

## NSI2 RR1

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### TOSS-UP

1) BIOLOGY – *Short Answer* Thermophiles are organisms that live at high temperatures. Thermophiles mostly belong to which biological kingdom in the 6 kingdom system?

ANSWER: Archaea (Accept: Archaeobacteria)

### BONUS

1) BIOLOGY – *Multiple Choice* Approximately what percent of energy stored as biomass is lost between trophic levels in a food chain?

W) 10%

X) 40%

Y) 70%

Z) 90%

ANSWER: Z) 90%

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### TOSS-UP

2) CHEMISTRY – *Multiple Choice* Which of the following ions has the largest radius?

- W)  $O^{2-}$
- X)  $F^{-}$
- Y)  $Na^{+}$
- Z)  $Mg^{2+}$

ANSWER: W)  $O^{2-}$

### BONUS

2) CHEMISTRY – *Multiple Choice* The reaction  $2NO_2 \rightleftharpoons N_2O_4$  is an exothermic process taking place in a closed 2L flask. Which of the following changes will shift the equilibrium to the left?

- W) Increasing the temperature
- X) Decreasing the temperature
- Y) Adding more  $NO_2$  to the flask
- Z) Increasing the pressure

ANSWER: W) Increasing the temperature

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### TOSS-UP

3) EARTH AND SPACE – *Multiple Choice* Which of the following terms refers to an iceberg under 1 meter in height and under 5 meters in length?

- W) Brash Ice
- X) Ice Island
- Y) Miniberg
- Z) Growler

ANSWER: Z) Growler

### BONUS

3) EARTH AND SPACE – *Multiple Choice* A wind storm characterized as a long-lived, straight line group of severe thunderstorms is known as which of the following?

- W) squall
- X) supercell
- Y) wind shear
- Z) derecho (pronounced: duh-reh-cho)

ANSWER: Z) derecho

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### TOSS-UP

4) PHYSICS – *Short Answer* A car with mass 100 kilograms moving east at 10 m/s collides with a 0.6 gram bug moving west at 8 m/s. If the car exerts an average force of 10 newtons over 5 seconds on the bug, in newtons, what is the average force that the bug exerted on the car during that time?

ANSWER: 10

### BONUS

4) PHYSICS – *Multiple Choice* The space industry uses radiation waves from what region of the electromagnetic spectrum to contact the international space station?

- W) Gamma
- X) Ultraviolet
- Y) Infrared
- Z) Radio

Answer: Z) Radio

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### TOSS-UP

5) MATH – *Short Answer* How many permutations are there of the word banana?

ANSWER: 60

### BONUS

5) MATH – *Short Answer* By name or number, name all of the following that an 8 by 5 matrix can be multiplied by: 1) a 7 by 5 matrix, 2) a 5 by 10 matrix, 3) a 2 by 10 matrix, 4) a 5 by 7 matrix

ANSWER: 2 and 4

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### TOSS-UP

6) ENERGY – *Short Answer* Researchers are studying new methods of constructing neural networks. One approach is through the use of non-deterministic stacks. Identify all of the following 4 choices that describe a stack: 1) First in First out; 2) First in Last out; 3) Last in First out; 4) Last in Last out.

ANSWER: 2 and 3

### BONUS

6) ENERGY – *Multiple Choice* Researchers are evaluating the changes in gene expression in drug studies. They run a hypothesis test to tell the significance of the gene changes from the various drugs. Which of the following is most likely the null hypothesis (H0) in this study?

- W) There is a significant change in gene expression due to the drugs.
- X) There is no significant change in gene expression due to the drugs.
- Y) The gene expression changes in the same way for all drugs.
- Z) The gene expression is different for each individual drug.

ANSWER: X) There is no significant change in gene expression due to the drugs

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### TOSS-UP

7) BIOLOGY – *Short Answer* The fossil record often shows long periods without change, interrupted by short periods of substantial change. What model of speciation is supported from this evidence?

ANSWER: PUNCTUATED (ACCEPT: PUNCTUATED EQUILIBRIUM)

### BONUS

7) BIOLOGY – *Short Answer* By name or number, identify all of the following four reproductive barriers that are postzygotic barriers to reproduction: 1) hybrid inviability, 2) mechanical isolation, 3) temporal isolation, 4) hybrid breakdown

ANSWER: 1 AND 4

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### TOSS-UP

8) CHEMISTRY – *Short Answer* By name or number, order the following four gases by decreasing rate of escape from a balloon with a pinhole poked in it: 1) HBr, 2) He, 3) O<sub>2</sub>, 4) Ne

ANSWER: 2, 4, 3, 1

### BONUS

8) CHEMISTRY – *Multiple Choice* Which of the following molecules has square pyramidal molecular geometry?

- W) SF<sub>6</sub>
- X) PH<sub>3</sub>
- Y) ClF<sub>5</sub>
- Z) XeF<sub>4</sub>

ANSWER: Y) ClF<sub>5</sub>

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### TOSS-UP

9) EARTH AND SPACE – *Short Answer* On Bowen's Reaction Series, amphibole falls directly between which two of the following minerals: 1) potassium feldspar, 2) pyroxene, 3) biotite, 4) olivine

ANSWER: 2 and 3

### BONUS

9) EARTH AND SPACE – *Multiple Choice* Which of the following correctly defines doldrums?

- W) high speed downslope mountain winds
- X) elongated hill created by glaciers
- Y) low pressure belt around the ITCZ
- Z) area of rock surrounding a magma chamber

ANSWER: Y) low pressure belt around the ITCZ

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### TOSS-UP

10) PHYSICS – *Short Answer* By name or number, rank the following four colors by increasing angle of refraction in normal glass: 1) Blue, 2) Yellow, 3) Red, 4) Violet

ANSWER: 3,2,1,4

### BONUS

10) PHYSICS – *Short Answer* A ball is launched horizontally off a cliff of height 30 meters with velocity 15 meters per second. Assuming gravitational acceleration is 10 meters per second squared, in meters what is the horizontal displacement of the ball as it hits the ground?

ANSWER:  $15\sqrt{6}$

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### TOSS-UP

11) MATH – *Short Answer* Gary lives in a world that can be mapped out as a cartesian plane. If his house is at point (0,0) and his job is at point (7,9), how many ways can he get there by only moving up or to the right if he has to stop at the coffee shop at point (5,3)?

ANSWER: 84

### BONUS

11) MATH – *Multiple Choice* What is the shortest distance between the point (4,3) and the equation  $3y=5x+1$ ?

Answer  $6\sqrt{34}/17$

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### TOSS-UP

12) ENERGY – *Short Answer* Alex Petrangelo is in honors chemistry learning about ideal gas laws when he realizes that no gas is ideal. In order to perform accurate experiments, what gas will Alex find to behave most ideally?

ANSWER: Helium

### BONUS

12) ENERGY – *Short Answer* Researchers are looking at the Fox-Wolfram Moment of jet production in relativistic heavy ion collisions and finding that these jets result in a normally distributed output. Which of the following is NOT a property of the standard normal distribution:

W) The total area under the curve is 1

X) It is bell shaped

Y) It is symmetric about the median

Z) 95% of the data lies between 2 standard deviations from the mean

ANSWER: Y) It is symmetric about the median



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**TOSS-UP**

13) BIOLOGY – *Multiple Choice* In photosynthesis, where in the chloroplast does the Calvin Cycle take place?

- W) Thylakoid Membrane
- X) Stroma
- Y) Lumen
- Z) Ribosomes

ANSWER: X) Stroma

**BONUS**

13) BIOLOGY – *Short Answer* Which intermolecular force is responsible for water's high surface tension?

ANSWER: Hydrogen Bonds

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**TOSS-UP**

14) CHEMISTRY – *Short Answer* What is the coordination number of a face-centered cubic cell?

ANSWER: 12

**BONUS**

14) CHEMISTRY – *Short Answer* When multiplied together, what two constants give the ideal gas constant, R?

ANSWER: Boltzmann constant and Avogadro's number

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### TOSS-UP

15) EARTH AND SPACE – *Short Answer* The Crab Nebula, M1, contains a famous example of what stellar object as its central star?

ANSWER: Pulsar (Accept: Neutron Star, Do not accept: Other types of Neutron Stars)

### BONUS

15) EARTH AND SPACE – *Short Answer* A star has an apparent magnitude of 8.6 and a distance of 0.14 arcseconds. What is the absolute magnitude of the star, to the nearest tenth?

ANSWER: -9.3

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### TOSS-UP

16) PHYSICS – *Short Answer* Andrew, who weighs 50 kilograms, is thrown in a particle accelerator and accelerated up to 10 meters per second in a period of 100 seconds. In watts, what could be the minimum average power rating of this particle accelerator over a period of 100 seconds?

ANSWER: 25

### BONUS

16) PHYSICS – *Short Answer* In the same particle accelerator, electrons can accelerate to almost the speed of light. By name or number, indicate which of the following types of physical fields the accelerator takes advantage of to speed up particles: 1) Gravitational Fields, 2) Electric Fields, 3) Magnetic Fields.

ANSWER: 2 and 3

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**TOSS-UP**

17) MATH – *Short Answer* How many diagonals are there in a dodecagon?

ANSWER: 54

**BONUS**

17) MATH – *Short Answer* There are three concentric circles of radius 3, 5 and 7. Two straight lines are drawn from their centers outward creating an arc split into three sections by the three circles. If the angle created by the two lines is 60 degrees. What is the combined area of the smallest and largest sections created by the circles?

ANSWER:  $11\pi/2$  (accept  $5.5\pi$ )

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### TOSS-UP

18) ENERGY – *Multiple Choice* In a nuclear power plant, the concept of neutron flux is crucial for maintaining a controlled chain reaction. The neutron flux is defined as the number of neutrons passing through a unit area per unit time. If a reactor is operated at a steady state with a constant neutron flux, what effect would an increase in neutron flux have on the reactor's reactivity if the fuel and moderator remain unchanged?

- W) The reactivity would decrease
- X) The reactivity would increase
- Y) The reactivity would remain constant
- Z) The reactivity would initially increase but then decrease

ANSWER: X) The reactivity would increase

### BONUS

18) ENERGY – *Multiple Choice* Which of the following isotopes is the main “poison” responsible for an iodine pit in nuclear reactors?

- W)  $^{135}\text{Xe}$  (xenon-135)
- X)  $^{135}\text{I}$  (iodine-135)
- Y)  $^{135}\text{Te}$  (technetium-135)
- Z)  $^{135}\text{Ce}$  (cerium-135)

ANSWER: W)  $^{135}\text{Xe}$