PHYSICS
1. PHYSICS
Toss Up: Multiple Choice
If the wave function is spherically symmetric then the radial probability density is given by:If the wave function is spherically symmetric then the radial probability density is given by:
W) 4r^2*
X) ||^2
Y) 4r^2||^2
Z) 4||^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

2. PHYSICS
Toss Up: Multiple Choice
D
W) WA
X) T
Y) R
Z) DEEZ

Toss Up Answer: Y

Bonus: Multiple Choice
GOTTEE
W) a
X) s
Y) d
Z) f

Bonus Answer: W

3. PHYSICS
Toss Up: Multiple Choice
A non-relativistic free electron has kinetic energy K. If its wavelength doubles, its kinetic energy is:
W) 4K
X) K/4
Y) still 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

4. PHYSICS
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- 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 F
X) 14 F
Y) 20 F
Z) 7.2F

Bonus Answer: Y

5. PHYSICS
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 R times C) the symbol t represents:
W) the time constant
X) the time it takes for C to lose the fraction 1/e of its initial charge
Y) the time it takes for C to lose the fraction (1 1/e) of its initial charge
Z) none of the above
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

6. PHYSICS
7. PHYSICS
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) Electric field lines can 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

8. PHYSICS
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

9. PHYSICS
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
If a magnet and a conducting loop are placed next to each other at rest. 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) The loop will move with the magnet.
X) Counter-clockwise
Y) clockwise
Z) There is no current.

Bonus Answer: X

10. PHYSICS
11. PHYSICS
Toss Up: Multiple Choice
In a simple, in-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
In a simple, parallel circuit, which of these is equal among all resistors?
W) Potential difference
X) Resistance
Y) Current
Z) Capacitance

Bonus Answer: W

12. PHYSICS
13. PHYSICS
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

14. PHYSICS
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

15. PHYSICS
Toss Up: Multiple Choice
The equation of continuity for uid ow 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 60 and an impedance of 100. Its reactance, in ohms, is:
W) 40
X) 60
Y) 80
Z) 117

Bonus Answer: Y

16. PHYSICS
Toss Up: Multiple Choice
Monochromatic light is normally incident on a diraction grating that is 1cm wide and has 10,000 slits. The rst 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 eect, the speed of recession of this star is:
W) .33c
X) .5c
Y) .71c
Z) .8c

Bonus Answer: Z

17. PHYSICS
Toss Up: Multiple Choice
An acceptor replacement atom in silicon might have 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) increases dramatically
Y) decreases slightly
Z) decreases dramatically

Bonus Answer: X

18. PHYSICS
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) to 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

19. PHYSICS
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 what is the induced emf in the coil?
Bonus Answer: -2.5 Volts

20. PHYSICS
21. PHYSICS
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

22. PHYSICS
23. PHYSICS
24. PHYSICS
25. PHYSICS
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 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

26. PHYSICS
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

27. PHYSICS
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

28. PHYSICS
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

29. PHYSICS
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

30. PHYSICS
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

31. PHYSICS
32. PHYSICS
33. PHYSICS
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

34. PHYSICS
35. PHYSICS
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

36. PHYSICS
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)

37. PHYSICS
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

38. PHYSICS
39. PHYSICS
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)

40. PHYSICS
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

41. PHYSICS

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

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

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

Z) (4/3)R^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

42. PHYSICS

43. PHYSICS

44. 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

45. PHYSICS
46. 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

47. PHYSICS
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

48. PHYSICS
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

49. PHYSICS
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

50. PHYSICS
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

51. PHYSICS
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 T is the same for all changes.
W) Raise the temperature of the hot reservoir by T
X) Raise the temperature of the cold reservoir by T
Y) Lower the temperature of the hot reservoir by 1 2 T and raise the temperature of the cold reservoir by 1 2 T
Z) Lower the temperature of the cold reservoir by T

Bonus Answer: X

52. PHYSICS
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 F. At time
 t = 0 the charge on the capacitor is 3.0 C and the current is 7.0mA. The total energy in joules is:
Bonus Answer: 9.0 * 10^-7 (accept equivalent forms)

53. PHYSICS
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

54. PHYSICS
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 dierent 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

55. PHYSICS
Toss Up: Multiple Choice
The zeroth law of thermodynamics allows us to dene:
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

56. PHYSICS
Toss Up: Multiple Choice
The rate of heat ow 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

57. PHYSICS
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

58. PHYSICS
59. PHYSICS