

Round 2

1. 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

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+ 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

2. 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: Shcrodinger's

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

3. PHYSICS

Writer: Stuyvesant

Toss Up: Short Answer

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

Bonus Answer: 9960 N*m

Bonus: Multiple Choice

A certain capacitor, in series with a 720-Ω 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 μF
- X) 14 μF

Y) 20 μ F

Z) 7.2F

Bonus Answer: Y

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4. 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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5. MATHEMATICS

Writer: Stuyvesant

Toss Up: Multiple Choice

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

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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6. 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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7. 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

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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8. 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: $195/6$

Bonus: Multiple Choice

With which of the following n th 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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9. BIOLOGY

Writer: Stuyvesant

Toss Up: Short Answer

Which amino acid would constitute a disulfide bridge?

Bonus Answer: Cysteine

Bonus: Short Answer

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

Bonus Answer: Spliceosome

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10. 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

Bonus: Short Answer

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

Bonus Answer: Corn and crabgrass

11. BIOLOGY

Writer: Centennial

Toss Up: Short Answer

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

Bonus Answer: The alpha subunit

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

12. 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

Bonus: Short Answer

Most pharmaceutical insulin is produced using what species of bacteria?

Bonus Answer: E. Coli

13. 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

Bonus: Short Answer

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

Bonus Answer: Corpus Callosum

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14. 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: H₂O and CO₂, Water and CO₂)

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15. 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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16. 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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17. 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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18. 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

Bonus: Short Answer

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

I. 2-bromo-2-methylpropane

II. $\text{CH}_3\text{CHCHCH}_2\text{Cl}$

III. Polyethylene

Bonus Answer: I only

19. 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)

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

20. 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

Bonus: Short Answer

What are the brightest events in the universe?

Bonus Answer: Gamma Ray Bursts

21. 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

Bonus: Short Answer

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

Bonus Answer: Doppler Effect

22. 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

Bonus: Short Answer

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

Bonus Answer: Dacite

23. ENERGY

Writer: Stuyvesant

Toss Up: Short Answer

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

Bonus Answer: Water (accept: H₂O or dihydrogen monoxide)

Bonus: Short Answer

What is China's largest renewable energy source?

Bonus Answer: Hydropower (accept: Hydro)

24. 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

Bonus: Multiple Choice

The arctic is estimated to hold 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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25. 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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