find the number of distinct positive integer factors of 1001. (DL)

ANSWER: 8

TOSS-UP

15) BIOLOGY *Multiple Choice* A higher frequency of tooth decay is a symptom of deficiency of a which of the following minerals?

W) Vitamin C

X) Iodine

Y) Sulfur

Z) Fluorine

ANSWER: Z) Fluorine

BONUS

15) BIOLOGY *Short Answer* What mammalian order contains organisms that lay eggs?

ANSWER: Monotremata

BONUS

16) CHEMISTRY *Short Answer* What gas is the main constituent of natural gas?

ANSWER: Methane (CH_4)

TOSS-UP

16) CHEMISTRY *Multiple Choice* Iron solid reacts with aqueous copper (II) nitrate to form iron (II) nitrate and copper metal. This is an example of:

W) synthesis

X) decomposition

Y) single replacement

Z) double replacement

ANSWER: Y) single replacement

TOSS-UP

17) EARTH & SPACE *Multiple Choice* Which of the following is not necessary for a material to be considered a mineral?

W) It must be solid

X) It must be naturally occurring

Y) It must be inorganic

Z) It must have cleavage

ANSWER: Z) It must have cleavage

BONUS

17) EARTH & SPACE *Short Answer* Minerals that break in a glass-like manner have what type of fracture?

ANSWER: Conchoidal Fracture

TOSS-UP

18) PHYSICS *Short Answer* If an object is dropped into freefall and reaches its terminal velocity of 98m/s after 10 seconds, what will be the object's velocity after 15 seconds?

ANSWER: 98m/s

BONUS

18) PHYSICS *Short Answer* A spring faced horizontally has a spring constant of 10N/m. If a mass of 4kg is attached to the spring and it is displaced by 4m, what will be the force that the spring exerts?

ANSWER: -160N (Do not accept 160N)

TOSS-UP

19) MATH *Multiple Choice* Which modern mathematician proved Fermat's Last Theorem in 1995?

W) George Cantor

X) Andrew Wiles

Y) Shinichi Mochizuki

Z) Terence Tao

ANSWER: X) Andrew Wiles

BONUS

19) MATH *Short Answer* If $3^k = 27^3$, find log base 3 of k.

ANSWER: 2

TOSS-UP

20) BIOLOGY *Short Answer* By name or number, order the following mitotic phases in chronological order.

I. Telophase

II. Prophase

III. Anaphase

ANSWER: II, III, I

BONUS

20) BIOLOGY *Short Answer* The formation of new species during the course of evolution is called speciation. This may be due to geographical isolation or without it through polyploidy. Name the two types of speciation.

ANSWER: Allopatric and sympatric speciation

TOSS-UP

21) CHEMISTRY *Short Answer* Which law of thermodynamics states that the entropy of the universe is constantly increasing?

ANSWER: 2nd law of thermodynamics

BONUS

21) CHEMISTRY *Short Answer* Fill in each blank with (increases/decreases/stays the same): During the melting of ice, entropy _____, enthalpy _____, and temperature _____.

ANSWER: Increases, increases, stays the same

TOSS-UP

22) EARTH & SPACE *Short Answer* Order the following four celestial objects from smallest to largest: 1. Sun 2. Moon 3. Jupiter 4. Mercury (James)

ANSWER: 2, 4, 3, 1

BONUS

22) EARTH & SPACE *Multiple Choice* Which of the following best explains how the moon formed?

W. It was pulled into orbit as it passed close by the Earth in the early history of the solar system

X. It was formed from the accretion of molten matter that was thrown off of the young Earth as it spun rapidly

Y. It formed in the same general area as the Earth and they happened to begin orbiting each other

Z. It was formed from material thrown off when a large object collided with Earth in its early history

ANSWER: Z

TOSS-UP

23) PHYSICS *Short Answer* What is the SI unit for potential energy? (Anka)

ANSWER: Joule

BONUS

23) PHYSICS *Short Answer* What system of units, contrasting to the SI system, uses the centimeter, gram, and second as its definite base units? (Anka)

ANSWER: CGS system (ACCEPT: Centimeter-Gram-Second Second)

TOSS-UP

24) MATH *Short Answer* How many ways are there to distribute 5 indistinguishable trophies among 3 different teams if each team must receive at least one trophy?

ANSWER: 6

BONUS

24) MATH *Short Answer* Find the sum of the first 100 terms of the arithmetic sequence with first term -6 and third term 0.

ANSWER: 14250

TOSS-UP

25) BIOLOGY *Short Answer* What is the full form of ATP?

ANSWER: Adenosine Triphosphate

BONUS

25) BIOLOGY *Short Answer* By name or number, which of the following is/are a part of a phospholipid?

I. Choline

II. Phosphate

III. Fatty acid

ANSWER: I, II, III