Round 23

1. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A 10 farad capacitor is used in a circuit. The voltage difference between the plates of the capacitor is 20 volts. What is the magnitude of the charge on each of the capacitor's plates?

Bonus Answer: 200 Coloumbs

Bonus: Multiple Choice

A circuit which employs a DIRECT CURRENT source has a branch which contains a capacitor. After the circuit has reached a steady state, what is the magnitude of the current in the circuit branch which contains the capacitor?

W) 0
X) havled
Y) doubled
Z) infinity

Bonus Answer: W

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2. EARTH and SPACE

Writer: Andrew Chen (Senior)

Toss Up: Multiple Choice

The San Andreas fault is what specific type of fault line?
W) Transform plate boundary
X) Normal faullt
Y) Reverse fault
Z) Strike slip fault

Toss Up Answer: Z

Bonus: Short Answer

There are different types of seismic waves, body waves and surface waves. Name the two different types of body waves.

Bonus Answer: P waves and S waves

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3. MATHEMATICS

Writer: Siam Muquit

Toss Up: Short Answer

If Bruce can do a job in 3 hours, and Clark can do the same job in 4 hours, how long, in hours, will it take them to do the job if they work together? You may leave your answer as a fraction.

Bonus Answer: 12/7

Bonus: Short Answer

What is the eccentricity of an ellipse with a = 5 and b = 4?

Bonus Answer: 3/5

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4. PHYSICS

Writer: Mohammed Jamil

Toss Up: Short Answer

Given that the specific heat capacity of water is 11 times that of copper, calculate the mass of copper at a temperature

of 100 °C required to raise the temperature of 200 g of water from 20.0 °C to 24.0 °C, assuming no energy is lost to the surroundings.

Bonus Answer: 0.116 kg

Bonus: Short Answer

1 kg of water at a temperature of 45 °C is mixed with 1.5 kg of alcohol at 20 °C. Find the final temperature of the mixture.

Take the specific heat capacity of water to be 4200 J kg –1 K –1 and the specific heat capacity of alcohol to be 2400 J kg –1 K –1 . Assume no other exchange of heat occurs.

Bonus Answer: 33°C

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5. MATHEMATICS

Writer: Siam Muquit

Toss Up: Short Answer

Find the perimeter of a right triangle with legs 11 and 60.

Bonus Answer: 132

Bonus: Short Answer

In a 15-75-90 degrees right triangle with hypotenuse 4, what are the lengths of the shorter and longer leg, respectively? Exact answers please.

Bonus Answer: radical 6 - radical 2, radical 6 + radical 2

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6. BIOLOGY

Writer: Ivan Zhang

Toss Up: Multiple Choice

Which of the following is the largest patch containing lymphocytes?

W) lymph nodes

X) spleen

Y) thymus

Z) tonsils

Toss Up Answer: Z

Bonus: Short Answer

What mineral deficiency is associated small sex glands and growth failure?

Bonus Answer: Zinc

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7. CHEMISTRY

Writer: Prangon Ghose

Toss Up: Short Answer

What is the electron configuration of Mg(2+)?

Bonus Answer: 1s2 2s2 2p6

Bonus: Short Answer

What is the electron configuration of Cu(2+)?

Bonus Answer: 1s2 2s2 2p6 3s2 3p6 3d9

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8. MATHEMATICS

Writer: Siam Muquit

Toss Up: Short Answer

If the first term in an arithmetic sequence is 2 and the third term is 6, find the 10th term.

Bonus Answer: 20

Bonus: Short Answer

Compute the sum of the first 100 positive integers.

Bonus Answer: 5050

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9. EARTH and SPACE

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The "firn line" on a glacier marks:

W) The dividing line between the zones of accumulation and ablation

X) The elevation above which snow never melts

Y) The elevation where the average annual temperature is below freezing

Z) The timber line, or elevation above which trees do not grow

Toss Up Answer: W

Bonus: Short Answer

During the Pleistocene, large lakes covered parts of the Western U.S. These lakes are known as:

Bonus Answer: Pluvial lakes (accept paleolakes)

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10. MATHEMATICS

Writer: Steven Litvack-Winkler

Toss Up: Multiple Choice

1. What statistical average is most appropriate to use when the quantities being averaged when one or more of the quantities are not necessarily bounded?

W) Geometric mean

X) median

Y) Harmonic mean

Z) Arithmetic mean

Toss Up Answer: Y

Bonus: Short Answer

You pick two cards at random without replacement from a standard, 52 card deck. Compute the probability

exactly one is a heart.

Bonus Answer: 13/34

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11. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What did Ernest Orlando Lawrence develop in 1932?

W) Nuclear Reactor

X) The Microwave

Y) Cyclotron

Z) X-Ray Machine

Toss Up Answer: Y

Bonus: Short Answer

What theory first appeared in a 1905 paper called "On the Electrodynamics of Moving Bodies"?

Bonus Answer: Special Theory of Relativity

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12. EARTH and SPACE

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

To the nearest day, how long is the sidereal period of the moon?

Bonus Answer: 27 days

Bonus: Short Answer

The only supernova explosion in modern times visible in the sky to the naked eye
became visible in which year?

Bonus Answer: 1987

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13. PHYSICS

Writer: Aaron Gee

Toss Up: Short Answer

A 10 volt battery connected to a capacitor delivers a charge of 0.5 coulombs. The capacitance of the capacitor is

Bonus Answer: 5 times 10^(-2) Farads

Bonus: Short Answer

To convert a galvanometer to a voltmeter, you should add what to a series?

Bonus Answer: high resistance

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14. BIOLOGY

Writer: Mohammed Jamil

Toss Up: Multiple Choice

The fundamental cause of sickle-cell anemia is a change in the structure of

W) blood

X) capillaries

Y) red blood cells

Z) hemoglobin

Toss Up Answer: Z

Bonus: Multiple Choice

Which regulatory chemical stimulates gastric gland activity and motility?

W) Secretin

X) Gastrin

Y) Leptin

Z) Histamine

Bonus Answer: X

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15. EARTH and SPACE

Writer: Seiji Yawata

Toss Up: Multiple Choice

Although scientists are unable to obtain samples by drilling, they believe the predominant mineral in the mantle is:

W) quartz

X) olivine

Y) potassium feldspar
Z) iron pyrite

Toss Up Answer: X

Bonus: Multiple Choice

If the intent is to neutralize soil acidity, the mixing of which of the following materials in the soil would be the LEAST effective?
W) gypsum
X) pure $CaCO_3$
Y) ground limestone
Z) ground oyster shells

Bonus Answer: W

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16. BIOLOGY

Writer: Olivia Gallager

Toss Up: Multiple Choice

Photorespiration occurs the most under which conditions?
W) High Levels of Carbon Dioxide, Low levels of Oxygen
X) in CAM plants
Y) low levels of carbon dioxide, high levels of oxygen
Z) in C4 plants

Toss Up Answer: Y

Bonus: Short Answer

How many carbons does ribulose bisphosphate have?

Bonus Answer: 5

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17. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What type of damping provides the quickest approach to zero amplitude for a damped oscillator?
W) Hyperdamping
X) Overdamping
Y) Critical Damping
Z) Underdamping

Toss Up Answer: Y

Bonus: Short Answer

What is the damping coefficient equal to for a critically damped spring system with a spring constant of 1000 Newtons/meters and oscillating mass of 10 kg?

Bonus Answer: 10Hz [at critical damping the damping coefficient is equal to the undamped resonant frequency, which is equal to the sqrt(spring constant/mass)]

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18. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Isolated RNA molecules are generally less stable than DNA at physiological pH because:
W) RNA has ribose

X) RNA is always linear
Y) RNA uses uracil instead of thymine
Z) RNA is usually single-stranded

Toss Up Answer: W

Bonus: Multiple Choice
What is the half-life of DNA?
W) 673 years
X) 100 years
Y) 272 years
Z) 521 years

Bonus Answer: Z

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19. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice
What is studied in ballistics?
W) explosive impact of chemicals
X) speeds of atomic particles
Y) travel of sound
Z) motion of projectiles

Toss Up Answer: Z

Bonus: Multiple Choice
What is it called when all possible states of a system are represented, with each possible state corresponding to 1 unique point?
W) Boltzmann Set
X) Phase Space
Y) Poincare Space
Z) Configuration Space

Bonus Answer: X

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20. BIOLOGY

Writer: Calvin Vuong

Toss Up: Multiple Choice
Which of the following statements is incorrect?
W) RNA polymerase adds nucleotides in the 5' to 3' direction.
X) There are three main RNA polymerases in eukaryotes.
Y) DNA transcription requires a helicase to unwind the DNA.
Z) Transcription adds about 40 nucleotides per second to the growing mRNA transcript in eukaryotes.
Toss Up Answer: Y

Bonus: Short Answer
Spliceosomes contain the greatest amount of which type of RNA?
Bonus Answer: snRNA (ACCEPT: small nuclear RNA, small nuclear ribonucleic acid) (DO NOT ACCEPT: snRNP)

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21. CHEMISTRY

Writer: Jason Mohabir

Toss Up: Multiple Choice

How many electrons occupy the bonding molecular orbitals of a CN triple bond?

W) 2

X) 4

Y) 6

Z) 8

Toss Up Answer: Y

Bonus: Multiple Choice

Which of the following compounds would have the highest boiling point?

W) $CH_3CH_2CH_2CH_3$

X) CH_3NH_2

Y) CH_2F_2

Z) CH_3OH

Bonus Answer: Z

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22. BIOLOGY

Writer: Josh Tish

Toss Up: Multiple Choice

Which of the following are characteristics of both bacteria and fungi?

W) Cell wall, unicellularity, and mitochondria

X) Cell wall, DNA, and plasma membrane

Y) Nucleus, organelles, and unicellularity

Z) Nucleus, RNA, and cell wall

Toss Up Answer: X

Bonus: Multiple Choice

Terminally differentiated cells are most often found in which phase of the cell cycle?

W) G0

X) G1

Y) G2

Z) S

Bonus Answer: W

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23. 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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24. CHEMISTRY

Writer: Hanna Yang

Toss Up: Short Answer

What characteristic of water causes its temperature to change slowly in response to the environment?

Bonus Answer: High Specific Heat

Bonus: Short Answer

What is the most abundant molecule in the human body?

Bonus Answer: Water

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25. CHEMISTRY

Writer: Nicholas Adit

Toss Up: Multiple Choice

Which of the following hydrocarbons have the highest boiling point.

W) CH4

X) C2H6

Y) C3H8

Z) C4H10

Toss Up Answer: Z

Bonus: Multiple Choice

Alloys are mixtures of metallic substances. Which of the following pairs are matched INCORRECTLY?

W) Steel - iron and copper

X) Brass - copper and zinc

Y) Pewter - tin, copper, bismuth, and antimony

Z) Sterling silver - silver and copper

Bonus Answer: W

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