

Round 43

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

An electric vehicle has two stages. If the first stage, the battery, has an efficiency of 90% and the second stage, the inverter, has an efficiency of 80%, calculate the approximate overall efficiency of the vehicle.

Bonus Answer: 72%

Bonus: Multiple Choice

Which of the following is congruent to $(n + 1)$ modulus n ?

W) 0

X) 1

Y) $n-1$

Z) $n-2$

Bonus Answer: W

2. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

In the SI system of measure, what is the unit of capacitance?

Bonus Answer: FARAD

Bonus: Short Answer

How much work in joules is done by friction on a sled weighing 100 newtons during a 10 meter displacement? The coefficient of sliding friction is 0.1.

Bonus Answer: 100

3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

For the hydrogen atom, which series describes electron transitions to the $N=1$ orbit, the lowest energy electron orbit?

Bonus Answer: Lyman series

Bonus: Short Answer

Electric current may be expressed in which one of the following units?

Bonus Answer: coulombs/second

4. PHYSICS

Writer: Aaron Gee

Toss Up: Multiple Choice

Radiocarbon is produced in the atmosphere as a result of?

W) collision between fast neutrons and nitrogen nuclei present in the atmosphere

X) action of ultraviolet light from the sun on atmospheric oxygen

Y) action of solar radiations particularly cosmic rays on carbon dioxide present in the atmosphere

Z) lightning discharge in atmosphere

Toss Up Answer: W

Bonus: Multiple Choice

Nuclear sizes are expressed in a unit named

- W) Fermi
- X) angstrom
- Y) newton
- Z) Tesla

Bonus Answer: W

5. PHYSICS

Writer: Raafiul Hossain

Toss Up: Multiple Choice

The graphs of the two equations $y = ax^2 + bx + c$ and $y = Ax^2 + Bx + C$, such that a and A have different signs and that the quantities $b^2 - 4ac$ and $B^2 - 4AC$ are both negative,

- W) 1 intersections
- X) 2 intersections
- Y) None
- Z) I do not know

Toss Up Answer: Z

Bonus: Multiple Choice

For x greater than or equal to zero and less than or equal to 2π , $\sin x$ and $\cos x$ are both decreasing on the intervals

- W) $(0, \pi/2)$
- X) $(\pi/2, \pi)$
- Y) $(\pi, 3\pi/2)$
- Z) $(3\pi/2, 2\pi)$

Bonus Answer: X

6. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

What is the height of an equilateral triangle with side length 4?

- W) 8
- X) 4
- Y) $2\sqrt{3}$
- Z) $4\sqrt{3}$

Toss Up Answer: Y

Bonus: Short Answer

What is the area of an isosceles right triangle with hypotenuse $10\sqrt{2}$?

Bonus Answer: 50

7. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Short Answer

What number is a factor of $y^3 + 10y^2 + 123y + 5$?

Bonus Answer: 1, -1

Bonus: Short Answer

What is the area of an equilateral triangle inscribed in a circle with a radius of 6?

Bonus Answer: $(27\sqrt{3})$

8. MATHEMATICS

Writer: Ashneel Das

Toss Up: Short Answer

How many non empty subsets are there of the set $\{1, 2, 6, 9\}$?

Bonus Answer: 15

Bonus: Short Answer

What are the roots of $x^4 - 5x^2 + 4$?

Bonus Answer: 1, -1, 4, -4

9. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is not an anabolic steroid?

W) Fenestrane

X) Stanozolol

Y) Fortesta

Z) Deca-Durabolin

Toss Up Answer: W

Bonus: Short Answer

Which scientist became known as the founder of molecular biology due to their discovery of the spiral structure of proteins?

Bonus Answer: Linus Pauling

10. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following conditions causes an autoimmune response to eating glucose?

W) Anaplasmosis

X) Anisakiasis

Y) celiac disease

Z) Candidiasis

Toss Up Answer: Y

Bonus: Multiple Choice

What is colony collapse disorder characterized by?

W) The disappearance of many male worker bees

X) The death of the queen bee

Y) The destruction of the honey produced by bees

Z) The destruction of the structure of a bee hive

Bonus Answer: W

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11. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the most common organic compound on Earth?

- W) chitin
- X) glucose
- Y) phospholipids
- Z) cellulose

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following syndrome occurs in women born with only 1 X chromosome?

- W) Marfan Syndrome
- X) Turner Syndrome
- Y) Prader-Willi syndrome
- Z) Porphyria

Bonus Answer: X

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12. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which gland releases the antidiuretic hormone?

- W) pituitary
- X) hypothalamus
- Y) pancreas
- Z) testes

Toss Up Answer: X

Bonus: Multiple Choice

Which part of the heart functions as a pacemaker?

- W) AV node
- X) S node
- Y) SA node
- Z) SA pacemaker

Bonus Answer: Y

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13. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following correctly states the composition of blood?

- W) 45 % RBC, 55% Plasma
- X) 65 % RBC, 25% Plasma
- Y) 85 % RBC, 15% Plasma

Z) 35% RBC, 65% Plasma

Toss Up Answer: W

Bonus: Multiple Choice

What is the function of basophils?

- W) to engulf pathogens through phagocytosis
- X) to stimulate inflammation by releasing histamine
- Y) to kill RBCs
- Z) to remove pathogens from RBCs

Bonus Answer: X

14. BIOLOGY

Writer: Aaron Gee

Toss Up: Short Answer

Nitrogenous base that occurs in RNA but not in DNA?

Bonus Answer: Uracil

Bonus: Short Answer

Which of the following correctly explains how a favorable genetic trait can increase in frequency in a population?

Bonus Answer: Natural Selection

15. BIOLOGY

Writer: Jason Mohabir

Toss Up: Short Answer

Nitrogen fixation refers to the direct conversion of atmospheric nitrogen gas into:

Bonus Answer: ammonia

Bonus: Short Answer

The transformation of nitrates to gaseous nitrogen is accomplished by microorganisms in a series of biochemical reactions. The process is known as:

Bonus Answer: denitrification

16. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Pine, fir, spruce, cedar, larch and cypress are the famous timber-yielding plants. All these belong to:

- W) angiosperms
- X) gymnosperms
- Y) monocotyledons
- Z) dicotyledons

Toss Up Answer: X

Bonus: Multiple Choice

The population of algae in soil is [blank] that of either bacteria or fungi.

- W) generally smaller than
- X) generally greater than

- Y) equal to
Z) none of these

Bonus Answer: W

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17. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Which of the following is true regarding anthrax:

- W) Anthrax is caused by a virus
X) Anthrax is highly contagious
Y) Inhalation anthrax and cutaneous anthrax are caused by separate strains of *Bacillus anthracis*
Z) Inhalation Anthrax requires infection with a large number of spores

Toss Up Answer: Z

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Bonus: Short Answer

Give the binomial nomenclature of the pathogen that causes anthrax:

Bonus Answer: *Bacillus anthracis*

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18. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

Which of the following has the highest electronegativity?

- W) Francium
X) Carbon
Y) Fluorine
Z) Oxygen

Toss Up Answer: Y

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Bonus: Short Answer

How many times faster does hydrogen diffuse through a hole than oxygen?

Bonus Answer: 4

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19. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

The H–C–O bond angle in $\text{H}_2\text{C}=\text{O}$ (formaldehyde) is approximately:

- W) 90
X) 109
Y) 120
Z) 180

Toss Up Answer: Y

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Bonus: Short Answer

In which compound does carbon have the highest oxidation state?

1. CH_4
2. HCN
3. H_2CO
4. CH_2Cl_2

Bonus Answer: 2. HCN

20. CHEMISTRY

Writer: Jason Mohabir

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) CH₃CH₂CH₂CH₃
- X) CH₃NH₂
- Y) CH₂F₂
- Z) CH₃OH

Bonus Answer: Z

21. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

What type of bond is formed between two atoms with an electronegativity difference of 1.0?

- W) Polar Covalent
- X) Nonpolar Covalent
- Y) Ionic
- Z) Hydrogen

Toss Up Answer: W

Bonus: Short Answer

Of the following, which increase with atomic number in group 5 of the periodic table? 1) Atomic Radius 2) Atomic mass 3) First Ionization Energy

Bonus Answer: 1 and 2

22. CHEMISTRY

Writer: Ashneel Das

Toss Up: Multiple Choice

How many carbon atoms and hydrogen atoms are present in one molecule of hexane?

- W) 6 hydrogen, 14 carbon
- X) 6 carbon, 14 hydrogen
- Y) 6 carbon, 12 hydrogen
- Z) 6 carbon, 10 hydrogen

Toss Up Answer: X

Bonus: Short Answer

Identify which of the following statements about carbon dioxide are true: 1) It has a molar mass of approximately 44 g/mol 2) It is a polar molecule 3) It has two double bonds

Bonus Answer: 1 and 3

23. EARTH and SPACE

Writer: Jessica Titensky

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

24. EARTH and SPACE

Writer: Andrew Chen (Senior)

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

Give the following classifications for these sedimentary rocks, breccia, conglomerate, and shale.

Bonus Answer: All Clastic sedimentary rocks.

25. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Glaciers effect the land through glacial erosion. Different geographies are formed but what is the specific name of the long narrow ridges that show where the glacier was once present?

W) Glacial retreat

X) Drumlins

Y) Glacial erotics

Z) Morianes

Toss Up Answer: Z

Bonus: Short Answer

Ice sheets and glaciers expanded to cover large areas of land during the last major glacial epoch. During which time period did this take place?

Bonus Answer: Quaternary
