

12

1. Mathematics

Toss Up: Multiple Choice

A function with real coefficients with the zero $1 + 23i$ must have a multiplicity of at least?

W) 1

X) 23

Y) 4

Z) 2

Toss Up Answer: Z

Bonus: Short Answer

Find the zeros of the function: $0 = x^4 - 81$

Bonus Answer: $3i, -3i, 3, -3$

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2. Chemistry

Toss Up: Short Answer

How many sigma and pi bonds does 1,3 butadiene have, respectively?

Toss Up Answer: 9 sigma, 2 pi

Bonus: Short Answer

S orbital overlap has what shape?

Bonus Answer: spherical, sphere

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3. Earth and Space Science

Toss Up: Short Answer

What phenomena best explains why the sky is blue?

Toss Up Answer: Rayleigh Scattering

Bonus: Short Answer

What are the high intensity spots of light at the horizontal points of the 22 degree halo that may form around the sun due to ice crystals in the air called?

Bonus Answer: Parhelia (ALSO ACCEPT: Sun Dogs, Parhelion)

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4. Physics

Toss Up: Short Answer

A 12-N horizontal force is applied to a 40-N box resting on a rough horizontal floor. If the static coefficient of friction is 0.5 and the kinetic coefficient of friction is 0.4, the magnitude of the frictional force on the box is:

Toss Up Answer: 12

Bonus: Multiple Choice

What is the coefficient of static friction between the ground and the object if it object is moving in a horizontal circle with a speed of 20 m/s around a radius of 50 m? Assume that $g = 10 \text{ m/s}^2$ (READ AS: meters per second squared)?

W) 0.3

X) 0.5

Y) 0.8

Z) 0.9

Bonus Answer: Y

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5. Earth and Space Science

Toss Up: Multiple Choice

What is the chemical formula for quartz?

W) Si

X) SiO

Y) SiO₂

Z) SiO₄

Toss Up Answer: Y

Bonus: Multiple Choice

What is the crystal form of sodium chloride?

W) halite

X) calcite

Y) chlorite

Z) natrite

Bonus Answer: W

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6. Biology

Toss Up: Multiple Choice

Which biome is characterized by population oscillations?

W) Temperate Deciduous

X) Tropical Rainforest

Y) Tundra

Z) Taiga

Toss Up Answer: Y

Bonus: Short Answer

Large-scale population oscillations in the tundra are caused by what abiotic factor?

Bonus Answer: Thawing and freezing of the ice (Also accept: population migrations)

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7. Mathematics

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

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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8. Earth and Space Science

Toss Up: Multiple Choice

New York City is primarily composed of sediments that were metamorphosed during the Taconic and Acadian orogenies roughly:

- W) 450 million years ago
- X) 550 million years ago
- Y) 650 million years ago
- Z) 750 million years ago

Toss Up Answer: W

Bonus: Short Answer

When the earth is closest to the sun, what season is it in the Southern Hemisphere?

Bonus Answer: Summer

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9. Biology

Toss Up: Multiple Choice

What does it mean when an organism that can self-fertilize is true breeding?

- W) the organism will produce offspring that are genetically identical to it
- X) the organism's offspring will all be genetically identical to each other
- Y) the organism is heterozygous for the gene that controls that trait
- Z) the organism's offspring will have the same phenotype for a certain trait

Toss Up Answer: Z

Bonus: Short Answer

Gregor Mendel is known as the father of modern genetics due to his work with pea plants. Which of the following traits did he study: plant height, pod color, leaf shape, flower position?

Bonus Answer: All except leaf shape

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10. Chemistry

Toss Up: Multiple Choice

How many electrons occupy the bonding molecular orbitals of a CN triple bond?

- W) 2
- X) 4
- Y) 6
- Z) 8

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following compounds would have the highest boiling point?

- W) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- X) CH_3NH_2
- Y) CH_2F_2
- Z) CH_3OH

Bonus Answer: Z

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11. Physics

Toss Up: Multiple Choice

A hose has a diameter of 2 inches and its nozzle is 0.2 inches in radius. If water flows at 4 m/s in the hose, then how fast will it leave the nozzle?

W) 4 m/s

X) 1 m/s

Y) 100 m/s

Z) 200 m/s

Toss Up Answer: Y

Bonus: Short Answer

To measure moderately low pressures, oil with a density of $8.5 \times 10^2 \text{ kg/m}^3$ (READ AS: 8.5 times 10 to the -2 kilogram per cubic meter) is used in place of mercury in a barometer. If the height of the oil column changes by 1.0mm, find the change in the pressure, assuming $g = 10 \text{ m/s}^2$.

Bonus Answer: 8.5 Pa

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12. Mathematics

Toss Up: Short Answer

What is the volume of a sphere if the radius is 7 inches? (use $22/7$ for pi) You may either use fractions or decimals rounded to the nearest hundredth as your answer.

Toss Up Answer: $V = 4312/3$ cubic inches

or $V = 1437.33$ cubic inches

(they must include the correct units)

Bonus: Short Answer

Find the surface area of a rectangular prism if the length is 2 inches, the width is 3 inches, and the height is 2 inches.

Bonus Answer: $V = 32$ square inches

(they must include the correct units)

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13. Chemistry

Toss Up: Short Answer

What is the most abundant element in the human body by mass?

Toss Up Answer: Oxygen

Bonus: Short Answer

What naturally occurring radioactive element is so common in homes that testing for its presence is often advisable?

Bonus Answer: Radon (accept: Rn)

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14. Physics

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?

Toss Up 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

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15. Biology

Toss Up: Multiple Choice

Which of the following are characteristics of both bacteria and fungi?

- W) Cell wall, unicellularity, and mitochondria
- X) Cell wall, DNA, and plasma membrane
- Y) Nucleus, organelles, and unicellularity
- Z) Nucleus, RNA, and cell wall

Toss Up Answer: X

Bonus: Multiple Choice

Terminally differentiated cells are most often found in which phase of the cell cycle?

- W) G0
- X) G1
- Y) G2
- Z) S

Bonus Answer: W

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16. Earth and Space Science

Toss Up: Short Answer

Put these soil horizons in order of increasing depth: bedrock, organic material and leached zone, broken rock, mineral enriched horizon

Toss Up Answer: organic material and leached zone, mineral enriched horizon, broken rock, bedrock

Bonus: Multiple Choice

At high elevations in New York State, which is the most common form of physical weathering?

- W) alternate freezing and melting of water
- X) oxidation by oxygen in the atmosphere
- Y) dissolving of minerals into solution
- Z) abrasion of rocks by wind

Bonus Answer: W

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17. Mathematics

Toss Up: Short Answer

How many distinct roots does x^3-6x^2+32 have

Toss Up Answer: 2

Bonus: Short Answer

What is the remainder when x^3-6x^2+32 is divided by $x-1$

Bonus Answer: 27

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18. Chemistry

Toss Up: Short Answer

What can be identified using the Tyndall Effect?

Toss Up Answer: A colloid

Bonus: Multiple Choice

Which of the following would make a weak electrolyte

W) Acetic Acid

X) Nitric Acid

Y) Sodium Chloride

Z) Hydrochloric Acid

Bonus Answer: W

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19. Biology

Toss Up: Multiple Choice

Exocytotic vesicles are most frequently exported via the

W) endoplasmic reticulum

X) the nuclear envelope

Y) the cis Golgi

Z) the trans Golgi

Toss Up Answer: Z

Bonus: Multiple Choice

Endosomes formed as a result of receptor-mediated endocytosis are most frequently coated with which type of proteins?

W) G proteins

X) clathrins

Y) pseudopodium

Z) microtubules

Bonus Answer: X

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20. Chemistry

Toss Up: Short Answer

What characteristic of water causes its temperature to change slowly in response to the environment?

Toss Up Answer: High Specific Heat

Bonus: Short Answer

What is the most abundant molecule in the human body?

Bonus Answer: Water

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21. Physics

Toss Up: Multiple Choice

Which of the following is the most correct statement of the equivalence principle?

W) General relativity is equivalent to Newtonian gravity under certain conditions

X) All kinds of energy are equivalent

Y) The effects of accelerating a frame are indistinguishable from gravitational forces

Z) The acceleration due to gravity is equivalent to GM/r under Newtonian conditions

Toss Up Answer: Y

Bonus: Short Answer

When a particle collides with its corresponding antiparticle, they annihilate, producing photons with energy equal to their rest mass energy. Imagine that you had 1 g of hydrogen and 1 g of anti-hydrogen. If the energy released when they collide is in the form $[a \times 10^k \text{ Joules}]$, what's the value of k?

Bonus Answer: 14

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22. Biology

Toss Up: Multiple Choice

How does atropine counter the effects of nerve gas?

W) Atropine binds to the nerve gas and inactivates it

X) Atropine inactivates acetylcholinesterase and allows more acetylcholine to cross the synaptic cleft

Y) atropine blocks the acetylcholine receptor which blocks the excess acetylcholine lingering in the synaptic cleft

Z) atropine stimulates the production of an enzyme that breaks down the nerve gas

Toss Up Answer: Y

Bonus: Short Answer

In order to flower, what does a short-day plant need?

Bonus Answer: Night that is longer than a certain critical length

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23. Earth and Space Science

Toss Up: Multiple Choice

Sedimentary rocks are formed from accumulation of different sediments. What is the term for a rock made by living organisms or composed of materials from life forms?

W) Conglomerate

X) Evaporites

Y) Crystalline

Z) Bioclastic

Toss Up Answer: Z

Bonus: Short Answer

What category do the following sedimentary rocks fall into: breccia, conglomerate, and shale.

Bonus Answer: All Clastic sedimentary rocks.

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24. Mathematics

Toss Up: Short Answer

What is the slope of a line parallel to $45x=9y+5$?

Toss Up Answer: 5

Bonus: Multiple Choice

How many vertical asymptotes does $f(x)=(x^2+2x+1)/(x^3-x)$ have?

W) 0

X) 1

Y) 2

Z) 3

Bonus Answer: Y

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25. Physics

Toss Up: Multiple Choice

The driver of a car moving at a speed of 10 m/s sees a child and immediately applies brakes to bring the car to rest in 150 meters. If the combined mass of the car and the driver is 1200 kg, the magnitude of the retarding force on the vehicle is:

W) 300 N

X) 350 N

Y) 400 N

Z) 450 N

Toss Up Answer: Y

Bonus: Short Answer

A body is projected upwards with twice the escape velocity on Earth, 11.2 km/s. Ignoring the presence of other heavenly bodies, what is the speed of the body at infinity? Give your answer in km/s rounded to one decimal point.

Bonus Answer: 19.4 km/s

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