

Round 4

1. PHYSICS

Toss Up: Short Answer

A gear with 40 teeth turns clockwise at 200 revolutions per minute. This gear is driving another gear with 20 teeth, which in turn is driving another gear with 80 teeth. How fast is the third gear going, and in what direction?

Bonus Answer: 100 revolutions per minute clockwise

Bonus: Multiple Choice

A diverging lens produces an image of an object that is:

- W) virtual, smaller, and upright
- X) virtual, larger, and upright
- Y) real, smaller, and upside down
- Z) real, larger, and upright

Bonus Answer: W

2. PHYSICS

Toss Up: Short Answer

What is the name of the five points in a two body system where a small object can remain gravitationally stable?

Bonus Answer: lagrange points

Bonus: Multiple Choice

Which of the following is the major contributor to an atom's mass?

- W) the weak force
- X) the strong force
- Y) quarks
- Z) the higgs boson

Bonus Answer: X

3. PHYSICS

Toss Up: Multiple Choice

Which is the weakest fundamental force?

- W) The color force
- X) The weak force
- Y) Electromagnetism
- Z) Gravity

Toss Up Answer: Z

Bonus: Short Answer

Identify all of the following that are false:

1. Neutrinos travel at speed C
2. The strength of the color force can increase with distance
3. Electrons have color charge
4. All baryons are unstable

Bonus Answer: 1, 3, 4

4. PHYSICS

Toss Up: Short Answer

Rank following electromagnetic radiations according to the energies of their photons, from least to greatest:

1. blue light
2. yellow light
3. x rays
4. radio waves

Bonus Answer: 4, 2, 1, 3 (accept equivalent forms)

Bonus: Multiple Choice

The work function for a certain sample is 2.3 eV. The stopping potential for electrons ejected from the sample by 7.0×10^{14} -Hz electromagnetic radiation is:

- W) 0 V
- X) 0.6 V
- Y) 2.3 V
- Z) 5.2 V

Bonus Answer: Y

5. MATHEMATICS

Toss Up: Short Answer

What is the integral of $\sec x \, dx$?

Bonus Answer: $\ln |\sec x + \tan x| + C$

Bonus: Multiple Choice

Which of these functions cannot be integrated and represented with elementary functions?

- W) $(\sin^5 x) \cos^6 x \, dx$
- X) $e^x \sin x^3 \, dx$
- Y) $e^{(x^2)} \, dx$
- Z) $\tan x \sin x \, dx$

Bonus Answer: Y

6. MATHEMATICS

Toss Up: Short Answer

What is the value of the quantity $((\sin^4 x) + 2(\cos^2 x)(\sin^2 x) + (\cos^4 x))^{1/2}$?

Bonus Answer: 1

Bonus: Multiple Choice

What is the probability of selecting two natural numbers and having them be relatively prime?

- W) $1/2$
- X) $2/3$
- Y) $6/(\pi^2)$
- Z) $2/\pi$

Bonus Answer: Y

7. MATHEMATICS

Toss Up: Short Answer

What is the sum of the infinite geometric series whose first term is 1 and fourth term is $1/64$?

Bonus Answer: $4/3$

Bonus: Multiple Choice

What is the value of e to the $(\pi \text{ times } i/2)$?

W) e^{-1}

X) 1

Y) -1

Z) i

Bonus Answer: Z

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8. MATHEMATICS

Toss Up: Short Answer

What is 11 base 5 in base 2?

Bonus Answer: 110

Bonus: Short Answer

If log base 10 of x is 100, what is log base 100 of x ?

Bonus Answer: 50

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9. BIOLOGY

Toss Up: Multiple Choice

During life, the pituitary gland is located in the...

W) cribriform plate

X) foramen magnum

Y) sella turcica

Z) jugular foramen

Toss Up Answer: X

Bonus: Multiple Choice

Pregnancy is most likely to contribute to which of these conditions?

W) kyphosis

X) lordosis

Y) scoliosis

Z) death

Bonus Answer: X

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10. BIOLOGY

Toss Up: Multiple Choice

Three bony shelves that project inferiorly in the nasal cavity are called

W) paranasal sinuses.

X) nasal conchae.

Y) the greater wing.

Z) the crista galli.

Toss Up Answer: X

Bonus: Multiple Choice

The olfactory foramina are found in the

W) nasal septum

X) cribriform plate

- Y) hard palate
- Z) lacrimal bone

Bonus Answer: X

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11. BIOLOGY

Toss Up: Multiple Choice

Who is considered the father of paleontology?

- W) Marquis de Condorcet
- X) George Cuvier
- Y) Marie Antoinette
- Z) Auguste Comte

Toss Up Answer: X

Bonus: Short Answer

List the taxonomic groups from least to most specific

Bonus Answer: KINGDOM, PHYLUM, CLASS, ORDER, FAMILY, GENUS, SPECIES

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12. BIOLOGY

Toss Up: Short Answer

What is powerhouse of cell?

Bonus Answer: mitochondria

Bonus: Short Answer

what are building blocks of life?

Bonus Answer: cell in perfect form

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13. BIOLOGY

Toss Up: Short Answer

What are the two types of genetic engineering?

Bonus Answer: restriction enzymes and gene cloning

Bonus: Short Answer

Define Population

Bonus Answer: A group of individuals of the same species living in the same place.

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14. CHEMISTRY

Toss Up: Multiple Choice

The ideal fuel for fuel cell use is:

- W) compressed natural gas
- X) reformulated gasoline
- Y) hydrogen
- Z) Methanol

Toss Up Answer: Y

Bonus: Short Answer

Which is the correct name for N₂O₃

Bonus Answer: Dinitrogen Trioxide

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15. CHEMISTRY

Toss Up: Short Answer

Charles law talks about what?

Bonus Answer: Hot air rising

Bonus: Short Answer

According to VSEPR bonding theory, what type of geometry does a molecule have when the central atom is surrounded by 4 bonded groups, such as in methane?

Bonus Answer: TETRAHEDRAL

16. CHEMISTRY

Toss Up: Short Answer

What is the general name for a hypothetical gas that obeys Boyles's law at all temperatures and pressures?

Bonus Answer: Ideal

Bonus: Short Answer

Knowing that the chemical name for gypsum is calcium sulfate dihydrate, gypsum is what percent water by weight? Assume the atomic masses of calcium = 40; sulfur = 32 and oxygen = 16.

Bonus Answer: 21

17. CHEMISTRY

Toss Up: Short Answer

You need to prepare 500 milliliters of a 0.100 molar NaOH solution from a 0.250 molar solution. What volume, in milliliters, of the 0.250 molar solution must be diluted to 500 milliliters?

Bonus Answer: 200

Bonus: Short Answer

Can MASS SPECTROMETRY be used to calculate endpoint pH?

Bonus Answer: nahh

18. CHEMISTRY

Toss Up: Short Answer

Name all of the following 4 species that contain an odd number of electrons: O₂¹⁻; O₂²⁻; SO₂; CO

Bonus Answer: O₂¹⁻

Bonus: Short Answer

What are the 2 alkenes (read as: al-KEENS) with the shortest carbon chains and lowest molecular weights?

Bonus Answer: ethene

19. CHEMISTRY

Toss Up: Short Answer

A Buchner funnel is a piece of laboratory glassware often used in chemistry labs for what?

Bonus Answer: Filtration

Bonus: Short Answer

Why are oxygenates used as gasoline additives?

Bonus Answer: ALLOW FOR MORE COMPLETE COMBUSTION

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20. EARTH and SPACE

Toss Up: Short Answer

Observation of the phases of which planet gave Galileo evidence for the Copernican model.

Bonus Answer: Venus

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Bonus: Short Answer

Name the four Galilean Satellites

Bonus Answer: Io, Europa, Ganymede, Callisto

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21. EARTH and SPACE

Toss Up: Multiple Choice

A pulsar is a particular type of:

- W) Neutron star
- X) Black hole
- Y) White dwarf
- Z) Black dwarf

Toss Up Answer: W

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Bonus: Short Answer

What does the Schwarzschild (pronounced: Sh-worts-shield) radius of a body represent?

Bonus Answer: The radius which, if all of the mass of the body were contained within it, the body would become a black hole (or: its escape velocity would be greater than C).

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22. EARTH and SPACE

Toss Up: Multiple Choice

Sunspots and other solar activity tend to follow a cycle lasting about how long?

- W) 1 year
- X) 11 years
- Y) 23 years
- Z) 57 years

Toss Up Answer: X

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Bonus: Short Answer

Identify each of the following solar events that is correctly paired with its origin

1. Prominence; the photosphere
2. Solar filament; the chromosphere
3. Coronal mass ejection; the corona

Bonus Answer: 1, 3

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23. EARTH and SPACE

Toss Up: Multiple Choice

Sunspots exist on which layer of the sun?

- W) Heliosphere
- X) Photosphere
- Y) Chromosphere
- Z) Corona

Toss Up Answer: X

Bonus: Multiple Choice

Sunspots are characterized by

W) High magnetic field flux, and cooler temperature

X) High magnetic field flux, and hotter temperature

Y) Low magnetic field flux, and cooler temperature

Z) Low magnetic field flux, and hotter temperature

Bonus Answer: W

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24. EARTH and SPACE

Toss Up: Multiple Choice

Which of the following parts of the sun has the lowest temperature

W) Corona

X) Chromosphere

Y) Transition region

Z) Photosphere

Toss Up Answer: Z

Bonus: Short Answer

Throughout the second half of the 20th century, the number of neutrinos measured coming from the Sun was a third of the theoretically predicted number. What behavior of neutrinos revealed that the predicted number of neutrinos were, indeed, being released?

Bonus Answer: Neutrino oscillation (accept: neutrinos change flavor)

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25. ENERGY

Toss Up: Short Answer

From what country does the US import the most coal?

Bonus Answer: Columbia

Bonus: Short Answer

Rank the coal production of these states from lowest to highest: Wyoming, West Virginia, Illinois, Pennsylvania.

Bonus Answer: Pennsylvania, Illinois, West Virginia, Wyoming.

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