PHYSICS

1. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

If the wave function ψ is spherically symmetric then the radial probability density is given by:If the wave function ψ is spherically symmetric then the radial probability density is given by:

W) 4πr^2*ψ

X) |ψ|^2

Y) 4πr^2|ψ|^2

Z) 4π|ψ|^2

Toss Up Answer: Y

Bonus: Short Answer

Maxwell's equations are to electric and magnetic fields as [ ] equation is to the wave function for a particle.

Bonus Answer: Schrodinger's

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2. PHYSICS

Writer: Charles Zhang

Toss Up: 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

Toss Up Answer: X

Bonus: 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

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3. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The Laplacian of an electric potential field is equal to the negative free charge density over this quantity. This quantity is equal to the negative time derivative of the magnetic flux, and in an inductor, it is equivalent to the inductance multiplied by the negative time derivative of the current. It is classically defined as Coulomb's constant multiplied by the sum of charge over distance, and also as the line integral of the electric field "dot dl." When it is multiplied by current, it gives power dissipated by a resistor. Kirchoff's Loop Rule states that the sum of this value around a loop in a circuit is zero. Name this quantity this is equal to the current times resistance by Ohm's Law.

Bonus Answer: Voltage (accept electric potential)

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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4. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

In the capacitor discharge formula q = q0e^(−t/(RC)) (read as q naught times e raised to the power of negative t over quantity R times C) the term RC is more commonly referred to as:

W) The time limit

X) The time of charge

Y) The time constant

Z) It does not have a specific name

Toss Up Answer: Z

Bonus: Short Answer

Resistor 1 has twice the resistance of resistor 2. They are connected in parallel to a battery.The ratio of the thermal energy generation rate in 1 to that in 2 is:

Bonus Answer: 1:2

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5. PHYSICS

Writer: Jan Wojcik

Toss Up: Short Answer

What is the equivalent capacitance in Farads of two capacitors connected in series, one with a capacitance of 4 microFarads and the other with a capacitance of 2 microFarads?

Bonus Answer: 4/3 microFarads

Bonus: Short Answer

Give your answer in scientific notation, in Farads, rounded to the nearest tenth. What is the approximate capacitance between two parallel plates of surface area 10cm squared, separated by a distance of 1 meter?

Bonus Answer: 8.9*10^-14 Farads

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6. PHYSICS

Writer: Jan Wojcik

Toss Up: Multiple Choice

Which of the following is NOT true about magnetism?

W) Electric field lines go from the North pole to the South pole

X) There are instances where electric field lines cross each other

Y) Cutting a magnet in half will not create two magnetic monopoles

Z) They are all true

Toss Up Answer: X

Bonus: Short Answer

By name or number, list all of the following elements that are ferromagnetic: Cobalt, Manganese, Cobalt, Cadmium, Silver

Bonus Answer: Cobalt. Accept: Co, 1

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7. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

When charging or discharging a capacitor, what the quantity RC (read as resistance times capacitance) known as?

Bonus Answer: Time constant

Bonus: Multiple Choice

At point 'A' on a circuit the wire is grounded. At point 'B' on the same circuit there is a emf of 30 volts. If there are two identical resistors with resistance of 10 ohms in parallel, between point 'A' and point 'B', what is the current in ampere flowing through either resistor?

W) 15
X) 3
Y) 9
Z) 6

Bonus Answer: X

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8. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A magnetic field CANNOT:

W) Exert a force on a charged particle
X) Change the trajectory of a charged particle
Y) Change the kinetic energy of a charged particle
Z) Do no work on a charged particle

Toss Up Answer: Y

Bonus: Multiple Choice

A magnet and a conducting loop are placed next to each other at rest on a horizontal surface. If the magnet with the north pole facing left is put through the loop and is moved left in which direction will the induced current within the loop move with reference to the magnet?

W) Into the magnet
X) Counter-clockwise
Y) Clockwise
Z) There is no current.

Bonus Answer: X

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9. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

Which principle of quantum mechanics allows for the quantum state of any particle to be expressed as a linear combination of distinct quantum states?

Bonus Answer: Superposition principle

Bonus: Short Answer

A free electron has a momentum of 5.0 × 10^(−24) kg · m/s (read as 5.0 times 10 to the negative 24 kilogram times meter per second). The wavelength of its wave function in meters is:

Bonus Answer: ~1.3×10^(-10) meters (explanation: deBroglie wavelength)

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10. PHYSICS

Writer: Siam Muquit

Toss Up: Multiple Choice

In a simple series circuit, which of these is equal among all resistors?
W) Potential difference
X) Resistance
Y) Current
Z) Capacitance

Toss Up Answer: Y

Bonus: Multiple Choice

A circuit is made with a battery and four resistors connected in series. Two resistors changed to be in parallel in the circuit. What is the change in the power dissipated by the original two resistors?
W) The power increases
X) The power decreases
Y) The power stays the same
Z) No power is being generated by any resistor

Bonus Answer: W

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11. PHYSICS

Writer: Andrew Chen

Toss Up: Short Answer

How many bosons are in a regular hydrogen atom?

Bonus Answer: 1 (it's the electron)

Bonus: Short Answer

Two forces have magnitudes of 15 newtons and 5 newtons. Using interval notation, what is the range of the possible magnitudes of their sum?

Bonus Answer: [10, 20], accept: between 10 and 20 Newtons inclusive

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12. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Short Answer

What is the name for the effect that explains the small attractive force that acts between two close parallel uncharged conducting plates in a vacuum?

Bonus Answer: The Casimir Effect

Bonus: Multiple Choice

According to Beer’s law:
W) the energy of a photon of light is inversely proportional to its wavelength
X) the concentration of a species that absorbs light can be measured by the amount of light absorbed
Y) the energy of characteristic X-rays increases with increasing atomic number of the emitting element
Z) excitation of the electrons in a molecule takes place on a shorter time scale than motion of the nuclei

Bonus Answer: X

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13. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Short Answer

The Curie temperature is the temperature at which ferromagnets become paramagnets. What is the name for the point at which antiferromagnets become paramagnets?

Bonus Answer: The Neel temperature

Bonus: Multiple Choice

A hall probe measures which of the following:

W) Capcitance

X) Viscosity

Y) Magnetic Field

Z) Electric Field

Bonus Answer: Y

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14. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The equation of continuity for fluid flow can be derived from the conservation of:

W) Energy

X) Mass

Y) Angular momentum

Z) Volume

Toss Up Answer: X

Bonus: Multiple Choice

A coil has a resistance of 60Ω and an impedance of 100Ω. Its reactance, in ohms, is:

W) 40

X) 60

Y) 80

Z) 117

Bonus Answer: Y

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15. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Monochromatic light is normally incident on a diffraction grating that is 1cm wide and has 10,000 slits. The first order line is deviated at a 30◦ angle. What is the wavelength, in nm, of the incident light?

W) 300

X) 500

Y) 877

Z) 1000

Toss Up Answer: X

Bonus: Multiple Choice

A spectral line of a certain star is observed to be “red shifted” from a wavelength of 500nm to a wavelength of 1500nm. Interpreting this as a Doppler effect, the speed of recession of this star is:

W) .33c

X) .5c

Y) .71c

Z) .8c

Bonus Answer: Z

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16. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

An acceptor replacement atom in silicon might have how many electrons in its outer shell?

W) 3

X) 4

Y) 5

Z) 6

Toss Up Answer: W

Bonus: Multiple Choice

When a forward bias is applied to a p-n junction the concentration of electrons on the p side:

W) increases slightly

X) decreases slightly

Y) increases dramatically

Z) decreases dramatically

Bonus Answer: Y

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17. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The binding energy of a nucleus is the energy that must be supplied to:

W) Remove a nucleon

X) Remove an alpha particle

Y) Remove a beta particle

Z) Separate the nucleus into its constituent nucleons

Toss Up Answer: Z

Bonus: Multiple Choice

A radium atom, 226Ra emits an alpha particle. The number of protons in the resulting atom is

W) 84

X) 85

Y) 86

Z) 88

Bonus Answer: W

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18. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Any change in the magnetic environment of a coil of wire will cause a voltage (emf) to be "induced" in the coil. Which law summarizes the ways in which voltage can be generated using this method?

W) Ohm's Law

X) Faraday's Law

Y) Pascal's Law
Z) Coulomb's Law
Toss Up Answer: X

Bonus: Short Answer
A magnet is brought close to a flat square coil of 50 loops. The coil is .2 meters on each side, and the magnetic field passing through the coil increased uniformly from 3 Tesla to 8 Tesla in 4 seconds. While that change in magnetic field takes place, using correct signs, what is the induced emf in the coil?
Bonus Answer: -2.5 Volts

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19. PHYSICS

Writer: Amrit Hingorani
Toss Up: Short Answer
What is the metric unit for mass?
Bonus Answer: Kilogram (kg)

Bonus: Short Answer
What is the SI unit of force?
Bonus Answer: Newton

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20. PHYSICS

Writer: Shantanu Jha
Toss Up: Short Answer
What is the S.I. unit for Inductance?
Bonus Answer: Henry

Bonus: Multiple Choice
Which law states that for any closed loop path, the sum of the length elements times the magnetic field in the direction of the length element is equal to the permeability times the electric current enclosed in the loop?
W) Faraday's Law of Induction
X) Kirchhoff's Law
Y) Coulomb's Law
Z) Ampere's Law

Bonus Answer: Z

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21. PHYSICS

Writer: Shantanu Jha
Toss Up: Short Answer
What is the equivalent capacitance of three Capacitors, each of 9 micro Farad Capacitance, placed in parallel?
Bonus Answer: 27 micro Farads

Bonus: Short Answer
Determine the amount of charge stored on either plate of a capacitor of 4 micro Farads when connected across a 12 Volt batter.
Bonus Answer: 48 micro Coulombs, 4.8 x 10^(-5) Coulombs

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22. PHYSICS

Writer: Charles Zhang
Toss Up: Short Answer

What is the unit of a Poynting vector?

Bonus Answer: Watt/meter^2 (accept equivalent variations)

Bonus: Short Answer

What's the order of magnitude of a Poynting vector of an EM wave, where the amplitude of the electric field is 300 N/C (newton per coulomb) and the amplitude of the magnetic field is 400 tesla?

Bonus Answer: 11

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23. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is the total voltage of a circuit with a total current of 10 Amperes running through four resistors placed in parallel, each with a resistance of 4 Ohms?

Bonus Answer: 10 Volts

Bonus: Short Answer

What does the abbreviation MOSFET stand for?

Bonus Answer: Metal-Oxide-Semiconductor Field-Effect Transistor

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24. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is the magnitude of the magnetic force caused by an electric current of 10 Amperes flowing perpendicular to a magnetic field of 10 Teslas through a length of 10 meters?

Bonus Answer: 1000 Newtons

Bonus: Multiple Choice

Two point charges are placed on the x-axis. The first has a charge of -3 Coulombs and is placed at x=0. The second is placed 3 meters to the right of the first and has a charge of 3 Coulombs. What is the dipole moment of these charges?

W) 9 Coulomb-Meters in the direction of the positive x-axis
X) 1 Coulomb-Meters in the direction of the positive x-axis
Y) 9 Coulomb-Meters in the direction of the negative x-axis
Z) 1 Coulomb-Meters in the direction of the negative x-axis

Bonus Answer: W

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25. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

What is a famous impossible result of the classical modeling of blackbody intensity as a function of frequency?

Bonus Answer: "Ultraviolet Catastrophe"

Bonus: Multiple Choice

What is the classical law that attempts to map blackbody intensity as a function of frequency and leads to "ultraviolet catastrophe"?

W) Henderson-Hasselbalch's Law
X) Rayleigh-Jeans Law
Y) Plank's Law
Z) Kirchhoff Law

Bonus Answer: X

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26. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

Which law says that the total electric flux of a closed surface is equal to the charge enclosed divided by the permittivity?

Bonus Answer: Gauss's Law

Bonus: Multiple Choice

What is the electric permittivity of free space?

W) 2.27 * 10^(-12) Farads / meters

X) 8.85 * 10^(-12) Farads / meters

Y) 8.99 * 10^(9) Farads / meters

Z) 6.67 * 10^(-11) Farads / meters

Bonus Answer: X

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27. PHYSICS

Writer: Seiji Yawata

Toss Up: Multiple Choice

Why do the bubbles from a freshly opened bottle of champagne grow as they rise to the surface?

W) Fluid pressure falls as the bubble rises in the glass.

X) The bubble continues to accumulate dissolved gas molecules as it moves through the champagne.

Y) The bubble does expansive work on the champagne as it loses potential energy.

Z) Friction with the champagne heats the gas inside the bubble.

Toss Up Answer: X

Bonus: Multiple Choice

The bubbles in a glass of champagne form a steady stream and leave the surface of the glass in regular time intervals. Why is this?

W) It takes a constant amount of time for gas from the air to make it to the growing bubble.

X) The bubbles occur due to vibrations in the room that have a constant frequency.

Y) The bubbles rise when the buoyant force exceeds the adhesive force.

Z) The bubbles form due to pressure waves in the champagne that have a constant wavelength.

Bonus Answer: Y

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28. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

For what major contribution was Albert Einstein awarded the nobel prize in 1921?

W) Einstein Field Equations

X) General Theory of Reletivity

Y) Special Theory of Relativity

Z) Photoelectric Effect

Toss Up Answer: Z

Bonus: Multiple Choice

Which year in Albert Einstein's life is now known as his "annus mirabilis"?

W) 1905

X) 1921

Y) 1915

Z) 1928

Bonus Answer: W

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29. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

Which law of thermodynamics states that if two thermodynamic systems are each in thermal equilibrium with a third, then they are in thermal equilibrium with each other?

W) Fourth

X) Third

Y) Second

Z) Zeroth

Toss Up Answer: Z

Bonus: Multiple Choice

What factor is the energy density in radiation of a region of space changed by if the absolute temperature is increased by a factor of 2?

W) Times 4

X) Times 1/4

Y) Times 2

Z) Times 16

Bonus Answer: Z

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30. PHYSICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What is the first derivative of velocity?

Bonus Answer: Acceleration

Bonus: Short Answer

If you are on an asteroid 100 km in diameter and it is rotating at 200 meters per second, what is your angular acceleration?

Bonus Answer: 0.4 meters per second

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31. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

Given two frequencies of 410 Hertz and 412 Hertz, what is the period of the beats produced?

Bonus Answer: .5 seconds

Bonus: Short Answer

A car is driving away at 50 meters/seconds from an observer at rest. The car is emitting a frequency at 80 Hz. What is the apparent frequency for the observer, given that the speed of sound is 350 meters/seconds? Give your answer to the nearest integer.

Bonus Answer: 70 Hertz

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32. PHYSICS

Writer: Shantanu Jha

Toss Up: Multiple Choice

What is true about the capacitance of two parallel plates?

W) it is proportional to the square of the Area of the plates

X) it is proportional to the inverse of the Area of the plates

Y) it is proportional to the inverse of the plate separation

Z) it is proportional to the plate separation

Toss Up Answer: Y

Bonus: Multiple Choice

A 200 farad capacitor is used in a circuit. The voltage difference between the plates of the capacitor is 10 volts. What is the magnitude of the charge on each of the capacitor's plates?

W) 100 Coulombs

X) 2000 Coulombs

Y) 10 Coulombs

Z) 200 Coulombs

Bonus Answer: X

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33. PHYSICS

Writer: Shamaul Dilmohamed

Toss Up: Short Answer

What color is a mirror?

Bonus Answer: green

Bonus: Short Answer

Using g = 10 m/s^2, given the weight of an object is 2700 Newtons, what is the mass of the object on the Moon, if its gravitational force is 1/6 as strong as that on Earth? Round your answer to the first decimal place.

Bonus Answer: 270 kg

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34. PHYSICS

Writer: Shantanu Jha

Toss Up: Short Answer

Which of the following units are a measure of magnetic field strength?

1 - Gauss

2 - Tesla

3 - Weber

4 - Henry

Bonus Answer: 1,2 (Gauss, Tesla)

Bonus: Multiple Choice

If the axle of a wheel is moving at a velocity of v, what is the instantaneous velocity of the top of the wheel?
W) -2v
X) 0
Y) v
Z) 2v

Bonus Answer: Z

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35. PHYSICS

Writer: William Xiang

Toss Up: Multiple Choice

Which of the following explains what happens when a negatively charged rod is held to the metal conductor of a leaf electroscope?
W) The leaves close because electrons flow from the rod to the electroscope, resulting in a net negative charge in the electroscope.
X) The leaves close because electrons flow from the electroscope to the rod, resulting in a net positive charge in the electroscope.
Y) The leaves open because electrons flow from the rod to the electroscope, resulting in a net negative charge in the electroscope.
Z) The leaves open because electrons flow from the electroscope to the rod, resulting in a net positive charge in the electroscope.

Toss Up Answer: Y

Bonus: Short Answer

A positive charge of +5.3 Coulombs is placed in an electric field of 420. Newtons per Coulomb. Find the magnitude of the force the charge experiences in this electric field, rounded to two significant figures.

Bonus Answer: 2200 N (Explanation: F = E * q)

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36. PHYSICS

Writer: Ahmad Alnasser

Toss Up: Multiple Choice

A constant force acting on a body experiencing no change in its environment will give the body:

W) constant acceleration
X) constant speed
Y) constant velocity
Z) zero acceleration

Toss Up Answer: W

Bonus: Multiple Choice

What is the MOST common term for the inwardly directed force exerted on an object to keep the object moving in a circle?
W) Centripetal Acceleration
X) Friction
Y) Normal Force
Z) Centripetal Force

Bonus Answer: Z

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37. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

The Kondo effect describes this quantity's divergence at low temperatures. Strain gauges operate by detecting changes in this quantity, because it is proportional to length and inversely proportional to cross-sectional area. Its AC-circuit extension is the complex quantity impedance, and its inverse, measured in siemens, is the conductance. Equal to voltage divided by current, according to Ohm's law, it is high for insulators and low for conductors.Name this measure of how much an object opposes electric current.

Bonus Answer: Resistance

Bonus: Short Answer

What's the emf in volts produced by an inductor with an inductance of 0.3 henry and a current with equation I(t)=2t^2+2 after 3 seconds of operation?

Bonus Answer: 3.6 volts

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38. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

What's the critical angle in radians when a ray passes from a medium with index of refraction of 1.4 to a medium with index of refraction of 0.7?

W) PI/2

X) PI/3

Y) PI/6

Z) PI

Toss Up Answer: Y

Bonus: Short Answer

A concave spherical mirror has a focal length of 12 cm. If an object is placed 6 cm in front of it the image position is:

Bonus Answer: 12cm behind the mirror (accept -12cm)

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39. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

Given G as the gravitational constant and there exists an equilateral triangle with side length "a" and identical objects with mass of "x" what is the total gravitational potential energy of an object with mass "y" that is located at the center?

Bonus Answer: - G*(xy) 3*sqrt(3)/a

Bonus: Multiple Choice

Given G as the gravitational constant and there exists an equilateral triangle with side length "a" and identical objects with mass of "x" what is the total gravitational potential energy of this system?

W) - 9*sqrt(3)*G*(xy)/a (read as negative nine times square root of 3 times G times the second power of x divided by a)

X) - 3*sqrt(3)*G*(x^2)/a (read as negative three times square root of 3 times G times the second power of x divided by a)

Y) - 3*G*(x^2)/a (read as negative three times G times the second power of x divided by a)

Z) - sqrt(3)*G*(x^2)/a (read as negative square root of 3 times G times the second power of x divided by a)

Bonus Answer: Y

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40. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A closed hemispherical shell of radius R is filled with fluid at uniform pressure p. The net force of the fluid on the curved portion of the shell is given by:

W) 2πR^2p (read as 2 pi times R squared times p)

X) 4πR^2p (read as 4 pi times R squared times p)

Y) πR^2p (read as pi times R squared times p)

Z) (4/3)πR^2p (read as 4 over 3 times pi times R squared times p)

Toss Up Answer: Y

Bonus: Short Answer

A boat floating in fresh water displaces 16, 000N of water. How many newtons of saltwater would it displace if it floats in saltwater of specific gravity 1.17?

Bonus Answer: 16, 000

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41. PHYSICS

Writer: Charles Zhang

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

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42. PHYSICS

Writer: Charles Zhang

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

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43. PHYSICS

Writer: Charles Zhang

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

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44. PHYSICS

Writer: Charles Zhang

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

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45. PHYSICS

Writer: Charles Zhang

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

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46. PHYSICS

Writer: Wilson Berkow

Toss Up: Multiple Choice

Which is the weakest fundamental force?

W) The color force
X) The weak force
Y) Electromagnetism
Z) Gravity
Toss Up Answer: Z

Bonus: Short Answer
Identify all of the following that are false:

1. Neutrinos travel at speed C
2. The strength of the color force can increase with distance
3. Electrons have color charge
4. All baryons are unstable

Bonus Answer: 1, 3, 4

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47. PHYSICS

Writer: Andrew Chen
Toss Up: Short Answer
What is the name of the five points in a two body system where a small object can remain gravitationally stable?
Bonus Answer: lagrange points

Bonus: Multiple Choice
Which of the following is the major contributor to an atom's mass?
W) the weak force
X) the strong force
Y) quarks
Z) the higgs boson

Bonus Answer: X

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48. PHYSICS

Writer: Andrew Chen
Toss Up: Short Answer
A gear with 40 teeth turns clockwise at 200 revolutions per minute. This gear is driving another gear with 20 teeth, which in turn is driving another gear with 80 teeth. How fast is the third gear going, and in what direction?
Bonus Answer: 100 revolutions per minute clockwise

Bonus: Multiple Choice
A diverging lens produces an image of an object that is:
W) virtual, smaller, and upright
X) virtual, larger, and upright
Y) real, smaller, and upside down
Z) real, larger, and upright

Bonus Answer: W

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49. PHYSICS

Writer: Charles Zhang
Toss Up: Multiple Choice
Which of the following is NOT a state variable?
W) Work

X) Heat
Y) Entropy
Z) Pressure
Toss Up Answer: W

Bonus: Short Answer
During an isobaric process, 80 joules of work is done on the surroundings by the gas. How much energy is added in joules?
Bonus Answer: 200 joules

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50. PHYSICS

Writer: Charles Zhang
Toss Up: Short Answer
A certain heat engine draws 500 cal/s from a water bath at 27◦ C and transfers 400 cal/s to a reservoir at a lower temperature. The efficiency of this engine is:
Bonus Answer: 20%

Bonus: Multiple Choice
An Carnot refrigerator runs between a cold reservoir at temperature TC and a hot reservoir at temperature TH. You want to increase its coefficient of performance. Of the following, which change results in the greatest increase in the coefficient? The value of ΔT is the same for all changes.
W) Raise the temperature of the hot reservoir by ΔT
X) Raise the temperature of the cold reservoir by ΔT
Y) Lower the temperature of the hot reservoir by 1 2 ΔT and raise the temperature of the cold reservoir by 1 2 ΔT
Z) Lower the temperature of the cold reservoir by ΔT

Bonus Answer: X

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51. PHYSICS

Writer: Charles Zhang
Toss Up: Multiple Choice
Find the angular frequency of oscillations in a LC circuit if the total inductance is 2 henry and the total capacitance is 8 farad.
W) 1/4
X) 1/2
Y) 1/3
Z) 1/5
Toss Up Answer: W

Bonus: Short Answer
An LC circuit has an inductance of 20mH and a capacitance of 5.0 μF. At time
t = 0 the charge on the capacitor is 3.0 μC and the current is 7.0mA. The total energy in joules is:
Bonus Answer: 9.0 * 10^-7 (accept equivalent forms)

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52. PHYSICS

Writer: Nicholas Parker Ng
Toss Up: Multiple Choice
A transverse traveling sinusoidal wave on a string has a frequency of 100Hz, a wavelength of 0.040m, and an amplitude of 2.0mm. The maximum velocity in m/s of any point on the string is
W) 0.2

X) 1.3
Y) 4
Z) 15

Toss Up Answer: X

Bonus: Multiple Choice

The time required for a small pulse to travel from A to B on a stretched cord shown is NOT altered by changing
W) the linear mass density of the cord
X) the length between A and B
Y) the shape of the pulse
Z) the tension in the cord

Bonus Answer: Y

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53. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

In order for two sound waves to produce audible beats, it is essential that the two waves have:
W) the same amplitude
X) slightly different amplitudes
Y) the same number of harmonics
Z) slightly different frequencies

Toss Up Answer: Z

Bonus: Multiple Choice

A 200-cm organ pipe with one end open is in resonance with a sound wave of wavelength 270cm. The pipe is operating in its
W) fundamental frequency
X) second harmonic
Y) third harmonic
Z) fourth harmonic

Bonus Answer: X

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54. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The zeroth law of thermodynamics allows us to define:
W) work
X) pressure
Y) temperature
Z) thermal equilibrium

Toss Up Answer: Y

Bonus: Short Answer

Which physicist contributed to the understanding of electrical circuits and coined the term “black body” radiation?

Bonus Answer: Kirchoff

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55. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

The rate of heat flow by conduction through a slab does NOT depend upon the

W) temperature difference between opposite faces of the slab

X) thermal conductivity of the slab

Y) slab thickness

Z) specific heat of the slab

Toss Up Answer: Z

Bonus: Multiple Choice

Inside a room at a uniform comfortable temperature, metallic objects generally feel cooler to the touch than wooden objects do. This is because:

W) a given mass of wood contains more heat than the same mass of metal

X) metal conducts heat better than wood

Y) the equilibrium temperature of metal in the room is lower than that of wood

Z) the human body, being organic, resembles wood more closely than it resembles metal

Bonus Answer: X

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56. PHYSICS

Writer: Nicholas Parker Ng

Toss Up: Multiple Choice

Sound waves can propagate through a plasma because of:

W) high coulomb interactions between particles

X) high density of particles

Y) high energy of particles

Z) high kinetic pressure force

Toss Up Answer: W

Bonus: Short Answer

Which description(s) of plasma is most often used to understand the macroscopic features of plasma: Single particle theory, kinetic theory, fluid description

Bonus Answer: Fluid description

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57. PHYSICS

Writer: William Xiang

Toss Up: Short Answer

In a well-known physical experiment, two small masses were suspended by a thread, each positioned near two much larger stationary masses. A mirror was used to measure the angle through which the thread twists due to the rotation of the small masses' movement. Which physicist conducted this experiment, and what constant did he/she derive from it?

Bonus Answer: Henry Cavendish (accept "Cavendish") and Universal gravitational constant (accept "big G", don't accept "gravity" or just "g")

Bonus: Short Answer

A skydiver leaps from a plane at a high altitude. Given acceleration due to gravity is equal to 10 meters per second squared and it takes 45 seconds for the skydiver to fall, calculate the height at which the skydiver fell from, rounded to the nearest thousand meters.

Bonus Answer: 20000 [Calculation: x = a * t^2 = (10 m/s^2)(45s)^2 = 20250m -> rounded to 20000]

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58. PHYSICS

Writer: Joyce Lei

Toss Up: Short Answer

A parallel circuit has two resistors, one with a resistance of 4 ohms, and the other of 8 ohms. What is the equivalent resistance of the circuit? State the answer as a fraction.

Bonus Answer: 8/3 ohms

Bonus: Short Answer

What is the equivalent capacitance of a parallel circuit with capacitors of 8 micro-Farads, 12 micro-Farads, and 15 micro-Farads?

Bonus Answer: 35 micro-Farads

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59. PHYSICS

Writer: Charles Zhang

Toss Up: Short Answer

It is known that 28 g of a certain ideal gas occupy 22.4 liters at standard conditions. The volume occupied by 42 g of this gas at standard conditions is:

Bonus Answer: 33.6 liters

Bonus: Multiple Choice

Use R = 8.2 × 10−5 m3 · atm/mol · K and NA = 6.02 × 10^23 mol−1. The approximate number of air molecules in a 1m3 volume at 300K and atmospheric pressure is:

W) 41

X) 450

Y) 2.5 × 10^25

Z) 5.4 × 10^26

Bonus Answer: Y

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60. PHYSICS

Writer: Charles Zhang

Toss Up: Multiple Choice

A body at rest in a system is capable of doing work if:

W) the potential energy of the system is positive

X) it is free to move in such a way as to decrease the potential energy of the system

Y) it is free to move in such a way as to increase the potential energy of the system

Z) it is free to move in such a way as to decrease its kinetic energy

Toss Up Answer: X

Bonus: Short Answer

If the force of a non-linear spring is defined as F(x) = 3x^2+2x+5, what is the work done on the spring if it's stretched to 3 meters from equilibrium?

Bonus Answer: 51 J

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