

## Round 22

### 1. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

An object of mass 2 kg has a linear momentum of magnitude 6 kg • m/s. What is this object's kinetic energy?

W) 3 J

X) 6 J

Y) 9 J

Z) 12 J

Toss Up Answer: Y

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Bonus: Short Answer

Two objects, one of mass 3 kg and moving with a speed of 2 m/s and the other of mass 5 kg and speed 2 m/s, move toward each other and collide head-on. If the collision is perfectly inelastic, find the speed of the objects after the collision.

Bonus Answer: 0.5 m/s

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### 2. PHYSICS

Writer: Shanjeed Ali

Toss Up: Short Answer

How many orbitals are there in the third electron shell?

Bonus Answer: 9

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Bonus: Short Answer

Who discovered the neutron?

Bonus Answer: James Chadwick

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### 3. PHYSICS

Writer: Nicholas Adit

Toss Up: Short Answer

The mean distance from Saturn to the sun is 9 times greater than the mean distance from Earth to the sun. How long is a Saturn year?

Bonus Answer: 27 Earth years

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Bonus: Short Answer

An object moves at constant speed in a circular path. True statements about the motion include which of the following?

I. The velocity is constant.

II. The acceleration is constant.

III. The net force on the object is zero since its speed is constant.

Bonus Answer: None of them (The vectors are changing)

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### 4. PHYSICS

Writer: Nicholas Adit

Toss Up: Multiple Choice

A sphere of charge +Q is fixed in position. A smaller sphere of charge +q is placed near the larger sphere and released from rest. The small sphere will move away from the large sphere with

W) decreasing velocity and acceleration

X) decreasing velocity and increasing acceleration.

Y) increasing velocity and decreasing acceleration.

Z) increasing velocity and increasing acceleration.

**Toss Up Answer: Y**

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**Bonus: Short Answer**

If the distance between two positive point charges is tripled, then the strength of the electrostatic repulsion between them will decrease by a factor of

**Bonus Answer: 9**

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## 5. MATHEMATICS

**Writer: Ahmad Alnasser**

**Toss Up: Multiple Choice**

Which of the following the derivative with the highest degree?

W)  $X^2$  (x squared)

X) 20

Y) 104

Z)  $3x$

**Toss Up Answer: W**

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**Bonus: Short Answer**

Find  $y' = dy/dx$  for  $x^3 + y^3 = 4$ . (x cubed + y cubed)

**Bonus Answer:  $-x^2/y^2$**  (negative x squared over y squared)

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## 6. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

In interval notation, find the domain of  $1/\sqrt{x^2+5x+4} \geq 0$  (1 over the square root of  $x^2+5x+4$  is greater than or equal to 0.)

**Bonus Answer:  $(-\infty, -4) \cup (-1, \infty)$**

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**Bonus: Short Answer**

If  $x^2+7x-5=0$ , find  $(\sqrt{1} + \sqrt{2})^2$

**Bonus Answer: 49**

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## 7. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

Compute the number of diagonals in a convex 30-sided polygon.

**Bonus Answer: 435**

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**Bonus: Short Answer**

Find the number of way 30 people can shake hands if each person shakes hands with everyone else, excluding themselves.

**Bonus Answer: 435**

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## 8. MATHEMATICS

**Writer: Calvin Aw**

**Toss Up: Short Answer**

An arithmetic progression has 10 terms. Find the maximum distance between any 2 terms if the minimum value for any term is 0 and the maximum is 100, inclusive.

**Bonus Answer: 99**

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**Bonus: Short Answer**

Find the number of factors of  $967 \times 515$

**Bonus Answer: 8**

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**9. BIOLOGY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Kuru is a disease caused by what type of microbe?

W) Bacteria

X) Virus

Y) Prion

Z) Viroid

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Give the genus and species name of the microbe that causes peptic ulcer disease.

**Bonus Answer: *Helicobacter pylori***

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**10. BIOLOGY**

**Writer: Siam Muquit**

**Toss Up: Multiple Choice**

Which term describes organisms that can only tolerate a narrow range of temperatures?

W) Eurythermal

X) Stenothermal

Y) Acrithermal

Z) Anglothermal

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

What is the name of the ecological phenomenon, related to the Small Population hypothesis, that describes a species' path to extinction due to inbreeding and genetic drift?

W) Inbreeding depression

X) Outbreeding depression

Y) Extinction cascade

Z) Extinction vortex

**Bonus Answer: Z**

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**11. BIOLOGY**

**Writer: Elias Milborn**

**Toss Up: Short Answer**

What is the main respiratory pigment of skeletal muscle cells?

**Bonus Answer: Myoglobin**

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**Bonus: Multiple Choice**

If a parent organism experiences a mutation, then all subsequent offspring of that individual will:

W) always carry the mutated gene, but only as a recessive.

X) Always carry the gene, but never express it phenotypically

Y) only carry the mutated gene if it is heritable  
Z) never carry the gene as mutations can never be heritable

**Bonus Answer: Y**

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## 12. BIOLOGY

**Writer: Elias Milborn**

**Toss Up: Short Answer**

What scientist in 1936, building on the discoveries of Szent-Gyorgyi [SENT-GEE-or-gee], postulated the basic reactions of the tricarboxylic acid cycle?

**Bonus Answer: Krebs**

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**Bonus: Short Answer**

If a plant that is heterozygous for each of three independently-assorting traits is allowed to self-fertilize, what portion of the offspring would be heterozygous for all three traits?

**Bonus Answer: 1/8**

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## 13. BIOLOGY

**Writer: Larry Wong**

**Toss Up: Short Answer**

What is the genus of the common domestic dog?

**Bonus Answer: Canis**

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**Bonus: Short Answer**

What family does the *Carcharodon carcharias* belong to?

**Bonus Answer: Lamnidae**

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## 14. BIOLOGY

**Writer: Larry Wong**

**Toss Up: Short Answer**

What plant hormone causes phototropism?

**Bonus Answer: auxin**

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**Bonus: Short Answer**

What two taxonomic domains are divided based on the presence, or absence, of peptidoglycan?

**Bonus Answer: Eubacteria and Archaeobacteria**

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## 15. BIOLOGY

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

The broad climatic zones that Earth's environments are organized into are called

**Bonus Answer: BIOMES**

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**Bonus: Short Answer**

What biome makes up the majority of NY State?

**Bonus Answer: Forest biome :)**

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## 16. BIOLOGY

**Writer: Zoe Orlin**

**Toss Up: Short Answer**

What is climax vegetation?

**Bonus Answer: The dominant type of vegetation in a biome**

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**Bonus: Short Answer**

What is the climax vegetation of the tundra?

**Bonus Answer: Mosses and/or lichens :D**

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**17. BIOLOGY**

**Writer: Zoe Orlin**

**Toss Up: Multiple Choice**

What is the main function of a vacuole in a cell?

W) storage

X) coordination

Y) synthesis of molecules

Z) release of energy

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

If 15% of a DNA sample is made up of thymine, T, what percentage is made up of cytosine, C?

W) 15%

X) 35%

Y) 70%

Z) 85%

**Bonus Answer: X**

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**18. CHEMISTRY**

**Writer: Calvin Aw**

**Toss Up: Short Answer**

Find the molecular geometry for a  $\text{NH}_3$  ion

**Bonus Answer: Trigonal Pyramidal**

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**Bonus: Short Answer**

State all the group numbers which consist of the representative elements.

**Bonus Answer: 1,2,13,14,15,16,17, and 18 (Accept 1-2, 13-18)**

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**19. CHEMISTRY**

**Writer: Ahmad Alnasser**

**Toss Up: Short Answer**

What is the name of a cyclic molecule with 6 carbons?

**Bonus Answer: cyclohexane**

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**Bonus: Multiple Choice**

Which of the following compounds contains a double bond?

W) butene

X) acetylene

Y) butane

Z) butyne

**Bonus Answer: W**

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## **20. CHEMISTRY**

**Writer: Ahmad Alnasser**

**Toss Up: Multiple Choice**

What is the name given to the non-superimposable mirror image forms of chiral compounds?

- W) Diastereomers
- X) Stereoisomers
- Y) Enantiomers
- Z) Cis-trans isomers

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What metal is used as a reducing agent to obtain iron from iron oxide in the Thermite process?

**Bonus Answer: Aluminum**

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## **21. CHEMISTRY**

**Writer: Elias Milborn**

**Toss Up: Multiple Choice**

Which of the following elements, in gaseous state, has the highest electron affinity?

- W) Fluorine
- X) bromine
- Y) sulfur
- Z) chlorine

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

In order to calculate the heat of fusion for a piece of ice placed in warm water, you must know:

- W) The energy released by the warm water and the mass of the water
- X) The energy released by the warm water and the mass of the ice
- Y) the energy released by the ice and the mass of the warm water
- Z) the energy released by the ice and the mass of the ice

**Bonus Answer: X**

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## **22. CHEMISTRY**

**Writer: Elias Milborn**

**Toss Up: Multiple Choice**

What is the mass of an electron relative to a proton?

- W)  $9.1 \times 10^{-31}$
- X)  $8.2 \times 10^{-14}$
- Y)  $1/1836$
- Z) 0.51

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following is not a component of a phospholipid?

- W) water
- X) glycerol
- Y) fatty acid
- Z) phosphate group

**Bonus Answer: W**

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## 23. EARTH and SPACE

**Writer: Shamaul Dilmohamed**

**Toss Up: Short Answer**

What are lines on a topographic map that connect points at the same elevation called?

**Bonus Answer: Contour lines**

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**Bonus: Multiple Choice**

In which state is the most bituminous coal produced?

- W) Kentucky
- X) Pennsylvania
- Y) Wyoming
- Z) West Virginia

**Bonus Answer: Z**

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## 24. EARTH and SPACE

**Writer: Benjamin Avrahami**

**Toss Up: Multiple Choice**

Which of these is not equivalent to Euclid's parallel postulate?

- W) There exist 2 triangles which are similar but not congruent
- X) The Pythagorean Theorem
- Y) The interior angles of a quadrilateral add up to 360 degrees
- Z) The exterior angles of a polygon add up to 360 degrees

**Toss Up Answer: Z**

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**Bonus: Short Answer**

If there are two strings that are a fifth apart in pitch, what is the ratio of their lengths?

**Bonus Answer: 2:3 or 3:2**

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## 25. EARTH and SPACE

**Writer: Benjamin Avrahami**

**Toss Up: Multiple Choice**

What element accounts for the second-most percentage of volume of the Earth's crust?

- W) Oxygen
- X) Calcium
- Y) Potassium
- Z) Silicon

**Toss Up Answer: Y**

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**Bonus: Short Answer**

Give four pieces of information that would be present on a typical weather map.

**Bonus Answer: Any four of the following: Temperature, visibility, weather or weather conditions, dew point, wind**

speed, wind direction, pressure or barometric pressure, precipitation, and cloud cover

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