

Round 35

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A helicopter is ascending vertically with a constant speed of 6 meters per second relative to the ground. At the instant the helicopter is 60 meters above the ground it releases a package.

What is the magnitude and direction of the velocity of the package, relative to the ground, the instant the package is released by the helicopter?

Bonus Answer: 6 meters/second up

Bonus: Multiple Choice

If the resultant force acting on a body of constant mass is zero, the body's momentum is

- W) increasing
- X) decreasing
- Y) always 0
- Z) Constant!

Bonus Answer: Z

2. EARTH and SPACE

Writer: Shanjeed Ali

Toss Up: Multiple Choice

Where is the Great Rift Valley located?

- W) Western Africa
- X) Eastern Asia
- Y) Eastern Africa
- Z) Western Asia

Toss Up Answer: Y

Bonus: Multiple Choice

Which of these countries does the Great Rift Valley not run through?

- W) Tanzania
- X) Kenya
- Y) Burundi
- Z) Angola

Bonus Answer: Z

3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A box is initially at rest on a horizontal, frictionless table. If a force of 10 Newtons acts on the box for 3 seconds, what is the momentum of the box at the end of the 3 second interval?

Bonus Answer: 30 N (newton) seconds

Bonus: Short Answer

A 10 kilogram body initially moving with a velocity of 10 meters per second makes a head-on collision with a 15 kilogram body initially at rest. The two objects stick together. What is the velocity of the combined system just after the

collision?

Bonus Answer: 4 meters per seconds

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4. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Short Answer

An ecologist recorded 12 white-tailed deer, *Odocoileus virginianus*, per square mile in one woodlot and 20 per square mile in another woodlot. What was the ecologist comparing?

Bonus Answer: density

Bonus: Short Answer

Why do populations grow more slowly as they approach their carrying capacity?

Bonus Answer: Density-dependent factors lead to fewer births and increased mortality. (Accept Density-Dependent factors)

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5. EARTH and SPACE

Writer: Sean Vaysburd

Toss Up: Multiple Choice

Which is not a type of rock?

W) sedimentary

X) metamorphic

Y) igneous

Z) elementary

Toss Up Answer: Z

Bonus: Short Answer

Which type of rock is formed from magma?

Bonus Answer: igneous rock

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6. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

Which of the following elements has the largest number of possible oxidation states?

W) Fe

X) Cl

Y) Ca

Z) Mn

Toss Up Answer: X

Bonus: Multiple Choice

What is the minimum number of electrons needed to balance the following half-reaction with whole number coefficients?

$\text{IO}_3^- \rightarrow \text{I}_2$

W) 1 e-

X) 2 e-

Y) 5 e-

Z) 10 e-

Bonus Answer: Z

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7. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

What is the area of an equilateral triangle with side lengths 2?

- W) 1
- X) $\sqrt{3}$
- Y) $\sqrt{6}$
- Z) 2

Toss Up Answer: X

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Bonus: Multiple Choice

If the roots of $P(x) = 64x^2 - 24x + 2$ are A and B, what is the harmonic mean of A and B in simplest fractional form?

- W) $\frac{1}{3}$
- X) $\frac{1}{6}$
- Y) $\frac{1}{12}$
- Z) $\frac{1}{24}$

Bonus Answer: X

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8. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Multiple Choice

Which of the following pairs of minerals share the same cleavage?

- W) Fluorite and Calcite
- X) Mica and Galena
- Y) Cryolite and Fluorite
- Z) Halite and Sylvite

Toss Up Answer: Z

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Bonus: Short Answer

In how many directions does muscovite break (cleave)?

Bonus Answer: 1 (one)

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9. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following types of symmetry does $x^2 + (y-1)^2 = 36$ have?

- W) Y-axis symmetry, only
- X) X-axis symmetry, only
- Y) Both x and y axis symmetry
- Z) Neither x nor y axis symmetry

Toss Up Answer: Y

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Bonus: Multiple Choice

Which of the following types of symmetry does $x^2 - y^2 = 36$ have?

- W) Y-axis symmetry, only
- X) X-axis symmetry, only
- Y) Both x and y axis symmetry
- Z) Neither x nor y axis symmetry

Bonus Answer: Y

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10. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

A trend toward the decrease in the size of plants on the slopes of mountains as altitudes increase is an example of

- W) a cline
- X) a bottleneck
- Y) relative fitness
- Z) geographic variation

Toss Up Answer: W

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Bonus: Short Answer

If thermoregulation is considered to be a secondary function of the large ears of jackrabbits, then the primary function of the ears is

Bonus Answer: to detect predators

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11. MATHEMATICS

Writer: Hanna Yang

Toss Up: Multiple Choice

$f(x) = x^4 + 5x^8 + 7x^6 + 5$ Which of the following is true about $f(x)$?

- W) $f(x)$ is odd, only
- X) $f(x)$ is even, only
- Y) $f(x)$ is neither odd nor even
- Z) $f(x)$ is both even and odd

Toss Up Answer: X

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Bonus: Short Answer

Simplify: $\cos(\sin^{-1}(3/5))$

Bonus Answer: 4/5

Solution:

Draw a 3-4-5 right triangle and find the angle that $\sin^{-1}(3/5)$ is equal to. Then, take its cosine.

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12. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following is closest in mass to a proton?

- W) Alpha Particle
- X) Positron
- Y) Neutron
- Z) Hydrogen Molecule

Toss Up Answer: Y

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Bonus: Short Answer

What is the amount of calories of heat transferred to the water is when the temperature of a 20-gram sample of water

is increased from 10°C to 30°C?

Bonus Answer: 400

13. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

$(mn)^2 - p^2$

Bonus Answer: $(mn - p)(mn + p)$

Difference of Squares

Bonus: Short Answer

Factor $a^4 + 4b^4$

Bonus Answer: $(a^2 + 2b^2 + 2ab)(a^2 + 2b^2 - 2ab)$

Solution:

$a^4 + 4b^4 = a^4 + 4a^2b^2 + 4b^4 - 4a^2b^2$

$(a^2 + 2b^2)^2 - (2ab)^2 = (a^2 + 2b^2 + 2ab)(a^2 + 2b^2 - 2ab)$

Difference of Squares

(This is also the Sophie Germain Identity)

14. PHYSICS

Writer: Aaron Gee

Toss Up: 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 meters per second²

Bonus: Short Answer

A certain machine exerts a force of 200 newtons on a box whose mass is 30 kilograms. The machine moves the box a distance of 20 meters along a horizontal floor. What amount of work does the machine do on the box?

Bonus Answer: 4000 J (joules)

15. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

The term(s) most useful in determining the solubility of a substance is (are)

W) K_a and Q

X) K_{sp}

Y) Q and Le Chatelier's Principle

Z) K_c

Toss Up Answer: X

Bonus: Multiple Choice

The effect of temperature on a chemical system is best described using

W) K_a and Q

X) K_{sp}

Y) Le Chatelier's Principle

Z) K_c

Bonus Answer: Y

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16. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

What structure in plant cells is similar to gap junctions in animal cells?

- W) Cell wall
- X) Central Vacuole
- Y) Plasmodesmata
- Z) Thylakoid

Toss Up Answer: Y

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Bonus: Multiple Choice

If, on average, 46% of the loci in a species' gene pool are heterozygous, then the average homozygosity of the species should be

- W) 23%
- X) 46%
- Y) 54%
- Z) There is not enough information to say.

Bonus Answer: Y

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17. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Multiple Choice

What is the correct term(s) used to determine if a system has come to equilibrium?

- W) K_a and Q
- X) K_{sp}
- Y) Q
- Z) K_c

Toss Up Answer: Y

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Bonus: Multiple Choice

Chemical equilibrium may be used to describe

- W) gas phase chemical reactions
- X) acid and based ionization
- Y) Solubility
- Z) All of the Above

Bonus Answer: Z

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18. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

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?

Bonus Answer: 1.8 meters

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Bonus: Short Answer

A boy throws a ball vertically upward with a velocity of 6 meters per second. How long does it take the ball to return to the boy's hand?

Bonus Answer: 1.22 seconds

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19. BIOLOGY

Writer: Siam Muquit

Toss Up: Short Answer

The enzyme catalase is associated with which cell organelle?

Bonus Answer: Peroxisome

Bonus: Short Answer

What dangerous product of fatty acid oxidation does catalase act on?

Bonus Answer: Hydrogen peroxide

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20. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

For an object moving in uniform circular motion, the direction of the instantaneous acceleration vector is:

W) tangent to the path of motion

X) equal to zero

Y) directed radially outward

Z) directed radially inward

Toss Up Answer: Z

Bonus: Multiple Choice

A Newton is equal to which of the following?

W) kilogram-meter per second

X) meter per second squared

Y) kilogram-meter per second

Z)) kilogram per meter-second

Bonus Answer: Y

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21. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following species is amphoteric?

W) Na_3PO_4

X) HSO_4^-

Y) KOH

Z) HNO_3

Toss Up Answer: X

Bonus: Short Answer

A 600-milliliter container holds 2 moles of $\text{O}_2(\text{g})$, 3 moles of $\text{H}_2(\text{g})$, and 1 mole of $\text{He}(\text{g})$. Total pressure within the container is 760 torr. What is the partial pressure of O_2 ?

Bonus Answer: 253 torr

22. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Multiple Choice

Which is not a part of the nucleus?

W) nuclear envelope

X) nucleolus

Y) chromatin

Z) plasmodesmata

Toss Up Answer: Z

Bonus: Multiple Choice

Which is not a part of the cytoskeleton?

W) microfilaments

X) intermediate filaments

Y) microtubules

Z) gap junctions

Bonus Answer: Z

23. BIOLOGY

Writer: Zoe Orlin

Toss Up: Short Answer

What is the material that makes up part of your nose and ears?

Bonus Answer: Cartilage

Bonus: Short Answer

How does one acquire an infection of the ear?

Bonus Answer: By a virus or bacteria

24. BIOLOGY

Writer: Olivia Gallager

Toss Up: Short Answer

What hormone regulates sleep cycles?

Bonus Answer: Melatonin

Bonus: Short Answer

What blood type is considered the universal donor?

Bonus Answer: O-, O-neg, O-negative

25. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Multiple Choice

What is a technique for studying cell membrane structure and function?

W) cell fractionation

X) freeze fracture

Y) cell centrifugation

Z) inserting radioactive substances

Toss Up Answer: X

Bonus: Short Answer

Which type of microscope is useful for studying the internal structure of cells?

Bonus Answer: transmission electron microscope
