

## Round 2

### 1. CHEMISTRY

Writer: Stuyvesant

Toss Up: Short Answer

What is the name of the elements in Group 16?

**Bonus Answer: Chalcogens (Accept: Chalcogen, Oxygen Family)**

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**Bonus: Short Answer**

When Carbonic acid is created what does it always decompose into?

**Bonus Answer: Dihydrogen Monoxide and Carbon Dioxide (Accept: H<sub>2</sub>O and CO<sub>2</sub>, Water and CO<sub>2</sub>)**

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### 2. BIOLOGY

Writer: Stuyvesant

Toss Up: Short Answer

Which amino acid would constitute a disulfide bridge?

**Bonus Answer: Cysteine**

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**Bonus: Short Answer**

What is the name of the cellular machinery that removes introns?

**Bonus Answer: Spliceosome**

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### 3. CHEMISTRY

Writer: Centennial

Toss Up: Short Answer

What is the most significant component in duralumin, other than aluminum?

**Bonus Answer: Copper**

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**Bonus: Short Answer**

The addition of copper makes the alloy susceptible to which process, from which pure aluminum is usually protected?

**Bonus Answer: Corrosion**

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### 4. EARTH and SPACE

Writer: Stuyvesant

Toss Up: Short Answer

Which type of star will live for the longest period of time?

**Bonus Answer: Red Dwarfs (they can live for 1 trillion years or so)**

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**Bonus: Multiple Choice**

What resonance does Pluto have with Neptune which ensures that the celestial objects will never impact each other?

W) 2:1

X) 3:2

Y) 5:2

Z) 5:4

**Bonus Answer: X**

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### 5. ENERGY

Writer: Stuyvesant

Toss Up: Short Answer

Which compound in the atmosphere contributes the most to the greenhouse effect?

**Bonus Answer: Water (accept: H<sub>2</sub>O or dihydrogen monoxide)**

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**Bonus: Short Answer**

What is China's largest renewable energy source?

**Bonus Answer: Hydropower (accept: Hydro)**

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## 6. PHYSICS

**Writer: American Heritage**

**Toss Up: Multiple Choice**

Jed and Sirajri both begin listening to a 60 minute album, Coloring Book by Chance the Rapper, at the same time. Jed then gets into a spaceship where he travels at 80% of the speed of light. Who finishes the album first, and how much of the album is left for the second person?

- W) Jed finishes 48 minutes before Sirajri
- X) Jed finishes 40 minutes before Sirajri
- Y) Sirajri finishes 48 minutes before Jed
- Z) Sirajri finishes 40 minutes before Jed

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Which of the following statements about the standard model is false?

- W) The Z gauge boson is less massive than the W<sup>+</sup> gauge boson
- X) There are 8 kinds of gluons
- Y) All 12 elementary particles in the standard model are fermions
- Z) The charm quark is a second generation particle

**Bonus Answer: W**

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## 7. BIOLOGY

**Writer: Centennial**

**Toss Up: Short Answer**

Name all of the following that are usually characteristics of monocots: (1) Petals in multiples of three, (2) taproot present, (3) vascular bundles arranged in a ring, (4) parallel veins

**Bonus Answer: (1) Petals in multiples of three, and (4) parallel veins**

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**Bonus: Short Answer**

Name all of the following that are monocots: corn, crabgrass, red bean

**Bonus Answer: Corn and crabgrass**

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## 8. MATHEMATICS

**Writer: Stuyvesant**

**Toss Up: Multiple Choice**

If the test scores of Mr. Coco's Calculus test are assumed to have a normal distribution, and if the mean test score was 91, what can be said about the median test score of that test?

- W) The median was lower than 91
- X) The median was higher than 91
- Y) The median was 91
- Z) The median cannot be determined

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

The z-score for Steven's physics test grade was found to be 0.375. If he scored a 94 on the test, and the standard deviation was 8, what was the mean test score on the physics test?

- W) 91
- X) 95
- Y) 92
- Z) 98

**Bonus Answer: W**

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**9. ENERGY**

**Writer: Stuyvesant**

**Toss Up: Multiple Choice**

In a conventional light bulb, what is the ratio of light energy to the heat energy produced?

- W) 1:9
- X) 3:2
- Y) 1:1
- Z) 7:3

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

The arctic is estimated to hold what percent of the worlds what percent of the world's undiscovered oil and natural gas reserves?

- W) 7%
- X) 13%
- Y) 22%
- Z) 35%

**Bonus Answer: Y**

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**10. EARTH and SPACE**

**Writer: Stuyvesant**

**Toss Up: Short Answer**

By name or number, list the following classes of stars from hottest to coolest:

1. Class K
2. Class O
3. Class A
4. Class B

**Bonus Answer: 2,4,3,1**

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**Bonus: Short Answer**

What are the brightest events in the universe?

**Bonus Answer: Gamma Ray Bursts**

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**11. CHEMISTRY**

**Writer: Centennial**

**Toss Up: Short Answer**

63/37 leaded solder is this type of mixture, which melts at once instead of melting as components.

**Bonus Answer: Eutectic**

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**Bonus: Short Answer**

Apart from tin whiskers, lead-free solder also suffers from this problem at low temperatures.

**Bonus Answer: Tin pest**

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## 12. ENERGY

**Writer: Stuyvesant**

**Toss Up: Multiple Choice**

Which country generates the highest percentage of its energy from nuclear power?

- W) Britain
- X) China
- Y) France
- Z) Denmark

**Toss Up Answer: Y**

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**Bonus: Short Answer**

By name or number, list the operating temperatures from lowest to highest of these types of fuel cells:

1. MCFC
2. PAFC
3. PEMFC
4. SOFC

**Bonus Answer: 3,2,1,4**

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## 13. EARTH and SPACE

**Writer: Centennial**

**Toss Up: Multiple Choice**

Which of the following was eventually proposed to explain the Pioneer anomaly?

- W) Radiation pressure
- X) Outgassing from spacecraft parts
- Y) Solar wind
- Z) Previously undiscovered planets

**Toss Up Answer: W**

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**Bonus: Short Answer**

What phenomenon was used to measure the speed of the Pioneer spacecraft?

**Bonus Answer: Doppler Effect**

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## 14. PHYSICS

**Writer: Stuyvesant**

**Toss Up: Short Answer**

Maxwell's equations are to electric and magnetic fields as what equation is to the wave function for a particle?

**Bonus Answer: Schrodinger's**

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**Bonus: Multiple Choice**

A non-relativistic free electron has kinetic energy  $K$ . If its wavelength doubles, what is its kinetic energy in terms of  $K$ ?

- W)  $4K$
- X)  $K/4$
- Y)  $K$

Z)  $K/2$

**Bonus Answer: X**

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## 15. MATHEMATICS

**Writer: Stuyvesant**

**Toss Up: Multiple Choice**

Simplify  $(\sin 15 \cos 75 - \cos 15 \sin 75) / (\cos 15 \cos 75 + \sin 15 \sin 75)$

W) negative square root of 3

X)  $1/2$

Y)  $-1/2$

Z) square root of 6 minus square root of 2 all over 2

**Toss Up Answer: W**

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**Bonus: Short Answer**

Compute  $(2 + 2\sqrt{3}i)^6$ . [the quantity 2+2 times the square root of 3 time i to the 6th power]

**Bonus Answer: 4096**

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## 16. PHYSICS

**Writer: Stuyvesant**

**Toss Up: Short Answer**

A molecule with a magnetic moment of  $83 \text{ N}\cdot\text{m/T}$  (read as Newton-meters per Tesla) experiences what amount of torque in  $\text{N}\cdot\text{m}$  (read as Newton-meter) when subjected to an external magnetic force of 120 teslas?

**Bonus Answer: 9960  $\text{N}\cdot\text{m}$**

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**Bonus: Multiple Choice**

A certain capacitor, in series with a  $720\text{-}\Omega$  resistor, is being charged. At the end of 10 ms (milliseconds) its charge is half the final value. The capacitance is about:

W)  $9.6 \mu\text{F}$

X)  $14 \mu\text{F}$

Y)  $20 \mu\text{F}$

Z)  $7.2\text{F}$

**Bonus Answer: Y**

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## 17. MATHEMATICS

**Writer: Centennial**

**Toss Up: Short Answer**

If X and Y are independent random variables with standard deviations of a and b respectively, what is the standard deviation of the quantity  $X+2Y$ ?

**Bonus Answer:  $\sqrt{a^2+4b^2}$**

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**Bonus: Short Answer**

If X and Y are independent random variables with expected values c and d respectively, what is the expected value of the quantity  $X+2Y$ ?

**Bonus Answer:  $c+2d$**

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## 18. EARTH and SPACE

**Writer: Centennial**

**Toss Up: Multiple Choice**

Which of the following compounds made up most of Mt. St. Helens' ash?

W) Magnesium oxide

X) Aluminum oxide

Y) Silicon dioxide

Z) Sodium oxide

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What mineral forms the dome of Mt. St. Helens?

**Bonus Answer: Dacite**

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## 19. MATHEMATICS

**Writer: Centennial**

**Toss Up: Short Answer**

What is the name for the group of four datasets with nearly identical summary statistics, but drastically different scatterplots?

**Bonus Answer: Anscombe's quartet**

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**Bonus: Short Answer**

X is a random variable with a uniform distribution with width w of values. In terms of w, what is the standard deviation of X?

**Bonus Answer:  $\sqrt{w^2/12}$**

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## 20. CHEMISTRY

**Writer: Granada Hills**

**Toss Up: Multiple Choice**

What is the name of the group of the periodic table that includes selenium?

W) Halogens

X) Noble gases

Y) Alkali metals

Z) Chalcogens

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the general name of the compounds that are highly toxic and are formed from reacting ammonia with baking soda?

**Bonus Answer: Chloramines**

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## 21. MATHEMATICS

**Writer: Centennial**

**Toss Up: Short Answer**

What is the exact average value of  $x^2+3x-2$  from  $x=3$  to  $x=6$ ?

**Bonus Answer: 195/6**

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**Bonus: Multiple Choice**

With which of the following nth terms will an infinite series converge?

W)  $1/n$

X)  $\ln n$

Y)  $\sin n$

Z)  $1/n^3$

**Bonus Answer: Z**

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## 22. BIOLOGY

**Writer: Centennial**

**Toss Up: Short Answer**

Which subunit of Na<sup>+</sup>/K<sup>+</sup>-ATPase binds the Na<sup>+</sup> ion?

**Bonus Answer: The alpha subunit**

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**Bonus: Multiple Choice**

Which of the following effects would a toxin that blocked voltage-gated potassium channels be most likely to cause?

W) A decrease in the strength of the action potential

X) A decrease in the length of the refractory period

Y) An increase in the speed of the action potential

Z) An increase in the strength of the action potential

**Bonus Answer: Z**

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## 23. CHEMISTRY

**Writer: Granada Hills**

**Toss Up: Short Answer**

Helium has a molar mass of 4 grams per mole and effuses at a rate of 10 moles per minute. If you have an unknown gas with a molar mass of 16 grams per mole, How many moles per minute would it effuse at?

**Bonus Answer: 5**

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**Bonus: Short Answer**

By name or number, indicate all of the following choices that would undergo SN1.

I. 2-bromo-2-methylpropane

II. CH<sub>3</sub>CHCHCH<sub>2</sub>Cl

III. Polyethylene

**Bonus Answer: I only**

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## 24. BIOLOGY

**Writer: Granada Hills**

**Toss Up: Multiple Choice**

The organ that produces glucagon is under what organ-system?

W) Musculo-Skeletal

X) Nervous

Y) Endocrine

Z) Circulatory

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Most pharmaceutical insulin is produced using what species of bacteria?

**Bonus Answer: E. Coli**

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## 25. BIOLOGY

**Writer: Granada Hills**

**Toss Up: Multiple Choice**

What part of the brain controls the ability to understand speech?

W) Olfactory

X) Frontal

Y) Broca's Area

Z) Wernicke's Area

**Toss Up Answer: Z**

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**Bonus: Short Answer**

Which neural tissue facilitates neural messages from the left to the right hemispheres?

**Bonus Answer: Corpus Callosum**

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