PHYSICS

1. PHYSICS

Writer: Stuyvesant

Toss Up: Multiple Choice

Radiocarbon is produced in the atmosphere as a result of?

W) collision between fast neutrons and nitrogen nuclei present in the atmosphere

X) action of ultraviolet light from the sun on atmospheric oxygen

Y) action of solar radiations particularly cosmic rays on carbon dioxide present in the atmosphere

Z) lightning discharge in atmosphere

Toss Up Answer: W

Bonus: Multiple Choice

What type of radiation is both the most penetrating and the most effectively stopped if blocked by a hydrogen-rich material?

W) Alpha

X) Beta

Y) Gamma

Z) Neutron

Bonus Answer: Z

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2. PHYSICS

Writer: American Heritage

Toss Up: Multiple Choice

Which of Maxwell's laws implies that magnetic monopoles do not exist?

W) Gauss's Law for fields

X) Gauss's Law for magnetism

Y) Maxwell-Faraday equation

Z) Kirchoff's Voltage Laws

Toss Up Answer: X

Bonus: Short Answer

Giving your answer in volts per meter, how strong is the electric field between the plates of an 8-μF air-gap capacitor, if they are 2.0 mm apart and each has a charge of 72 μC?

Bonus Answer: 4500 V/m

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3. PHYSICS

Writer: American Heritage

Toss Up: Short Answer

A reflecting telescope has a radius of curvature of 3.0m for its objective mirror and a radius of curvature of -1.50m for its eyepiece mirror. If the distance between the two mirrors is 0.90m, how far in front of the eyepiece should you place the photographic film to record the image of a star?

Bonus Answer: 3m

Bonus: Short Answer

Name the principle that states that two images are just resolvable when the center of the diffraction disk of one image is directly over the first minimum in the diffraction pattern of the other.

Bonus Answer: Rayleigh criterion

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4. PHYSICS

Writer: American Heritage

Toss Up: Multiple Choice

Jed and Sirajri both begin listening to a 60 minute album, Coloring Book by Chance the Rapper, at the same time. Jed then gets into a spaceship where he travels at 80% of the speed of light. Who finishes the album first, and how much of the album is left for the second person?

W) Jed finishes 48 minutes before Sirajri

X) Jed finishes 40 minutes before Sirajri

Y) Sirajri finishes 48 minutes before Jed

Z) Sirajri finishes 40 minutes before Jed

Toss Up Answer: Z

Bonus: Multiple Choice

Which of the following statements about the standard model is false?

W) The Z gauge boson is less massive than the W+ gauge boson

X) There are 8 kinds of gluons

Y) All 12 elementary particles in the standard model are fermions

Z) The charm quark is a second generation particle

Bonus Answer: W

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5. PHYSICS

Writer: Stuyvesant

Toss Up: Short Answer

Maxwell’s equations are to electric and magnetic fields as what equation is to the wave function for a particle?

Bonus Answer: Shcrodinger's

Bonus: Multiple Choice

A non-relativistic free electron has kinetic energy K. If its wavelength doubles, what is its kinetic energy in terms of K?

W) 4K

X) K/4

Y) K

Z) K/2

Bonus Answer: X

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6. PHYSICS

Writer: Stuyvesant

Toss Up: Short Answer

A molecule with a magnetic moment of 83 N*m/T(read as Newton-meters per Tesla) experiences what amount of torque in N*m (read as Newton-meter) when subjected to an external magnetic force of 120 teslas?

Bonus Answer: 9960 N*m

Bonus: Multiple Choice

A certain capacitor, in series with a 720-Ω resistor, is being charged. At the end of 10 ms(milliseconds) its charge is half the final value. The capacitance is about:

W) 9.6 μF

X) 14 μF

Y) 20 μF

Z) 7.2F

Bonus Answer: Y

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7. PHYSICS

Writer: Centennial

Toss Up: Short Answer

What is the resonant frequency, to the nearest hertz, of an LC circuit with L=0.1H and C=150uF?

Bonus Answer: 41 Hz

Bonus: Short Answer

An RLC circuit has R=200ohms, L=0.5H, and C=50uF. Is this circuit (1) overdamped, (2) underdamped, or (3) critically damped?

Bonus Answer: (3) critically damped

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8. PHYSICS

Writer: Centennial

Toss Up: Short Answer

A body orbits another with a pericenter of 100km and an apocenter of 500km, and travels 40m/s at the apocenter. To the nearest m/s, what is the speed at the pericenter?

Bonus Answer: 200 m/s

Bonus: Short Answer

The central body is changed to one with double the mass, and the shape and size of the orbit are kept constant. By what factor will the speed of the orbiting object change?

Bonus Answer: Sqrt(2) times faster

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9. PHYSICS

Writer: Centennial

Toss Up: Short Answer

According to Darcy's law, by what factor will the fluid velocity change if the pressure gradient is doubled?

Bonus Answer: It will double

Bonus: Short Answer

In turbulent flow, if the velocity of an object doubles and the object is scaled down by a factor of 1/3, by what factor will the drag force change?

Bonus Answer: 4/9

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10. PHYSICS

Writer: Granada Hills

Toss Up: Multiple Choice

A runner begins a sprint on a perfectly circular track. In 5 seconds, the runner travels exactly ¼ of lap. If the runner begins with a velocity of 10m/s, and ends with a velocity of 10m/s, what is the average angular velocity of the runner?

W) 5
X) 12
Y) 13
Z) 18

Toss Up Answer: Z

Bonus: Short Answer

What is the angular momentum of a solid sphere with a mass of 100 Kilograms and a radius of .1 Meters rotating at an angular velocity of 5 radians per seconds about the center of the sphere?

Bonus Answer: 2

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11. PHYSICS

Writer: Granada Hills

Toss Up: Short Answer

Name every force that is acting upon a mid-air cannonball that was shot from a cannon at a 45 degree angle, ignoring air resistance

Bonus Answer: Weight (Accept: Force of gravity/Gravitational force)

Bonus: Short Answer

Planet Phi, weighing 100 kg, is 13 meters away from Planet Theta of 1200 grams. In kilograms per meters per second squared, what is the Universal Gravitational Force expressed between the two planets? Round to one significant figure.

Bonus Answer: 5 x 10-11

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12. PHYSICS

Writer: Granada Hills

Toss Up: Short Answer

What is the spin of a tau neutrino?

Bonus Answer: ½

Bonus: Short Answer

A system contains a capacitor with two plates. The area overlapped by two plates is 5m^2. The dielectric constant of this system is 3.5. Initially, the capacitance is 20 farads. What is the distance between the plates?

Bonus Answer: 7/8

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13. PHYSICS

Writer: Brooklyn Tech

Toss Up: Multiple Choice

Radio waves are propagated through the inter- action of

W) nuclear and electric fields

X) electric and magnetic fields

Y) gravitational and magnetic fields

Z) gravitational and electric fields

Toss Up Answer: X

Bonus: Multiple Choice

A positively charged glass rod attracts object X. The net charge of object X
W) may be zero or negative
X) may be zero or positive
Y) must be negative
Z) must be positive

Bonus Answer: W

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14. PHYSICS

Writer: Lakeside

Toss Up: Short Answer

Name this subset of fermions that do not interact via the strong interaction, have antiparticles that are only opposite in charge and number, and contain the set of
neutral particles known as neutrinos.

Bonus Answer: Leptons

Bonus: Short Answer

In the Davisson-Germer experiment, electrons were fired at nickel crystals and a diffraction pattern was observed, proving what principle or equation?

Bonus Answer: De Broglie Equation

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15. PHYSICS

Writer: Lakeside

Toss Up: Short Answer

What is the term referring to an electronic circuit with two stable states, often also called a bistable multivibrator, which can serve as one bit of memory?

Bonus Answer: FLIP-FLOP

Bonus: Short Answer

Name the following property: It is believed to be caused by fields of electron spins in combination with exchange coupling and substances exhibit this property below the Curie temperature.

Bonus Answer: FERROMAGNETISM

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16. PHYSICS

Writer: Lakeside

Toss Up: Short Answer

The reason that microscopic black holes that could be created by collisions in particle accelerators are not feared to consume the Earth is because of what hypothesized black body radiation due to quantum effects?

Bonus Answer: HAWKING RADIATION

Bonus: Short Answer

Which law in electromagnetism describes the magnetic field generated by a steady current and results in a B field consistent with both Ampere’s law and Gauss’ law for magnetism?

Bonus Answer: BIOT-SAVART LAW

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17. PHYSICS

Writer: Brooklyn Tech

Toss Up: Short Answer

Solve for x to the nearest thousandth: 3 x 2^(5x) = 216

Bonus Answer: X=1.234

Bonus: Multiple Choice

How many points of intersection between the graphs: y-x-2=0 and (x-1)^2 + (x-3)^2 = 8

W) 1

X) 2

Y) 0

Z) Not enough information to answer

Bonus Answer: W

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18. PHYSICS

Writer: Brooklyn Tech

Toss Up: Short Answer

What is the units for displacement?

Bonus Answer: Meters

Bonus: Short Answer

Name all seven SI base units.

Bonus Answer: ampere, mole, meter, kelvin, second, kilogram, candela

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19. PHYSICS

Writer: Venice

Toss Up: Multiple Choice

A barycenter is located at which of the following points on an ellipse in an orbital system?

W) Focus

X) Paryapsis

Y) Center

Z) Apoapsis

Toss Up Answer: W

Bonus: Short Answer

What is the eccentricity of an orbit with a semimajor axis of 1000 kilometers and a focal distance of 375 kilometers, to the nearest thousandth?

Bonus Answer: 0.375

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20. PHYSICS

Writer: Venice

Toss Up: Short Answer

What is the eccentricity of a parabolic escape orbit?

Bonus Answer: 1

Bonus: Short Answer

A planet orbiting a star has a semimajor axis of 2 AU and an orbital period of 3 years. Giving your answer in terms of an improper fraction with radicals, what is the orbital period of a planet of the same mass as the first orbiting the same star but with a semimajor axis of 3 AU?

Bonus Answer: 9/(2sqrt(2))

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21. PHYSICS

Writer: Venice

Toss Up: Short Answer

What force is exerted on a moving charge by a magnetic field?

Bonus Answer: LORENTZ FORCE

Bonus: Short Answer

If a charged particle is moving forward through a magnetic field whose field lines are moving left, in which direction is the Lorentz Force applied?

Bonus Answer: UP

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22. PHYSICS

Writer: Venice

Toss Up: Short Answer

What is the name for the lightest hadron?

Bonus Answer: PION

Bonus: Short Answer

Pions are commonly found to act as what in an atomic nucleus?

Bonus Answer: FORCE CARRIER PARTICLE

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