

Round 2

1. ENERGY

Writer: Centennial

Toss Up: Multiple Choice

Which of the following is closest to the capacity of the largest offshore wind farm?

- W) 60 MW
- X) 600 MW
- Y) 6000 MW
- Z) 60000 MW

Toss Up Answer: X

Bonus: Short Answer

In which country is the largest offshore wind farm?

Bonus Answer: The United Kingdom

2. 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: $\sqrt{w^2/12}$

3. ENERGY

Writer: Centennial

Toss Up: Multiple Choice

Which of the following compounds is not usually a major component of fly ash?

- W) Silicon dioxide
- X) Aluminum oxide
- Y) Magnesium oxide
- Z) Calcium oxide

Toss Up Answer: Y

Bonus: Short Answer

What is the name for the ash that, unlike fly ash, does not escape up the chimney?

Bonus Answer: Bottom ash

4. 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

5. 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

6. BIOLOGY

Writer: Granada Hills

Toss Up: Multiple Choice

One mantis shrimp has how many more sets of photoreceptors than one dog?

W) 2

X) 4

Y) 14

Z) 27

Toss Up Answer: Y

Bonus: Short Answer

By name or number, name all of the following species that produce insulin in the Brockmann body.

I) Salmon

II) Chimpanzee

III) Horse

IV) Tilapia

V) Octopus

Bonus Answer: I and IV only

7. PHYSICS

Writer: Centennial

Toss Up: Short Answer

A body orbits another with a pericenter of 100km and an apocenter of 500km, and travels 40m/s at the apocenter. To

the nearest m/s, what is the speed at the pericenter?

Bonus Answer: 200 m/s

Bonus: Short Answer

The central body is changed to one with double the mass, and the shape and size of the orbit are kept constant. By what factor will the speed of the orbiting object change?

Bonus Answer: Sqrt(2) times faster

8. 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

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

9. 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

10. 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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11. 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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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

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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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13. PHYSICS

Writer: Centennial

Toss Up: Short Answer

What is the resonant frequency, to the nearest hertz, of an LC circuit with $L=0.1\text{H}$ and $C=150\mu\text{F}$?

Bonus Answer: 41 Hz

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Bonus: Short Answer

An RLC circuit has $R=200\Omega$, $L=0.5\text{H}$, and $C=50\mu\text{F}$. Is this circuit (1) overdamped, (2) underdamped, or (3) critically

damped?

Bonus Answer: (3) critically damped

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14. 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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15. BIOLOGY

Writer: Centennial

Toss Up: Short Answer

Which subunit of Na⁺/K⁺-ATPase binds the Na⁺ 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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16. 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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17. 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

18. EARTH and SPACE

Writer: Stuyvesant

Toss Up: Multiple Choice

Which of the following rocks is responsible for the formation of black sand?

W) Quartzite

X) Schist

Y) Slate

Z) Basalt

Toss Up Answer: Z

Bonus: Short Answer

What is the scale used to measure the hardness of minerals?

Bonus Answer: Moh Scale (accept: Moh)

19. PHYSICS

Writer: Stuyvesant

Toss Up: Short Answer

A molecule with a magnetic moment of $83 \text{ N}\cdot\text{m}/\text{T}$ (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: $9960 \text{ N}\cdot\text{m}$

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) 7.2F

Bonus Answer: Y

20. 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: $\sqrt{a^2+4b^2}$

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: $c+2d$

21. 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

Bonus: Short Answer

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

Bonus Answer: Tin pest

22. 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

23. 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

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

24. CHEMISTRY

Writer: Centennial

Toss Up: Short Answer

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

Bonus Answer: Copper

Bonus: Short Answer

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

Bonus Answer: Corrosion

25. 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

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
