

## Round 3

### 1. PHYSICS

#### Toss Up: Short Answer

An infinitely long wire carries a current of three amps. How does the magnetic field outside the wire look like?

**Bonus Answer: Circles the wire**

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#### Bonus: Short Answer

Iron is what type of magnetic material?

**Bonus Answer: ferromagnetic**

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### 2. MATHEMATICS

#### Toss Up: Short Answer

If  $(x-1)(x+1)=15$ , find  $x^2$ .

**Bonus Answer: 16**

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#### Bonus: Short Answer

Find all the roots of the cubic:  $x^3-25x$

**Bonus Answer: -5, 0, and 5 (in no particular order)**

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### 3. PHYSICS

#### Toss Up: Short Answer

A 10 farad capacitor is used in a circuit. The voltage difference between the plates of the capacitor is 20 volts. What is the magnitude of the charge on each of the capacitor's plates?

**Bonus Answer: 200 Coloumbs**

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#### Bonus: Multiple Choice

A circuit which employs a DIRECT CURRENT source has a branch which contains a capacitor. After the circuit has reached a steady state, what is the magnitude of the current in the circuit branch which contains the capacitor?

- W) 0
- X) Infinity
- Y) Nonexistant
- Z) 1

**Bonus Answer: W**

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### 4. BIOLOGY

#### Toss Up: Multiple Choice

Which of the following types of cells do not exhibit density-dependent inhibition concerning reproduction?

- W) neurons
- X) cells in your liver
- Y) cells in a malignant tumor
- Z) cells surrounding your stomach

**Toss Up Answer: Y**

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#### Bonus: Short Answer

Which cell part is most directly responsible for detecting the cell density of its surrounding area in order for the cell to exhibit density-dependent inhibition?

**Bonus Answer: extracellular matrix**

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## **5. PHYSICS**

**Toss Up: Short Answer**

Two forces have magnitudes of 11 newtons and 5 newtons. What's the highest value of their magnitude?

**Bonus Answer: 16 N**

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**Bonus: Short Answer**

A toy train moves in a circle of 8 meters radius with a speed of 4 meters per second. What is the magnitude of the acceleration of the train?

**Bonus Answer: 2 m/s<sup>2</sup>**

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## **6. CHEMISTRY**

**Toss Up: Short Answer**

What is the name of the molecule containing 4 carbon and 10 hydrogen atoms?

**Bonus Answer: Butane**

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**Bonus: Multiple Choice**

Which of the following has the highest Van't Hoff factor?

W) NaCl

X) CaCl<sub>2</sub>

Y) H<sub>2</sub>O

Z) CH<sub>4</sub>

**Bonus Answer: Y**

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## **7. PHYSICS**

**Toss Up: Multiple Choice**

A block of metal which weighs 60 newtons in air and 40 newtons under water has a density, in kilograms per meter cubed of

W) 2400

X) 1000

Y) 3000

Z) 5000

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

A ball leaves a girl's hand with an upward velocity of 6 meters per second. What is the maximum height of the ball above the girl's hand?

W) 10

X) 6

Y) 1.8

Z) 2.8

**Bonus Answer: Y**

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## 8. MATHEMATICS

### Toss Up: Short Answer

What is the most descriptive name for a quadrilateral whose sides are all congruent to one another?

**Bonus Answer: Rhombus**

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### Bonus: Short Answer

Given a cyclic quadrilateral whose sides are 5 units long and one of its diagonals is  $5\sqrt{2}$  units long, find the other diagonal.

**Bonus Answer:  $5\sqrt{2}$**

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## 9. BIOLOGY

### Toss Up: Multiple Choice

The MPF protein complex turns itself off in the cell cycle by

- W) activating a process that destroys its cyclin components
- X) activating an enzyme that stimulates cyclin
- Y) binding to chromatin
- Z) activating the anaphase-promoting complex

**Toss Up Answer: W**

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### Bonus: Short Answer

The cyclin component of MPF is destroyed toward the end of which cell cycle phase?

**Bonus Answer: M phase (ACCEPT: mitosis, mitotic phase)**

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## 10. EARTH and SPACE

### Toss Up: Multiple Choice

Which of the following are sheet silicates?

- W) Micas and clay minerals
- X) pyroxenees and amphiboles
- Y) olivine and feldspar
- Z) staurolite and quartz

**Toss Up Answer: W**

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### Bonus: Multiple Choice

The most common intermediate volcanic rock is

- W) Andesite
- X) Basalt
- Y) Rhyolite
- Z) Diorite

**Bonus Answer: W**

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## 11. MATHEMATICS

### Toss Up: Short Answer

If  $4^x = 256$ , find  $x^4$ .

**Bonus Answer: 256**

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### Bonus: Short Answer

If  $5^x = 300$ , find  $5^{x-2}$  [5 to the power of the quantity x minus 2]

**Bonus Answer: 12**

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## **12. EARTH and SPACE**

**Toss Up: Multiple Choice**

Which is not a silicate

- W) Quartz
- X) Halite
- Y) Feldspar
- Z) Mica

**Toss Up Answer: X**

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**Bonus: Multiple Choice**

Which of these mineral groups has the best cleavage?

- W) Silicates
- X) Sulfides
- Y) Oxides
- Z) Carbonates

**Bonus Answer: Z**

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## **13. CHEMISTRY**

**Toss Up: Short Answer**

What is the hybridization of methane?

**Bonus Answer: sp<sup>3</sup>**

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**Bonus: Short Answer**

How many sigma bonds does methane have?

**Bonus Answer: 4**

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## **14. EARTH and SPACE**

**Toss Up: Multiple Choice**

The ozone is in what layer

- W) Stratosphere
- X) Troposphere
- Y) Hydrosphere
- Z) Mesosphere

**Toss Up Answer: W**

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**Bonus: Multiple Choice**

Atmospheric convection is driven by

- W) Ocean currents
- X) Evaporation of oceans
- Y) Unequal heating by the sun
- Z) Fluctuations of the Earth's magnetic field

**Bonus Answer: Y**

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## **15. CHEMISTRY**

**Toss Up: Short Answer**

What is the energy level and orbital of the outermost electrons in a ground state sulfur atom?

**Bonus Answer: 3p**

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**Bonus: Short Answer**

What is the maximum number of covalent bonds sulfur can form?

**Bonus Answer: 6**

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**16. PHYSICS**

**Toss Up: Short Answer**

A heated 8 kg ring with a radius of 4m cools as it rotates, causing it to shrink to a radius of 2m. If it was initially rotating at 6 rad/s, what is it's final angular velocity?

**Bonus Answer: 24 rad/s**

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**Bonus: Short Answer**

A 120-N child sits on a light swing and is pulled back and held with a horizontal force of 90 N. What is the magnitude of the tension force in each of the two supporting ropes?

**Bonus Answer: 75 N**

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**17. CHEMISTRY**

**Toss Up: Multiple Choice**

Which element has the highest ionization energy?

W) Chlorine

X) Bromine

Y) Selenium

Z) Technetium

**Toss Up Answer: W**

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**Bonus: Short Answer**

What are the periodic table trends for ionization energy?

**Bonus Answer: Increases left to right and decreases from the top to the bottom**

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**18. MATHEMATICS**

**Toss Up: Short Answer**

Let a and b be positive numbers. Find the maximum value of ab if  $a+b=8$ .

**Bonus Answer: 16**

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**Bonus: Short Answer**

Let a, b, and c be positive numbers. Find the minimum value of  $a+b+c$  if  $abc=27$ .

**Bonus Answer: 9**

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**19. BIOLOGY**

**Toss Up: Short Answer**

Which cyclin-Cdk complex triggers the cell's passage past the G2 checkpoint into mitosis?

**Bonus Answer: MPF (ACCEPT: mitosis promoting factor, maturation promoting factor)**

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**Bonus: Short Answer**

In which cell cycle phase does the most important checkpoint, also called the restriction point, occur?

**Bonus Answer: G1 (ACCEPT: between G1 and S)**

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## 20. CHEMISTRY

### Toss Up: Short Answer

Convert 25 degrees Celsius to Kelvin

**Bonus Answer: 298**

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### Bonus: Short Answer

What is the molecular geometry of methane?

**Bonus Answer: Tetrahedral**

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## 21. BIOLOGY

### Toss Up: Multiple Choice

Which of the following proteins are involved in binary fission as well as eukaryotic mitotic division?

W) cyclins

X) Cdks (read as an acronym)

Y) condensins

Z) actin and tubulin

**Toss Up Answer: Z**

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### Bonus: Short Answer

The materials used to synthesize a new cell wall in plant cell cytokinesis comes primarily from which plant cell organelle?

**Bonus Answer: Golgi apparatus (ACCEPT: Golgi complex, Golgi body, Golgi)**

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## 22. BIOLOGY

### Toss Up: Multiple Choice

In the genetic pathway containing genes A, B, and C, gene A negatively regulates gene B, which in turn negatively regulates gene C. If a loss-of-function mutation were introduced into gene B, what would be the resulting effect on the expression of gene C?

W) Decreased expression of gene C.

X) No effect on expression of gene C.

Y) Changes in expression levels of gene C would be the same as those for gene A.

Z) Increased expression of gene C.

**Toss Up Answer: Z**

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### Bonus: Multiple Choice

Concentration of urine is essential to the survival of many vertebrates.

Which class of vertebrates would you expect does not use this mechanism for homeostasis?

W) Aves

X) Lepidosauria

Y) Mammalia

Z) Osteichthyes

**Bonus Answer: Z**

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## 23. BIOLOGY

### Toss Up: Short Answer

What is the process called by which tumor spreads to other parts of the body?

**Bonus Answer: Metastasis**

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**Bonus: Short Answer**

How many subunits does tubulin have?

**Bonus Answer: 2**

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## **24. BIOLOGY**

**Toss Up: Multiple Choice**

Where do the microtubules of the spindle originate during mitosis in both plant and animal cells?

- W) centromere
- X) centrosome
- Y) centriole
- Z) kinetochore

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

If cells in the process of dividing are subjected to colchicine, at which stage will mitosis be arrested?

- W) anaphase
- X) prophase
- Y) metaphase
- Z) interphase

**Bonus Answer: Y**

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## **25. BIOLOGY**

**Toss Up: Multiple Choice**

Which of the following is required for motor proteins to function in the movement of chromosomes toward the poles of the mitotic spindle?

- W) intact centromeres
- X) a kinetochore attached to the metaphase plate
- Y) ATP as an energy source
- Z) synthesis of cohesin

**Toss Up Answer: Y**

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**Bonus: Short Answer**

At which phase are centrioles beginning to move apart in animal cell mitosis?

**Bonus Answer: prophase (DO NOT ACCEPT: prometaphase)**

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