

Niskayuna Summer Invitational Round Robin 1

TOSS-UP

1) Physics – *Multiple Choice* Which of the following is not necessarily true of the particles of ideal gasses? (TJ)

W) They behave like hard, spherical objects in a state of constant, random motion.

X) They have no volume or intermolecular forces

Y) They do not exert pressure

Z) They collide perfectly elastically

ANSWER: Y) THEY DO NOT EXERT PRESSURE

BONUS

1) Physics – *Multiple Choice* A capacitor has an electric charge of 80 coulombs(READ AS: coo-lumbs) and a capacitance of 20 Farads(READ AS: feh-rudz). What is the applied voltage?

W) 4 volts

X) 10 volts

Y) 16 volts

Z) 1600 volts

ANSWER: W) 4 volts

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### TOSS-UP

2) Chemistry – *Short Answer* What element has the highest first ionization energy? (MK)

ANSWER: HELIUM

### BONUS

2) Chemistry – *Short Answer* What type of nuclear particle is emanated from the first radioactive decay step of uranium-238?

ANSWER: ALPHA(Accept: HELIUM-4)

### TOSS-UP

3) Energy – *Short Answer* In 1913, Fritz Haber coined a method to produce ammonia from free nitrogen, which could be used as artificial fertilizer. Considering  $N_2 + 3H_2 \rightleftharpoons 2NH_3$  (READ AS: the reversible reaction N2 plus 3H2 yields 2NH3) in a closed system, if the pressure of hydrogen gas were to increase, what could be expected to happen to the pressure of nitrogen gas after the system reestablishes equilibrium? (MK)

ANSWER: DECREASE

### BONUS

3) Energy – *Multiple Choice* Approximately how much energy is released per mole hydrogen gas consumed in the Haber process, assuming that the enthalpy of formation of ammonia gas is -45 kilojoules per mole?

- W) 30 kJ
- X) 45 kJ
- Y) 60 kJ
- Z) 90 kJ

ANSWER: W) 30 kJ



### TOSS-UP

4) Earth and Space – *Short Answer* What term is given to the measure of the ability of a planet to reflect incident light or radiation? (DY)

ANSWER: ALBEDO

### BONUS

4) Earth and Space – *Multiple Choice* Which of the following planets has an albedo (READ AS: Al-bee-doe) closest to Earth's?

- W) Mercury
- X) Venus
- Y) Mars
- Z) Neptune

ANSWER: Z) NEPTUNE

**TOSS-UP**

5) Math – *Multiple Choice* How many positive factors does 360 have? (AR)

- W) 6
- X) 12
- Y) 24
- Z) 48

ANSWER: Y) 24

**BONUS**

5) Math – *Short Answer* What is the area of the convex quadrilateral with vertices (0,0), (1,3), (4,2), and (3,1)?

ANSWER: 6



**TOSS-UP**

6) Chemistry – *Short Answer* How many hydrogen atoms are present in a molecule of ethyne (READ AS: eth-Ine)? (MK)

ANSWER: 2

**BONUS**

6) Chemistry – *Short Answer* What type of intermolecular force will be strongest between molecules in pure hydrogen chloride?

ANSWER: DIPOLE-DIPOLE (DO NOT ACCEPT: HYDROGEN BONDS)

### TOSS-UP

7) Physics – *Short Answer* A square loop with side length 10 cm is placed in a uniform magnetic field of magnitude 0.5 Teslas. If the magnetic field is oriented perpendicular to the plane of the loop, then, in teslas times meters squared, what is the magnetic flux through the loop? (TJ)

ANSWER: 0.005

### BONUS

7) Physics – *Short Answer* A projectile is launched with an initial speed of 30 m/s at an angle of 45 degrees above the horizontal. To the nearest whole number, in meters, what is the horizontal range of the projectile?

ANSWER: 92

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### TOSS-UP

8) Biology – *Multiple Choice* What is the name of the process in which blood cells are formed by bone marrow stem cells? (MK)

- W) Angiogenesis (READ AS: ann-jee-oh-gen-esis)
- X) Osteogenesis
- Y) Ostedangiogenesis
- Z) Hematopoiesis (READ AS: he-ma-tuh-poy-ee-sus)

ANSWER: Z) HEMATOPOIESIS

### BONUS

8) Biology – *Short Answer* What class of immunoglobulins is associated with allergies?

ANSWER: IMMUNOGLOBULIN E (ACCEPT: IgE)

**TOSS-UP**

9) Earth and Space – *Multiple Choice* Which of the following is an example of an active galactic nucleus (AGN)? (TJ)

- W) Andromeda Galaxy
- X) Sombrero Galaxy
- Y) Crab Nebula
- Z) Seyfert Galaxy

ANSWER: Z) SEYFERT GALAXY

**BONUS**

9) Earth and Space – *Multiple Choice* Rank the following layers of the sun's atmosphere in order from least to greatest average temperature. 1) Chromosphere, 2) Corona, 3) Photosphere

ANSWER: 3, 1, 2



**TOSS-UP**

10) Math – *Short Answer* In the right triangle ABC,  $AB = 5$  and  $BC = 12$ . What is the radius of the circle inscribed in triangle ABC? (AR)

ANSWER: 2

**BONUS**

10) Math – *Multiple Choice* How many of the 5 statements are true? 1. Exactly two of the statements are true. 2. Exactly two of the statements are false. 3. One or more of the statements are true. 4. One or more of the statements are false. 5. None of the statements are true.

- W) 1
- X) 2
- Y) 3
- Z) 4

ANSWER: Y) 3

### TOSS-UP

11) Physics – *Short Answer* What is the SI unit for luminous intensity? (AI)

ANSWER: CANDELA

### BONUS

11) Physics – *Short Answer* For an electron accelerated through a potential difference of 100 Volts, what is its final kinetic energy in joules? Express your answer in scientific notation to two significant figures.

ANSWER:  $1.6 * 10^{-17}$

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### TOSS-UP

12) Energy – *Multiple Choice* Scientists at Oak Ridge National Lab have developed The Material Plasma Exposure eXperiment, which is a next-generation linear plasma device that will support study of the way plasma will interact long term with the components of future fusion reactors. Which of the following is not a viable fuel for artificial fusion? (AR)

- W) Helium-3
- X) Hydrogen-3
- Y) Helium-4
- Z) Hydrogen-2

ANSWER: Y) HELIUM-4

### BONUS

12) Energy – *Short Answer* Researchers at Argonne National Labs have worked to develop a device to reduce methane emissions. By name or number, rank the following four gases in terms of increasing concentration in Earth's atmosphere. 1) Argon, 2) Carbon Dioxide, 3) Methane, 4) Neon.

ANSWER: METHANE, NEON, CARBON DIOXIDE, ARGON (ACCEPT: 3, 4, 2, 1)

### TOSS-UP

13) Biology – *Multiple Choice* Based on the cisternal (READ AS: sis-ter-nul) maturation model, what direction do vesicles in a Golgi apparatus mature? (MK)

- W) trans to cis
- X) cis to trans
- Y) left to right
- Z) right to left

ANSWER: X) CIS TO TRANS

### BONUS

13) Biology – *Multiple Choice* What is the microtubule arrangement found in the centrioles of *C. Elegans*?

- W) 9+0 singlets
- X) 9+0 doublets
- Y) 9+2 singlets
- Z) 9+2 doublets

ANSWER: W) 9+0 SINGLETS

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TOSS-UP

14) Earth and Space – *Multiple Choice* Approximately what percentage of water on Earth is freshwater? (AP)

- W) 0.7%
- X) 2.8%
- Y) 7.2%
- Z) 10.3%

ANSWER: X) 2.8%

BONUS

14) Earth and Space – *Short Answer* By name or number give all of the following 3 statements that are true about S waves.

- 1) They travel faster than P waves
- 2) They are capable of traveling through the outer core but not the inner core
- 3) The ground oscillates parallel to the direction of the wave (DY)

ANSWER: NONE

TOSS-UP

15) Math – *Short Answer* What is the probability that, when flipped, exactly two out of five fair coins land heads? (AR)

ANSWER: 5/16

BONUS

15) Math – *Multiple Choice* What is the remainder when the polynomial $x^3 + 2x^2 - 3x + 4$ (READ AS: x cubed plus two x squared minus three x plus four) is divided by $x^2 + 3$ (READ AS: x squared plus 3)?

ANSWER: $-6x - 2$ (negative six x minus two)

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### TOSS-UP

16) Chemistry – *Short Answer* What is the hybridization of the central phosphorus atom in phosphorus pentachloride? (AR)

ANSWER:  $sp^3d$  (ACCEPT:  $dsp^3$ )

### BONUS

16) Chemistry – *Short Answer* By name or number, rank the following three compounds in terms of increasing solubility in water: 1) Silver Sulfate, 2) Barium Nitrate, 3) Barium Sulfate

ANSWER: BARIUM SULFATE, SILVER SULFATE, BARIUM NITRATE (Accept: 3, 1, 2)



**TOSS-UP**

17) Biology – *Multiple Choice* What is the formal charge on the Nitrogen in the amine group of an amino acid at physiological pH? (MK)

- W) -1
- X) 0
- Y) +1
- Z) +2

ANSWER: Y) +1

**BONUS**

17) Biology – *Multiple Choice* How many bonds are formed around the Phosphorus atom in a phospholipid?

- W) 2
- X) 3
- Y) 4
- Z) 5

ANSWER: Z) 5



**TOSS-UP**

18) Earth and Space – *Multiple Choice* Which of the following is not a glacial feature? (DY)

- W) Tarn
- X) Oxbow lake
- Y) Esker
- Z) Kettle lake

ANSWER: X) OXBOW LAKE

**BONUS**

18) Earth and Space – *Short Answer* What term is given to sediment that is deposited by a glacier?

ANSWER: TILL (ACCEPT: GLACIAL DRIFT)

### TOSS-UP

19) Math – *Multiple Choice* What is the value of  $(\sqrt[3]{3})^6$  (READ AS the quantity of the cube root of 3 to the power of 6)? (MK)

- W) 3
- X) 9
- Y) 27
- Z) 81

ANSWER: X) 9

### BONUS

19) Math – *Short Answer* Given that  $\log(2)$  is 0.30 and  $\log(3)$  is 0.48, find the value, to the nearest tenth, of  $\log_2 12$  (READ AS: log base 2 of 12). (AR)

ANSWER: 3.6

### ESTIMATION

20) Estimation – *Short Answer* Not including this question, to the nearest ten, how many times did the character 'a' appear in this packet?

ANSWER: 520