

## Niskayuna Winter Invitational Round Robin 2

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### TOSS-UP

1) PHYSICS – *Multiple Choice*—Which of the following devices is capable of storing electric charge in an electric field?

- W) capacitor
- X) resistor
- Y) ammeter
- Z) electroscope

ANSWER: W) CAPACITOR

### BONUS

1) PHYSICS – *Short Answer*—Expressing your answer as a fraction, what is the total capacitance of capacitors of 2 microfarads, 4 microfarads and 8 microfarads in series, in microfarads?

ANSWER: 8/7

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### TOSS-UP

2) CHEMISTRY – *Short Answer*—How many carbons are in the molecule 2,3-Dimethylpentane-3-thiol?

ANSWER: 7

### BONUS

2) CHEMISTRY – *Multiple Choice* — Which of the following compounds will have the greatest boiling point elevation when 1 mole of each is placed in 5 kg of water?

- W) Sodium chloride
- X) Calcium chloride
- Y) Vinegar
- Z) Glucose

ANSWER: X) CALCIUM CHLORIDE

### TOSS-UP

3) ENERGY – *Multiple Choice*—Researchers at the University of Michigan’s Solar and Heliospheric research group are studying solar winds. Which of the following is not true about solar winds?

- W) They can contain the atomic nuclei of carbon atoms
- X) They are responsible for the aurora borealis on earth
- Y) Solar wind is mostly positively charged
- Z) They are released from the corona

ANSWER: Y) SOLAR WIND IS MOSTLY POSITIVELY CHARGED

### BONUS

3) ENERGY – *Multiple Choice*—GOES-16 is a geostationary weather satellite operated by NASA. Which of the following is not true about a satellite in geostationary orbit?

- W) It must have an orbital period of one sidereal day
- X) They are in prograde orbit
- Y) They cannot be in orbit over the equator
- Z) They are in a circular orbit

ANSWER: Y) THEY CANNOT BE IN ORBIT OVER THE EQUATOR

### TOSS-UP

4) EARTH AND SPACE— *Multiple Choice*—Earth is not perfectly spherical, but Venus is an example of a planet that is more spherical than Earth. Which of the following best explains Venus's more spherical shape?

- W) Slower rotation relative to Earth
- X) Retrograde rotation
- Y) Faster orbital period around the sun relative to Earth
- Z) Lack of plate tectonics

ANSWER: W) SLOWER ROTATION RELATIVE TO EARTH

### BONUS

4) EARTH AND SPACE – *Multiple Choice*—Which of the following types of volcanic eruptions is not paired correctly with its description?

- W) Plinian; large explosion producing a convective cloud and pyroclastic flows
- X) Strombolian; steam explosion when seawater enters a magma chamber
- Y) Phreatic; steam explosion when groundwater interacts with magma
- Z) Vulcanian; eruption of lapilli and plumes of debris

ANSWER: X) STROMBOLIAN; STEAM EXPLOSION WHEN SEAWATER ENTERS A MAGMA CHAMBER



### TOSS-UP

5) MATH – *Short Answer*—Oscar is playing a science tournament against empty seats to see how many points he can rack up. He gets 4 points per correct answer, but has a bad habit of negging, so every fifth buzz ends up losing him 4 points. If he buzzes every question in a 20 question round, how many points will he score, if he can only answer correctly or neg?

ANSWER: 48

### BONUS

5) MATH – *Short Answer*—Oscar, looking for better competition, now plays against a teammate in a 1v1. Oscar still gets 4 points per correct answer, but if he answers correctly, he now has a 50% chance to get an extra 10 points. Miraculously, his negging skills have improved, and he now gets every third question wrong, losing 4 points. If he now only buzzes 10 times in the round, what is the expected number of points he scores, if Oscar can only answer correctly or neg?

ANSWER: 51

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### TOSS-UP

6) BIOLOGY – *Short Answer*—By name or number, order the following three steps from earliest to latest when one conducts polymerase chain reaction: 1) denaturing, 2) annealing, 3) elongation.

ANSWER: DENATURING, ANNEALING, ELONGATION (ACCEPT: 1, 2, 3)

### BONUS

6) BIOLOGY – *Multiple Choice*—In which of the following groups of organisms would one expect to find haplodiploidy?

- W) Frogs
- X) Bees
- Y) Fish
- Z) Grasshoppers

ANSWER: X) BEES

### TOSS-UP

7) PHYSICS – *Multiple Choice*—An object is placed 20 centimeters to the left of a convex lens of focal length 30 centimeters. What is the image distance in centimeters and its location relative to the lens?

- W) 60 cm left of the lens
- X) 60 cm right of the lens
- Y) 10 cm left of the lens
- Z) 10 cm right of the lens

ANSWER: W) 60CM LEFT OF THE LENS

### BONUS

7) PHYSICS – *Multiple Choice*—A box is sitting on a ramp set at a ramp angle of 35 degrees. Which of the following is closest to the coefficient of static friction necessary for the box to begin sliding down the ramp at this angle?

- W) 0.3
- X) 0.5
- Y) 0.7
- Z) 0.9

ANSWER: Y) 0.7

### TOSS-UP

8) CHEMISTRY – *Short Answer*—When a 2L solution of 0.6 molar hydrofluoric acid is titrated by a solution of 0.2 molar calcium hydroxide, what volume of base is needed for the solution to reach its equivalence point?

ANSWER: 3 L

### BONUS

8) CHEMISTRY – *Multiple Choice*—Which of the following values is closest to the pH of a solution containing 1 mol acetic acid, given that the pKa of acetic acid is 4.8?

W) 2

X) 2.4

Y) 2.8

Z) 3.2

ANSWER: X) 2.4

### TOSS-UP

9) ENERGY – *Short Answer*—What international treaty, signed in 1987, agreed to phase out the production of harmful substances, especially chlorofluorocarbons, with the goal of protecting the ozone layer?

ANSWER: MONTREAL PROTOCOL

### BONUS

9) ENERGY – *Multiple Choice*—The compound ozone is most potent in absorbing radiation from which of the following portions of the electromagnetic spectrum?

- W) UV-B
- X) UV-A
- Y) Gamma
- Z) Infrared

ANSWER: W) UV-B

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### TOSS-UP

10) EARTH AND SPACE – *Short Answer*—By name or number, identify all of the following three metamorphic rocks that are foliated: 1) hornfels, 2) gneiss, 3) schist

ANSWER: 2 AND 3

### BONUS

10) EARTH AND SPACE – *Multiple Choice*—Which of the following metamorphic rocks would you be most likely to find at the site of an accretionary wedge due to its relatively high pressure and relatively low temperature of formation?

- W) Blueschist
- X) Migmatite
- Y) Gneiss
- Z) Schist

ANSWER: W) BLUESCHIST

**TOSS-UP**

11) MATH – *Short Answer*—In degrees, what is the interior angle measure of a regular dodecagon?

ANSWER: 150

**BONUS**

11) MATH – *Short Answer*—What is the 50th term in the sequence where  $a_1 = 1$ ,  $a_2 = -3$ , and  $a_n = a_{n-1} - a_{n-2}$ ?

ANSWER: -3

**TOSS-UP**

12) BIOLOGY – *Short Answer*—By name or number, identify all of the following three statements that are true if the smaller and larger subunits of a ribosome have sedimentation coefficients of 30s (read as: 30-S) and 50s (read as: 50-S) respectively: 1) the ribosome is eukaryotic, 2) Only the 50s subunit contains RNA, 3) the entire ribosome has a sedimentation coefficient of 80s

ANSWER: NONE

**BONUS**

12) BIOLOGY – *Multiple Choice*—If Mary’s mother is a carrier for hemophilia, and Mary’s father has hemophilia, what is the probability that Mary’s son will have hemophilia given that Mary’s husband does not have hemophilia?

- W)  $\frac{1}{2}$
- X)  $\frac{3}{4}$
- Y)  $\frac{5}{8}$
- Z)  $\frac{7}{8}$

ANSWER: X)  $\frac{3}{4}$



### TOSS-UP

13) PHYSICS – *Multiple Choice*—In air conditioning units, refrigerant fluid is pumped into an area of low pressure, allowing it to expand and vaporize without losing or gaining heat from its surroundings. What type of thermodynamic process occurs in this situation?

ANSWER: ADIABATIC

### BONUS

13) PHYSICS – *Short Answer*—A spring is connected to a wall and experiences an 80 N force. It stretches 0.25 meters. Determine the spring constant in newton-meters

ANSWER: 320

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### TOSS-UP

14) CHEMISTRY – *Short Answer*—If the reaction  $2A + 2B \rightleftharpoons 2C$  has an equilibrium constant of  $1/25$ , what is the equilibrium constant for the reaction  $C \rightleftharpoons A + B$ ?

ANSWER: 5

### BONUS

14) CHEMISTRY – *Multiple Choice*—When performing the Haber process in a 5L tank, your reaction reaches equilibrium. If you were to double the temperature, which of the following would you expect to happen to the concentration of Nitrogen gas?

- W) Increases
- X) Decreases slightly
- Y) Stays the same
- Z) Becomes 0

ANSWER: W) INCREASES

### TOSS-UP

15) ENERGY – *Short Answer*—What term, first used by Gustav Kirchoff, describes an ideal body that absorbs all incident radiation, regardless of frequency or angle of incidence?

ANSWER: BLACKBODY

### BONUS

15) ENERGY – *Multiple Choice*—According to the Stefan-Boltzmann law, the thermal radiation emitted by a body is directly proportional to the body's temperature raised to what power?

W)  $\frac{1}{4}$

X)  $\frac{1}{2}$

Y) 2

Z) 4

ANSWER: Z) 4

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### TOSS-UP

16) EARTH AND SPACE – *Multiple Choice*—Cratons and shields are both examples of areas in which metamorphic and igneous rocks from the Precambrian Era have survived. What is the main difference between cratons and shields?

W) Cratons are exposed, shields are not exposed

X) Shields are exposed, cratons are not exposed

Y) Cratons are composed mainly of high grade metamorphic rocks, while shields are composed mainly of igneous rock

Z) Shields are composed mainly of igneous rock, while cratons are composed mainly of high grade metamorphic rocks

ANSWER: X) SHIELDS ARE EXPOSED, CRATONS ARE NOT EXPOSED

### BONUS

16) EARTH AND SPACE – *Short Answer*—What type of metamorphism, often associated with nonfoliated metamorphic rocks, occurs due to the heat around a pluton?

ANSWER: CONTACT METAMORPHISM (ACCEPT: CONTACT)

**TOSS-UP**

17) MATH – *Short Answer*—If three fair six-sided dice are rolled simultaneously, what is the probability that their sum will be odd?

ANSWER: 1/2

**BONUS**

17) MATH – *Short Answer*—Find the area, in simplest radical form, of an equilateral triangle whose circumcircle has a diameter of 12.

ANSWER:  $27\sqrt{3}$



**TOSS-UP**

18) BIOLOGY – *Multiple Choice*—Which of the following effects would not be observed in someone undergoing a fight-or-flight response?

- W) Increased respiratory rate
- X) Increased rate of digestion
- Y) Constriction of blood vessels
- Z) Dilation of bronchi and bronchioles

ANSWER: X) INCREASED RATE OF DIGESTION

**BONUS**

18) BIOLOGY – *Short Answer*—During the fight-or-flight response, a pathway beginning with a hormone secreted by the juxtaglomerular cells in the kidneys is responsible for increasing blood pressure by increasing fluid retention and inducing vasoconstriction. Rank the following three hormones in order of first produced to last produced in this pathway: 1) angiotensin, 2) renin, 3) aldosterone

ANSWER: 2, 1, 3

### TOSS-UP

19) PHYSICS – *Short Answer*—A spring with a spring constant of 40 N/m compresses by 5 cm. In newtons, what is the magnitude of the force exerted by the spring?

ANSWER: 2

### BONUS

19) PHYSICS – *Short Answer*—A simple pendulum attached to the ceiling has a mass of 0.2kg hanging from the end of the pendulum. If the pendulum is 9.8 meters long, to the nearest hundredth of a second, what is the period of the pendulum?

ANSWER: 6.28 (ACCEPT:  $2\pi$ )

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### TOSS-UP

20) BIOLOGY – *Short Answer*—If a sample of DNA consists of 35% adenine, what percentage of the sample is made up of pyrimidines?

ANSWER: 50

### BONUS

20) BIOLOGY – *Short Answer*—By name or number, identify all of the following three forms of inhibition that are correctly paired with its description: 1) competitive; an inhibitor binds to a region outside of the enzyme's active site, inhibiting the complex, 2) uncompetitive; an inhibitor only binds to a substrate-enzyme complex, not the free enzymes themselves 3) noncompetitive; the inhibitor binds to the active site of the enzyme, effectively blocking out the intended substrate.

ANSWER: 2 ONLY