

Round 13

1. CHEMISTRY

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Identify the INCORRECT statement below:

- W) In the most fundamental sense, the properties of the elements are periodic functions of their atomic weight.
- X) The vertical columns of the periodic chart are called groups, sharing similar properties.
- Y) Elements with atomic numbers of 9, 17, 35, and 53 are members of the halogen family, meaning "salt formers."
- Z) Elements Li, B, N and F are all in the same period.

Toss Up Answer: W

Bonus: Multiple Choice

All of the following statements are true EXCEPT:

- W) the enthalpy change of an endothermic reaction is positive.
- X) at constant pressure the heat flow for a reaction equals the change in enthalpy.
- Y) ΔH for a reaction is equal in magnitude but opposite in sign to ΔH for the reverse reaction.
- Z) enthalpy change is dependent upon the number of steps in a reaction.

Bonus Answer: Z

2. PHYSICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

A car accelerates from rest at 4 (m/s)^2 . What is the distance traveled by the car in 3 seconds?

Bonus Answer: 18 meters (m)

Bonus: Multiple Choice

A motor scooter travels east at a speed of 13 m/s. The driver then reverses direction and heads west at 17 m/s. What was the change in velocity of the scooter?

- W) 13 m/s
- X) 17 m/s
- Y) 30 m/s
- Z) 4 m/s

Bonus Answer: Y

3. CHEMISTRY

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

Which of these ionic compounds will have the greatest melting point?

- W) NaCl
- X) NaBr
- Y) NaI
- Z) NaF

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the given compounds exhibit sp^3 hybridization?

- W) Ozone
- X) Oxygen gas
- Y) Nitrogen gas
- Z) Methane

Bonus Answer: Z

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4. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A quarter of a wavelength is equal to how many degrees of phase?

Bonus Answer: 90 degrees

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Bonus: Short Answer

Davisson and Germer scattered electrons from a crystal of nickel. The scattered electrons formed a strong diffraction pattern. What important conclusion was drawn from this experiment?

Bonus Answer: Electrons act like waves

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5. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Multiple Choice

Which of the following is not a typical storm track in the United States?

- W) from Alberta straight to Maine
- X) from the Gulf states northward along the eastern seaboard
- Y) from Colorado to the Appalachian Mountains
- Z) from the Pacific Northwest to the Southeastern US by way of Texas

Toss Up Answer: Z

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Bonus: Multiple Choice

Present day weather predictions are based primarily upon

- W) land and sea breezes
- X) cloud height
- Y) air mass movements
- Z) ocean currents

Bonus Answer: Y

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6. BIOLOGY

Writer: Calvin Vuong

Toss Up: Short Answer

Motor proteins transport vesicles along which cytoskeletal fiber?

Bonus Answer: microtubules

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Bonus: Short Answer

Shape abnormalities of the nuclear lamina are most likely a result of a defect in which cytoskeletal structure?

Bonus Answer: intermediate filaments

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7. MATHEMATICS

Writer: Aaron Gee

Toss Up: Short Answer

What is the volume of a sphere of radius "R"?

Bonus Answer: $(4/3) \pi R^3$

Bonus: Short Answer

Using an x-y coordinate axis, a parabola is given by the equation $y = x^2$. Give the x-y coordinates of the focal point for this parabola.

Bonus Answer: (0, 1/4)

8. BIOLOGY

Writer: Matthew Lee

Toss Up: Multiple Choice

Theodore Engelmann performed a famous experiment with filamentous algae and aerobic bacteria. What was he trying to find out about photosynthesis?

- W) action spectrum
- X) absorption spectrum
- Y) electromagnetic spectrum
- Z) spectrophotometric range

Toss Up Answer: W

Bonus: Short Answer

What metallic atom is at the center of the light-absorbing head of a chlorophyll molecule?

Bonus Answer: Magnesium

9. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

Two trailers, X with mass 500kg and Y with mass 2000kg, are being pulled at the same speed. Find the ratio of the kinetic energy of Y to that of X in simplest terms.

Bonus Answer: 4:1 (or 4 to 1)

Bonus: Multiple Choice

Given a potential energy function $U(x)$, the corresponding force F is in the positive x direction if:

- W) U is positive
- X) U is negative
- Y) U is an increasing function of x
- Z) U is a decreasing function of x

Bonus Answer: Z

10. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Natural selection has allowed life to flourish in ever-changing environments because:

- W) causes speciation
- X) changes allele frequencies
- Y) increases the mean fitness of a population

Z) leads to fixation or loss of particular alleles

Toss Up Answer: Y

Bonus: Short Answer

You tie a ribbon to a tree trunk. The height measured from the ribbon to the ground is five feet. The tree grows at a rate of three feet per year. After 10 years, how far up from the ground will the ribbon be?

Bonus Answer: Five feet. (EXPLANATION: The elongation of a tree trunk occurs from the apical meristem up.)

11. CHEMISTRY

Writer: Olivia Gallager

Toss Up: Short Answer

What are the numbers of sigma bonds and pi bonds, in ethyne, respectively?

Bonus Answer: 3 sigma bonds, 2 pi bonds

Bonus: Short Answer

Pi bonds are created by the overlap of what type of orbital?

Bonus Answer: p, p orbitals

12. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

What is a fluid analogous to blood in most invertebrates

- W) Interstitial fluid
- X) Hemolymphs
- Y) Hemocyanin
- Z) Plasma

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following do not have a double circulatory system

- W) Lizard
- X) Human
- Y) A bird
- Z) A fish

Bonus Answer: Z

13. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Under what conditions do gases act more ideal?

- W) Higher pressure, Higher temperature
- X) Higher pressure, Lower temperature
- Y) Lower Pressure, Higher temperature
- Z) Lower pressure, Lower temperature

Toss Up Answer: Y

Bonus: Short Answer

Rank the following gases in order from most ideal to least ideal:

1. He
2. N₂
3. HCl
4. SF₆

Bonus Answer: He, N₂, SF₆, HCl (accept 1,2,4,3)

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14. MATHEMATICS

Writer: Ahmad Alnasser

Toss Up: Short Answer

Describe the expression $2 \log_3 x + \log_3 5$ as a single logarithmic expression

Bonus Answer: $\log_3 (5x^2)$

Bonus: Short Answer

Solve the equation $2|3x - 2| - 3 = 7$

Bonus Answer: $x = (7/3), -1$

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15. 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 errotics
- 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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16. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What German physicist developed the 2nd law of thermodynamics, showing that the universe's entropy always increases?

- W) Wilhelm Röntgen
- X) Rudolf Clausius
- Y) Wilhelm Weber
- Z) Hermann von Helmholtz

Toss Up Answer: X

Bonus: Multiple Choice

What German physicist, who died in 1855, formulated separate electrostatic and electrodynamical laws?

- W) James Clerk Maxwell
- X) Johann Gauss
- Y) Frederick Beck
- Z) Max von Laue

Bonus Answer: X

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17. EARTH and SPACE

Writer: Elias Milborn

Toss Up: Short Answer

Pandora is a moon of which planet?

Bonus Answer: Saturn

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Bonus: Multiple Choice

Sea water is approximately what percent salt by mass?

W) 1%

X) 2%

Y) 4%

Z) 8%

Bonus Answer: Y

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18. MATHEMATICS

Writer: Elias Milborn

Toss Up: Short Answer

On a blueprint, if $\frac{3}{4}$ of an inch represents 1 foot, then 2 inches will represent what distance, in feet, expressed as the most reduced simple fraction?

Bonus Answer: $\frac{8}{3}$

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Bonus: Short Answer

Assuming that the probability of A is 0.3, the probability of B is 0.3, and the probability of A union B is 0.5, providing your answer as decimals to the nearest 10th, what are the probabilities respectively of A intersection B and the complement of the quantity A union B?

Bonus Answer: 0.1 and 0.5

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19. EARTH and SPACE

Writer: Janine Goh

Toss Up: Short Answer

Name 3 dwarf planets

Bonus Answer: Pluto, Ceres, Makemake, Eris, Haumea (any 3)

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Bonus: Short Answer

Which coloured stars are the hottest?

Bonus Answer: Blue

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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

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Bonus: Short Answer

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

Bonus Answer: 10rad(3) m/s

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21. BIOLOGY

Writer: Matthew Lee

Toss Up: Short Answer

What fatal, degenerative disease caused by a prion is most commonly found in sheep and goats?

Bonus Answer: scrapie

Bonus: Short Answer

What fatal, degenerative disease caused by a prion is most commonly found in people?

Bonus Answer: Creutzfeldt-Jakob disease (DO NOT ACCEPT: mad cow disease)

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22. CHEMISTRY

Writer: Siam Muquit

Toss Up: Multiple Choice

Which of the following does not exhibit resonance stabilization?

W) Ozone

X) SO₂

Y) NO₃

Z) H₂O

Toss Up Answer: Z

Bonus: Short Answer

What is the bond order of H₂O?

Bonus Answer: 2

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23. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

What kind of friction will act on a rolling, round object at an instant if the surface is horizontal and rough and no other force acts in the horizontal direction?

W) Static Friction

X) Kinetic Friction

Y) Rolling Friction

Z) No Friction

Toss Up Answer: Y

Bonus: Short Answer

If the acceleration due to gravity is 10 m/s², find the force required to move an object of mass 200 kilograms up an incline of 1 in 50 with an acceleration of 2 m/s² and a frictional force of 20 N.

Bonus Answer: 420 N

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24. 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

25. EARTH and SPACE

Writer: Matthew Lee

Toss Up: Short Answer

Put these soil horizons in order of increasing depth: bedrock, organic material and leached zone, broken rock, mineral enriched horizon

Bonus Answer: organic material and leached zone, mineral enriched horizon, broken rock, bedrock

Bonus: Multiple Choice

At high elevations in New York State, which is the most common form of physical weathering?

W) alternate freezing and melting of water

X) oxidation by oxygen in the atmosphere

Y) dissolving of minerals into solution

Z) abrasion of rocks by wind

Bonus Answer: W
