

## Round 21

### 1. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

Two trailers, X with mass 500kg and Y with mass 2000kg, are being pulled at the same speed. Find the ratio of the kinetic energy of Y to that of X in simplest terms.

Bonus Answer: 4:1 (or 4 to 1)

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Bonus: Multiple Choice

Given a potential energy function  $U(x)$ , the corresponding force  $F$  is in the positive  $x$  direction if:

W)  $U$  is positive

X)  $U$  is negative

Y)  $U$  is an increasing function of  $x$

Z)  $U$  is a decreasing function of  $x$

Bonus Answer: Z

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### 2. PHYSICS

Writer: Nicholas Adit

Toss Up: Short Answer

A baseball is thrown straight upward. What is the acceleration at the highest point?

Bonus Answer: 0

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Bonus: Multiple Choice

A rock is dropped off a cliff and strikes the ground with an impact velocity of 30 m/s. How high was the cliff?

W) 15 m

X) 30 m

Y) 45 m

Z) 60 m

Bonus Answer: Y

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### 3. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

If all of the forces acting on an object balance so that the net force is zero, then

W) The object must be at rest

X) The object speed will decrease

Y) The object direction can change but its speed cannot

Z) None of the above

Toss Up Answer: Z

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Bonus: Short Answer

A person who weighs 800 N steps onto a scale that is on the floor of an elevator car. If the elevator accelerates upward at a rate of 5 m/s<sup>2</sup>, what will the scale read ( $G = 10 \text{ m/s}^2$ )?

Bonus Answer: 1200 N

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### 4. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

A force  $F$  of strength 20 N acts on an object of mass 3 kg as it moves a distance of 4 m. If  $F$  is perpendicular to the 4 m displacement, the work it does is equal to

- W) 0 J
- X) 60 J
- Y) 80 J
- Z) 600 J

**Toss Up Answer: W**

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**Bonus: Short Answer**

Under the influence of a force, an object of mass 4 kg accelerates from 3 m/s to 6 m/s in 8 s. How much work was done on the object during this time?

**Bonus Answer: 54 J**

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## 5. MATHEMATICS

**Writer: Brian Lim**

**Toss Up: Short Answer**

What is the value of  $\sqrt{20 + \sqrt{20 + \sqrt{20 + \dots}}}$ ?

[Read as "the nested radical expression square root 20 plus square root 20 + square root 20 repeating"]

**Bonus Answer: 5**

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**Bonus: Short Answer**

How many asymptotes are in the graph of  $y = (x^4 + 1)/(x^3 + 3x^2 - 9x - 27)$ ?

**Bonus Answer: 3**

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## 6. MATHEMATICS

**Writer: Benjamin Avrahami**

**Toss Up: Multiple Choice**

What is the smallest positive 'taxicab' number?

- W) 87
- X) 91
- Y) 95
- Z) 100

**Toss Up Answer: X**

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**Bonus: Short Answer**

To what power do you have to raise any number for it to be 0, 1, or -1 in mod 7?

**Bonus Answer: 3**

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## 7. MATHEMATICS

**Writer: Mohammed Haque**

**Toss Up: Short Answer**

How many degrees are in a 79-gon

**Bonus Answer: 13860 degrees**

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**Bonus: Multiple Choice**

The sum of the measures of the exterior angles of  $n$ -gon is \_\_\_\_\_

- W) 720 degrees
- X) 360 degrees
- Y) 1440 degrees
- Z) non of the above

Bonus Answer: X

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## 8. MATHEMATICS

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

What is the integral from 1 to 4 of  $4x^3$ ?

Bonus Answer: 255

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Bonus: Multiple Choice

What is  $d/dx \tan x / \sec x$ , in simplest form?

W)  $\sec^2 x - \tan x$

X)  $\sec^2 x - \tan^2 x$

Y)  $\sec^3 x - \tan^2 x \sec x$

Z)  $(\sec x - \tan x)^2$

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Bonus Answer: X

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## 9. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Motor proteins transport vesicles along which cytoskeletal fiber?

Bonus Answer: microtubules

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Bonus: Short Answer

Shape abnormalities of the nuclear lamina are most likely a result of a defect in which cytoskeletal structure?

Bonus Answer: intermediate filaments

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## 10. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Glycoproteins are mainly created by ribosomes attached to which structure?

Bonus Answer: the rough endoplasmic reticulum (accept: rough ER; do NOT accept: ER or endoplasmic reticulum)

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Bonus: Short Answer

Drugs like barbiturates commonly increase the size of which endomembrane organelle?

Bonus Answer: the smooth endoplasmic reticulum

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## 11. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

The double membranes found in mitochondria and chloroplasts suggest which of the following?

W) mitochondria and chloroplasts are part of the endomembrane system

X) the endosymbiont theory

Y) chloroplasts evolved before mitochondria

Z) chloroplasts and mitochondria are capable of synthesizing their own proteins

Toss Up Answer: X

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Bonus: Short Answer

The light reactions occur in which part of the chloroplast?

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Bonus Answer: the thylakoid (or thylakoid membrane)

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## 12. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Protein digestion in humans begins in the

W) mouth

X) stomach

Y) small intestine

Z) large intestine

Toss Up Answer: X

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Bonus: Short Answer

Which protein is responsible for protein digestion in the stomach?

Bonus Answer: pepsin (DO NOT accept: pepsinogen)

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## 13. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

In which two process of cellular does carbon dioxide released?

Bonus Answer: Co2 is released in the link reaction and in the Krebs cycle.

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Bonus: Short Answer

What type of acid do birds excrete?

Bonus Answer: Uric acid.

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## 14. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

What type of cell are chromosomes located in the nucleus?

Bonus Answer: Eukaryotes.

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Bonus: Short Answer

Meiosis of a diploid cell results in\_

Bonus Answer: 4 haploid cells.

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## 15. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

Why do we need oxygen for cellular respiration?

Bonus Answer: Oxygen is the final electron acceptor for cellular respiration.

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Bonus: Short Answer

How are saturated fat and unsaturated fat different?(refer to bonds)

Bonus Answer: Saturated fats are single bonded, and straight. Unsaturated fats are double bonds and curved.

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## 16. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

Which plant tissue conducts water from the roots to the leaves?

**Bonus Answer: Xylem**

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**Bonus: Multiple Choice**

Which system rids of nitrogenous waste?

- W) Digestive system
- X) Integumentary system
- Y) Respiratory system
- Z) Urinary system

**Bonus Answer: Z**

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## 17. BIOLOGY

**Writer: Yae June Lee**

**Toss Up: Short Answer**

What type of endocytosis is used when it uses pseudopods to move cells between membranes?

**Bonus Answer: Receptor mediated endocytosis.**

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**Bonus: Multiple Choice**

How can small intestine increase its surface area?

- W) Rugae
- X) Villi
- Y) Cecae
- Z) Sphincters

**Bonus Answer: X**

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## 18. CHEMISTRY

**Writer: Olivia Gallager**

**Toss Up: Short Answer**

How many sigma and pi bonds does 1,3 butdiene have, respectively?

**Bonus Answer: 3 sigma, 2 pi**

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**Bonus: Short Answer**

S orbital overlap has what shape?

**Bonus Answer: spherical, sphere**

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## 19. CHEMISTRY

**Writer: Mohammed Haque**

**Toss Up: Short Answer**

What is the electron configuration for Fluorine?

**Bonus Answer:  $1s^2 2s^2 2p^5$**

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**Bonus: Short Answer**

What is the noble gas configuration of Fluorine ?

**Bonus Answer:  $[\text{He}]2s^2 2p^5$**

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## 20. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

Which element is the more electronegative?

**Bonus Answer: Flourine**

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**Bonus: Short Answer**

Name all the atoms that are diatomic.

**Bonus Answer: Hydrogen (H<sub>2</sub>)**

Nitrogen (N<sub>2</sub>)

Oxygen (O<sub>2</sub>)

Fluorine (F<sub>2</sub>)

Chlorine (Cl<sub>2</sub>)

Iodine (I<sub>2</sub>)

Bromine (Br<sub>2</sub>)

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## 21. CHEMISTRY

**Writer: Mohammed Haque**

**Toss Up: Short Answer**

How did Mendeleev arrange the elements of the periodic table?

**Bonus Answer: In order of increasing atomic mass.**

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**Bonus: Short Answer**

How did Moseley change the periodic table?

**Bonus Answer: He arranged the elements in increasing atomic numbers.**

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## 22. CHEMISTRY

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

What is the word that describes a substance that reacts with both strong acids and strong bases?

**Bonus Answer: Amphoteric**

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**Bonus: Multiple Choice**

The triple bond between the carbon atoms causes acetylene, C<sub>2</sub>H<sub>2</sub>, to have which of the following shapes?

W) Trigonal planar (pron: try-gon-al)

X) Linear

Y) Tetrahedral

Z) Trigonal bipyramidal

**Bonus Answer: X**

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## 23. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

What are two general types of soils that have developed in the United States?

**Bonus Answer: pedocals and pedalfers**

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**Bonus: Short Answer**

What are the two most prominent elements dissolved in seawater?

**Bonus Answer: Chlorine and Sodium**

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## 24. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

What is the name of Uranus' smallest moon, which is best known for the idea that it was shattered in a collision billions of years ago and reformed?

**Bonus Answer: Miranda**

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**Bonus: Short Answer**

Which two moons in the solar system are bigger than the smallest planet?

**Bonus Answer: Ganymede and Titan**

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## 25. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Multiple Choice**

Which of the following minerals has the highest number on the Mohs hardness scale?

W) Apatite

X) Fluorite

Y) Quartz

Z) Orthoclase

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What are the three most abundant elements in Earth's crust?

**Bonus Answer: Oxygen, Silicon, Aluminum**

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