

## Round 4

### 1. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

What is the thrust of a rocket ejecting fuel at 200 kg/s and with an exhaust velocity of 1500 m/s?

- W) 30000 newton meters
- X) 60000 newton meters
- Y) 90000 newton meters
- Z) 300000 newton meters

Toss Up Answer: W

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Bonus: Multiple Choice

A solid disk with a rotational inertia of  $5 \text{ kg}\cdot\text{m}^2$  (READ AS: kilogram meters squared) and a radius of 0.25 m rotates on a fixed axis perpendicular to the disk and through its center. If a force of 2 N is applied tangentially to the disk, what is the work done by the force after half of a revolution to the nearest tenth?

- W) 0.4 J
- X) 0.8 J
- Y) 1.6 J
- Z) 3.1 J

Bonus Answer: Y

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### 2. MATHEMATICS

Writer: Mohammed Jamil

Toss Up: Short Answer

Find how many different 4-digit numbers can be formed from the digits 1, 3, 5, 6, 8 and 9 if each digit may be used only once.

Bonus Answer: 360

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Bonus: Short Answer

A true or false test has six questions. If a person guesses the answers, how many different ways are there to answer the test?

Bonus Answer: 64

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### 3. PHYSICS

Writer: Ashneel Das

Toss Up: Multiple Choice

A car drives 3 blocks west and 4 blocks north. What is the total displacement of the car?

- W) 7 blocks northwest
- X) 5 blocks northwest
- Y) 1 block northwest
- Z) 4 blocks northwest

Toss Up Answer: X

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Bonus: Short Answer

A cart has a mass of 3 kg and moves with a velocity of 2 m/s towards another cart with mass 3 kg. Find the velocity of the two carts after the first cart collides with the second.

Bonus Answer: 1 m/s

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## 4. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If  $A+B+C=10$  and  $A-B-C=-6$ , compute  $B+C$

Bonus Answer: 8

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Bonus: Short Answer

Given a right triangle with legs 12 and 16, find the length of the altitude to the hypotenuse.

Bonus Answer: 48/5 or 9.6

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## 5. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

By name or number, which of these is a non-newtonian fluid?

1. Ketchup
2. Water
3. Custard
4. Toothpaste

Bonus Answer: 1,3,4

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Bonus: Multiple Choice

What two parts comprise a semiconductor crystal?

- W) Lattice and Symmetry
- X) Motif and Basis
- Y) Motif and Symmetry
- Z) Basis and Lattice

Bonus Answer: Z

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## 6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

For natural numbers  $m$  and  $n$ , if 6 divides  $m$  evenly and 8 divides  $n$  evenly, what is the largest integer that divides  $mn$  evenly?

Bonus Answer: 48

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Bonus: Short Answer

For natural numbers  $m$  and  $n$ , if  $mn$  is divisible by 48 and  $m$  is divisible by 6, what is the largest integer  $n$  is divisible by.

Bonus Answer: 1

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## 7. PHYSICS

Writer: Ashneel Das

Toss Up: Short Answer

Given that the acceleration due to gravity on earth is  $9.8 \text{ m/s}^2$ , what is the velocity of a ball 1 second after it is dropped (neglect air resistance)?

Bonus Answer:  $9.8 \text{ m/s}$

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Bonus: Short Answer

If a ball is thrown directly upwards with a velocity of  $49 \text{ m/s}$ , after how many seconds will the ball be at the top of its

path?

**Bonus Answer: 5 seconds**

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## 8. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

What is the probability, in fractions, that after rolling two six-sided die, the sum of the numbers shown on top is 7?

**Bonus Answer: 1/6 (one-sixth or one over six is acceptable)**

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**Bonus: Short Answer**

Mr. SciBowl flips 2017 coins. What is the probability that exactly 50% of the coins show a heads?

**Bonus Answer: 0**

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## 9. PHYSICS

**Writer: Shantanu Jha**

**Toss Up: Multiple Choice**

Whose law defines the relationship between angle of incidence and of refraction?

W) Snell's

X) DeBroglie's

Y) Kepler's

Z) Carnot's

**Toss Up Answer: W**

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**Bonus: Short Answer**

What are the names of Hydrogen's three isotopes?

**Bonus Answer: Protium, Deuterium, Tritium (accept: Hydrogen, Deuterium, Tritium)**

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## 10. BIOLOGY

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Insulin release results in all of the following physiological effects EXCEPT:

W) Decreased glycogen stores in liver cells.

X) Activation of glycogen synthase.

Y) Inhibition of glycogen phosphorylase.

Z) Increased fat production from glycerol and fatty acids in adipose tissue.

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

All of the following are stimulated by the sympathetic nervous system

EXCEPT:

W) increased heart rate.

X) increase secretion of the sweat glands.

Y) constriction of blood vessels

Z) increased peristalsis in the gastrointestinal tract.

**Bonus Answer: Z**

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## 11. CHEMISTRY

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

What will happen solubility of oxygen gas as temperature increases?

**Bonus Answer: Decrease**

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**Bonus: Short Answer**

Which elements are found in the form of diatomic gases at room temperature?

**Bonus Answer: Hydrogen, oxygen, fluorine, chlorine, nitrogen**

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**12. BIOLOGY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Polarity in the developing *Drosophila* embryo is determined by:

- W) a protein gradient of the segmentation protein engrailed
- X) a protein gradient of the bicoid protein expressed from maternal mRNA
- Y) a protein gradient of the gap protein hunchback
- Z) expression of the segmentation protein engrailed throughout the embryo

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

When a four-cell *Xenopus* embryo is divided into ventral and dorsal halves, the half containing the Nieuwkoop center will develop:

- W) ventralized features
- X) dorsalized features
- Y) as a normal embryo
- Z) only to the 8-cell stage

**Bonus Answer: X**

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**13. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Short Answer**

What intermolecular force is responsible for the high melting point and boiling point of water?

**Bonus Answer: Hydrogen bonds**

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**Bonus: Short Answer**

What is the pOH of a solution with hydrogen ion concentration of  $1.0 \times 10^{-6}$

**Bonus Answer: 8**

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**14. BIOLOGY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

Which of the following would lead to a DECREASE in activity of the Anterior Pituitary gland?

- W) A lack of receptors for Cortisol on the Hypothalamus.
- X) A lack of receptors for Cortisol on the Anterior Pituitary.
- Y) Intravenous injection of a large amount of ACTH.
- Z) A tumor of the Hypothalamus causing it to secrete excess Corticotropin- Releasing Hormone

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

What would happen if the Adrenal Cortex was artificially stimulated to produce large amounts of Cortisol?

- W) Less Corticotropin-Releasing Hormone would be released.
- X) More ACTH would be released.
- Y) The activity of the Hypothalamus would increase.
- Z) The activity of the Anterior Pituitary would increase.

**Bonus Answer: W**

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**15. CHEMISTRY**

**Writer: Shanjeed Ali**

**Toss Up: Multiple Choice**

Which of the following is least reactive with water at room temperature?

- W) Sodium
- X) Potassium
- Y) Rubidium
- Z) Cesium

**Toss Up Answer: W**

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**Bonus: Short Answer**

What is the most abundant alkali metal on earth?

**Bonus Answer: Sodium**

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**16. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Short Answer**

What fatal, degenerative disease caused by a prion is most commonly found in sheep and goats?

**Bonus Answer: scrapie**

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**Bonus: Short Answer**

What fatal, degenerative disease caused by a prion is most commonly found in people?

**Bonus Answer: Creutzfeldt-Jakob disease**

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**17. CHEMISTRY**

**Writer: Shanjeed Ali**

**Toss Up: Short Answer**

Mixing 250 mL of 2.0 M sulfuric acid with 2 liters of 0.5 M sodium hydroxide will produce a solution with what pH?

**Bonus Answer: 7**

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**Bonus: Short Answer**

Which of the following are strong bases: lithium hydroxide, strontium hydroxide, cesium hydroxide, barium hydroxide?

**Bonus Answer: All except cesium hydroxide**

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**18. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Short Answer**

What is the repeated 6-base DNA sequence of a human telomere?

**Bonus Answer: TTAGGG**

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**Bonus: Multiple Choice**

Which histone is involved in the formation of the 30-nm chromatin fiber during chromatin packing?

- W) H3
- X) H2B
- Y) H4
- Z) H1

**Bonus Answer: Z**

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**19. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Multiple Choice**

How many neutrons does carbon-14 have?

- W) 14
- X) 8
- Y) 6
- Z) 2

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Which of the following is the decay mode of Uranium-238?

- W) Alpha
- X) Beta
- Y) Gamma
- Z) Proton Emission

**Bonus Answer: W**

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**20. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Short Answer**

What model of DNA replication did Watson and Crick propose?

**Bonus Answer: Semiconservative model**

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**Bonus: Multiple Choice**

What enzyme replaces RNA primers with DNA during DNA replication?

- W) DNA polymerase I
- X) DNA polymerase III
- Y) Primase
- Z) DNA ligase

**Bonus Answer: W**

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**21. EARTH and SPACE**

**Writer: Nicholas Parker Ng**

**Toss Up: Multiple Choice**

Where is the sea of tranquility?

- W) Near the bermuda triangle

- X) In the Atlantic Ocean
- Y) In the Pacific Ocean
- Z) On the Moon

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

The outermost layer of the sun is called the:

- W) Ionosphere
- X) Chromosphere
- Y) Corona
- Z) Photosphere

**Bonus Answer: Y**

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## **22. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Short Answer**

Chronic myelogenous leukemia can occur when a portion of chromosome 9 translocated with chromosome 22. What is this abnormal version of chromosome 22 commonly called?

**Bonus Answer: Philadelphia chromosome**

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**Bonus: Multiple Choice**

If nondisjunction occurs in a cell during meiosis I, how many of the 4 daughter cells will have an abnormal chromosome number?

- W) 1
- X) 2
- Y) 3
- Z) 4

**Bonus Answer: Z**

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## **23. EARTH and SPACE**

**Writer: Nicholas Adit**

**Toss Up: Multiple Choice**

What is the main source of energy for the Sun?

- W) Hydrogen fusion
- X) Internal combustion
- Y) Nuclear fission of metals
- Z) Burning of solar gases

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

The Long Valley Caldera in east-central California was formed by a massive volcanic eruption about 760,000 years ago. Since then, it has erupted several times. Of the following, which would be least likely to indicate that another eruption will soon occur?

- W) Recurring earthquakes in the vicinity
- X) decreases of precipitation in the area
- Y) changes of emissions from the caldera

Z) uplifting of the floor of the caldera

**Bonus Answer: X**

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## **24. BIOLOGY**

**Writer: Matthew Lee**

**Toss Up: Multiple Choice**

Which one of the following is hexaploid?

W) apple

X) wheat

Y) strawberry

Z) banana

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the only animal known to reproduce asexually?

**Bonus Answer: Bdelloid rotifer**

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## **25. EARTH and SPACE**

**Writer: Matthew Lee**

**Toss Up: Short Answer**

A time difference of 5 hours separates London and New York City. What is the longitude of New York City?

**Bonus Answer: 75 degrees west**

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**Bonus: Short Answer**

Any location north of the equator has latitude equal to the angle what star makes above the horizon at said location?

**Bonus Answer: Polaris (accept: The North Star)**

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