

Round 14

1. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following has the greatest entropy?

W) Gaseous Substances

X) Gases

Y) Liquids

Z) Solids

Toss Up Answer: X

Bonus: Short Answer

What is the name of the value commonly used to determine if a reaction is spontaneous or not?

Bonus Answer: Gibbs Free Energy

2. MATHEMATICS

Writer: William Xiang

Toss Up: Short Answer

Find the integral of $2x^3 + 2$ with respect to x in simplest terms.

Bonus Answer: $(x^4)/2 + 2x$

Bonus: Multiple Choice

Which of the following is a conic section?

W) Cylinder

X) Triangle

Y) Hyperbola

Z) Asymptote

Bonus Answer: Y

3. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Which of the following is a storage protein?

W) aquaporin

X) actin

Y) ovalbumin

Z) AP2

Toss Up Answer: Y

Bonus: Short Answer

What amino acid common in living organisms has a sulfhydryl group in its side chain?

Bonus Answer: cysteine

4. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The longest wavelength absorption in the UV visible spectrum of acetone, CH_3COCH_3 , occurs at 335 nm. Predict the energy required to excite an electron from a lone pair orbital on the oxygen atom to an antibonding orbital centred on the carbonyl group.

- W) 3.7 eV
- X) .27 eV
- Y) 2.99 eV
- Z) 1.67 eV

Toss Up Answer: W

Bonus: Multiple Choice

The Pauling electronegativities of fluorine and chlorine are 4.0 and 3.0 respectively. Estimate the dipole moment of chlorine monofluoride, ClF.

- W) 4 D
- X) 3 D
- Y) 1.6 D
- Z) 1 D

Bonus Answer: Z

5. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

Although scientists are unable to obtain samples by drilling, they believe the predominant mineral in the mantle is:

- W) quartz
- X) olivine
- Y) potassium feldspar
- Z) iron pyrite

Toss Up Answer: X

Bonus: Multiple Choice

If the intent is to neutralize soil acidity, the mixing of which of the following materials in the soil would be the LEAST effective?

- W) gypsum
- X) pure CaCO_3
- Y) ground limestone
- Z) ground oyster shells

Bonus Answer: W

6. CHEMISTRY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

Which of the following solutions would probably have the highest boiling point

- W) 0.1m of KOH
- X) 0.2m of CaCl_2
- Y) 0.2m of $\text{C}_6\text{H}_{12}\text{O}_6$
- Z) 0.1m CaCO_3

Toss Up Answer: X

Bonus: Short Answer

The molarity of a solution obtained when a stock solution of 50.0 ml of 6.0M HCl is diluted to a final volume of 480ml

Bonus Answer: 0.625

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7. BIOLOGY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Which immune cell does HIV directly target?

W) B Cells

X) Immunoglobulins

Y) CD4 Cells

Z) Killer T Cells

Toss Up Answer: Y

Bonus: Short Answer

Individuals heterozygous for the gene for which genetic disease have increased immunity to malaria?

Bonus Answer: Sickle Cell Anemia

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8. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of these compounds is not a saturated compound?

W) ethane

X) propanol

Y) butanal

Z) acetylene

Toss Up Answer: Z

Bonus: Short Answer

What are the two compounds formed when ethanoic acid and ethanol react?

Bonus Answer: Ethyl ethanoate and water

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9. BIOLOGY

Writer: Jason Mohabir

Toss Up: Multiple Choice

Metastasis involves

W) decreased levels of proteins that regulate metalloproteins

X) programmed cell death

Y) closing of aromatic rings

Z) bioinformatic analysis of clinical trial

Toss Up Answer: W

Bonus: Multiple Choice

BRAC1, an inherited form of breast cancer, regulates cell division by

W) binding to a DNA sequence

X) binding to the protein RAD 51 which repairs DNA damage

Y) complexing with cyclins

Z) binding to the cell outer membrane

Bonus Answer: X

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10. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

For the unfolding reaction of Protein G, $\Delta H^\circ = 210.6 \text{ kJ/mol}$, this means that

- W) unfolding is not favored enthalpically
- X) unfolding is favored enthalpically
- Y) the entropy is positive at all temperatures
- Z) the entropy is negative at all temperatures

Toss Up Answer: X

Bonus: Multiple Choice

At the midpoint of a temperature transition curve,

- W) all of the protein is denatured
- X) $K_{eq} = 1.0$ and $\Delta G = 0$
- Y) $[Native] = 1/2 [Unfolded]$ (READ AS: concentration of Native = half of the concentration of Unfolded)
- Z) $K_{eq} = 0$ and $\Delta G = 1.0$

Bonus Answer: X

11. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

What is the defining characteristic of the classification of types of supernovas?

- W) total energy released
- X) elemental spectral lines
- Y) duration of the supernova
- Z) size of the initial star

Toss Up Answer: X

Bonus: Short Answer

What element is released in a Type IA supernova that is not released in other Type I supernovae?

Bonus Answer: silicon

12. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A plane mirror is in a vertical plane and is rotating about a vertical axis at 100 rpm. A horizontal beam of light is incident on the mirror. The reflected beam will rotate at:

Bonus Answer: 200 rpm (ACCEPT 200)

Bonus: Short Answer

The curvature of a concave spherical mirror is 50 cm^{-1} . How far away from the mirror does an object need to be placed as to not create an image?

Bonus Answer: 25 cm (ACCEPT 0.25m or equivalent forms)

13. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What is the process of breaking down fatty acids and converting them to acetyl CoA called?

Bonus Answer: beta oxidation

Bonus: Short Answer

For every 6 molecules of carbon dioxide consumed for photosynthesis, how many molecules of water are consumed?

Bonus Answer: 12

14. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

An electron travels 45 degrees north of east in a magnetic field which points 45 degrees west of north. In what direction does the magnetic force acting on the electron points?

Bonus Answer: Down

Bonus: Short Answer

A 2C charge travels through a magnetic field $B = 6i + 15j + 9k$ with velocity $v = 2i + 5j + 3k$. What is the magnetic force acting on the charge?

Bonus Answer: 0

15. BIOLOGY

Writer: Ahmad Alnasser

Toss Up: Short Answer

Both fungus-farming ants and their fungi can synthesize the same structural polysaccharide from the β -glucose. What is this polysaccharide?

Bonus Answer: Chitin

Bonus: Short Answer

Plasmogamy can directly result in which of the following? 1. cells with a single haploid nucleus 2. heterokaryotic cells 3. dikaryotic cells 4. cells with two diploid nuclei

Bonus Answer: 2 and 3

16. MATHEMATICS

Writer: Hanna Yang

Toss Up: Short Answer

Compute: $\sqrt{(3^4 \cdot 5 - 60)^2}$

Bonus Answer: 0

Bonus: Short Answer

Compute $(\frac{34}{17} - 2 + 5) * (96 + -144) * (\frac{1}{46 - \frac{130}{5}})$

Bonus Answer: -12

17. PHYSICS

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

How many elements are in between the first two radioactive elements on the Periodic Table?

W) 15

X) 16

Y) 17

Z) 18

Toss Up Answer: Y

Bonus: Short Answer

What is the name for the line dividing the metals and the nonmetals on the periodic table?

Bonus Answer: Amphoteric line or semimetal line or metalloid line

18. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

Find the points of intersection of the following curves:

$$y = \sqrt{x^2 - x + 29}$$

$$y = x + 2$$

W) (5,7)

X) $(\sqrt{2} - 1, \sqrt{2} + 1)$

Y) $(\sqrt{29} - 1, \sqrt{29} + 1)$

Z) (2,4)

Toss Up Answer: W

Bonus: Multiple Choice

Which of the following expressions is not divisible by 9

W) $5^3 + 7^3$

X) $4^5 + 2^5$

Y) $10^3 - 7^3$

Z) $9^7 - 6^7$

Bonus Answer: W

19. PHYSICS

Writer: Jason Mohabir

Toss Up: Multiple Choice

NMR spectroscopy is

W) diffraction

X) absorption

Y) radiation

Z) emission

Toss Up Answer: X

Bonus: Multiple Choice

NMR is based on

W) nuclear fission

X) charge of nucleus

Y) magnetic moment of the nucleus

Z) electrical moment of the nucleus

Bonus Answer: Y

20. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Multiple Choice

Which of the following is NOT true regarding cirrus clouds?

- W) They are typically found between 10,000 feet and 15,000 feet above sea level
- X) They can be formed from any cloud that goes under glaciation
- Y) They cover 25% of the Earth and have a heating effect
- Z) They have been seen forming on other planets such as Mars and Jupiter

Toss Up Answer: W

Bonus: Multiple Choice

The most common cloud source for a majority of tornadoes is:

- W) Cumulus
- X) Nimbostratus
- Y) Altostratus
- Z) Cumulonimbus

Bonus Answer: Z

21. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

In a totally inelastic collision, what happens to the two colliding objects?

Bonus Answer: They STICK together!

Bonus: Short Answer

For a uniformly rotating object, what do we call the rate of change in the angle through which the object turns in one second?

Bonus Answer: ANGULAR VELOCITY

22. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Where is the Sea of Tranquility?

- W) Near the Bermuda Triangle
- X) In the Atlantic Ocean
- Y) In the Pacific Ocean
- Z) On the Moon

Toss Up Answer: Z

Bonus: Multiple Choice

The outermost layer of the sun is called the:

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

Bonus Answer: Y

23. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

A horse moves a sleigh 10 meters by applying a horizontal 60-newton force on its harness for 2 minutes. What is the power of the horse?

Bonus Answer: 5 Watts

Bonus: Short Answer

A force of 100 newtons is used to move an object a distance of 15 meters. Find the time the force is applied to achieve a power of 25 Watts.

Bonus Answer: 60 seconds

24. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

In which hemisphere are constellations named after scientific instruments?

Bonus Answer: Southern

Bonus: Short Answer

What is the latin name for the constellation that the big dipper is a part of?

Bonus Answer: Ursa Major

25. EARTH and SPACE

Writer: Justin Lam

Toss Up: Multiple Choice

Which of the following is an extrusive igneous rock?

W) Granite

X) Obsidian

Y) Slate

Z) Diorite

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following minerals is the hardest?

W) Quartz

X) Talc

Y) Feldspar

Z) Corundum

Bonus Answer: Z
