

Round 8

1. EARTH and SPACE

Writer: Wilson Berkow

Toss Up: Multiple Choice

A red dwarf is

W) A large variation of brown dwarf

X) The remnant of a main sequence star

Y) A small and cool star in the main sequence

Z) Unable to complete nuclear fusion

Toss Up Answer: Y

Bonus: Short Answer

What type of star will the Sun become once it leaves the main sequence?

Bonus Answer: Red giant

2. MATHEMATICS

Writer: Andrew Chen

Toss Up: Short Answer

How many vertices does a dodecahedron have?

Bonus Answer: 20

Bonus: Short Answer

In $a+bi$ form, what is the square root of i (give the answer with positive imaginary part)?

Bonus Answer: $(1/(\sqrt{2})) + (1/(\sqrt{2}))i$

3. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

What is the general name for a hypothetical gas that does not obey Boyle's law at all temperatures and pressures?

Bonus Answer: non ideal

Bonus: Short Answer

Gypsum is calcium sulfate hydrated with two water molecules. Gypsum is what percent water by weight? (atomic mass of calcium = 40; sulfur = 32 and oxygen = 16.)

Bonus Answer: 21

4. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is a famous impossible result of the classical modeling of blackbody intensity as a function of frequency?

Bonus Answer: "Ultraviolet Catastrophe"

Bonus: Multiple Choice

What is the classical law that attempts to map blackbody intensity as a function of frequency and leads to "ultraviolet catastrophe"?

W) Henderson-Hasselbalch's Law

X) Rayleigh-Jeans Law

Y) Plank's Law

Z) Kirchhoff Law

Bonus Answer: X

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5. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

If the electronegativity difference in the bonding atoms is between 0.4 and 1.7, what type of bond is formed?

Bonus Answer: polar covalent

Bonus: Short Answer

what is the formula for potassium perchlorate?

Bonus Answer: KClO_4

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6. BIOLOGY

Writer: Amrit Hingorani

Toss Up: Short Answer

Which structural component of the cell cytoskeleton has alpha and beta subunits and is involved with intracellular transport?

Bonus Answer: Microtubules

Bonus: Short Answer

What are the units of inheritance?

Bonus Answer: Genes (accept DNA)

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7. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

How many calories of heat are required to vaporize one gram of water?

Bonus Answer: 540

Bonus: Short Answer

What is the name for the straight-chain alkane containing 5 carbons?

Bonus Answer: pentane

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8. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Researchers in 2015 reported that resistance to a certain antibiotic was found in a growing number of bacteria from meat samples in China. What is the name of this antibiotic that treats Gram-negative bacteria?

W) Colistin

X) Carbapenems

Y) Linezolid

Z) Vancomycin

Toss Up Answer: W

Bonus: Short Answer

What is the name of polymer in bacterial walls not found in Gram-negative bacteria?

Bonus Answer:

Peptidoglycan

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9. ENERGY

Writer: Amrit Hingorani

Toss Up: Multiple Choice

Using current technologies, which of the following sources of energy is nonrenewable?

- W) Geothermal
- X) Wind
- Y) Nuclear
- Z) Solar

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following is NOT a fossil fuel?

- W) Coal
- X) Petroleum
- Y) Natural gas
- Z) Uranium

Bonus Answer: Z

10. EARTH and SPACE

Writer: Wilson Berkow

Toss Up: Short Answer

What is the name of the plane on which the planets and Sun of the solar system move?

Bonus Answer: The ecliptic

Bonus: Short Answer

"Planet" means "wanderer", as the ancients saw that planets, unlike stars, sometimes move forward with the stars through the sky and sometimes change direction and move in the opposite direction. What are the names of these two types of motion through the sky?

Bonus Answer: Retrograde and prograde

11. MATHEMATICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Let f be an odd function over the real numbers. What is the value of f at 0?

- W) -1
- X) 0
- Y) 1
- Z) There is not enough information to determine an answer

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is true?

- W) An irrational number raised to an irrational power must have an irrational value.
- X) For all positive number x and y , $x^{\ln(y)}$ is equal to $y^{\ln(x)}$
- Y) For all real numbers a, b, c, d with b and d being non-zero, if $a/b > c/d$, then $a*d$ must be greater than $b*c$
- Z) There are more complex numbers than there are real numbers.

Bonus Answer: X

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12. EARTH and SPACE

Writer: Wilson Berkow

Toss Up: Multiple Choice

What type of star has the most similar characteristics to Jupiter and does not necessarily perform nuclear fusion?

W) Red dwarf

X) White dwarf

Y) Brown dwarf

Z) Hot Jupiter

Toss Up Answer: Y

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Bonus: Short Answer

What mechanism occurs in Jupiter and in brown dwarfs, and is responsible for Jupiter radiating more energy than it receives from the Sun?

Bonus Answer: Kelvin–Helmholtz mechanism (accept: the outer layers cool and the object compresses, which then heats up the core)

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13. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

To test products, there is a test that identifies 95% of defective products as defective, but also labels 10% of all working products as defective. If 85% of the products made are not defective, what probability of products the test determines to be defective are actually defective?

W) 39%

X) 84%

Y) 67%

Z) 42%

Toss Up Answer: Y

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Bonus: Short Answer

Compute the surface area of a cylinder with radius 8 and height 2

Bonus Answer: 160pi

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14. EARTH and SPACE

Writer: Wilson Berkow

Toss Up: Short Answer

What behavior of Mercury could not be explained by Newtonian mechanics, and perplexed the astronomical community until it was explained by General Relativity?

Bonus Answer: Precession of its orbit (accept: advance of its perihelion; advance of its periapsis)

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Bonus: Short Answer

The space race between the United States and the Soviet Union was a big deal for the two nations in the 1960's and early 1970's. In 1971, NASA deployed the first spacecraft ever to orbit a another planet, and beat the USSR's deployment by a month. What planet did the NASA mission orbit?

Bonus Answer: Mars

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15. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Short Answer

which of the following are true about the number and nature of the roots of the polynomial

$$x^3 - 29x^2 + 229x$$

I. 0 is a root

II. There must be a real, positive root

III. There must be three real roots

Bonus Answer: I

Bonus: Short Answer

Solve the following linear system of equations in 3 variables:

$$2x + y + 4z = 9$$

$$-x + 2y + 5z = -11$$

$$5x + 3y + 3z = -4$$

Bonus Answer: $x=4, y=-11, z=3$

Also accept (4, -11, 3)

16. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is the magnitude of the magnetic force caused by an electric current of 10 Amperes flowing perpendicular to a magnetic field of 10 Teslas through a length of 10 meters?

Bonus Answer: 1000 Newtons

Bonus: Multiple Choice

Two point charges are placed on the x-axis. The first has a charge of -3 Coulombs and is placed at $x=0$. The second is placed 3 meters to the right of the first and has a charge of 3 Coulombs. What is the dipole moment of these charges?

W) 9 Coulomb-Meters in the direction of the positive x-axis

X) 1 Coulomb-Meters in the direction of the positive x-axis

Y) 9 Coulomb-Meters in the direction of the negative x-axis

Z) 1 Coulomb-Meters in the direction of the negative x-axis

Bonus Answer: W

17. BIOLOGY

Writer: Amrit Hingorani

Toss Up: Multiple Choice

What is MYC?

W) Holoenzyme

X) Oncogene

Y) DNA

Z) Scientist name

Toss Up Answer: X

Bonus: Short Answer

What is the pacemaker of the heart?

Bonus Answer: SA (sinoatrial) node

18. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is the total voltage of a circuit with a total current of 10 Amperes running through four resistors placed in parallel, each with a resistance of 4 Ohms?

Bonus Answer: 10 Volts

Bonus: Short Answer

What does the abbreviation MOSFET stand for?

Bonus Answer: Metal-Oxide-Semiconductor Field-Effect Transistor

19. BIOLOGY

Writer: Amrit Hingorani

Toss Up: Multiple Choice

What is another name for the cell body of neurons?

W) Stroma

X) Soma

Y) Cellulite

Z) Thylakoid

Toss Up Answer: X

Bonus: Short Answer

What molecule do Ras protein's hydrolyze?

Bonus Answer: GTP

20. CHEMISTRY

Writer: Raafiul Hossain

Toss Up: Short Answer

1)An aqueous solution with amount of OH^- ions is greater than that of H^+ ions is what

Bonus Answer: basic

Bonus: Short Answer

3)Charles law talks about what?

Bonus Answer: Hot air rising after being heated

21. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

What is the unit of a Poynting vector?

Bonus Answer: Watt/meter^2 (accept equivalent variations)

Bonus: Short Answer

What's the order of magnitude of a Poynting vector of an EM wave, where the amplitude of the electric field is 300 N/C (newton per coulomb) and the amplitude of the magnetic field is 400 tesla?

Bonus Answer: 11

22. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

In the standard notation for a voltaic cell, the double vertical line "||" represents

Bonus Answer: A standard Hydrogen Electrode (Accept: Hydrogen Electrode)

Bonus: Short Answer

Approximately how long must a current of 5.0 amperes be maintained to electroplate 60 g of calcium from molten Calcium Chloride (Molar Mass = 111 g/mol)? Answer in hours.

Bonus Answer: 16 hours

23. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is the equivalent capacitance of three Capacitors, each of 9 micro Farad Capacitance, placed in parallel?

Bonus Answer: 27 micro Farads

Bonus: Short Answer

Determine the amount of charge stored on either plate of a capacitor of 4 micro Farads when connected across a 12 Volt batter.

Bonus Answer: 48 micro Coulombs, 4.8×10^{-5} Coulombs

24. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the most common isotope of Hydrogen?

Bonus Answer: Protium

Bonus: Short Answer

What is the hybridization of carbon atoms in alkanes?

Bonus Answer: sp³

25. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

Which noble gas is heavier than air?

Bonus Answer: Xenon (Accept: Xe)

Bonus: Short Answer

What is the mass of Sodium Chloride that is in the average human body? Answer in grams.

Bonus Answer: 250 grams
