Round 7

1. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Vectors A and B each have magnitude L. What is the cross product of these vectors if the angle between them when drawn with their tails at the same point is 60 degrees.

W) Zero

X) L/2

Y) L^2

Z) (L^2)/2

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following is true when a system is at equilibrium?

W) The object is at rest.

X) The object is not accelerating.

Y) The object is at constant velocity.

Z) Internal forces sum to zero.

Bonus Answer: X

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2. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

A ball is thrown vertically up from the ground. Which of the following explains the ball's motion on its way up?

W) The ball is decelerating.

X) The ball's velocity is decreasing exponetially.

Y) The change in the ball's displacement is decreasing exponentially.

Z) The ball's velocity is constant.

Toss Up Answer: Y

Bonus: Multiple Choice

A ball is thrown horizontally at the same speed from the same height, one on the Earth and one on the Moon. Which of the following statements is/are true?

I. The horizontal distance traveled by the bullet is greater on the Moon.

II. The flight time is less for the bullet on the Earth.

III. The velocities of the bullets at impact are the same.

W) III only

X) I and II only

Y) II and III only

Z) I, II, and III

Bonus Answer: X

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3. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

A vector extends 6 meters in the x direction and 2 root 3 meters in the y direction. The angle this vector makes with the positive x axis is:
W) 30 degrees
X) 60 degrees
Y) 90 degrees
Z) 180 degrees

Toss Up Answer: W

Bonus: Multiple Choice

A brick slides on a horizontal surface. Which of the following will increase the frictional force on it?
W) Increasing the surface of contact
X) Decreasing the surface of contact
Y) Increasing the mass of the brick
Z) Decreasing the mass of the brick

Bonus Answer: Y

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4. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

A ball with a weight of 3.5 Newtons is thrown at an angle of 30 degrees above the horizontal with an initial speed of 16 meters per second. Give the magnitude and direction of the net force on the ball at its highest point.

Bonus Answer: 3.5 Newtons, downward

Bonus: Short Answer

A car is traveling at 15 meters per second on a horizontal road. The brakes are applied and the car skids to a stop in 4 seconds. Assuming gravitational acceleration is 10 meters per second squared, find the coefficient of kinetic friction between the tires and road. Round your answer to the nearest tenth.

Bonus Answer: 0.38

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5. MATHEMATICS

Writer: Jason Weng

Toss Up: Multiple Choice

If x is positive, what is the minimum value of $2x + (2/x)$?
W) 1
X) 2
Y) 3
Z) 4

Toss Up Answer: Z

Bonus: Multiple Choice

What is f(15) if $f(x) = 2\sin(x)\cos(x)$, where x is in degrees?
W) $(\sqrt{3})/2$
X) $1/(\sqrt{3})$
Y) 1/2
Z) 1

Bonus Answer: Y

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6. 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)

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7. 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

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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8. 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

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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9. 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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10. 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

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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11. 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

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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12. 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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13. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Short Answer

What is the central dogma?

Bonus Answer: DNA to RNA to Protein.

Bonus: Short Answer

What types of RNA are used in translation.

Bonus Answer: mRNA and tRNA

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14. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Multiple Choice

Which of the following places contains ribosomes?

W) Rough endoplasmic reticulum

X) Smooth endoplasmic reticulum

Y) Cell wall

Z) lysosomes

Toss Up Answer: W

Bonus: Short Answer

Do prokaryotic cells have ribosomes?

Bonus Answer: Yes

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15. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Short Answer

Where is prokaryotic genetic material located?

Bonus Answer: plasmids

Bonus: Short Answer

Do prokaryotic cells have cell walls?

Bonus Answer: Yes

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16. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Short Answer

What is the most current model of the cell membrane called?

Bonus Answer: Fluid Mosaic Model

Bonus: Short Answer

Who came up with the fluid mosaic model?

Bonus Answer: SJ Singer and GL Nicolson

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17. BIOLOGY

Writer: Sean Vaysburd

Toss Up: Short Answer

What is the name of the proteins in cell membranes that allow for rapid transport of water into and out of the cell?

Bonus Answer: Aquaporins

Bonus: Short Answer

What membrane bound structures in cells are important for exocytosis?

Bonus Answer: transport vesicles

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18. 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

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

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19. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Short Answer

In 12.4 hours, a 100 gram sample of an element decays so that its mass is 25 grams. What is the approximate half-life of this radioactive substance?

Bonus Answer: 6.2 hours

Bonus: Multiple Choice

Which of the following will raise the boiling point of a sample of water?

W) Heat the water

X) Mix gasoline into the water

Y) Bring the water to a higher altitude

Z) Dissolve table sugar in the water

Bonus Answer: Z

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20. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Short Answer

An ideal gas in a closed inflexible container has a pressure of 6 atmospheres and a temperature of 27°C. What will be

the new pressure of the gas if the temperature is decreased to –73°C?

Bonus Answer: 4 atmospheres

Bonus: Multiple Choice

When CO_2 is bubbled through distilled water at 25°C, which of the following is most likely to occur?

W) Solid carbon will form

X) The pH of the solution will be reduced

Y) The water will boil

Z) Methane gas will be formed

Bonus Answer: X

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21. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following is a nonpolar molecule?

W) Carbon dioxide

X) Water

Y) Ammonia

Z) Hydrochloric acid

Toss Up Answer: W

Bonus: Short Answer

Which of the following forms of radioactive decay has (or have) no electrical charges? 1) Alpha Decay 2) Beta Decay 3) Gamma Decay

Bonus Answer: 3 only

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22. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following statements is NOT true for the element of sodium?

W) It has an oxidation state of +1

X) It forms a basic solution with water

Y) It gives off a bright red color when burned

Z) It reacts with a halogen to form a salt

Toss Up Answer: Y

Bonus: Short Answer

Which of the following are products made from the reaction $H_2SO_4(aq) + Ba(OH)_2(aq) \rightarrow ?$ I) $O_2(g)$ II) $H_2O(l)$ III) $BaSO_4(s)$

Bonus Answer: II and III

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23. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Multiple Choice

What happens as air rises?

W) It gets warmer

X) It gets colder

Y) The temperature fluctuates

Z) Nothing

Toss Up Answer: X

Bonus: Short Answer

How are winds named?

Bonus Answer: By the direction they are coming in

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24. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What is the driving force behind all erosion?

Bonus Answer: Gravity

Bonus: Short Answer

What type of body of water does the most erosion?

Bonus Answer: Streams

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25. EARTH and SPACE

Writer: Zoe Orlin

Toss Up: Short Answer

What determines a mineral's properties?

Bonus Answer: The internal arrangement of its atoms.

Bonus: Short Answer

What type of currents cause plates to move in the mantle?

Bonus Answer: Convection currents

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