Round 14

1. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Not all laws that hold in an inertial frame hold in a non-inertial frame. An obvious example is the law of inertia. Does the Work-Energy Theorem hold in a non-inertial frame?

W) It only holds in inertial frames.

X) It will not hold in a non-inertial frame unless there aren't any conservative forces at work.

Y) It will hold in a non-inertial frame unless there are non-conservative forces.

Z) It holds for any non-inertial frame.

Toss Up Answer: Z

Bonus: Short Answer

An object is launched on a horizontal surface with an initial speed of 20 m/s, so that it covers a distance of 5 meters in the time interval 4 sec to 5 sec. What is the coefficient of friction between the object and the horizontal surface? Assume gravitational acceleration is 10 m/s^2

Bonus Answer: 1/3

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2. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

You decide to set off on a voyage to another star. To stop your muscles from atrophying, you want to generate artificial gravity by having your ship constantly accelerate at 1 g from your reference frame. Ignoring fuel requirements, is there a problem with generating artificial gravity this way over very long time frames?

W) Yes, this setup would not work to generate artificial gravity

X) Yes, 1 g isn't enough to prevent your muscles from atrophying

Y) No, this can be used indefinitely to generate artificial gravity

Z) Yes, eventually the ship would need to go faster than the speed of light, which is impossible

Toss Up Answer: Y

Bonus: Short Answer

A box of mass 3 kg is placed on the edge of a merry-go-round of radius 4 m. The coefficient of static friction between the box and the merry-go-round is 0.4. What is the square of the merry-go-round's speed at the moment the box slides off?

Bonus Answer: 12 (m/s)^2

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3. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

When 236U fissions, the products might be which of the following?

W) Ba-146 (READ AS: barium 146), Kr-89 (READ AS: krypton 89), and a proton

X) Ba-146 (READ AS: barium 146), Kr-89 (READ AS: krypton 89), and a neutron

Y) Cs-148 (READ AS: cesium 148) and Br-85 (READ AS: barium 85)

Z) two uranium nuclei

Toss Up Answer: X

Bonus: Short Answer

In the proton-proton cycle, two hydrogen atoms initially react to form what 3 particles?

Bonus Answer: Deuterium, a positron, and an electron neutrino (ACCEPT neutrino)

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4. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

An electrical current flows across an infinite rectilinear wire. If its intensity of is doubled, then the magnetic field at a generic point:

W) quadruples

X) doubles

Y) halves

Z) remains unchanged

Toss Up Answer: X

Bonus: Short Answer

The current I(t) flowing for a wire for t >= 0 is given by I(t) = 2^(-t). Find the total charge that will flow through the wire.

Bonus Answer: 1/(ln 2)

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5. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

What is the product of the following 2 values: (1) the greatest common divisor of 7 and 14; and (2) the least common multiple of 7 and 14?

W) 21

X) 49

Y) 98

Z) 196

Toss Up Answer: Y

Bonus: Short Answer

Multiply the following complex numbers, giving your answer in standard a + bi form: (6 + 3i)(4 + i)

Bonus Answer: 21 + 18i

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6. MATHEMATICS

Writer: Henry Zheng

Toss Up: Short Answer

By words or number, name all of the following 3 statements that are TRUE for the function, f(x) = –3x^2 – 2x – 2 = 0:

1) there are no real zeros

2) the graph is a parabola opening downward

3) the graph has no x-intercepts

Bonus Answer: All or 1,2,3

Bonus: Short Answer

Factor the following expression completely over integers: x^4 – 16

Bonus Answer: (x – 2)(x + 2)(x^2 + 4)

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7. MATHEMATICS

Writer: Henry Zheng

Toss Up: Multiple Choice

What trigonometric ratio is equal to 1/2?

W) sin 60

X) sin 30
Y) cos 30
Z) sin 30 degrees
Toss Up Answer: Z

Bonus: Short Answer
What is the probability of rolling a 1 on 3 die rolls?
Bonus Answer: 1/216

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8. MATHEMATICS

Writer: Henry Zheng
Toss Up: Short Answer
What is the probability of rolling a even number on an 8 sided die labeled 1 through 8?
Bonus Answer: 1/2

Bonus: Short Answer
What is the probability of rolling an even number on an 8 sided die labeled 1 through 8 and rolling an odd number on a 7 sided die labeled 1 through 7 in simplest fractional form?
Bonus Answer: 2/7

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9. BIOLOGY

Writer: Kerwin Chen
Toss Up: Short Answer
How many classes of immunoglobulins are there in the human body?
Bonus Answer: 5

Bonus: Short Answer
Which immunoglobulin is the largest, with 10 light and heavy chains each?
Bonus Answer: IgM, Immunoglobulin M, Immunoglobulin Mu

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10. BIOLOGY

Writer: Kerwin Chen
Toss Up: Short Answer
What are noncoding regions of dna called?
Bonus Answer: introns

Bonus: Short Answer
What are coding regions of dna called?
Bonus Answer: exons

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11. BIOLOGY

Writer: Kerwin Chen
Toss Up: Short Answer
The A site, P site, and E site are located in which organelle?
Bonus Answer: ribosome

Bonus: Short Answer
Which site does the tRNA enter the ribosome?
Bonus Answer: A site, aminoacyl-tRNA site

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12. BIOLOGY

Writer: Kerwin Chen

Toss Up: Short Answer

What is the name of the gene recombination that allows for the diversity of an antibody's heavy chain?

Bonus Answer: V(D)J Recombination

Bonus: Short Answer

Which scientist won a Nobel prize in 1987 in Physiology or Medicine for his discovery on the mechanism behind antibody diversity?

Bonus Answer: Susumu Tonegawa, Tonegawa

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13. BIOLOGY

Writer: Kerwin Chen

Toss Up: Short Answer

What is the name of the gene sequence that is recognized by VDJ recombinases?

Bonus Answer: Recombination signal sequences, RSS

Bonus: Short Answer

In V(D)J recombination, which enzyme adds nucleotides to allow for further diversity?

Bonus Answer: Terminal Deoxynucleotidyl Transferase, TdT

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14. BIOLOGY

Writer: Kerwin Chen

Toss Up: Short Answer

What is the origin of replication of DNA called?

Bonus Answer: Ori

Bonus: Short Answer

What is the ori of Escherichia Coli called?

Bonus Answer: OriC

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15. BIOLOGY

Writer: Nten Nylam

Toss Up: Multiple Choice

Which of the following are true regarding angiosperm seed development?

W) Seeds often develop on leaves

X) They often exist in cone form

Y) Seeds are enclosed within the ovary

Z) Seeds are on the stamen

Toss Up Answer: Y

Bonus: Short Answer

What enzyme catalyses the removal of electrons?

Bonus Answer: oxidase

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16. BIOLOGY

Writer: Janine Goh

Toss Up: Multiple Choice

How is the lagging strand of DNA synthesised during DNA replication?

W) Semi-conservatively

X) Okazaki Fragments
Y) With topoisomerase
Z) Continuously
Toss Up Answer: X

Bonus: Short Answer
What is the purpose of topoisomerase?
Bonus Answer: Ensure that DNA isn't wound to tightly

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17. BIOLOGY

Writer: Janine Goh
Toss Up: Short Answer
What is the purpose of SSBs (single strand binding proteins) in DNA replication?
Bonus Answer: To prevent hybridisation of original parent strands

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Bonus: Short Answer
What is the origin of replication called?
Bonus Answer: Ori

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18. CHEMISTRY

Writer: Banpreet Singh
Toss Up: Multiple Choice
What is the second most electronegative element?
W) Fluorine
X) Oxygen
Y) Chlorine
Z) Neon

Toss Up Answer: X

Bonus: Multiple Choice
Which of the following is a weak electrolyte?
W) Ammonium Hydroxide
X) Glucose
Y) Water
Z) Nitric Acid

Bonus Answer: W

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19. CHEMISTRY

Writer: Banpreet Singh
Toss Up: Multiple Choice
Which of the following is insoluble in water?
W) Magnesium Chloride
X) Ammonium Hydroxide
Y) Potassium Carbonate
Z) Barium Sulfate
Toss Up Answer: Z

Bonus: Short Answer

What is the chemical name and formula of the compound that makes up quartz?

Bonus Answer: Silicon Dioxide SiO_2

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20. CHEMISTRY

Writer: Hanna Yang

Toss Up: Multiple Choice

Which of the following is the lightest element with no stable isotopes?

W) Tellurium

X) Technetium

Y) Promethium

Z) Radon

Toss Up Answer: X

Bonus: Multiple Choice

Which of the following is the strongest intermolecular force?

W) Hydrogen Bonding

X) Ionic Bonding

Y) London Dispersion Force

Z) Covalent Bonding

Bonus Answer: W

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21. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

Name the most reactive nonmetal.

Bonus Answer: Fluorine

Bonus: Short Answer

Name the transition metal whose carbide is known to be one of the hardest, is used in drills, saws, and lightbulbs, and has the highest melting point of all pure metals.

Bonus Answer: Tungsten

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22. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

Name the most reactive member of the alkaline earth metals.

Bonus Answer: Radium

Bonus: Short Answer

By name or by number, Identify the ion(s) that has/have the smallest ionic radius?

Ca 2+, Sr 2+, Mg 2 +, Na +, F -

Bonus Answer: Mg 2+

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23. EARTH and SPACE

Writer: Justin Lam

Toss Up: Short Answer

What is the shape of the path planets take around the sun?

Bonus Answer: Elliptical

Bonus: Short Answer

Name three of the closest stars to Earth.

Bonus Answer: Three of the following: Sun, Alpha Centauri, Barnard, Wolf, Luyten, Sirius

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24. EARTH and SPACE

Writer: Kerwin Chen

Toss Up: Short Answer

On the moh's scale of mineral hardness, how hard is corundum?

Bonus Answer: 9

Bonus: Short Answer

On the moh's scale of mineral hardness, how hard is orthoclase feldspar?

Bonus Answer: 6

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25. EARTH and SPACE

Writer: Nten Nylam

Toss Up: Short Answer

Which rock has a bioclastic texture, is composed of carbon, and is formed from the compaction of plant remains.

Bonus Answer: coal

Bonus: Multiple Choice

Which of these periods came first?

W) Cretaceous

X) Cambrian

Y) Jurassic

Z) Quaternary

Bonus Answer: Z

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