Round 38

1. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A cube with 2-m sides and a bulk modulus of 4*10^5 N/m^2 (READ 4 times 10 to the sixth newton meters squared). When it's subjected to a pressure of 2*10^5 Pa, what is the resulting volume of the cube?

W) 0.5m^3

X) 2m^3

Y) 3m^3

Z) 4m^3

Toss Up Answer: Z

Bonus: Multiple Choice

A 4.0-m long steel beam with a cross-sectional area of 1.0 × 10^−2 m^2 and a Young's modulus of 2.0 × 10^11 N/m^2 is wedged horizontally between two vertical walls. In order to wedge the beam, it is compressed by 0.020mm. If the coefficient of static friction between the beam and the walls is 0.70, what is the maximum mass (including its own) it can bear without slipping?

W) 700kg

X) 710kg

Y) 900kg

Z) 910kg

Bonus Answer: X

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2. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The mass of the planet Yor'Ectum is 1/100 that of Earth and its radius is 1/4 that of Earth. If a person weighs 600N on Earth, what would he weigh on Yor'Rectum?

Bonus Answer: 96N

Bonus: Multiple Choice

The escape speed at the surface of Earth is approximately 8 km/s. What is the mass, in units of Earth's mass, of a planet with twice the radius of Earth for which the escape speed is twice that for Earth?

W) 2

X) 4

Y) 8

Z) 1/2

Bonus Answer: Y

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3. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

An object is dropped from an altitude of one Earth radius above Earth's surface. In terms of M, the mass of Earth, and R, Earth's radius, what is the speed of the object just before it hits Earth?

Bonus Answer: sqrt(GM/R) (READ AS: square root of GM over R)

Bonus: Short Answer

Two particles, each of mass m, are a distance d apart. If an external force brings a third particle, with mass 2m, from far away to a resting point midway between the two particles, what is the work done by this force?

Bonus Answer: −8Gm^2/d^2

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4. PHYSICS

Writer: Andrew Zheng

Toss Up: Multiple Choice

An artificial satellite orbiting Earth above North America releases a bomb. Neglecting air resistance, the bomb will do which one of the following?

W) strike North America at the instant of release

X) strike China at the instant of impact

Y) never strike Earth

Z) strike China at the instant of release

Toss Up Answer: Y

Bonus: Short Answer

In planetary motion the line from the star to the planet sweeps out equal areas in equal times. This is a direct consequence of which law?

Bonus Answer: law of conservation of angular momentum (DO NOT ACCEPT Kepler's Second Law)

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5. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

Assume that Earth is in circular orbit around the Sun with kinetic energy K and potential energy U, taken to be zero for infinite separation. What is the relationship between K and U?

Bonus Answer: K = -U/2 (accept equivalent forms)

Bonus: Multiple Choice

A planet is in circular orbit around the Sun. Its distance from the Sun is four times the average distance of Earth from the Sun. The period of this planet, in Earth years, is:

W) 4

X) 8

Y) 16

Z) 64

Bonus Answer: X

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6. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

What is the probability, in fractions, that after rolling two six-sided die, the sum of the numbers shown on top is 7?

Bonus Answer: 1/6 (one-sixth or one over six is acceptable)

Bonus: Short Answer

Mr. SciBowl flips 2017 coins. What is the probability that exactly 50% of the coins show a heads?

Bonus Answer: 0

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7. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

For natural numbers m and n, if 6 divides m evenly and 8 divides n evenly, what is the largest integer that divides mn evenly?

Bonus Answer: 48

Bonus: Short Answer

For natural numbers m and n, if mn is divisible by 48 and m is divisible by 6, what is the largest integer n is divisible by.

Bonus Answer: 1

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8. MATHEMATICS

Writer: Calvin Aw

Toss Up: Short Answer

If A+B+C=10 and A-B-C=-6, compute B+C

Bonus Answer: 8

Bonus: Short Answer

Given a right triangle with legs 12 and 16, find the length of the altitude to the hypotenuse.

Bonus Answer: 48/5 or 9.6

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9. MATHEMATICS

Writer: Mohammed Jamil

Toss Up: Short Answer

Find how many different 4-digit numbers can be formed from the digits
1, 3, 5, 6, 8 and 9 if each digit may be used only once.

Bonus Answer: 360

Bonus: Short Answer

A true or false test has six questions. If a person guesses the answers, how many different ways are there to answer the test?

Bonus Answer: 64

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10. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Using accelerator mass spectrometry, the 14C atoms in a 2 mg bone
fragment were directly counted and found to be 1/8 of those that
would be present in a 2 mg bone fragment in 1950. What is the
approximate age of this specimen?

W) 1,540 years
X) B. 5,730 years
Y) C. 17,190 years
Z) D. 22,920 years

Toss Up Answer: Y

Bonus: Multiple Choice

Positive cooperativity is an emergent property of what type of
enzymatic regulatory mechanism?

W) Allosteric interactions.
X) Cellular compartmentalization.

Y) Genetic regulatory mechanisms.
Z) Second messenger systems.

Bonus Answer: W

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11. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

The chemical EDTA is routinely used in many experiments. For example, EDTA is used in electrophoresis buffer solutions. Which of the following statements is not true?
W) EDTA has a strong binding affinity for divalent and some trivalent cations.
X) EDTA is a catalyst for polymer formation and essential for protein and nucleic acid polymerization.
Y) EDTA is a chelator.
Z) EDTA is used to help denature proteins and weaken cell membranes.

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following statements is not true?
W) Insects, birds, and many reptiles excrete nitrogenous waste in the form of urea.
X) Neurons have evolved to speed the communication between distant cells in multi-cellular organisms.
Y) Synapses are specialized connections between neurons to facilitate the formation of complex neuronal networks.
Z) The regulatory proteins tropomysin and troponin control the contraction of contractile filaments, actin and myosin.

Bonus Answer: W

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12. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

When the temperature increases, which of the following statements is not true?
W) Dissolved oxygen decreases at higher temperatures and higher salinity.
X) Many corals die when the temperature exceeds 86°F.
Y) Metabolic reactions are less likely to achieve their activation energy.
Z) The amount of carbon dioxide that can be absorbed by the ocean decreases.

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following carbohydrates contain α-1, 4-linkages?
W) amylose
X) Cellulose
Y) Deoxyarabinose
Z) Glucose

Bonus Answer: W

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13. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

What is the name of the first livestock virus eradicated by a vaccine?

W) Smallpox

X) Polio

Y) Rinderpest

Z) Mumps

Toss Up Answer: Y

Bonus: Short Answer

By mass, what element makes up most of the human body?

Bonus Answer: Oxygen

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14. BIOLOGY

Writer: Hanna Yang

Toss Up: Multiple Choice

Some birds, such as pigeons and doves secrete "milk" that they feed to their children. From which of the following organs does it come from?

W) Crop

X) Gizzard

Y) Mammary Gland

Z) Stomach

Toss Up Answer: W

Bonus: Short Answer

What is the common name for Columba livia?

Bonus Answer: Feral/City/Street pigeon

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15. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

All of the following processes involve hydrogen bonding except

W) DNA replication

X) Protein folding

Y) Formation of ice crystals

Z) Binding of an enzyme and substrate

Toss Up Answer: Z

Bonus: Multiple Choice

Which of these is not an example of eukaryotic post-transcriptional modification?

W) The 3' end of the growing strand is cleaved

X) After splicing, exons are rejoined to make a final mRNA transcript

Y) Exons, non-coding regions, are removed via splicing

Z) A poly-A tail is added to the 5' end

Bonus Answer: Y

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16. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

From where do autotrophs obtain their carbon, nutrients, and minerals?
W) From the sun
X) From human activities
Y) The inorganic environment
Z) From the atmosphere
Toss Up Answer: Y

Bonus: Short Answer

What is the name of the parasite that causes malaria?
Bonus Answer: Plasmodium parasites (also accept plasmodium)

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17. BIOLOGY

Writer: Kerwin Chen
Toss Up: Short Answer
The vision of a person with myopia can be corrected with which type of lens?
Bonus Answer: diverging, concave

Bonus: Short Answer
What is the name of the surgical procedure in which cuts are made around the cornea to allow for the correction of myopia?
Bonus Answer: Radial keratotomy

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18. CHEMISTRY

Writer: Shanjeed Ali
Toss Up: Multiple Choice
Which of the following is least reactive with water at room temperature?
W) Sodium
X) Potassium
Y) Rubidium
Z) Cesium
Toss Up Answer: W

Bonus: Short Answer
What is the most abundant alkali metal on earth?
Bonus Answer: Sodium

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19. CHEMISTRY

Writer: Shanjeed Ali
Toss Up: Short Answer
What will happen solubility of oxygen gas as temperature increases?
Bonus Answer: Decrease

Bonus: Short Answer
Which elements are found in the form of diatomic gases at room temperature?
Bonus Answer: Hydrogen, oxygen, fluorine, chlorine, nitrogen

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20. CHEMISTRY

Writer: Shanjeed Ali
Toss Up: Multiple Choice

Which element has the highest ionization energy?
W) Chlorine
X) Bromine
Y) Selenium
Z) Technetium
Toss Up Answer: W

Bonus: Short Answer
What are the periodic table trends for ionization energy?
Bonus Answer: Increases left to right and decreases from the top to the bottom

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21. CHEMISTRY

Writer: Shanjeed Ali
Toss Up: Short Answer
What is the energy level and orbital of the outermost electrons in a ground state sulfur atom?
Bonus Answer: 3p

Bonus: Short Answer
What is the maximum number of covalent bonds sulfur can form?
Bonus Answer: 6

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22. CHEMISTRY

Writer: Olivia Gallager
Toss Up: Short Answer
Given 2,3-dichloropentane, what is the resulting molecule if potassium hydroxide is reacted with it at 200 degrees celsius?
Bonus Answer: 2 pentyne

Bonus: Short Answer
Which single atom is the difference between an organic acid functional group and an aldehyde functional group?
Bonus Answer: O, Oxygen

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23. EARTH and SPACE

Writer: Shamaul Dilmohamed
Toss Up: Multiple Choice
Which of the following elements is found in the earth's crust as both
a native element and as a compound?
W) argon
X) copper
Y) chlorine
Z) silicon

Toss Up Answer: X

Bonus: Multiple Choice
In geological studies, cemented volcanic ash is called:
W) caldera
X) a-a
Y) lava
Z) tuff

Bonus Answer: Z

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24. EARTH and SPACE

Writer: Banpreet Singh

Toss Up: Short Answer

What scientist first predicted the existence of black holes in 1916?

Bonus Answer: Albert Einstein

Bonus: Short Answer

What probe was launched in 2011 to study Jupiter?

Bonus Answer: The Juno probe

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25. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the most common galaxy shape in our universe?

Bonus Answer: irregular

Bonus: Multiple Choice

Astronomers use cepheids principally as measures of what?

W) size

X) speed

Y) chemical composition

Z) distance

Bonus Answer: Z

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