Round 4

1. PHYSICS

Toss Up: Short Answer

Rank following electromagnetic radiations according to the energies of their photons, from least to greatest:

1. blue light
2. yellow light
3. x rays
4. radio waves

Bonus Answer: 4, 2, 1, 3 (accept equivalent forms)

Bonus: Multiple Choice

The work function for a certain sample is 2.3 eV. The stopping potential for electrons ejected from the sample by 7.0 × 10^14-Hz electromagnetic radiation is:

W) 0 V
X) 0.6 V
Y) 2.3 V
Z) 5.2 V

Bonus Answer: Y

==========

2. PHYSICS

Toss Up: Short Answer

What is the torque in N*m (read as newton meters) acting on a disk with radius of 3 meters, mass of 5kg, and rotating with an angular acceleration of 10 rad/s^2?

Bonus Answer: 225 N*m

Bonus: Short Answer

If a sphere with radius of 4 meters and a mass of 5kg is rolling at a velocity of 12m/s, find the total energy of the sphere in joules.

Bonus Answer: 648 J

==========

3. PHYSICS

Toss Up: Multiple Choice

Which of the following is the most accurate? The center of mass of the system consisting of Earth, the Sun, and the planet Mars is:

W) closer to the Sun than to either of the other bodies
X) closer to Earth than to either of the other bodies
Y) at the geometric center of the triangle formed by the three bodies
Z) at the center of the line joining Earth and Mars

Toss Up Answer: W

Bonus: Multiple Choice

At the same instant that a 0.50-kg ball is dropped from 25m above Earth, a second ball, with a mass of 0.25 kg, is thrown straight upward from Earth's surface with an initial speed of 15m/s. They move along nearby lines and pass each other without colliding. At the end of 2.0 s the height above Earth's surface of the center of mass of the two-ball system is:

W) 3.0m
X) 5.0m
Y) 6.5m

Z) 7.1m

Bonus Answer: Z

==========

4. PHYSICS

Toss Up: Short Answer

In a spherical shell with radius of 2 meters a magnetic field with strength of 2 teslas passes though. What is the net magnetic flux?

Bonus Answer: 0

Bonus: Short Answer

What is the magnitude of the induced current produced as the magnetic field passing through a circle with radius of 2m and resistance of 5 ohms changes from 50 teslas to 25 teslas in 5 seconds to the nearest whole number?

Bonus Answer: 13 amperes

==========

5. PHYSICS

Toss Up: Short Answer

The quantity epsilon naught multiplied by the time derivative of electric flux represents what quantity in the Maxwell-Ampere equation?

Bonus Answer: Displacement current

Bonus: Short Answer

In a solenoid of length 20m with a current of 10 amperes traveling through it and undergoes 20 turns what is the magnitude of the magnetic field within it in teslas? Assume the vacuum permittivity is 9*10^-12 and PI is approximately 3.

Bonus Answer: 1.8*10^-9 teslas

==========

6. MATHEMATICS

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

==========

7. MATHEMATICS

Toss Up: Multiple Choice

What is the limit as x approaches 0 of x times ln x?

W) -1

X) 1

Y) 0

Z) The limit does not exist.

Toss Up Answer: Y

Bonus: Short Answer

What is the derivative of arcsec x?

Bonus Answer: 1/(x((x^2)-1)^.5)

==========

8. MATHEMATICS

Toss Up: Short Answer

What is the length of the longest diagonal of a unit cube?

Bonus Answer: root3

Bonus: Short Answer

What is the largest integer that cant be written as the sum of 3's and 4's?

Bonus Answer: 5

==========

9. MATHEMATICS

Toss Up: Short Answer

You are trying to give 5 apples to 3 friends. You can give any number of apples to each friend, including 0. How many ways are there to share the apples?

Bonus Answer: 56 (its 8C3)

Bonus: Multiple Choice

If a cubic function equals 0 at exactly two points, which of the following must be true?

W) the function passes through the origin

X) there is a double root

Y) the function is even

Z) one of the roots is imaginary

Bonus Answer: X

==========

10. BIOLOGY

Toss Up: Multiple Choice

Three bony shelves that project inferiorly in the nasal cavity are called

W) paranasal sinuses.

X) nasal conchae.

Y) the greater wing.

Z) the crista galli.

Toss Up Answer: X

Bonus: Multiple Choice

The olfactory foramina are found in the

W) nasal septum

X) cribriform plate

Y) hard palate

Z) lacrimal bone

Bonus Answer: X

==========

11. BIOLOGY

Toss Up: Multiple Choice

Who is considered the father of paleontology?

W) Marquis de Condorcet

X) George Cuvier
Y) Marie Antoinette
Z) Auguste Compte
Toss Up Answer: X

Bonus: Short Answer
List the taxonomic groups from least to most specific
Bonus Answer: KINGDOM, PHYLUM, CLASS, ORDER, FAMILY, GENUS, SPECIES

==========

12. BIOLOGY

Toss Up: Short Answer
How many ATP molecules are produced by the Calvin cycle?
Bonus Answer: 0

Bonus: Short Answer
How many ATP molecules are used in the Calvin cycle to make one glucose molecule?
Bonus Answer: 18

==========

13. BIOLOGY

Toss Up: Multiple Choice
If the recessive allele of gene A is epistatic to gene B, what is the phenotypic ratio of the two genes?
W) 9:3:3:1
X) 12:4:3
Y) 9:4:3
Z) 9:7
Toss Up Answer: Y

Bonus: Short Answer
What genetic structure is responsible for the metabolism of lactose in E. Coli?
Bonus Answer: the lac operon

==========

14. CHEMISTRY

Toss Up: Multiple Choice
Monatomic, diatomic, and polyatomic ideal gases each undergo slow adiabatic expansions from the same initial volume and the same initial pressure to the same final volume. The magnitude of the work done by the environment on the gas:
W) is greatest for the polyatomic gas
X) is greatest for the diatomic gas
Y) is greatest for the monatomic gas
Z) is the same only for the diatomic and polyatomic gases

Toss Up Answer: W

Bonus: Multiple Choice
The mean free path of a gas molecule is:
W) the shortest dimension of the containing vessel
X) the cube root of the volume of the containing vessel
Y) average distance between adjacent molecules
Z) average distance a molecule travels between intermolecular collisions

Bonus Answer: Z

==========

15. CHEMISTRY

Toss Up: Multiple Choice

The root-mean-square sped of molecules in a gas is:

W) the most probable speed

X) that speed such that half the molecules are moving faster than vrms and the other half are moving slower

Y) the average speed of the molecules

Z) the square root of the sum of the velocities squared

Toss Up Answer: Z

Bonus: Multiple Choice

An ideal monatomic gas has a molar specific heat Cv at constant volume of:

W) R

X) 3R/2

Y) 5R/2

Z) 7R/2

Bonus Answer: X

==========

16. CHEMISTRY

Toss Up: Multiple Choice

The number of degrees of freedom of a triatomic molecule is:

W) 1

X) 3

Y) 6

Z) 9

Toss Up Answer: Z

Bonus: Short Answer

The internal energy of an ideal gas depends on which of the following: temperature, pressure, volume.

Bonus Answer: Temperature

==========

17. CHEMISTRY

Toss Up: Multiple Choice

If the molecules in a tank of hydrogen have the same rms speed as the molecules in a tank of oxygen, we may be sure that:

W) the pressures are the same

X) the hydrogen is at the greater pressure

Y) the temperatures are the same

Z) the oxygen is at the higher temperature

Toss Up Answer: Z

Bonus: Multiple Choice

The number of degrees of freedom of a rigid diatomic molecule is

W) 2

X) 3

Y) 4

Z) 5

Bonus Answer: Z

==========

18. CHEMISTRY

Toss Up: Multiple Choice

An adiabatic process for an ideal gas is represented on a p-V diagram by:

W) a horizontal line

X) a vertical line

Y) a hyperbola

Z) a curve connecting isotherms

Toss Up Answer: Z

Bonus: Multiple Choice

Evidence that molecules of a gas are in constant motion is:

W) winds exert pressure

X) two gases interdiffuse quickly

Y) warm air rises

Z) gases are easily compressed

Bonus Answer: X

==========

19. CHEMISTRY

Toss Up: Multiple Choice

Which one of the following has the greatest tendency to lose an electron?

W) Zn

X) Cl^-

Y) Br_2

Z) A mixture of $PbSO_4$ and H_2O

Toss Up Answer: W

Bonus: Short Answer

The wavelength of yellow light is 600 nanometers. What is the wavelength in centimeters: (use scientific notation

Bonus Answer: 6.0 X 10^-5

==========

20. CHEMISTRY

Toss Up: Multiple Choice

The ideal fuel for fuel cell use is:

W) compressed natural gas

X) reformulated gasoline

Y) hydrogen

Z) Methanol

Toss Up Answer: Y

Bonus: Short Answer

Which is the correct name for N_2O_3

Bonus Answer: Dinitrogen Trioxide

==========

21. EARTH and SPACE

Toss Up: Multiple Choice

Within the early Earth's vast molten region, substances underwent a process known as differentiation, during which

W) substanes of low density rise to Earth's surface, while those of high density sink toward its center

X) substances of high density float to Earth's surface, while those of low density sink toward its center.

Y) substances of high and low density chemically combine to form uniformly dense substances.

Z) substances of high density form gases, while those of low density form solids.

Toss Up Answer: W

Bonus: Multiple Choice

Earth's magnetic field is likely a result of

W) convection currents in Earth's mantle

X) convection currents in Earth's core

Y) a high concentration of iron in Earth's crust

Z) high-energy particles in the solar wind

Bonus Answer: X

==========

22. EARTH and SPACE

Toss Up: Multiple Choice

Which statement best describes how galaxies generally move?

W) Galaxies move toward one another.

X) Galaxies move away from one another.

Y) Galaxies move randomly.

Z) Galaxies do not move.

Toss Up Answer: X

Bonus: Multiple Choice

The observable universe is estimated to be roughly 16-20 billion years old. Which statement best describes why a galaxy located 25 billion light-years from Earth may not be visible to an observer on Earth?

W) Galaxies 25 billion light-years away would emit no visible light.

X) Light from beyond 20 billion light years has not yet reached Earth.

Y) Light from beyond 20 billion light years passed out galaxy before Earth existed.

Z) No galaxies are located farther than 5 billion light-years from Earth.

Bonus Answer: X

==========

23. EARTH and SPACE

Toss Up: Multiple Choice

Rock samples brought back from the Moon show absolutely no evidence of chemical weathering. This is most likely due to

W) the lack of an atmosphere on the Moon

X) extremely low surface temperatures on the Moon

Y) lack of biological activity on the Moon

Z) large quantities of water in the lunar "seas"

Toss Up Answer: W

Bonus: Multiple Choice

A major belt of asteroids is located between Mars and Jupiter. What is the approximate average distance between the Sun and this major asteroid belt?
W) 110 million kilometers
X) 220 million kilometers
Y) 390 million kilometers
Z) 850 million kilometers

Bonus Answer: Y

==========

24. EARTH and SPACE

Toss Up: Multiple Choice

The surface of Venus is much hotter than would be expected, considering its distance from the Sun. Which statement best explains this fact?
W) Venus has many active volcanoes.
X) Venus as a slow rate of rotation
Y) The clouds of Venus are highly reflective
Z) The atmosphere of Venus contains a high percentage of carbon dioxide.

Toss Up Answer: Z

Bonus: Multiple Choice

The existence of Pluto and Neptune was accurately predicted through the study of the movements of
W) comets
X) other planets
Y) stars
Z) the Sun

Bonus Answer: X

==========

25. ENERGY

Toss Up: Multiple Choice

The world has the least amount of which of the following fuel types?
W) oil
X) coal
Y) uranium
Z) there are about the same amount of each of these

Toss Up Answer: W

Bonus: Short Answer

What region of the world holds the majority of already discovered oil fields?

Bonus Answer: The Middle East

==========