

Round 8

1. PHYSICS

Toss Up: Multiple Choice

Block A, with a mass of 4 kg, is moving with a speed of 3.0m/s while block B, with a mass of 8 kg, is moving in the opposite direction with a speed of 3.0m/s. The center of mass of the two block-system is moving with a velocity of:

- W) 1.0 m/s in the same direction as B
- X) 1.3 m/s in the same direction as A
- Y) 4.0 m/s in the same direction as B
- Z) 6.0 m/s in the same direction as A

Toss Up Answer: W

Bonus: Multiple Choice

A 60kg hunter gets a rope around a 300kg polar bear. They are stationary, 12m apart, on frictionless level ice. When the hunter pulls the polar bear to him, the polar bear will move:

- W) 0.5 m
- X) 2 m
- Y) 4 m
- Z) 7m

Bonus Answer: X

2. PHYSICS

Toss Up: Multiple Choice

A 2-kg object is moving to the right at 3m/s. A 4-N force is applied to the left of the object and then removed after the object has traveled an additional 5m. The work done by this force is:

- W) 20 joules
- X) 15 joules
- Y) 13 joules
- Z) -20 joules

Toss Up Answer: Z

Bonus: Short Answer

A 20kg dog initially runs at 10 m/s. What is the dog's final speed if 3000 joules of work is done on it?

Bonus Answer: 20

3. 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:

Bonus 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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4. PHYSICS

Toss Up: Multiple Choice

What is the Zeroth Law of Thermodynamics?

W) Energy cannot be created or destroyed in an isolated system.

X) Absolute Zero is the lowest temperature that is theoretically possible.

Y) If two systems are at the same time in thermal equilibrium with a third system, they are in thermal equilibrium with each other.

Z) The entropy of any isolated system always increases.

Toss Up Answer: Y

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Bonus: Short Answer

If the actual vapor density is 5.8 g/m^3 and the saturation vapor density is 10 g/m^3 , then what is the relative humidity?

Bonus Answer: 58%

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5. PHYSICS

Toss Up: Short Answer

What is the third derivative of displacement with respect to time

Bonus Answer: Jerk

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Bonus: Short Answer

What is the fourth derivative of displacement with respect to time

Bonus Answer: jounce

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6. MATHEMATICS

Toss Up: Short Answer

What is $\tan(\arcsin(9/41))$

Bonus Answer: 9/40

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Bonus: Short Answer

What is $\sin(\operatorname{arccot}(\tan(\arccos(3/5))))$

Bonus Answer: 3/5

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7. MATHEMATICS

Toss Up: Short Answer

How many seconds are in a day

Bonus Answer: 86400

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Bonus: Multiple Choice

How many days are in a second

W) 1.16×10^{-3}

X) 1.16×10^{-4}

Y) 1.16×10^{-5}

Z) 1.16×10^{-6}

Bonus Answer: Y

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8. MATHEMATICS

Toss Up: Short Answer

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

Bonus Answer: 2

Bonus: Short Answer

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

Bonus Answer: 27

9. MATHEMATICS

Toss Up: Short Answer

What is the area of the circle $x^2+y^2=6/\pi^2$ in terms of π

Bonus Answer: $6/\pi$

Bonus: Short Answer

What is the area of the circle $x^2-4x+y^2-6y-2=0$ in terms of π

Bonus Answer: 15π

10. BIOLOGY

Toss Up: Short Answer

Where is the smallest bone in your body located?

Bonus Answer: Ear

Bonus: Short Answer

What is the name of the smallest bone in the human body

Bonus Answer: Stapes, Stirrup

11. BIOLOGY

Toss Up: Multiple Choice

How many sections does the small intestine consist of?

W) 2

X) 3

Y) 4

Z) 5

Toss Up Answer: X

Bonus: Short Answer

What are the names of the three sections of the small intestine?

Bonus Answer: Duodenum, Jejunum, Ileum

12. BIOLOGY

Toss Up: Multiple Choice

Tetrachromacy is the condition of possessing how many types of cone cells?

W) 1

X) 2

Y) 3

Z) 4

Toss Up Answer: Z

Bonus: Short Answer

The lens of the human eye blocks out ultraviolet light, which in turn prevents us from seeing UV light directly. What is

the absence of the lens of the eye called?

Bonus Answer: Aphakia

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13. BIOLOGY

Toss Up: Short Answer

What is the smallest and simplest amino acid called?

Bonus Answer: Glycine, GLY

Bonus: Short Answer

What is the R group of the amino acid glycine?

Bonus Answer: a single hydrogen

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14. BIOLOGY

Toss Up: Short Answer

Where was GFP originally isolated?

Bonus Answer: Jellyfish

Bonus: Multiple Choice

In which of the following organisms was the gene originally expressed in?

W) C. elegans

X) Salmonella

Y) E. coli

Z) Petromyzon

Bonus Answer: W

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15. BIOLOGY

Toss Up: Short Answer

In DNA replication, the lagging strand is replicated in what fragments?

Bonus Answer: Okazaki

Bonus: Short Answer

Sickle-cell anemia is caused by what type of mutation?

Bonus Answer: Point mutation/deletion

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16. BIOLOGY

Toss Up: Short Answer

In which end of DNA is the hydroxyl group found?

Bonus Answer: 3 prime

Bonus: Multiple Choice

Which of the following are types of non-essential amino acids?

W) Phenylalanine and Valine

X) Leucine and Histidine

Y) Histidine and Lysine

Z) Arginine and Tyrosine

Bonus Answer: Z

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17. CHEMISTRY

Toss Up: Multiple Choice

Why is diamond a thermal conductor, even though it isn't an electrical conductor?

- W) heat vibrations can move along the rigid structure
- X) carbon has a low heat capacity
- Y) there are no impurities which increase resistance
- Z) carbon has a high heat capacity

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following has the highest carbon content?

- W) wrought iron
- X) cast iron
- Y) pig iron
- Z) slag

Bonus Answer: Y

18. CHEMISTRY**Toss Up: Multiple Choice**

Which of the following exhibits diamagnetism?

- W) bronze
- X) water
- Y) liquid oxygen
- Z) diamond

Toss Up Answer: X

Bonus: Short Answer

Order the following by second ionization energy, from lowest to highest: Sodium, Magnesium, Aluminum

Bonus Answer: Magnesium, Aluminum, Sodium

19. CHEMISTRY**Toss Up: Multiple Choice**

From what two molecules is an ester synthesized?

- W) alcohol and ester
- X) alcohol and aldehyde
- Y) carboxylic acid and ester
- Z) carboxylic acid and alcohol

Toss Up Answer: Z

Bonus: Short Answer

If one mole of an acid is dissolved in a liter of water, and the acid has a pKa of 10, what is the pH of the solution?

Bonus Answer: 7

20. CHEMISTRY**Toss Up: Multiple Choice**

Choose the strongest acid from the choices below.

- W) Hydrochloric acid
- X) Hydrobromic acid
- Y) Hydroiodic acid

Z) Hydrofluoric acid

Toss Up Answer: Y

Bonus: Short Answer

What are the conjugate bases of HCl, HBr, and HI?

Bonus Answer: Cl⁻, Br⁻, I⁻

21. CHEMISTRY

Toss Up: Multiple Choice

Given the following ions, Na⁺, Br⁻, Ag⁺, and Cu²⁺ which ion has the greatest atomic radius?

W) Na⁺

X) Br⁻

Y) Ag⁺

Z) Cu²⁺

Toss Up Answer: Y

Bonus: Short Answer

Name the group of elements with the least electronegativity.

Bonus Answer: Noble gases (Group 18)

22. CHEMISTRY

Toss Up: Multiple Choice

When 50 mL of stock solution of 6M NaCl (aq) is diluted into a 150 mL solution what will be the molarity of the diluted solution?

W) 3M

X) 2M

Y) 1M

Z) 6M

Toss Up Answer: X

Bonus: Short Answer

What is the given equation for calculating molarity?

Bonus Answer: Moles of solute divided by liters of solution

23. EARTH and SPACE

Toss Up: Short Answer

What compound are most cave stalagmites and stalactites made of?

Bonus Answer: Calcium Carbonate, CaCO₃, limestone, calcite, dolomite, marble, chalk, etc.

Bonus: Multiple Choice

Why do many rivers around the world meander when a straight path would be shorter?

W) curves create eddies, which are more stable configurations

X) a slight curve has faster moving water on the outside, which further erodes and enlargens the curve

Y) there are slightly elevated regions that prevent a straight path

Z) random drift

Bonus Answer: X

24. EARTH and SPACE

Toss Up: Multiple Choice

How many comet-like bodies are estimated to exist in the Oort cloud?

W) a billion

X) a trillion

Y) a quadrillion

Z) a quintillion

Toss Up Answer: X

Bonus: Short Answer

What is the name of the telescope which has produced the most scientific papers out of all telescopes on the ground, located in the Atacama desert?

Bonus Answer: Very Large Telescope

25. EARTH and SPACE

Toss Up: Multiple Choice

What is the closest star to earth

W) Sirius

X) Betelgeuse

Y) Alpha proxima

Z) The sun

Toss Up Answer: Z

Bonus: Short Answer

What is the closest star to the sun

Bonus Answer: Proxima centauri
