

## Round 4

### 1. PHYSICS

Writer: Granada Hills

Toss Up: Multiple Choice

A runner begins a sprint on a perfectly circular track. In 5 seconds, the runner travels exactly  $\frac{1}{4}$  of lap. If the runner begins with a velocity of 10m/s, and ends with a velocity of 10m/s, what is the average angular velocity of the runner?

W) 5

X) 12

Y) 13

Z) 18

Toss Up Answer: Z

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Bonus: Short Answer

What is the angular momentum of a solid sphere with a mass of 100 Kilograms and a radius of .1 Meters rotating at an angular velocity of 5 radians per seconds about the center of the sphere?

Bonus Answer: 2

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### 2. PHYSICS

Writer: Granada Hills

Toss Up: Short Answer

Name every force that is acting upon a mid-air cannonball that was shot from a cannon at a 45 degree angle, ignoring air resistance

Bonus Answer: Weight (Accept: Force of gravity/Gravitational force)

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Bonus: Short Answer

Planet Phi, weighing 100 kg, is 13 meters away from Planet Theta of 1200 grams. In kilograms per meters per second squared, what is the Universal Gravitational Force expressed between the two planets? Round to one significant figure.

Bonus Answer:  $5 \times 10^{-11}$

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### 3. PHYSICS

Writer: Granada Hills

Toss Up: Short Answer

What is the spin of a tau neutrino?

Bonus Answer:  $\frac{1}{2}$

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Bonus: Short Answer

A system contains a capacitor with two plates. The area overlapped by two plates is  $5\text{m}^2$ . The dielectric constant of this system is 3.5. Initially, the capacitance is 20 farads. What is the distance between the plates?

Bonus Answer:  $\frac{7}{8}$

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## 4. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Short Answer

$$\sin(x+20)=\cos(50)$$

Bonus Answer:  $X = 20$

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Bonus: Short Answer

$$X^2+4x+4$$

Bonus Answer:  $X=2$

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## 5. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Multiple Choice

$$Y=11 \text{ find } x \text{ in } y=4(x^2)-3$$

W) 3

X) 4

Y) 2

Z) 5

Toss Up Answer: Y

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Bonus: Short Answer

$$\text{Find } x, 45-x=21^2$$

Bonus Answer: -396

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## 6. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Short Answer

What type of function looks like a logarithmic function when reflected over line  $y=x$ ?

Bonus Answer: Exponential function

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Bonus: Short Answer

$$\text{Solve for } x \text{ in } 32=2^x$$

Bonus Answer: 5

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## 7. MATHEMATICS

Writer: Brooklyn Tech

Toss Up: Multiple Choice

If the height of a pole is equal to 24 meters and it's shadow is equal to 3.5 meters. what is the height of a man with a shadow of 10.5 meters?

W) 18 meters

X) 72 yards

Y) 72 meters

Z) 78 yards

Toss Up Answer: Y

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Bonus: Multiple Choice

What is the value of  $x$  when  $3x$  to the power of 4 equals 19683?

W) 7

- X) 8
- Y) 9
- Z) 10

**Bonus Answer: Y**

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## 8. MATHEMATICS

**Writer: Lakeside**

**Toss Up: Short Answer**

Consider a function  $f(x)$  (read: eff of ex). If  $f(x)$  is a positive monotone decreasing function on the interval from 1 to infinity and the integral from one to infinity of  $f(x)$  equals a finite number, what can be said about the convergence of an infinite series defined by the summation of the values of  $f(x)$  from 1 to infinity?

**Bonus Answer: IT CONVERGES**

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**Bonus: Multiple Choice**

Which of the following eccentricities describes a circle?

- W)  $e=0$
- X)  $0 < e < 1$
- Y)  $e=1$
- Z)  $e > 1$

**Bonus Answer: W**

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## 9. BIOLOGY

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

In which phase of meiosis are the chromosomes pulled apart?

- W) Anaphase 1
- X) Prophase 1
- Y) Anaphase 2
- Z) Metaphase

**Toss Up Answer: W**

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**Bonus: Short Answer**

In what types of organisms does meiosis occur?

**Bonus Answer: Eukaryote**

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## 10. BIOLOGY

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

Chlorophyll is a naturally occurring chelate compound in which central metal is

- W) Copper
- X) Magnesium
- Y) Iron
- Z) Calcium

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Pollination by birds is called:

- W) autogamy
- X) ornithophily (pron: or-nith-o-philly)
- Y) entomophily (pron: ent-eh-mof-illy)
- Z) anemophily (pron: an-eh-mof-illy)

**Bonus Answer: X**

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## 11. BIOLOGY

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

If an organism has a haploid number of 28, how many chromosomes does it have?

- W) 14
- X) 28
- Y) 42
- Z) 56

**Toss Up Answer: Z**

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**Bonus: Multiple Choice**

Cellular respiration in the absence of oxygen is called fermentation. What is the product of fermentation in animal cells?

- W) Acetyl-CoA
- X) alcohol
- Y) carbon dioxide
- Z) lactic acid

**Bonus Answer: Z**

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## 12. BIOLOGY

**Writer: Brooklyn Tech**

**Toss Up: Multiple Choice**

If one parent has an autosomal dominant disease, what is the chance of the offspring having the same disease?

- W) 25%
- X) 75%
- Y) 50%
- Z) 100%

**Toss Up Answer: Y**

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**Bonus: Short Answer**

What is osteomalacia?

**Bonus Answer: the softening of bones**

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## 13. BIOLOGY

**Writer: Brooklyn Tech**

**Toss Up: Short Answer**

Name the two tests a pregnant woman can take to determine any genetic diseases the baby will have.

**Bonus Answer: -Amniocentesis**

**-Chorionic Villus Sampling**

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**Bonus: Short Answer**

What are the 3 parts of a nucleotide?

**Bonus Answer:** Nitrogenous base, 5 carbon Pentose sugar, phosphate group.

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## 14. CHEMISTRY

**Writer:** Brooklyn Tech

**Toss Up:** Multiple Choice

The inert gas which is substituted for nitrogen in the air used by deep sea divers for breathing, is

- W) Argon
- X) Xenon
- Y) Helium
- Z) Krypton

**Toss Up Answer:** Y

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**Bonus:** Multiple Choice

The property of a substance to absorb moisture from the air on exposure is called

- W) osmosis
- X) deliquescence
- Y) efflorescence
- Z) desiccation

**Bonus Answer:** X

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## 15. CHEMISTRY

**Writer:** Brooklyn Tech

**Toss Up:** Short Answer

How many electrons can fill the d orbital?

**Bonus Answer:** 10 electrons

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**Bonus:** Short Answer

If a process is only thermodynamically favorable at high temperatures then it has...

**Bonus Answer:** High enthalpy and high entropy

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## 16. CHEMISTRY

**Writer:** Brooklyn Tech

**Toss Up:** Multiple Choice

What is the name of  $\text{CoCl}_2$ ?

- W) Cobalt(II) Chloride
- X) Cobalt(III) Chloride
- Y) Copper(II) Chloride
- Z) Copper(III) Chloride

**Toss Up Answer:** W

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**Bonus:** Short Answer

What type of compound is  $\text{CoCl}_2$ ?

**Bonus Answer:** Ionic Compound

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## 17. CHEMISTRY

**Writer:** Brooklyn Tech

**Toss Up:** Short Answer

At what point does a liquid boil?

**Bonus Answer:** When the vapor pressure and atmospheric pressure are equal.

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**Bonus: Short Answer**

Which term is used to describe the resistance to flow of a liquid?

**Bonus Answer:** viscosity

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## 18. CHEMISTRY

**Writer:** Brooklyn Tech

**Toss Up:** Multiple Choice

At what temperature in degrees Celsius is water most dense?

- W) 11
- X) 4
- Y) 0
- Z) -5

**Toss Up Answer:** X

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**Bonus: Multiple Choice**

In which compound or molecule is Oxygen's oxidation number not -2?

- W) Hydrogen oxide
- X) Hydrogen flouride
- Y) Dioxygen diflouride
- Z) Potassium hydroxide

**Bonus Answer:** Y

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## 19. EARTH and SPACE

**Writer:** Granada Hills

**Toss Up:** Short Answer

Which scientist is noted with identifying the relationship between a galaxy's distance from a body and its speed?

**Bonus Answer:** Edwin Hubble

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**Bonus: Multiple Choice**

Which of the following is close to the value of the average temperature of Venus's atmosphere?

- W) 270 C
- X) 390 C
- Y) 470 C
- Z) 590 C

**Bonus Answer:** Y

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## 20. EARTH and SPACE

**Writer:** Brooklyn Tech

**Toss Up:** Multiple Choice

Which atmosphere do meteors burn up?

- W) stratosphere

- X) mesosphere
- Y) troposphere
- Z) thermosphere

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Which planet has the longest year?

- W) Venus
- X) Jupiter
- Y) Uranus
- Z) Neptune

**Bonus Answer: Z**

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## 21. EARTH and SPACE

**Writer: Brooklyn Tech**

**Toss Up: Short Answer**

What is the name of the constellation that lies within the Summer Triangle?

**Bonus Answer: Vulpecula**

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**Bonus: Short Answer**

Due to the ionized oxygen creating a green color, is another name for the Dumbbell Nebula?

**Bonus Answer: Apple Core Nebula**

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## 22. EARTH and SPACE

**Writer: Brooklyn Tech**

**Toss Up: Short Answer**

What is the black hole region furthest from the event horizon?

**Bonus Answer: The ergosphere**

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**Bonus: Short Answer**

What type of black hole has an ergosphere?

**Bonus Answer: A rotating black hole**

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## 23. ENERGY

**Writer: Granada Hills**

**Toss Up: Short Answer**

In what city was the protocol that phased out the use of chlorofluorocarbons signed?

**Bonus Answer: Montreal (Do not accept Vienna)**

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**Bonus: Multiple Choice**

At what national laboratory was a Shelby Cobra 3D printed in 2015?

- W) Oak Ridge National Laboratory
- X) Argonne National Laboratory
- Y) Lawrence Berkeley National Laboratory
- Z) Lawrence Livermore National Laboratory

**Bonus Answer: W**

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## **24. ENERGY**

**Writer: Granada Hills**

**Toss Up: Multiple Choice**

What type of geothermal power plant relies on highly pressurized water to generate electricity?

- W) Dry Steam
- X) Binary Cycle
- Y) Subsurface reservoir
- Z) Flash Steam

**Toss Up Answer: Z**

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**Bonus: Short Answer**

What nuclear power plant was formerly located on the Pacific Coast of California in San Diego County and was closed in 2013?

**Bonus Answer: San Onofre**

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## **25. ENERGY**

**Writer: Lakeside**

**Toss Up: Multiple Choice**

About how many nuclear power plants are currently in the US?

- W) 57
- X) 104
- Y) 233
- Z) 312

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

What developed country was the first to follow through on the agreements to destroy nuclear weapon stockpiles and cease production of nuclear weapons?

- W) France
- X) USA
- Y) Hungary
- Z) South Africa

**Bonus Answer: Z**

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