

## Round 14

### 1. EARTH and SPACE

Writer: Mohammed Jamil

Toss Up: Multiple Choice

The seasons we experience on the Earth are caused by

- W) the change in the Earth's distance from the sun during the year
- X) the precession of the Earth's pole
- Y) the tilt of the Earth's axis with respect to the ecliptic pole
- Z) the change in the Moon's distance from the Earth during the year

Toss Up Answer: Y

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Bonus: Multiple Choice

If we compare two stars of different temperature, the hotter star

- W) will appear redder
- X) emits more energy from each unit area of surface
- Y) will have a brighter apparent magnitude
- Z) will have a brighter absolute magnitude

Bonus Answer: X

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### 2. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

In a compound gearing arrangement where a 40-tooth gear drives

an 80-tooth gear which is directly connected to a 50-tooth gear that drives a 100-tooth gear, the total reduction is a factor of:

- W) 2
- X) 6
- Y) 4
- Z) 21

Toss Up Answer: Y

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Bonus: Multiple Choice

Elastic deformation is BEST described as ...

- W) the linear portion of a stress/strain curve
- X) 99% elongation
- Y) strength of a material
- Z) deformation

Bonus Answer: W

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### 3. EARTH and SPACE

Writer: Aryan Bhatt

Toss Up: Short Answer

When the planets of our solar system are listed in order from most moons to least moons, which planet is fourth in the list?

Bonus Answer: Neptune

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**Bonus: Short Answer**

Name the Galilean moons.

**Bonus Answer: Io, Ganymede, Callisto, Europa**

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**4. BIOLOGY**

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

Blood headed toward the lungs exits which chamber of the heart, and through into what blood vessel?

**Bonus Answer: Exits the Right ventricle into the pulmonary artery**

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**Bonus: Short Answer**

how many chambers do the hearts of bony fish and frogs have, respectively?

**Bonus Answer: 2 and 3**

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**5. PHYSICS**

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

The process in which an atom reradiates a photon after interacting with an incident photon of the same energy is called:

W) Cooleo Theorem

X) the Cherenkov effect

Y) Bragg's Law

Z) Thomson scattering

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

A protanomalous person has decreased sensitivity of the red cones

in his or her eyes. Which of the following color pairs will this person have difficulty distinguishing between:

W) black and yellow

X) blue green

Y) purple blue

Z) red and yellow

**Bonus Answer: Y**

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**6. MATHEMATICS**

**Writer: Larry Wong**

**Toss Up: Short Answer**

What is the sum of coefficients of  $(1+x^7)^7$ ?

**Bonus Answer: 128**

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**Bonus: Short Answer**

Find x if  $\log_{[base\ 5]}(x) = -2$ .

**Bonus Answer: 1/25**

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**7. BIOLOGY**

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

Which of the following tissues is MOST directly responsible for

the increased diameter of a tree trunk from year to year?

- W) apical meristem
- X) pericycle
- Y) vascular cambium
- Z) pith

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Name all of the following 3 metabolic processes which directly require oxygen: glycolysis; alcohol fermentation; electron transport system

**Bonus Answer: Electron transport system**

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## 8. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

e Often some of the strongest spectral lines in cold interstellar gas are produced by

- W) neutral lithium
- X) ionized iron
- Y) carbon and iron
- Z) calcium and sodium

**Toss Up Answer: Z**

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**Bonus: Short Answer**

The cosmic background radiation discovered by Penzias and Wilson closely matches the radiation from a black body with what temperature Kelvin, to the nearest whole number?

**Bonus Answer: 3**

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## 9. BIOLOGY

**Writer: Aryan Bhatt**

**Toss Up: Short Answer**

This genetic condition results in developmental delays and a flattened facial profile. It is caused by trisomy of the 21st chromosome in humans.

**Bonus Answer: Down Syndrome**

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**Bonus: Short Answer**

What is the name of the genetic condition in which a person has two X chromosomes and one Y chromosome?

**Bonus Answer: Klinefelter syndrome**

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## 10. MATHEMATICS

**Writer: Larry Wong**

**Toss Up: Short Answer**

The figure represented by the equation  $\frac{x^2}{36} + \frac{y^2}{16} = 1$  is centered about what x-y coordinate point?

**Bonus Answer: (0,0)**

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**Bonus: Short Answer**

In a right triangle,  $\sin(A)$  is  $\frac{3}{5}$ , what is  $\tan(A)$ ?

**Bonus Answer:  $\frac{3}{4}$**

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## 11. BIOLOGY

Writer: Shanjeed Ali

Toss Up: Multiple Choice

What stimulates root branching in plants?

W) Gibberellin

X) Auxin

Y) Ethylene

Z) Cytokinin

Toss Up Answer: X

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Bonus: Multiple Choice

A plant with low levels of gibberellin will have:

W) high levels of ethylene

X) decreased levels of lignin

Y) undeveloped leaves

Z) decreased growth

Bonus Answer: Z

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## 12. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the center of a circle with the equation  $X^2 + Y^2 = 69$ ?

Bonus Answer: (0,0)

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Bonus: Short Answer

What is the area of an ellipse with axis lengths of 5 and 3, in terms of pi?

Bonus Answer: 15 pi

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## 13. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

How many nodes are there in the first overtone in a standing wave of a vibrating guitar string?

Bonus Answer: 3

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Bonus: Short Answer

If  $g = 9.8$  meters per second squared, to the first decimal place and in newtons, how many newtons of force are required to keep a 450 kilogram slab of granite moving across a horizontal surface at constant speed if there is a kinetic frictional coefficient of 0.20 between the surface and the slab?

Bonus Answer: 882 N

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## 14. MATHEMATICS

Writer: Larry Wong

Toss Up: Short Answer

What is the volume of a sphere?

Bonus Answer:  $\frac{4}{3} \pi r^3$

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Bonus: Short Answer

what is the sum of the 7th row of Pascal's triangle?

**Bonus Answer: 128**

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## 15. EARTH and SPACE

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

How much of the total mass of the solar system is found in the Sun?

- W) between 60.0% and 60.1%
- X) between 78.5% and 78.6%
- Y) between 98.2% and 98.3%
- Z) between 99.8% and 99.9%

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

What is the temperature at the Sun's core?

- W) 5 million degrees Celsius
- X) 10 million degrees Celsius
- Y) 15 million degrees Celsius
- Z) 20 million degrees Celsius

**Bonus Answer: Y**

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## 16. PHYSICS

**Writer: Aaron Gee**

**Toss Up: Multiple Choice**

If the atomic mass of carbon-12 is exactly 12 atomic mass units, why is the atomic mass of carbon not exactly 12 when listed on the Periodic Table?

- W) mass deficit
- X) neutrons are not the same mass as protons
- Y) it adds mass of electrons
- Z) the presence in nature of about 1.1% carbon-13

**Toss Up Answer: Z**

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**Bonus: Short Answer**

If 2500 pounds is applied to a spring with spring constant of 100 pounds per inch on top of a hydraulic piston, how many pounds of force is transferred to the piston:

**Bonus Answer: 2500**

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## 17. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Which of the following is a weaker oxidizer than oxygen?

- W) ozone
- X) carbon dioxide
- Y) hydrogen peroxide
- Z) dioxygen difluoride

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the coordination number of the hexagonal close packed crystal structure?

**Bonus Answer: 12**

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## 18. BIOLOGY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Where are short tandem repeats usually located?

**Bonus Answer: Accept introns OR noncoding DNA**

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**Bonus: Short Answer**

Why do DNA molecules travel through the gel in gel electrophoresis?

**Bonus Answer: DNA has a negative charge**

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## 19. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Which element reacts vigorously with water, producing a purple color?

W) sodium

X) chromium

Y) potassium

Z) barium

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following doesn't dissolve in aqua regia?

W) lead

X) gold

Y) titanium

Z) zinc

**Bonus Answer: Y**

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## 20. BIOLOGY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Who discovered that DNA has equal amounts of adenine and thymine as well as equal amounts of guanine and cytosine?

**Bonus Answer: Accept Erwin Chargaff OR Chargaff**

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**Bonus: Short Answer**

What method was used to obtain Photograph 51, which was used to determine the structure of DNA?

**Bonus Answer: X-ray diffraction**

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## 21. CHEMISTRY

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What is the flame test result of boric acid?

**Bonus Answer: green**

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**Bonus: Multiple Choice**

Which of the following metal ions appears green in solution?

- W) nickel two
- X) iron three
- Y) copper two
- Z) silver

**Bonus Answer: W**

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**22. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Which two scientists proved that DNA replication was semi-conservative?

**Bonus Answer: Meselson and Stahl**

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**Bonus: Short Answer**

Meselson and Stahl replaced an element in DNA with an isotope in order to tag the original DNA molecule. Which element did they replace?

**Bonus Answer: Nitrogen**

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**23. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Short Answer**

What is the term for a substance that yields a mechanical response upon application of electricity?

**Bonus Answer: piezoelectric**

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**Bonus: Multiple Choice**

At the yield point of a material, what happens?

- W) the material breaks into two pieces
- X) the material cracks
- Y) the material begins to deform plastically
- Z) the material begins to neck, or narrow

**Bonus Answer: Y**

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**24. BIOLOGY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

In DNA, to which carbon of the sugar is the nitrogenous base bonded?

**Bonus Answer: Accept one OR one prime**

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**Bonus: Short Answer**

On which carbon of the sugar is the hydroxyl group located?

**Bonus Answer: Accept three OR three prime**

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**25. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

Heating ferrite above 1000 kelvin yields what phase of steel?

- W) cementite

- X) austenite
- Y) martensite
- Z) ceramic steel

**Toss Up Answer: X**

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**Bonus: Short Answer**

Cooling white tin below 13 degrees Celsius turns it into what?

**Bonus Answer: gray tin**

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