

Round 22

1. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Multiple Choice

Which of these numbers are transcendental?

- W) i
- X) root 2
- Y) e to the pi i
- Z) pi

Toss Up Answer: Z

Bonus: Short Answer

What conic section does this equation create? $25x^2 - 150x - 16y^2 - 128y + 481 = 0$

Bonus Answer: Two intersecting lines/ a degenerate hyperbola

2. EARTH and SPACE

Writer: Jan Wojcik

Toss Up: Short Answer

Name the wave that you would typically feel during an earthquake if you were standing on the ground after feeling the first primary wave.

Bonus Answer: S-wave (secondary wave)

Bonus: Short Answer

An earthquake is measured to have a Richter scale value of around 4. Another earthquake is measured to have a Richter scale value of 7. How much smaller is the first earthquake to the second earthquake?

Bonus Answer: 1000 times smaller (accept 1000)

3. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A helicopter is ascending vertically with a constant speed of 6 meters per second relative to the ground. At the instant the helicopter is 60 meters above the ground it releases a package.

What is the magnitude and direction of the velocity of the package, relative to the ground, the instant the package is released by the helicopter?

Bonus Answer: 6 meters/second up

Bonus: Multiple Choice

If the resultant force acting on a body of constant mass is zero, the body's momentum is

- W) increasing
- X) decreasing
- Y) always 0
- Z) Constant!

Bonus Answer: Z

4. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is $(1000! + 999!)/(998!)$?

Bonus Answer: 999,999

Bonus: Short Answer

What is the first number with 5 distinct prime factors?

Bonus Answer: 2,310

5. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

There are two small, thermally isolated rooms A and B. The heat capacitance of room A is 40 units of energy and room A contains 32 units of energy. The heat capacitance of room B is 100 units of energy and room B contains 50 units of energy. When the two rooms are thermally connected, in which direction will energy flow, on average?

- W) Energy will not flow
- X) Can't tell
- Y) Room A to Room B
- Z) Room B to Room A

Toss Up Answer: Y

Bonus: Short Answer

A piece of aluminium with mass 800 g is heated up to 1000 degrees C. Given the specific heat capacity of aluminium is 900 J/(kg K), calculate the amount of heat (in Joules) given out if the piece is cooled down to 200 degrees C.

Bonus Answer: 576,000 J

6. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

In the following redox reaction: $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ 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

7. MATHEMATICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

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

Bonus Answer: 1

Bonus: Multiple Choice

Which of the following assumptions are made in chaos theory?

- W) The initial parameters are unknown and the future is deterministic
- X) The initial parameters are known and the future is deterministic
- Y) The initial parameters are not all known and the future is randomly determined
- Z) The initial parameters are all known and the future is randomly determined

Bonus Answer: X

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8. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the common oxidation state of Radium?

Bonus Answer: +2 (don't accept 2)

Bonus: Short Answer

List the following atoms in order of increasing electron affinity: oxygen, boron, and fluorine.

Bonus Answer: (1) BORON, (2) OXYGEN, (3) FLUORINE

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9. BIOLOGY

Writer: Elias Milborn

Toss Up: Short Answer

What scientist in 1936, building on the discoveries of Szent-Gyorgyi [SENT-GEE-or-gee], postulated the basic reactions of the tricarboxylic acid cycle?

Bonus Answer: Krebs

Bonus: Short Answer

If a plant that is heterozygous for each of three independently-assorting traits is allowed to self-fertilize, what portion of the offspring would be heterozygous for all three traits?

Bonus Answer: 1/8

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10. 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

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11. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

What hormone is released by the kidneys in response to oxygen deficiency?

W) erythropoietin

X) Renin

Y) calcitonin

Z) Leptin

Toss Up Answer: W

Bonus: Short Answer

By what type of system is RBC numbers regulated?

Bonus Answer: negative-feedback system

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12. PHYSICS

Writer: Jan Wojcik

Toss Up: Short Answer

An electron is being held in an electric field. The direction of the electric field lines of the electric field are East. In what direction will the electron move when it is released.

Bonus Answer: West (accept: Left)

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Bonus: Multiple Choice

A proton is traveling to the right with a velocity of 1m/s and there is a magnetic field of 3 Teslas coming towards you. What is the direction and magnitude of the force, in scientific notation to the nearest tenth, felt by the proton?

W) 4.8×10^{-19} N down

X) 4.8×10^{-19} N up

Y) 3.6×10^{-19} N down

Z) 3.6×10^{-19} N up

Bonus Answer: W

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13. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

SNPs can be characterized by all of the following EXCEPT for:

W) always causing diseases.

X) being common in a population.

Y) acting as a point mutation.

Z) acting as a transition mutation.

Toss Up Answer: W

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Bonus: Short Answer

Which of the following cells are phagocytic?

1.Megakaryocyte

2.Dendritic cells

3.Natural killer cells

4.Neutrophils

5.Monocytes

Bonus Answer: 2, 4, 5

(Dendritic cells, Neutrophils, Monocytes)

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14. MATHEMATICS

Writer: Siam Muquit

Toss Up: Multiple Choice

Given the equation of a conic section, $y^2/16 - x^2/25 = 1$, what is the length of the conjugate axis?

W) 16

X) 8

Y) 10

Z) 25

Toss Up Answer: Y

Bonus: Multiple Choice

Compute $\log(\text{base } 2)$ of 2048^2

W) 20

X) 22

Y) 24

Z) 26

Bonus Answer: X

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15. BIOLOGY

Writer: Justin Lam

Toss Up: Short Answer

In photosynthesis, what are the three products released from hydrolysis?

Bonus Answer: Hydrogen or Hydrogen Ions (H^+) , Oxygen or Oxygen Gas , and Electrons

Bonus: Multiple Choice

Which of the following carbohydrates the human body can NOT digest?

W) Fructose

X) Cellulose

Y) Sucrose

Z) Dextrose

Bonus Answer: X

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16. 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

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17. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice

Embryological cell differentiation and pattern formation is not directly determined by which of the following?

W) cytoplasmic determinants in the mother egg cell

X) morphogens

Y) catabolite activator protein

Z) homeotic genes

Toss Up Answer: Y

Bonus: Short Answer

Epigenetic inheritance is most commonly caused by modifications to which structures or molecules?

Bonus Answer: chromatin (ACCEPT: histones)

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18. 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

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19. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of these is a weak electrolyte?

W) C₆H₁₂O₆

X) MgCl₂

Y) NaC₂H₃O₂

Z) NH₄OH

Toss Up Answer: Z

Bonus: Short Answer

By name or number, which of the following can conduct electricity in solution?

1. Hydrocarbons

2. Salts

3. Weak Acids

4. Strong Acids

Bonus Answer: Salts, weak acids, strong acids (2, 3, and 4 only)

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20. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Multiple Choice

Between which two reference minerals from Moh's Scale of Hardness does the hardness of a steel file fall in between?

W) Fluorite and Apatite

X) Apatite and Feldspar

Y) Feldspar and Quartz

Z) Quartz and Topaz

Toss Up Answer: W

Bonus: Short Answer

Name in order from smallest grain size to greatest grain size these rocks: Sandstone, Conglomerate, Shale.

Bonus Answer: Shale, Sandstone, Conglomerate

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21. PHYSICS

Writer: Charles Zhang

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

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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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22. 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

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Bonus: Short Answer

What category do the following sedimentary rocks fall into: breccia, conglomerate, and shale.

Bonus Answer: All Clastic sedimentary rocks.

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23. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

A heat engine does positive work W as it absorbs energy Q_h (READ AS: $Q_{\text{sub } h}$) from a heat reservoir and transfers energy Q_c (READ AS: $Q_{\text{sub } c}$) to a cold reservoir. What is the efficiency of the heat engine in terms of Q_h , Q_c , and W ?

Bonus Answer: W/Q_h

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Bonus: Multiple Choice

For Christmas, Bobby Tables got a heater with a coefficient of performance of 10. If the heater supplies 50 kilojoules of heat into the room in 2 seconds, what is the power of the heater in kilowatts?

W) 1

X) 2.4

Y) 2.1

Z) 2.5

Bonus Answer: Z

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24. BIOLOGY

Writer: Justin Lam

Toss Up: Multiple Choice

Which of the following stages in cellular respiration generates the most ATP (Adenosine triphosphate) ?

W) Krebs Cycle

X) Glycolysis

Y) Electron Transport Chain

Z) Pyruvate Oxidation

Toss Up Answer: Y

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Bonus: Short Answer

In cellular respiration, there are two main electron carriers produced. What are their chemical formulas?

Bonus Answer: NADH and FADH₂ (Some may mention the "empty forms" of these electron carriers: NAD⁺ and FAD ; those answers are acceptable as well).

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25. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A ball leaves a girl's hand with an upward velocity of 6 meters per second. What is the maximum height of the ball above the girl's hand?

Bonus Answer: 1.8 meters

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Bonus: Short Answer

A boy throws a ball vertically upward with a velocity of 6 meters per second. How long does it take the ball to return to the boy's hand?

Bonus Answer: 1.22 seconds

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