

## Round 39

### 1. PHYSICS

Writer: Raafiul Hossain

Toss Up: Short Answer

An educated guess or explanation for an observation or experimental result. Not yet fully accepted as fact is what?

Bonus Answer: Hypothesis

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Bonus: Short Answer

A systematic methodology for gathering, organizing and applying knowledge is?

Bonus Answer: A scientific method

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### 2. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

In terms of mass, what are the four biggest planets in our solar system?

Bonus Answer: Jupiter, Saturn, Neptune, Uranus

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Bonus: Multiple Choice

Dark energy makes up about how much of the energy in the universe?

W) 20%

X) 40%

Y) 70%

Z) 80%

Bonus Answer: Y

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### 3. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The coefficient of linear expansion of a certain steel is 0.000034 per  $^{\circ}\text{C}$  (READ AS: celsius degree). What is the exact coefficient of volume expansion, in  $(^{\circ}\text{C})^{-1}$  (READ AS: celsius degree to the negative 1)?

Bonus Answer: 0.000102 (DO NOT ACCEPT APPROXIMATIONS)

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Bonus: Multiple Choice

The energy given off as heat by 300 g of an alloy as it cools through  $50^{\circ}\text{C}$  (READ AS: 50 celsius degree) raises the temperature of 300 g of water from  $30^{\circ}\text{C}$  (READ AS: 30 degrees celsius) to  $40^{\circ}\text{C}$ . The specific heat of the alloy (in  $\text{cal/g} \cdot ^{\circ}\text{C}$ ) is:

W) 0.0015

X) 0.1

Y) 0.2

Z) 1

Bonus Answer: Y

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### 4. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

In the Northern Hemisphere, the Coriolis force deflects in which direction?

W) Up

X) Down

Y) Right

Z) Left

**Toss Up Answer: Y**

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**Bonus: Short Answer**

The altitude of Polaris is equal to...

**Bonus Answer: Your latitude**

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## 5. PHYSICS

**Writer: Charles Zhang**

**Toss Up: Multiple Choice**

The sound intensity 3.0m from a point source is  $22 \text{ W/m}^2$  (READ AS: 25 watts per meter squared). The power output of the source is:

W) 53

X)  $396\pi$

Y) 168

Z)  $300\pi$

**Toss Up Answer: X**

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**Bonus: Short Answer**

A string has length L and mass M. If its fundamental frequency is f, find its tension in terms of L, M and f.

**Bonus Answer:  $4LMf^2$  (READ AS: 4 times L times M times f squared)**

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## 6. MATHEMATICS

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

Simplify the following expression:  $(x^3+27)/(x+3)$  if  $x=12$

W) 125

X) 117

Y) 136

Z) 109

**Toss Up Answer: X**

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**Bonus: Short Answer**

Find all the real solutions of  $x^4-18=-2$

**Bonus Answer:  $x=2, x=-2$**

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## 7. EARTH and SPACE

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What determines a mineral's properties?

**Bonus Answer: The internal arrangement of its atoms.**

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**Bonus: Short Answer**

What type of currents cause plates to move in the mantle?

**Bonus Answer: Convection currents**

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## 8. MATHEMATICS

**Writer: Ashneel Das**

**Toss Up: Short Answer**

If Robert can paint a fence in 12 hours and George can paint a fence in 6 hours how long will they take to paint the fence together?

**Bonus Answer: 4 hours**

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**Bonus: Multiple Choice**

What is the coefficient of the 3rd term in the expansion of  $(x+y)^7$

- W) 1
- X) 7
- Y) 21
- Z) 35

**Bonus Answer: Y**

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**9. CHEMISTRY**

**Writer: Andrew Chen**

**Toss Up: Multiple Choice**

From what two molecules is an ester synthesized?

- W) alcohol and ester
- X) alcohol and aldehyde
- Y) carboxylic acid and ester
- Z) carboxylic acid and alcohol

**Toss Up Answer: Z**

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**Bonus: Short Answer**

If one mole of an acid is dissolved in a liter of water, and the acid has a pKa of 10, what is the pH of the solution?

**Bonus Answer: 7**

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**10. BIOLOGY**

**Writer: Josh Tish**

**Toss Up: Multiple Choice**

What is the cause of trisomy 21?

- W) error during meiosis
- X) error during mitosis
- Y) over duplication of chromosome 21
- Z) chromosomal insertion

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Why is pepsinogen secreted as a zymogen into the stomach?

- W) to change the pH of the stomach fluids to aid digestion.
- X) to prevent digestion of the gastric glands
- Y) to inactivate pepsinogen
- Z) to digest complex carbohydrates

**Bonus Answer: X**

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**11. MATHEMATICS**

**Writer: Ashneel Das**

**Toss Up: Short Answer**

What is  $64x^3 + 27y^3$  factored in simplest form?

**Bonus Answer:**  $(4x+3y)(16x^2-12xy+9y^2)$

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**Bonus: Short Answer**

If  $i$  is the square root of  $-1$ , what is the value of  $i^{97}$ ?

**Bonus Answer:**  $i$

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**12. CHEMISTRY**

**Writer:** Andrew Chen (Senior)

**Toss Up: Multiple Choice**

Choose the strongest acid from the choices below.

W) Hydrochloric acid

X) Hydrobromic acid

Y) Hydroiodic acid

Z) Hydrofluoric acid

**Toss Up Answer:** Y

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**Bonus: Short Answer**

What are the conjugate bases of HCl, HBr, and HI?

**Bonus Answer:**  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$

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**13. BIOLOGY**

**Writer:** Josh Tish

**Toss Up: Short Answer**

A population of 2800 flowers is in Hardy-Weinberg equilibrium, and 2352 of them are red in color. The red allele  $R$  is dominant; the white allele  $r$  is recessive. What is the frequency of heterozygotes in the population?

**Bonus Answer:** 48%, or any equivalent form

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**Bonus: Multiple Choice**

Which of the following would be least damaged by a lipase?

W) endoplasmic reticulum

X) mitochondria

Y) ribosome

Z) nuclei

**Bonus Answer:** Y

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**14. PHYSICS**

**Writer:** Charles Zhang

**Toss Up: Multiple Choice**

A wave's equation is given as  $y = 0.1 \sin(3x + 10t)$  (READ AS:  $y$  equals 0.1 times sine of open parentheses  $3x$  plus  $10t$  close parentheses). What is the angular wave number?

W) 0.3

X) 1

Y) 10

Z) 3

**Toss Up Answer:** Z

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**Bonus: Short Answer**

An EM wave has a magnetic field with an amplitude of 200 Teslas. What is the amplitude of the wave's electric field in N/c (READ AS: newtons per coulomb)?

**Bonus Answer:**  $6 \times 10^{10}$  N/c

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## 15. BIOLOGY

**Writer:** Josh Tish

**Toss Up:** Multiple Choice

Isolated RNA molecules are generally less stable than DNA at physiological pH because:

- W) RNA has ribose
- X) RNA is always linear
- Y) RNA uses uracil instead of thymine
- Z) RNA is usually single-stranded

**Toss Up Answer:** W

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**Bonus:** Multiple Choice

What is the half-life of DNA?

- W) 673 years
- X) 100 years
- Y) 272 years
- Z) 521 years

**Bonus Answer:** Z

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## 16. CHEMISTRY

**Writer:** Andrew Chen (Senior)

**Toss Up:** Multiple Choice

Given the following ions, Na<sup>+</sup>, Br<sup>-</sup>, Ag<sup>+</sup>, and Cu<sup>2+</sup> which ion has the greatest atomic radius?

- W) Na<sup>+</sup>
- X) Br<sup>-</sup>
- Y) Ag<sup>+</sup>
- Z) Cu<sup>2+</sup>

**Toss Up Answer:** Y

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**Bonus:** Short Answer

Name the group of elements with the least electronegativity.

**Bonus Answer:** Noble gases (Group 18)

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## 17. BIOLOGY

**Writer:** Kerwin Chen

**Toss Up:** Short Answer

Which two scientists are credited with the discovery of the double helix of DNA?

**Bonus Answer:** James Watson and Francis Crick, Watson and Crick

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**Bonus:** Short Answer

Which scientist incorrectly proposed the triple DNA helix model, with the nitrogenous bases pointing outwards and the phosphate forming the core?

**Bonus Answer:** Linus Pauling, Paulingb

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## 18. MATHEMATICS

**Writer: Hussain Waris**

**Toss Up: Multiple Choice**

A set is countable:

W) If and only if it is finite.

X) If and only if a surjection can be made between the set and the natural numbers.

Y) If it has the same cardinality as some subset of the natural numbers.

Z) If it has the same cardinality as some subset of the real numbers.

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Who was the famous German mathematician that invented Set Theory and effectively proved the uncountableness of the reals?

**Bonus Answer: Georg Cantor (accept Cantor)**

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## 19. BIOLOGY

**Writer: Kerwin Chen**

**Toss Up: Short Answer**

Where is the smallest bone in your body located?

**Bonus Answer: Ear**

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**Bonus: Short Answer**

What is the name of the smallest bone in the human body

**Bonus Answer: Stapes, Stirrup**

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## 20. PHYSICS

**Writer: Charles Zhang**

**Toss Up: Short Answer**

If an object attached to one end of a spring makes 20 complete oscillations in  $2\pi$  s, what is its angular frequency?

**Bonus Answer: 20 rad/s**

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**Bonus: Multiple Choice**

A 1-kg object attached to a spring whose spring constant is 400N/m executes simple harmonic motion. If its maximum speed is 5.0m/s, find the amplitude of its oscillation.

W) 0.1

X) 0.25 m

Y) 0.45

Z) 0.75

**Bonus Answer: X**

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## 21. CHEMISTRY

**Writer: Andrew Chen (Senior)**

**Toss Up: Multiple Choice**

When 50 mL of stock solution of 6M NaCl (aq) is diluted into a 150 mL solution what will be the molarity of the diluted solution?

W) 3M

X) 2M

Y) 1M

Z) 6M

**Toss Up Answer: X**

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**Bonus: Short Answer**

What is the given equation for calculating molarity?

**Bonus Answer: Moles of solute divided by liters of solution**

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**22. BIOLOGY**

**Writer: Kerwin Chen**

**Toss Up: Multiple Choice**

How many sections does the small intestine consist of?

W) 2

X) 3

Y) 4

Z) 5

**Toss Up Answer: X**

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**Bonus: Short Answer**

What are the names of the three sections of the small intestine?

**Bonus Answer: Duodenum, Jejunum, Ileum**

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**23. CHEMISTRY**

**Writer: Ashneel Das**

**Toss Up: Short Answer**

Where does oxidation occur in an electrochemical cell?

**Bonus Answer: Anode**

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**Bonus: Short Answer**

In the redox reaction  $2H_2 + O_2 \rightarrow 2H_2O$  how many electrons are transferred?

**Bonus Answer: 4**

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**24. BIOLOGY**

**Writer: Kerwin Chen**

**Toss Up: Multiple Choice**

Tetrachromacy is the condition of possessing how many types of cone cells?

W) 1

X) 2

Y) 3

Z) 4

**Toss Up Answer: Z**

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**Bonus: Short Answer**

The lens of the human eye blocks out ultraviolet light, which in turn prevents us from seeing UV light directly. What is the absence of the lens of the eye called?

**Bonus Answer: Aphakia**

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**25. BIOLOGY**

**Writer: Kerwin Chen**

**Toss Up: Short Answer**

What is the smallest and simplest amino acid called?

**Bonus Answer: Glycine, GLY**

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**Bonus: Short Answer**

What is the R group of the amino acid glycine?

**Bonus Answer: a single hydrogen**

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