

## NSI2 RR2

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### TOSS-UP

1) BIOLOGY – *Short Answer* What is the term given to organisms such as yeast and bacteria that can generate ATP using either cellular respiration or fermentation?

ANSWER: Facultative Anaerobes

### BONUS

1) BIOLOGY – *Short Answer* Suppose the ability to get a 5 in AP Statistics is a dominant trait over not getting a 5 in AP Statistics, and getting a 5 in AP Physics is a recessive trait to not getting a 5 in AP Physics. If two parents are both heterozygous for the two traits, what is the probability that an offspring does not have the ability to get a 5 in AP Statistics, but has the ability to get a 5 in AP Physics?

ANSWER: 1/16



### TOSS-UP

2) CHEMISTRY – *Short Answer* What is the work done by a gas when it expands from 2 liters to 4 liters at a constant pressure of 100 kPa?

ANSWER: -200 JOULES

### BONUS

2) CHEMISTRY – *Short Answer* What is the standard reduction potential of an electrochemical cell with copper anode and silver cathode if the standard reduction potential of  $\text{Cu}^{2+}$  to Cu is 0.34 V and the standard reduction potential of  $\text{Ag}^{+}$  to Ag is 0.80 V?

ANSWER: 0.46 VOLTS

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**TOSS-UP**

3) EARTH AND SPACE – *Short Answer* What is the adjective used to describe a fault with a curved fault plane?

ANSWER: Listric

**BONUS**

3) EARTH AND SPACE – *Multiple Choice* Which of the following is not an example of a desert landform?

- W) Tombolo
- X) Yardang
- Y) Bajada
- Z) Hogback

ANSWER: Y) Bajada

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**TOSS-UP**

4) PHYSICS – *Short Answer* What is the resistance, in ohms, of a fan that draws 15 amperes on a 240 volt circuit?

ANSWER: 16

**BONUS**

4) PHYSICS – *Short Answer* What color is formed when blue light and yellow light of equal intensities are combined together?

ANSWER: White

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**TOSS-UP**

5) MATH – *Multiple Choice* How many numbers less than or equal to 54 are relatively prime to 54?

W) 12

X) 14

Y) 16

Z) 18

ANSWER: Z) 18

**BONUS**

5) MATH – *Short Answer* What is the infinite sum of  $\frac{3}{4} + \frac{4}{8} + \frac{5}{16} + \frac{6}{32} \dots$

ANSWER: 2

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### TOSS-UP

6) ENERGY – *Multiple Choice* Which of the following binary operations does logistic regression predict the worst?

- W) AND
- X) OR
- Y) XOR
- Z) NOT

ANSWER: Y) XOR

### BONUS

6) ENERGY – *Multiple Choice* Which of the following best describes the Z-score for a data set?

- W) It provides you an optimal threshold for binary classification
- X) It provides a measure of central tendency in a data set
- Y) It describes the variance of a data set
- Z) It describes how far from the mean a data point is

ANSWER: Z) It describes how far from the mean a data point is

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### TOSS-UP

7) BIOLOGY – *Short Answer* What term refers to the rhythmic waves of muscle contraction responsible for pushing contents (for example food) forward?

ANSWER: Peristalsis

### BONUS

7) BIOLOGY – *Short Answer* The descending limb of the loop of Henle is highly permeable to water due to the presence of what family of membrane proteins responsible for facilitating the transport of water across the cell membrane?

ANSWER: Aquaporins

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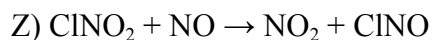
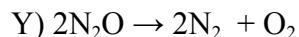
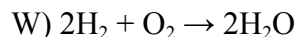
### TOSS-UP

8) CHEMISTRY – *Short Answer* In a chemical reaction, the plot of 1 over the reactant concentration versus time is linear. What is the order of this reaction?

ANSWER: Second Order

### BONUS

8) CHEMISTRY – *Multiple Choice* Which of the following gaseous state reactions has the largest ratio of  $K_p$  to  $K_c$  at STP? (Read arrow as yields)



ANSWER: Y)  $2\text{N}_2\text{O} \rightarrow 2\text{N}_2 + \text{O}_2$

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### TOSS-UP

9) EARTH AND SPACE – *Multiple Choice* Glacial melting of the Greenland Ice Sheet has caused minimal local sea level change due to which of the following effects?

W) Isostatic Rebound

X) Isostatic Compression

Y) Upwelling

Z) Seafloor Spreading

ANSWER: W) Isostatic Rebound

### BONUS

9) EARTH AND SPACE – *Short Answer* Order the following three areas of tectonic activity by decreasing temperature gradient: 1) Mid-Atlantic Ridge 2) Mariana Trench 3) Amazonian Craton

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ANSWER: 1, 3, 2

### TOSS-UP

10) PHYSICS – *Short Answer* A 2 L tank of Oxygen gas undergoes a cyclic process with an initial isothermal process where 1500 joules of work are done on the gas, then an isochoric process where the gas loses 800 joules to heat, and finally a isobaric process. In joules, how much work is done on the gas in one cycle?

ANSWER: 2300

### BONUS

10) PHYSICS – *Short Answer* Alex Petrangelo is training using a high speed boxing bar, which is a bar that spins around a stationary rod. If he lands a punch with force 15 newtons with direction 45 degrees relative to the bar at a position 1 meter from the stationary rod, to the nearest tenth of a Newton meter, how much torque does he exert on the bar?

ANSWER: 10.6



### TOSS-UP

11) MATH – *Short Answer* By name or number, rank the following three numbers in terms of increasing size: 1)  $\sqrt{8}$ , 2)  $2\pi/3$ , 3)  $e$

ANSWER: 2, 3, 1

### BONUSF

11) MATH – *Short Answer* Assuming  $\log_7 2 = 0.36$  and  $\log_7 5 = 0.83$ , what is  $\log_{20} 49$  in simplified form?

ANSWER: 40/31

**TOSS-UP**

12) ENERGY – *Short Answer* Given that a graph has  $n$  nodes and  $e$  edges, what is the time complexity for depth first search?

ANSWER:  $O(n+e)$

**BONUS**

12) ENERGY – *Short Answer* CUDA allows for general computing on what computational component?

ANSWER: GPU

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**TOSS-UP**

13) BIOLOGY – *Short Answer* By name or number, identify all of the following three genera of bacteria that are Gram positive: 1) Clostridium, 2) Bacillus, 3) Streptococcus

ANSWER: ALL

**BONUS**

13) BIOLOGY – *Multiple Choice* Which of the following organisms is not iteroparous?

- W) Humans
- X) Penguins
- Y) Mosquitos
- Z) Salmon

ANSWER: Z) SALMON

**TOSS-UP**

14) CHEMISTRY – *Multiple Choice* In reaction  $A + B \rightarrow C + D$ , the rate of the reaction doubles when the initial concentration of A is doubled, and the rate of the reaction decreases by a factor of 9 when the concentration of B is tripled. Which of the following expressions best gives the rate law for this reaction?

- W)  $k[A]/[B]$  (READ AS: k times the concentration of A divided by the concentration of B)
- X)  $k[A]^2[B]$  (READ AS: k times the concentration of A squared times the concentration of B)
- Y)  $k[A]/[B]^2$
- Z)  $k[A]^2[B]^2$

ANSWER: Y)  $k[A]/[B]^2$

**BONUS**

14) CHEMISTRY – *Short Answer* Order the following three compounds in order of decreasing boiling point elevation when 1kg is dissolved in 10 liters of water: 1)  $Li_2O$ , 2)  $PCl_5$ , 3)  $NaNO_3$

ANSWER: 1, 3, 2

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**TOSS-UP**

15) EARTH AND SPACE – *Short Answer* The Conrad discontinuity separates which two layers of Earth?

ANSWER: Upper and Lower Crust

**BONUS**

15) EARTH AND SPACE – *Short Answer* What term refers to small standing waves on an enclosed body of water which are often caused by wind?

ANSWER: Seiche



**TOSS-UP**

16) PHYSICS – *Multiple Choice* Which of the following choices best explains why either an alpha particle or a proton has greater acceleration in a uniform electric field?

- W) The alpha particle speeds up faster because it has less mass and greater charge.
- X) The alpha particle speeds up faster as its greater charge outweighs its greater mass.
- Y) The proton speeds up faster as its lesser mass outweighs its lesser charge.
- Z) The proton speeds up faster because it has less mass and less charge.

ANSWER: Y) The proton speeds up faster as its lesser mass outweighs its lesser charge.

**BONUS**

16) PHYSICS – *Short Answer* A spring attached to the ground with spring constant 200 newtons per meter is compressed by a 5 kilogram block dropped from 1 meter above the springs equilibrium position. Assuming gravitational field strength 10 meters per second square, in meters, how much will the spring be compressed?

Answer:  $\sqrt{2}/2$  meters

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**TOSS-UP**

17) MATH – *Multiple Choice* How many solutions are there to the equation  $\tan(3x)=1$  from 0 to  $2\pi$  inclusive radians.

W) 2

X) 4

Y) 6

Z) 8

ANSWER: Y) 6

**BONUS**

17) MATH – *Short Answer* What is the coordinates of the hole of the graph  $f(x)= (2x^2-18) / (x-3)$

ANSWER: (3, 12)

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### TOSS-UP

18) ENERGY – *Multiple Choice* The Red Queen Hypothesis suggests that organisms must constantly adapt and evolve to survive against opposing species, such as parasites or predators. Which of the following best explains how this hypothesis relates to host-parasite coevolution?

- W) Hosts and parasites reach a stable equilibrium, with little evolutionary change over time.
- X) Parasites evolve more slowly than hosts, leading to eventual host resistance.
- Y) Both hosts and parasites continuously evolve in response to each other
- Z) Hosts evolve to eliminate parasites completely

ANSWER: Y) Both hosts and parasites continuously evolve in response to each other

### BONUS

18) ENERGY – *Short Answer* Binary trees are used to store data for alphabetic codes. Given that a binary search tree has  $n$  elements, what is the worst case runtime for deleting an element?

ANSWER:  $O(n)$