Round 21

1. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

In the following redox reaction: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ which compound is the oxidizing agent?

W) O_2

X) CH_4

Y) CO_2

Z) H_2O

Toss Up Answer: W

Bonus: Short Answer

Given the organic molecule C_6H_{14} how many different structural isomers can be formed?

Bonus Answer: Five

==========

2. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Short Answer

From least to greatest, order these minerals in order of pressure needed to create it: Schist, Phyllite, Gneiss, Slate

Bonus Answer: 3, 2, 4, 1

Bonus: Short Answer

During what era did oxygen begin to enter the atmosphere in abundance?

Bonus Answer: Early Protorezoic or Protorezoic

==========

3. MATHEMATICS

Writer: Benjamin Avrahami

Toss Up: Short Answer

In simplest form, express the surface area to volume ratio of a cube with side length s.

Bonus Answer: 6:s

Bonus: Short Answer

Calculate the harmonic mean of the first two perfect numbers and 10.

Bonus Answer: 4 * sqrt(105)

==========

4. PHYSICS

Writer: Elias Milborn

Toss Up: Short Answer

A train moving 35 meters per second emits a whistle with a frequency of 900 hertz. Assuming that the speed of sound in air is 350 meters per second, what is the frequency, in hertz, measured by a stationary observer in front of the train?

Bonus Answer: 1000

Bonus: Multiple Choice

Which of the following has the highest vapor pressure at STP?

W) mercury

X) ethyl alcohol

Y) methyl alcohol

Z) acetone

Bonus Answer: Z

==========

5. BIOLOGY

Writer: Yae June Lee

Toss Up: Short Answer

How many turns in the Calvin Cycle can it produce one PGAL molecule?

Bonus Answer: 2

Bonus: Short Answer

What diffuses through the ATP syntheses in the process of photosynthesis?

Bonus Answer: Hydrogen ions/protons. The protons in the thylakoids membrane is diffused out by the process of chemiosmosis.

==========

6. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

For E2 reactions to occur, the Hydrogen has to be what to the leaving group?

Bonus Answer: antiperiplanar

Bonus: Short Answer

List the following formations in order of lowest stability to highest: Trans, Geminal, Cis

Bonus Answer: cis, geminal, trans

==========

7. PHYSICS

Writer: Yevgeniy Gorbachev

Toss Up: Short Answer

Given a fuel flow rate of 5 kg/s and a thrust of 20 kN, what is the exhaust velocity of the thruster? Assume standard gravity to be 10 m/s^2.

Bonus Answer: 4 km/s (also acceptable: 4000 m/s)

Bonus: Short Answer

If one of the engines of a single stage has a specific impulse of 40 seconds and a fuel flow rate of 2 kg/s, and the other engine has a specific impulse of 100 seconds and a fuel flow rate of 10 kg/s, what is the total thrust of the stage? Assume standard gravity to be 10 m/s^2.

Bonus Answer: 10800 N

==========

8. MATHEMATICS

Writer: Ashneel Das

Toss Up: Multiple Choice

How many roots does the equation x^4 + 3x^3 + 2x^2 + 9x + 14 = 0 have?

W) 1

X) 2

Y) 3

Z) 4

Toss Up Answer: Z

Bonus: Short Answer

What is the limit of (1-1/n) as n goes to infinity?

Bonus Answer: 1

==========

9. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Acetone has a distinct smell, which many people associate with the smell of nail polish remover. What might the smell of acetone in the urine or on the breath of a patient indicate?

W) The patient might be degrading too many amino acids from muscle proteolysis.

X) The patient's body might be oxidizing too many fatty acids.

Y) The patient might have enteritis and is absorbing endproducts of fermentation.

Z) The patient might have fructose toxicity.

Toss Up Answer: X

Bonus: Multiple Choice

Which description best describes what would happen to the carbon cycle if all
detritivores suddenly went on "strike" and stopped working?

W) Carbon would increase in inorganic mass, while the atmospheric reservoir of carbon would continue to increase and plants would not be jeopardized.

X) Carbon would accumulate in organic mass, the atmospheric reservoir of carbon would decline, and plants would eventually be starved for CO_2 .

Y) Carbon would increase in organic mass, while the atmospheric reservoir of carbon would increase and plant-life would be starved for CO_2.

Z) Carbon would decrease in organic mass, while the atmospheric reservoir of carbon would increase with the result that plant-life would be starved for CO_2.

Bonus Answer: X

==========

10. MATHEMATICS

Writer: Andrew Chen (Senior)

Toss Up: Short Answer

A square is inscribed within a circle with a radius of 2.5 cm. To the nearest tenths place what is the area of the square?

Bonus Answer: 12.5 cm^2

Bonus: Multiple Choice

Given the parabola y=4x^2+2x-10 what is the equation of the line tangent to it at the point (0,-10)?

W) y=2x+10

X) y=2x-5

Y) y=5x-8

Z) y=2x-10

Bonus Answer: Z

==========

11. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which element breaks the octet rule?

W) Ga

X) Xe

Y) Cu

Z) F

Toss Up Answer: X

Bonus: Short Answer

What is the empirical formula of C6H11?

Bonus Answer: C6H11

==========

12. EARTH and SPACE

Writer: Benjamin Avrahami

Toss Up: Multiple Choice

At above what size does a rock need to be in order to be a boulder?

W) 15.3

X) 25.6

Y) 40.2

Z) 22.9

Toss Up Answer: X

Bonus: Short Answer

At which two zones of Earth's atmosphere does the temperature rise as the altitude increases?

Bonus Answer: Stratosphere and Thermosphere

==========

13. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following elements has the highest reflectivity?

W) Gold

X) Silver

Y) Mercury

Z) Gallium

Toss Up Answer: X

Bonus: Short Answer

What is Avogadro number to the nearest ten-thousandths?

Bonus Answer: 6.0221 * 10 ^ 23

==========

14. EARTH and SPACE

Writer: Olivia Gallager

Toss Up: Short Answer

How many planets in our solar system have moons?

Bonus Answer: 6

Bonus: Short Answer

What layer of the atmosphere lies between the troposphere and mesosphere?

Bonus Answer: Stratosphere

==========

15. MATHEMATICS

Writer: Ivan Zhang

Toss Up: Multiple Choice

A function with the zero 1 + 23i must have a multiplicity of at least?

W) 1

X) 23

Y) 4
Z) 2
Toss Up Answer: Z

Bonus: Short Answer
Find the zeros of the function: 0 = x^4 -81
Bonus Answer: 3i, -3i, 3, -3

==========

16. PHYSICS

Writer: Prangon Ghose
Toss Up: Short Answer
A rock is thrown downward from the top of a tower with an initial speed of 12 m/s. If the rock hits the ground after 2 s, what is the speed of the rock as it hits the ground if air resistance is negligible to the nearest whole number?
Bonus Answer: 32 m/s

Bonus: Short Answer
Human reaction time is usually greater 0.10 s. If someone holds a ruler between your finger and thumb and releases it without warning, how far can you expect the ruler to fall before you catch in cm to the 10th place?
Bonus Answer: 4.9 cm

==========

17. BIOLOGY

Writer: Eric Shau
Toss Up: Short Answer
Which scientist studied pea plants for years to conclude a pattern was in the height?
Bonus Answer: Gregor Mendel.

Bonus: Short Answer
How is radiation harmful?
Bonus Answer: It causes cells to mutate, or spontaneously die.

==========

18. PHYSICS

Writer: Prangon Ghose
Toss Up: Short Answer
A sports car dealer claims that his product will accelerate at a constant rate from rest to a speed of 90 km/hr in 8s. What is the acceleration of the car in m/s^2 to the nearest whole number?
Bonus Answer: 3 m/s^2

Bonus: Short Answer
A rock released at rest from the top of a tower hits the ground after falling for 2 s. What is the height of the tower if air resistance is negligible to the nearest whole number?
Bonus Answer: 20 m

==========

19. BIOLOGY

Writer: Eric Shau
Toss Up: Short Answer
Which cell does HIV attack?
Bonus Answer: The C4 Cells.

Bonus: Short Answer
What is the optimal pH for pepsin?

Bonus Answer: Around 2-3 pH.

==========

20. PHYSICS

Writer: Prangon Ghose

Toss Up: Short Answer

Just before hitting a nail, a 2 kg hammer is moving at 10 m/s. If the wood exerts a constant 180 N force on the nail, how far does the nail go?

Bonus Answer: 0.6 m

Bonus: Short Answer

What is the velocity of a particle after falling 10 m if its initial velocity is 10 m/s?

Bonus Answer: 10rad(3) m/s

==========

21. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Certain amino acids are considered essential in an animal's diet because they cannot be produced within the organism. Which of the following cellular processes would be most DIRECTLY affected by a dietary deficiency in essential amino acids?

W) Translation of mRNA
X) Cellular respiration
Y) Cell division
Z) Oxygen transport

Toss Up Answer: W

Bonus: Multiple Choice

Integral transmembrane proteins are proteins embedded in the cell membrane. Which of the following amino acids would you MOST expect to find in the transmembrane region of such proteins?

W) Tryptophan
X) Lysine
Y) Arginine
Z) Serine

Bonus Answer: W

==========

22. CHEMISTRY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following forces is the only force that bonds noble gases?

W) Dipole-Dipole
X) Ionic
Y) Covalent
Z) London Dispersion Forces

Toss Up Answer: Z

Bonus: Short Answer

What term is used to describe the energy released by the bonding of gaseous ions to form one mole of a substance?

Bonus Answer: lattice energy

==========

23. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

What type of pathogen causes malaria?

Bonus Answer: Parasites (or protists).

Bonus: Short Answer

When specialization is starting in the fetus, what three layers are formed (inner to outer)?

Bonus Answer: Endoderm, Mesoderm, Ectoderm

==========

24. BIOLOGY

Writer: Eric Shau

Toss Up: Short Answer

What phylum are jellyfish in?

Bonus Answer: Cnidaria.

Bonus: Short Answer

What order are humans in?

Bonus Answer: Primates.

==========

25. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Concerning the generation of ATP by oxidative phosphorylation, all of the following are true EXCEPT:

W) NADH produced in the cytosol of the cell will generate approximately 2.5 ATPs.

X) NADH produced in the mitochondria will generate approximately 2.5 ATPs.

Y) NADH produced by the succinate thiokinase reaction will generate approximately 1.5 GTPs.

Z) FADH2 produced in the mitochondria will generate approximately 1.5 ATPs.

Toss Up Answer: Y

Bonus: Multiple Choice

What enzyme does a retrovirus primarily rely on to create a copy of its genome that is ready for integration into the host genome?

W) DNA gyrase

X) RNA polymerase

Y) Reverse transcriptase

Z) DNA polymerase

Bonus Answer: Y

==========