

Centennial

1. Energy

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

2. Energy

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

3. Energy

Toss Up: Short Answer

What is the name of the theoretical maximum proportion of energy that can be extracted from an airflow?

Toss Up Answer: Betz's law or the Betz limit

Bonus: Short Answer

What is the exact value of the Betz limit?

Bonus Answer: 16/27

4. Physics

Toss Up: Short Answer

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

Toss Up Answer: 41 Hz

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

5. Physics

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?

Toss Up 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

6. Physics

Toss Up: Short Answer

According to Darcy's law, by what factor will the fluid velocity change if the pressure gradient is doubled?

Toss Up Answer: It will double

Bonus: Short Answer

In turbulent flow, if the velocity of an object doubles and the object is scaled down by a factor of 1/3, by what factor will the drag force change?

Bonus Answer: 4/9

7. Mathematics

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 $X+2Y$?

Toss Up 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: $c+2d$

8. Mathematics

Toss Up: Short Answer

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

Toss Up 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: $\sqrt{w^2/12}$

9. Mathematics

Toss Up: Short Answer

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

Toss Up Answer: 195/6

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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10. Earth and Space Science

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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11. Earth and Space Science

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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12. Earth and Space Science

Toss Up: Multiple Choice

Which of the giant planets has the least massive moon system?

- W) Jupiter
- X) Saturn
- Y) Uranus
- Z) Neptune

Toss Up Answer: Y

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Bonus: Short Answer

Which moon is the only one in the Solar System to have a retrograde orbit?

Bonus Answer: Triton

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13. Biology

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

Toss Up 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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14. Biology

Toss Up: Short Answer

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

Toss Up 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

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15. Chemistry

Toss Up: Short Answer

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

Toss Up 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

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16. Chemistry

Toss Up: Short Answer

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

Toss Up Answer: Eutectic

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. Biology

Toss Up: Short Answer

What is the name for the vessel network that supplies the large blood vessels?

Toss Up Answer: vasa vasorum

Bonus: Short Answer

Order the following sinuses in the human skull from superior to inferior: maxillary, frontal, ethmoid

Bonus Answer: Frontal, ethmoid, maxillary

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18. Chemistry

Toss Up: Short Answer

How many alkenes have the formula of C₄H₈?

Toss Up Answer: four

Bonus: Short Answer

Rank the following elements in increasing order of melting point: vanadium, iron, cobalt, tantalum

Bonus Answer: cobalt, iron, vanadium, tantalum

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