

## Round 2

### 1. EARTH and SPACE

#### Toss Up: Short Answer

Name the soil horizon that contains a mixture of organic matter and highly altered mineral matter and is dark in color.

**Bonus Answer: A-horizon**

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#### Bonus: Short Answer

By name or number, which of the following phenomena cause acidification in agricultural soils:

- 1) Leaching of excess nitrate
- 2) Build-up in mostly plant-based organic matter
- 3) Removal of plant and animal products
- 4) Addition of nitrogen based fertilisers

**Bonus Answer: All of them (accept 1,2,3,4)**

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### 2. PHYSICS

#### Toss Up: Short Answer

What is the name of the first American physicist to win two Nobel prizes? (very random lol)

**Bonus Answer: John Bardeen (can accept just last name?)**

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#### Bonus: Multiple Choice

If the resultant force acting on a body of constant mass is zero, the body's momentum is:

- W) constant
- X) 0
- Y) increasing
- Z) decreasing

**Bonus Answer: W**

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### 3. EARTH and SPACE

#### Toss Up: Short Answer

In which atmospheric level does the "good" ozone reside?

**Bonus Answer: Stratosphere**

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#### Bonus: Short Answer

In which atmospheric level does the "bad" ozone reside?

**Bonus Answer: Troposphere**

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### 4. MATHEMATICS

#### Toss Up: Short Answer

Write an equation for a sine function with an amplitude of  $\frac{5}{3}$ , a period of  $\pi/2$ , and a vertical shift of 4 units up.

**Bonus Answer:  $y = (\frac{5}{3})\sin(4x) + 4$**

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#### Bonus: Short Answer

Two large and 1 small pumps can fill a swimming pool in 4 hours. One large and 3 small pumps can also fill the same swimming pool in 4 hours. How many hours will it take 4 large and 4 small pumps to fill the swimming pool.

**Bonus Answer: 1 hour and 40 minutes**

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## 5. BIOLOGY

### Toss Up: Short Answer

Defects in the myelin sheath lead to what disease?

**Bonus Answer: Multiple Sclerosis**

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### Bonus: Short Answer

From which parent do we inherit mitochondrial DNA?

**Bonus Answer: Mothers, maternal**

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## 6. MATHEMATICS

### Toss Up: Short Answer

Find the derivative of:  $4x^3 + 18x + 2$

**Bonus Answer:  $8x^2 + 18$**

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### Bonus: Short Answer

At what point is the slope of the tangent line to the parabola  $y = 3x^2 + 5x + 23$  equal to 0?

**Bonus Answer:  $(-5/6, 441/36)$**

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## 7. EARTH and SPACE

### Toss Up: Short Answer

What spectral type does the star Betelgeuse fall into?

**Bonus Answer: M**

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### Bonus: Multiple Choice

When was the last major supernova in the Milky Way detected?

W) 1604

X) 1863

Y) 1973

Z) 1989

**Bonus Answer: W**

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## 8. CHEMISTRY

### Toss Up: Short Answer

During glycolysis, electrons removed from glucose are passed to

**Bonus Answer: NAD<sup>+</sup>**

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### Bonus: Multiple Choice

A biological redox reaction always involves

W) an oxidizing agent

X) a gain of electrons

Y) a reducing agent

Z) All of the Above

**Bonus Answer: Z**

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## 9. PHYSICS

### Toss Up: Short Answer

A 40 kilogram girl climbs a vertical distance of 5 meters in twenty seconds at a constant velocity. How much work has

the girl done?

**Bonus Answer:** 2000 joules / 1960 joules (accept either)

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**Bonus: Short Answer**

A machine performs 8 Joules of work in 2 seconds. How much power is delivered by this machine?

**Bonus Answer:** 4 Watts

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## 10. CHEMISTRY

**Toss Up: Multiple Choice**

cis 1,2 chloro-ethene and trans 1,2 chloro-ethene differ in which of the following?

W) electron geometry

X) enthalpy

Y) entropy

Z) boiling point

**Toss Up Answer:** Z

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**Bonus: Short Answer**

In an acid/base reaction, which (acid or base) is the electrophile?

**Bonus Answer:** acid

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## 11. PHYSICS

**Toss Up: Multiple Choice**

If the distance between two objects, each of mass 'M', is tripled, the force of attraction between the two objects is

W) 1/2 original force

X) 1/3 original force

Y) 1/9 original force

Z) unchanged

**Toss Up Answer:** Y

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**Bonus: Multiple Choice**

In physics, a radian per second is a unit of:

W) angular displacement

X) angular velocity

Y) angular acceleration

Z) angular momentum

**Bonus Answer:** X

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## 12. CHEMISTRY

**Toss Up: Short Answer**

What is the name for a molecule with tetrahedral electron geometry but only three substituent groups?

**Bonus Answer:** trigonal pyramidal

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**Bonus: Multiple Choice**

Which of the following is not an ionic compound?

W) NaCl

X) HF

Y) FeCl<sub>3</sub>  
Z) H<sub>2</sub>SO<sub>4</sub>

**Bonus Answer: X**

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### 13. MATHEMATICS

**Toss Up: Short Answer**

Given  $y = |x - 6|$ , what is the derivative at  $x = 6$ ?

**Bonus Answer: The derivative does not exist**

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**Bonus: Short Answer**

Find the derivative of  $x^3 / x^2$

**Bonus Answer: 1**

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### 14. BIOLOGY

**Toss Up: Short Answer**

What part of the brain controls the interaction between the two hemispheres?

**Bonus Answer: corpus callosum**

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**Bonus: Short Answer**

Which lobe of the brain is known for spatial reasoning and navigation?

**Bonus Answer: parietal lobes**

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### 15. MATHEMATICS

**Toss Up: Short Answer**

What type of number is defined as a number that is not a root of a polynomial with rational coefficients?

**Bonus Answer: Transcendental numbers**

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**Bonus: Short Answer**

Of the following, which of these numbers are transcendental?  $\pi$ ,  $e$ ,  $i$ ,  $\phi$ ,  $e \cdot i$ ,  $2^{\sqrt{2}}$

**Bonus Answer:  $\pi$ ,  $e$ ,  $e \cdot i$ ,  $2^{\sqrt{2}}$**

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### 16. BIOLOGY

**Toss Up: Multiple Choice**

Which of the following enzymes makes C<sub>4</sub> and CAM species more efficient in hotter, dryer climates?

W) phosphofructokinase

X) Rubisco

Y) DNA polymerase

Z) PEP Carboxylase

**Toss Up Answer: Z**

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**Bonus: Short Answer**

During the light dependent reactions, on what membrane does ATP synthesis take place via ATP Synthase?

**Bonus Answer: thylakoid, thylakoid membrane**

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### 17. MATHEMATICS

**Toss Up: Short Answer**

The surface area of a sphere is how many times the area of a circle?

**Bonus Answer: 4**

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**Bonus: Short Answer**

What is the area of a cone?

**Bonus Answer:**  $(\pi)r^2h$

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**18. CHEMISTRY**

**Toss Up: Multiple Choice**

A molecule is considered a lewis acid if

- W) accepts a pair of electrons to form a bond
- X) accepts a proton from water
- Y) donates a pair of electrons to form a bond
- Z) donates a proton to water

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Which of the following is a binary compound?

- W) Hydrogen Sulfate
- X) Hydrogen Sulfide
- Y) Ammonium Sulfide
- Z) Ammonium Sulfate

**Bonus Answer: X**

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**19. PHYSICS**

**Toss Up: Multiple Choice**

A certain spring is known to obey Hooke's Law. If a force of 10 newtons stretches the spring 2 meters, how far will a 30 newton force stretch the spring?

- W) 1 meter
- X) 60 meters
- Y) 6 meters
- Z) 16 meters

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A block of metal which weighs 60 newtons in air and 40 newtons under water has a density, in kilograms per meter cubed, of:

- W) 1000
- X) 3000
- Y) 5000
- Z) 7000

**Bonus Answer: X**

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**20. MATHEMATICS**

**Toss Up: Multiple Choice**

A statement about a relationship between natural quantities. The statement has been tested many times, and has not been contradicted. What is it?

- W) Fact
- X) Hypothesis
- Y) Law
- Z) Theory

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A framework that includes many well-tested and verified hypotheses about one or more aspects of the natural world.

- W) Fact
- X) Hypothesis
- Y) Law
- Z) Theory

**Bonus Answer: Z**

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## 21. PHYSICS

**Toss Up: Short Answer**

A helicopter is ascending vertically with a constant speed of 6 meters per second relative to the ground. At the instant the helicopter is 60 meters above the ground it releases a package.

What is the magnitude and direction of the velocity of the package, relative to the ground, the instant the package is released by the helicopter?

**Bonus Answer: 6 meters/second up**

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**Bonus: Multiple Choice**

If the resultant force acting on a body of constant mass is zero, the body's momentum is

- W) increasing
- X) decreasing
- Y) always 0
- Z) Constant!

**Bonus Answer: Z**

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## 22. MATHEMATICS

**Toss Up: Short Answer**

What is the name for the rule that states that when you have a limit of indeterminate form as a fraction, it is equal to the limit of the derivative of the numerator over the derivative of the denominator?

**Bonus Answer: L'hospital's rule**

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**Bonus: Short Answer**

What famous function, named after a mathematician, takes the infinite sum of the reciprocals of the natural numbers raised to an argument?

**Bonus Answer: Riemann zeta function**

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## 23. BIOLOGY

**Toss Up: Short Answer**

What is the name of the proteins in cell membranes that allow for rapid transport of water into and out of the cell?

**Bonus Answer: Aquaporins**

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**Bonus: Short Answer**

What membrane bound structures in cells are important for exocytosis?

**Bonus Answer: transport vesicles**

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**24. CHEMISTRY**

**Toss Up: Short Answer**

At room temperature, what is the only metal that is in liquid form?

**Bonus Answer: Mercury (Hg)**

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**Bonus: Multiple Choice**

What is the third most common gas found in the air in the atmosphere?

- W) Argon
- X) Hydrogen
- Y) Oxygen
- Z) Helium

**Bonus Answer: W**

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**25. CHEMISTRY**

**Toss Up: Multiple Choice**

Which of the following does not exhibit resonance stabilization?

- W) Ozone
- X) SO<sub>2</sub>
- Y) NO<sub>3</sub>
- Z) H<sub>2</sub>O

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What is the bond order of H<sub>2</sub>O?

**Bonus Answer: 2**

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