

## 1. Physics

### Toss Up: Multiple Choice

A loaded freight car A with a mass of 14,000 kg moves at a constant velocity of 15 m/s on a horizontal railroad track and collides with an empty car B with a mass of 6,000 kg moving at 5 m/s. After the collision the cars stick to each other and moves like one object. What is the velocity of two cars after the collision?

- W) 6 m/s
- X) 8 m/s
- Y) 10 m/s
- Z) 12 m/s

Toss Up Answer: Z

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### Bonus: Multiple Choice

When two objects collide elastically the momentum is conserved. Which of the following is true about the kinetic energy during the collision?

- W) The kinetic energy is lost
- X) The kinetic energy is gained
- Y) The kinetic energy is conserved
- Z) The kinetic energy completely transforms into thermal energy

Bonus Answer: Y

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## 2. Earth and Space Science

### Toss Up: Short Answer

Name 3 dwarf planets

Toss Up Answer: Pluto, Ceres, Makemake, Eris, Haumea (any 3)

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### Bonus: Short Answer

Which coloured stars are the hottest?

Bonus Answer: Blue

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## 3. Mathematics

### Toss Up: Short Answer

Factor the following equation:  $x^3 + 8(x^2) + 8x + 64$

Toss Up Answer:  $(x + 8)(x + 8)(x^2 + 8)$  or  $(x^2 + 8)[(x + 8)^2]$

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### Bonus: Multiple Choice

Which of the following is a primitive Pythagorean triple?

- W) 9, 12, 15
- X) 10, 24, 26
- Y) 3, 4, 5
- Z) 16, 30, 34

Bonus Answer: Y

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## 4. Biology

### Toss Up: Multiple Choice

Which disease was famously eradicated in 1977?

- W) Polio
- X) Smallpox
- Y) Mumps
- Z) AIDS

Toss Up Answer: X

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### Bonus: Short Answer

Which human body system is attacked by AIDS?

Bonus Answer: Immune system

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## 5. Earth and Space Science

### Toss Up: Multiple Choice

The Cascadia Subduction Zone separates the North American Plate and the

- W) Caribbean Plate
- X) Juan de Fuca Plate
- Y) Okhotsk Plate
- Z) Cocos Plate

Toss Up Answer: X

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### Bonus: Short Answer

During which geologic period did Pangaea start breaking up?

Bonus Answer: Jurassic

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## 6. Chemistry

### Toss Up: Multiple Choice

Which of the following solutions would probably have the highest boiling point

- W) 0.1m of KOH
- X) 0.2m of  $\text{CaCl}_2$
- Y) 0.2m of  $\text{C}_6\text{H}_{12}\text{O}_6$
- Z) 0.1m  $\text{CaCO}_3$

Toss Up Answer: X

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### Bonus: Short Answer

The molarity of a solution obtained when a stock solution of 50.0 ml of 6.0M HCl is diluted to a final volume of 480ml

Bonus Answer: 0.625

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## 7. Biology

### Toss Up: Multiple Choice

What hormone is released by the kidneys in response to oxygen deficiency?

- W) erythropoietin
- X) Renin
- Y) calcitonin
- Z) Leptin

Toss Up Answer: W

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**Bonus: Short Answer**

By what type of system is RBC numbers regulated?

**Bonus Answer: negative-feedback system**  
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**8. Mathematics**

**Toss Up: Multiple Choice**

If 8 moles dig 8 holes in 8 years, how many holes can 4 moles dig in 1461 days?

W) 1

X) 2

Y) 4

Z) 8

**Toss Up Answer: X**  
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**Bonus: Short Answer**

If 9 moles dig 24 holes in 10 days, how many holes can 3 moles dig in 5 days?

**Bonus Answer: 4**  
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**9. Physics**

**Toss Up: Multiple Choice**

If the distance between two objects, each of mass 'M', is tripled, the force of attraction between the two objects is

W) 1/2 original force

X) 1/3 original force

Y) 1/9 original force

Z) unchanged

**Toss Up Answer: Y**  
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**Bonus: Multiple Choice**

In physics, a radian per second is a unit of:

W) angular displacement

X) angular velocity

Y) angular acceleration

Z) angular momentum

**Bonus Answer: X**  
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**10. Mathematics**

**Toss Up: Multiple Choice**

Triangle ABC is similar to triangle DEF. If triangle ABC has an area of 27, triangle DEF has an area of 3, and AC=12, then compute DF.

W) 9

X) 36

Y)  $2\sqrt{3}$

Z) 4

Toss Up Answer: Z

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**Bonus: Multiple Choice**

What is the surface area, in terms of pi, of a cone if the slant height is 13 and the radius of the base is 5.

W) 10 pi

X) 20 pi

Y) 30 pi

Z)  $10\sqrt{3}\pi + 20$

Bonus Answer: X

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## 11. Physics

**Toss Up: Short Answer**

A bullet with mass 0.01 kg and a velocity of 300 m/s is aimed at a wood block on a table. If the mass of the block is 1 kg and the bullet is embedded in the wood block, what is the final velocity of the system?

Toss Up Answer: 3 m/s

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**Bonus: Short Answer**

A 0.400 kg soccer ball approaches a player horizontally with a speed of 15 m/s. The player illegally strikes the ball with her hand and causes it to move in the opposite direction with a speed of 22 m/s. What impulse was delivered to the ball by the player to the nearest whole number?

Bonus Answer: -15 kgm/s

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## 12. Mathematics

**Toss Up: Multiple Choice**

Simplify:  $(24 \cdot 63) / (72 \cdot 21)$

W) 1

X) 3

Y) 7

Z)  $1/3$

Toss Up Answer: W

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**Bonus: Short Answer**

Simplify  $(333(x^4 - x^2)) / (9(x^2 + 2x + 1)(x^2))$

Bonus Answer:  $37(x-1)/(x+1)$

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## 13. Earth and Space Science

**Toss Up: Multiple Choice**

Although scientists are unable to obtain samples by drilling, they believe the predominant mineral in the mantle is:

W) quartz

X) olivine

Y) potassium feldspar

Z) iron pyrite

Toss Up Answer: X

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**Bonus: Multiple Choice**

If the intent is to neutralize soil acidity, the mixing of which of the following materials in the soil would be the LEAST effective?

- W) gypsum
- X) pure  $\text{CaCO}_3$
- Y) ground limestone
- Z) ground oyster shells

**Bonus Answer: W**

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**14. Chemistry**

**Toss Up: Multiple Choice**

Which of the following reactions is expected to produce a precipitate?

- W)  $\text{CdSO}_4 + \text{K}_2\text{S} \rightarrow \text{CdS} + \text{K}_2\text{SO}_4$
- X)  $\text{CoCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{CoSO}_4 + \text{NaCl}$
- Y)  $\text{HI} + \text{Zn}(\text{NO}_3)_2 \rightarrow \text{ZnI}_2 + \text{H}(\text{NO}_3)_2$
- Z)  $\text{Pb}(\text{NO}_3)_2 + \text{K}_2\text{SO}_4 \rightarrow 2\text{KNO}_3 + \text{PbSO}_4$

**Toss Up Answer: W**

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**Bonus: Short Answer**

Name the precipitate for the following reaction:  $3\text{CaCl}_2 + 2\text{Na}_3\text{PO}_4 \rightarrow ? + ?$

**Bonus Answer:  $\text{Ca}_3(\text{PO}_4)_2$  (Calcium Phosphate)**

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**15. Biology**

**Toss Up: Short Answer**

Both fungus-farming ants and their fungi can synthesize the same structural polysaccharide from the - glucose. What is this polysaccharide?

**Toss Up Answer: Chitin**

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**Bonus: Short Answer**

Plasmogamy can directly result in which of the following? 1. cells with a single haploid nucleus 2. heterokaryotic cells 3. dikaryotic cells 4. cells with two diploid nuclei

**Bonus Answer: 2 and 3**

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**16. Chemistry**

**Toss Up: Multiple Choice**

Which of the following statements is true?

- W) Hydrogen peroxide has a planar structure
- X) Tritium is radioactive and emits alpha particles
- Y)  $\text{H}_2$  is insoluble in water
- Z) Hydrogen constitutes 70% of the Earth's crust by mass

**Toss Up Answer: Y**

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**Bonus: Multiple Choice**

Which of the following gas mixtures is not applicable to Dalton's law of Partial Pressures?

- W) CO<sub>2</sub> and N<sub>2</sub>
- X) CO<sub>2</sub> and CO
- Y) SO<sub>2</sub> and O<sub>2</sub>
- Z) N<sub>2</sub> and CO

Bonus Answer: Y

## 17. Earth and Space Science

Toss Up: Multiple Choice

To the nearest order of magnitude, how thick are Saturn's rings?

- W) 10 m
- X) 100 m
- Y) 1000 m
- Z) 10000 m

Toss Up Answer: W

Bonus: Short Answer

Which planets have active plate tectonics?

Bonus Answer: Earth

## 18. Physics

Toss Up: Short Answer

An electron travels 45 degrees north of east in a magnetic field which points 45 degrees west of north. In what direction does the magnetic force acting on the electron points?

Toss Up Answer: Down

Bonus: Short Answer

A 2C charge travels through a magnetic field  $B = 6i + 15j + 9k$  with velocity  $v = 2i + 5j + 3k$ . What is the magnetic force acting on the charge?

Bonus Answer: 0

## 19. Chemistry

Toss Up: Short Answer

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

Toss Up Answer: cyclohexane

Bonus: Multiple Choice

Which of the following compounds contains a double bond?

- W) butene
- X) acetylene
- Y) butane
- Z) butyne

Bonus Answer: W

## 20. Biology

### Toss Up: Multiple Choice

SNPs can be characterized by all of the following EXCEPT for:

- W) always causing diseases.
- X) being common in a population.
- Y) acting as a point mutation.
- Z) acting as a transition mutation.

Toss Up Answer: W

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### Bonus: Short Answer

Which of the following cells are phagocytic?

- 1.Megakaryocyte
- 2.Dendritic cells
- 3.Natural killer cells
- 4.Neutrophils
- 5.Monocytes

Bonus Answer: 2, 4, 5

(Dendritic cells, Neutrophils, Monocytes)

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## 21. Chemistry

### Toss Up: Multiple Choice

What do the Neon, Fluorine(1-) and Magnesium(2+) have in common?

- W) They are isotopes of each other
- X) They are isomers of each other
- Y) They are isoelectronic with each other
- Z) They have nothing in common

Toss Up Answer: Y

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### Bonus: Multiple Choice

The half-life of francium-212 is 19 minutes. How many minutes will it take for 1 gram of this isotope to decay to 0.125 grams?

- W) 4.75 min
- X) 9.5 min
- Y) 38 min
- Z) 57 min

Bonus Answer: Z

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## 22. Earth and Space Science

### Toss Up: Multiple Choice

What is the defining characteristic of the classification of types of supernovas?

- W) total energy released
- X) elemental spectral lines
- Y) duration of the supernova
- Z) size of the initial star

Toss Up Answer: X

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**Bonus: Short Answer**

What element is released in a Type IA supernova that is not released in other Type I supernovae?

**Bonus Answer: silicon**  
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**23. Energy**

**Toss Up: Multiple Choice**

Which material takes the least energy and CO<sub>2</sub> to produce?

W) Wood

X) Aluminum

Y) Glass

Z) HDPE (High Density Polyethylene Plastic)

**Toss Up Answer: W**  
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**Bonus: Short Answer**

What electrophysical process is behind wireless charging?

**Bonus Answer: Induction**  
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**24. Physics**

**Toss Up: Multiple Choice**

What type of radiation is both the most penetrating and the most effectively stopped if blocked by a hydrogen-rich material?

W) Alpha

X) Beta

Y) Gamma

Z) Neutron

**Toss Up Answer: Z**  
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**Bonus: Multiple Choice**

What type of radiation originates from the electron cloud?

W) Alpha

X) Beta

Y) X-Ray

Z) Gamma

**Bonus Answer: Y**  
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