

## *Science Bowl*

## PHYSICS

PHYS-91; Multiple Choice: For the hydrogen atom, which series describes electron transitions to the  $N=1$  orbit, the lowest energy electron orbit? Is it the:

- w) Lyman series
- x) Balmer series
- y) Paschen series
- z) Pfund series

ANSWER: W -- LYMAN SERIES

PHYS-91; Multiple Choice: Electric current may be expressed in which one of the following units?

- w) coulombs/volt
- x) joules/coulomb
- y) coulombs/second
- z) ohms/second

ANSWER: Y -- COULOMBS/SECOND

PHYS-91; Short Answer: In the SI system of measure, what is the unit of capacitance?

ANSWER: FARAD

PHYS-91; Multiple Choice: A Newton is equal to which of the following?

- w) kilogram-meter per second
- x) meter per second squared
- y) kilogram-meter per second squared
- z) kilogram per meter-second

ANSWER: Y -- KILOGRAM-METER PER SECOND SQUARED

PHYS-91; Multiple Choice: For an object moving in uniform circular motion, the direction of the instantaneous acceleration vector is:

- w) tangent to the path of motion
- x) equal to zero
- y) directed radially outward
- z) directed radially inward

ANSWER: Z -- DIRECTED RADIALY INWARD

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: A boy is standing on an elevator which is traveling downward with a constant velocity of 30 meters per second. The boy throws a ball vertically upward with a velocity of 10 meters per second relative to the elevator. What is the velocity of the ball, MAGNITUDE AND DIRECTION, relative to the elevator shaft the instant the boy releases the ball?

ANSWER: 20 METERS PER SECOND DOWN

PHYS-91; Multiple Choice: Work is equal to which of the following?

- w) the cross product of force and displacement.
- x) the product of force times time
- y) force divided by time
- z) the dot product of force and displacement

ANSWER: Z -- THE DOT PRODUCT OF FORCE AND DISPLACEMENT

PHYS-91; Multiple Choice: The work done by a friction force is:

- w) always positive
- x) always negative
- y) always zero
- z) either positive or negative depending upon the situation.

ANSWER: X -- ALWAYS NEGATIVE

PHYS-91; Multiple Choice: As defined in physics, work is:

- w) a scalar quantity
- x) always a positive quantity
- y) a vector quantity
- z) always zero

ANSWER: W -- A SCALAR QUANTITY

## Science Bowl

## PHYSICS

PHYS-91; Multiple Choice: A pendulum which is suspended from the ceiling of a railroad car is observed to hang at an angle of 10 degrees to the right of vertical. Which of the following answers could explain this phenomena?

- w) The railroad car is at rest.
- x) The railroad car is accelerating to the left.
- y) The railroad car is moving with constant velocity to the right.
- z) The railroad car is accelerating to the right.

ANSWER: X -- THE RAILROAD CAR IS ACCELERATING TO THE LEFT.

PHYS-91; Multiple Choice: Two forces have magnitudes of 11 newtons and 5 newtons. The magnitude of their sum could NOT be equal to which of the following values?

- w) 16 newtons
- x) 5 newtons
- y) 9 newtons
- z) 7 newtons

ANSWER: X -- 5 NEWTONS

PHYS-91; Short Answer: A ball leaves a girl's hand with an upward velocity of 6 meters per second. What is the maximum height of the ball above the girl's hand?

ANSWER: 1.8 METERS

PHYS-91; Short Answer: A boy throws a ball vertically upward with a velocity of 6 meters per second. How long does it take the ball to return to the boy's hand?

ANSWER: 1.22 SECONDS (accept: 1.2 seconds)

PHYS-91; Short Answer: A toy train moves in a circle of 8 meters radius with a speed of 4 meters per second. What is the magnitude of the acceleration of the train?

ANSWER: 2 METERS PER SECOND SQUARED

PHYS-91; Short Answer: A certain machine exerts a force of 200 newtons on a box whose mass is 30 kilograms. The machine moves the box a distance of 20 meters along a horizontal floor. What amount of work does the machine do on the box?

ANSWER: 4000 JOULES

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Short Answer: A box is initially at rest on a horizontal, frictionless table. If a force of 10 Newtons acts on the box for 3 seconds, what is the momentum of the box at the end of the 3 second interval?

ANSWER: 30 NEWTON-SECONDS or 30 KILOGRAM-METER PER SECOND

PHYS-91; Multiple Choice: A block of metal which weighs 60 newtons in air and 40 newtons under water has a density, in kilograms per meter cubed, of:

- w) 1000
- x) 3000
- y) 5000
- z) 7000

ANSWER: X -- 3000

PHYS-91; Short Answer: A 10 kilogram body initially moving with a velocity of 10 meters per second makes a head-on collision with a 15 kilogram body initially at rest. The two objects stick together. What is the velocity of the combined system just after the collision?

ANSWER: 4 METERS PER SECOND

PHYS-91; Short Answer: A certain spring is known to obey Hooke's Law. If a force of 10 newtons stretches the spring 2 meters, how far will a 30 newton force stretch the spring?

ANSWER: 6 METERS

PHYS-91; Short Answer: A helicopter is ascending vertically with a constant speed of 6 meters per second relative to the ground. At the instant the helicopter is 60 meters above the ground it releases a package. What is the magnitude and direction of the velocity of the package, relative to the ground, the instant the package is released by the helicopter?

ANSWER: 6 METERS/SECOND UP

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: If the distance between two objects, each of mass 'M', is tripled, the force of attraction between the two objects is:

- w) 1/2 the original force
- x) 1/3 the original force
- y) 1/9 the original force
- z) unchanged

ANSWER: Y -- 1/9 THE ORIGINAL FORCE

PHYS-91; Short Answer: A 40 kilogram girl climbs a vertical distance of 5 meters in twenty seconds at a constant velocity. How much work has the girl done?

ANSWER: 2000 JOULES or 1960 JOULES

PHYS-91; Short Answer: A machine performs 8 Joules of work in 2 seconds. How much power is delivered by this machine?

ANSWER: 4 WATTS

PHYS-91; Multiple Choice: In physics, a radian per second is a unit of:

- w) angular displacement
- x) angular velocity
- y) angular acceleration
- z) angular momentum.

ANSWER: X -- ANGULAR VELOCITY

PHYS-91; Multiple Choice: If the resultant force acting on a body of constant mass is zero, the body's momentum is:

- w) increasing
- x) decreasing
- y) always zero
- z) constant

ANSWER: Z -- CONSTANT

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Short Answer: What is the name of the first American physicist to win two Nobel prizes?

ANSWER: (JOHN) BARDEEN

PHYS-91; Multiple Choice: Which of the following scientists is responsible for the exclusion principle which states that two objects may NOT occupy the same space at the same time? Was it:

- w) Heisenberg
- x) Bohr
- y) Teller
- z) Pauli

ANSWER: Z -- PAULI

PHYS-91; Short Answer: Who shared the Nobel Prize in Physics in 1909 with Guglielmo Marconi for his contribution to the development of wireless telegraphy?

ANSWER: (CARL FERDINAND) BRAUN

PHYS-91; Short Answer: Who first theoretically predicted the existence of the positron, a positively charged electron? He received the Nobel Prize in Physics in 1933.

ANSWER: (PAUL ADRIEN MAURICE) DIRAC

PHYS-91; Short Answer: Name the female physicist who received the Nobel Prize in 1963 for her discovery concerning the shell structure of the nucleus.

ANSWER: (MARIA GOEPPERT) MAYER

PHYS-91; Short Answer: The constant potential difference across a 2 ohm resistor is 20 volts. How many watts of power are dissipated by this resistor?

ANSWER: 200 WATTS

PHYS-91; Short Answer: The potential difference across a 4 ohm resistor is 20 volts. Assuming that all of the energy dissipated by this resistor is in the form of heat, how many joules of heat are radiated in 10 seconds?

ANSWER: 1000 JOULES

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: The force acting between two point charges can be computed using which of the following laws?

- w) Ohm's Law
- x) Ampere's Law
- y) Coulomb's Law
- z) Newton's Second Law.

ANSWER: Y -- COULOMB'S LAW

PHYS-91; Short Answer: Five volts are applied across the plates of a parallel plate capacitor. The distance of separation of the plates is .02 meters. What is the magnitude of the electric field inside the capacitor?

ANSWER: 250 VOLTS PER METER or 250 NEWTONS PER COULOMB

PHYS-91; Short Answer: Used normally, a 150-watt, 120 volt light bulb requires how many amps of current?

ANSWER: 1.25 AMPS

PHYS-91; Short Answer: If 10 joules of energy are required to move 5 coulombs of charge between two points, the potential difference between the two points is equal to how many volts?

ANSWER: 2 VOLTS

PHYS-91; Multiple Choice: Induced electric currents can be explained using which of the following laws?

- w) Gauss's Law
- x) Faraday's Law
- y) Ohm's Law
- z) Ampere's Law

ANSWER: X -- FARADAY'S LAW

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: For a negative point charge, the electric field vectors:

- w) circle the charge
- x) point radially in toward the charge
- y) point radially away from the charge
- z) cross at infinity

ANSWER: X -- POINT RADIALLY IN TOWARD THE CHARGE

PHYS-91; Multiple Choice: For an infinite sheet of positive charge, the electric field lines:

- w) run parallel to the sheet of charge
- x) are perpendicular to the sheet of charge and point in toward the sheet
- y) are perpendicular to the sheet of charge and point away from the sheet
- z) fall off as one over r squared

ANSWER: Y -- ARE PERPENDICULAR TO THE SHEET OF CHARGE AND POINT AWAY

PHYS-91; Multiple Choice: Five coulombs of charge are placed on a thin-walled conducting shell. Once the charge has come to rest, the electric potential inside the hollow conducting shell is found to be:

- w) zero
- x) uniform inside the sphere and equal to the electric potential on the surface of the sphere
- y) smaller than the electric potential outside the sphere
- z) varying as one over r squared.

ANSWER: X -- UNIFORM INSIDE THE SPHERE AND EQUAL TO THE ELECTRIC POTENTIAL

PHYS-91; Short Answer: A two farad and a four farad capacitor are connected in series. What single capacitance is "equivalent" to this combination?

ANSWER: 4/3 FARADS



## Science Bowl

## PHYSICS

PHYS-91; Multiple Choice: Three capacitors with different capacitances are connected in series. Which of the following statements is TRUE?

- w) All three of the capacitors have the same potential difference between their plates.
- x) The magnitude of the charge is the same on all of the capacitor plates.
- y) The capacitance of the system depends on the voltage applied across the three capacitors.

ANSWER: X -- THE MAGNITUDE OF THE CHARGE IS THE SAME ON ALL OF THE CAPACITOR PLATES

PHYS-91; Multiple Choice: For a parallel-plate capacitor with plate area "A" and plate separation "d", the capacitance is proportional to which of the following?

- w) A divided by d squared
- x) A times d
- y) A divided by d
- z) d divided by A

ANSWER: Y -- A DIVIDED BY D

PHYS-91; Multiple Choice: A constant potential difference is applied across the plates of a parallel-plate capacitor. Neglecting any edge effects, the electric field inside the capacitor is:

- w) constant
- x) varying as one over r squared
- y) decreasing as one moves from the positive to the negative plate
- z) zero

ANSWER: W -- CONSTANT

PHYS-91; 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?

ANSWER: 200 COULOMBS

PHYS-91; Short Answer: 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?

ANSWER: THE CURRENT IS ZERO

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: A charged particle is moving in a UNIFORM magnetic field. If the direction of motion of the charged particle is parallel to the magnetic field, describe the shape of the charged particle's path.

ANSWER: STRAIGHT LINE

PHYS-91; Multiple Choice: An infinitely long wire carries a current of three amps. The magnetic field outside the wire:

- w) points radially away from the wire
- x) points radially inward
- y) circles the wire
- z) is zero.

ANSWER: Y -- CIRCLES THE WIRE

PHYS-91; Multiple Choice: A copper rod which is 1 centimeter in diameter carries a current of 5 amps. The current is distributed uniformly throughout the rod. The magnetic field half way between the axis of the rod and its outside edge is:

- w) zero.
- x) pointing radially outward
- y) pointing radially inward
- z) circles the axis of the rod

ANSWER: Z -- CIRCLES THE AXIS OF THE ROD

PHYS-91; Multiple Choice: Iron is what type of magnetic material? Is it:

- w) diamagnetic
- x) paramagnetic
- y) ferromagnetic
- z) non-magnetic

ANSWER: Y -- FERROMAGNETIC

PHYS-91; Short Answer: The focal length of a concave mirror is 2 meters. An object is positioned 8 meters in front of the mirror. Where is the image of this object formed?

ANSWER: 8/3 METER or 2.66 METERS IN FRONT OF THE MIRROR

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Short Answer: A converging thin lens has a focal length of 27 centimeters. An object is placed 9 centimeters from the lens. Where is the image of this object formed?

ANSWER: -13.5 CENTIMETERS or 13.5 CENTIMETERS ON THE OBJECT SIDE OF THE LENS

PHYS-91; Short Answer: In Bohr's theory of the atom, what force was responsible for holding the electrons in their orbit?

ANSWER: COULOMB FORCE or THE FORCE OF ATTRACTION BETWEEN THE PROTON (NUCLEUS) AND THE ELECTRON

PHYS-91; Short Answer: Davisson and Germer scattered electrons from a crystal of nickel. The scattered electrons formed a strong diffraction pattern. What important conclusion was drawn from this experiment?

ANSWER: ELECTRONS ACTED LIKE WAVES

PHYS-91; Short Answer: The speed at which a wave propagates down a string is 300 meters per second. If the frequency of this wave is 150 Hertz, what is the wavelength of this wave?

ANSWER: 2 METERS

PHYS-91; Multiple Choice: A standing wave is formed on a tightly stretched string. The distance between a node and an antinode is:

- w) 1/8 wavelength
- x) 1/4 wavelength
- y) 1/2 wavelength
- z) 1 wavelength

ANSWER: X -- 1/4 WAVELENGTH

PHYS-91; Multiple Choice: When a physical property such as charge exists in discrete "packets" rather than in continuous amounts, the property is said to be:

- w) discontinuous
- x) abrupt
- y) quantized
- z) noncontinuous

ANSWER: Y -- QUANTIZED

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Short Answer: Assume a ray of light is incident on a smooth reflecting surface at an angle of incidence of 15 degrees to the normal. What is the angle between the incident ray and the reflected ray?

ANSWER: 30 DEGREES

PHYS-91; Short Answer: The focal length of a concave spherical mirror is equal to 1 meter. What is the radius of curvature of this mirror?

ANSWER: 2 METERS

PHYS-91; Short Answer: A virtual image can be formed by one or more of the following single mirrors? Identify them.

- w) plane mirror
- x) concave spherical mirror
- y) convex spherical mirror
- z) all of the above

ANSWER: Z -- ALL OF THE ABOVE (accept: A, B and C)

PHYS-91; Short Answer: A quarter of a wavelength is equal to how many degrees of phase?

ANSWER: 90 DEGREES

PHYS-91; Multiple Choice: An organ pipe which is open at both ends resonates at its fundamental frequency. Neglecting any end effects, what wavelength is formed by this pipe in this mode of vibration if the pipe is 2 meters long?

- w) 2 meters
- x) 4 meters
- y) 6 meters
- z) 8 meters.

ANSWER: X -- 4 METERS

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: Whose principle or law states that each point on a wavefront may be considered a new wave source? Is it:

- w) Snell's Law
- x) Huygen's Principle
- y) Young's Law
- z) Hertz's Law.

ANSWER: X -- HUYGEN'S PRINCIPLE

PHYS-91; Short Answer: The frequency of a wave is 50 Hertz and its wavelength is 25 meters. What is the velocity of this wave?

ANSWER: 1250 METERS/SECOND

PHYS-91; Multiple Choice: The wave nature of light is demonstrated by which of the following?

- w) the photoelectric effect
- x) color
- y) the speed of light
- z) diffraction

ANSWER: Z -- DIFFRACTION

PHYS-91; Multiple Choice: The collision between a photon and a free electron was first explained by which of the following scientists?

- w) Einstein
- x) Heisenberg
- y) Compton
- z) Bohr

ANSWER: Y -- COMPTON

PHYS-91; Short Answer: Besides solid, liquid, and gas, what is the fourth form of matter?

ANSWER: PLASMA

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: What is 25,000 miles per hour on earth, and 5,300 miles per hour on the Moon?

ANSWER: ESCAPE VELOCITY

PHYS-91; Short Answer: In Einstein's universe, what is the fourth dimension?

ANSWER: TIME

PHYS-91; Multiple Choice: The Tesla and the Gauss are units of measure of:

- w) conductance
- x) magnetic field strength
- y) magnetic flux
- z) electrical current

ANSWER: X -- MAGNETIC FIELD STRENGTH

PHYS-91; Short Answer: Shockley, Brattain and Bardeen won a Nobel prize for what small invention?

ANSWER: TRANSISTOR

PHYS-91; Short Answer: What mechanical and electronic device has a name derived from a Czechoslovakian word meaning "work; compulsory service"?

ANSWER: ROBOT

PHYS-91; Short Answer: What is the name of the temperature and pressure conditions at which water can be in the solid, liquid and gas phases simultaneously?

ANSWER: TRIPLE POINT

PHYS-91; Multiple Choice: Which of the following colors of visible light has the longest wavelength? Is it:

- w) violet
- x) green
- y) yellow
- z) red

ANSWER: Z -- RED

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: A 10 kilogram mass rests on a horizontal frictionless surface. A horizontal force of 5 Newtons is applied to the mass. After the force has been applied for 1 second, the velocity of the mass is:

- w) 0 meters per second
- x) 0.5 meters per second
- y) 5 meters per second
- z) 50 meters per second

ANSWER: X -- 0.5 METERS PER SECOND

PHYS-91; Multiple Choice: A worker lifts a 10 kilogram block a vertical height of 2 meters. The work he does on the block is:

- w) 5 Joules
- x) 20 Joules
- y) 49 Joules
- z) 200 Joules

ANSWER: Z -- 200 JOULES

PHYS-91; Multiple Choice: An impulse of 10 kilogram-meter per second acting on an object whose mass is 5 kilogram will cause a change in the objects velocity of:

- w) 0.5 meters per second
- x) 2 meters per second
- y) 10 meters per second
- z) 50 meters per second

ANSWER: X -- 2 METERS PER SECOND

PHYS-91; Multiple Choice: The time needed for a net force of 10 newtons to change the velocity of a 5 kilograms mass by 3 meters/second is:

- w) 1.5 seconds
- x) 6 seconds
- y) 16.7 seconds
- z) 150 seconds

ANSWER: W -- 1.5 SECONDS

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: The value of G, the universal gravitational constant, was measured experimentally by:

- w) Newton
- x) Cavendish
- y) Copernicus
- z) Kepler

ANSWER: X -- CAVENDISH

PHYS-91; Multiple Choice: Two steel balls are at a distance S from one another. As the mass of ONE of the balls is doubled, the gravitational force of attraction between them is:

- w) quartered
- x) halved
- y) doubled
- z) quadrupled

ANSWER: Y -- DOUBLED

PHYS-91; Multiple Choice: If the distance between the earth and moon were halved, the force of the attraction between them would be:

- w) one fourth as great
- x) one half as great
- y) twice as great
- z) four times as great

ANSWER: Z -- FOUR TIMES AS GREAT

PHYS-91; Multiple Choice: As a 10 kilogram mass on the end of a spring passes through its equilibrium position, the kinetic energy of the mass is 20 joules. The speed of the mass is:

- w) 2.0 meters per second
- x) 4.0 meters per second
- y) 5.0 meters per second
- z) 6.3 meters per second

ANSWER: W -- 2.0 METERS PER SECOND



## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: As a longitudinal wave moves through a medium, the particles of the medium:

- w) vibrate in a path parallel to the path of the wave
- x) vibrate in a path perpendicular to the path of the wave
- y) follow the wave along its entire path
- z) do not move

ANSWER: W -- VIBRATE IN A PATH PARALLEL TO THE PATH OF THE WAVE

PHYS-91; Multiple Choice: As a pendulum is raised to higher altitudes, its period:

- w) increases
- x) decreases
- y) remains the same
- z) decreases, then remains the same

ANSWER: W -- INCREASES

PHYS-91; Multiple Choice: Two vibrating particles that are "out of phase" differ in the phase of their vibration by:

- w) 1/4 cycle
- x) 1/2 cycle
- y) 3/4 cycle
- z) 1 cycle

ANSWER: X -- 1/2 CYCLE

PHYS-91; Multiple Choice: The SI unit of pressure is the:

- w) Torr
- x) dyne per centimeter squared
- y) atmosphere
- z) pascal

ANSWER: Z -- PASCAL

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: An electroscope charged WITHOUT contacting a charged body is charged by:

- w) induction
- x) conduction
- y) convection
- z) insulation

ANSWER: W -- INDUCTION

PHYS-91; Multiple Choice: The potential drop between the terminals of a battery is equal to the battery's EMF when:

- w) no current is drawn from the battery
- x) a very large current is drawn from the battery
- y) the internal resistance of the battery is very large
- z) the resistance in the external circuit is small

ANSWER: W -- NO CURRENT IS DRAWN FROM THE BATTERY

PHYS-91; Multiple Choice: To convert a galvanometer to a voltmeter, you should add a:

- w) high resistance in series
- x) high resistance in parallel
- y) low resistance in series
- z) low resistance in parallel

ANSWER: W -- HIGH RESISTANCE IN SERIES

PHYS-91; Multiple Choice: The greatest induced EMF will occur in a straight wire moving at constant speed through a uniform magnetic field when the angle between the direction of the wire's motion and the direction of the magnetic field is

- w) 0 degrees
- x) 30 degrees
- y) 60 degrees
- z) 90 degrees

ANSWER: Z -- 90 DEGREES

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: A 10 volt battery connected to a capacitor delivers a charge of 0.5 coulombs. The capacitance of the capacitor is:

- w)  $2 \times 10^{-2}$  farads
- x)  $5 \times 10^{-2}$  farads
- y) 2 farads
- z) 5 farads

ANSWER: X --  $5 \times 10^{-2}$  FARADS

PHYS-91; Multiple Choice: Two light rays will interfere constructively with maximum amplitude if the path difference between them is:

- w) one wavelength
- x) one-half wavelength
- y) one-quarter wavelength
- z) one-eighth wavelength

ANSWER: W -- ONE WAVELENGTH

PHYS-91; Multiple Choice: Light is normally incident on a thin soap film and is reflected. If the wavelength of this light is "L" and the index of refraction of the soap film is "N", complete destructive interference will occur for a film thickness of:

- w)  $L / 8N$
- x)  $L / 4N$
- y)  $L / 2N$
- z)  $3L / 4N$

ANSWER: Y --  $L / 2N$

PHYS-91; Multiple Choice: The Michelson interferometer was designed to study the nature of:

- w) water waves
- x) sound waves
- y) an "ether"
- z) sunlight

ANSWER: Y -- AN "ETHER"

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: The Millikan experiment showed that electric charge was:

- w) negative
- x) quantized
- y) positive
- z) unmeasurable

ANSWER: X -- QUANTIZED

PHYS-91; Multiple Choice: When a metal becomes a superconductor, there is a tremendous decrease in its:

- w) total volume
- x) electrical resistance
- y) length
- z) density

ANSWER: X -- ELECTRICAL RESISTANCE

PHYS-91; Multiple Choice: An x-ray photon collides with a free electron, and the photon is scattered. During this collision there is conservation of:

- w) momentum but not energy
- x) neither momentum nor energy
- y) energy but not momentum
- z) both momentum and energy

ANSWER: Z -- BOTH MOMENTUM AND ENERGY

PHYS-91; Multiple Choice: In the sun, helium is produced from hydrogen by:

- w) radioactive decay
- x) disintegration
- y) fission
- z) fusion

ANSWER: Z -- FUSION

## ***Science Bowl***

## **PHYSICS**

HYS-91; Multiple Choice: The half-life of an isotope of an element is 5 days. The mass of a 10 gram sample of this isotope remaining after 20 days is:

- w) 0.312 grams
- x) 0.625 grams
- y) 1.25 grams
- z) 2.50 grams

ANSWER: X -- 0.625 GRAMS

PHYS-91; Multiple Choice: The idea that electrons revolved in orbits around the nucleus of an atom without radiating energy away from the atom was postulated by:

- w) Thompson
- x) Bohr
- y) Rutherford
- z) Einstein

ANSWER: X -- BOHR

PHYS-91; Multiple Choice: Alpha particles are nuclei of:

- w) hydrogen
- x) helium
- y) oxygen
- z) nitrogen

ANSWER: X -- HELIUM

PHYS-91; Multiple Choice: A ball falling vertically from rest for 3 seconds travels very nearly:

- w) 14.7 meters
- x) 29.4 meters
- y) 44.1 meters
- z) 88.2 meters

ANSWER: Y -- 44.1 METERS

## Science Bowl

## PHYSICS

HYS-91; Multiple Choice: A car is moving along a straight horizontal road at a speed of 20 meters per second. The brakes are applied and a constant force of 5000 Newtons decelerates the car to a stop in 10 seconds. The mass of the car is:

- w) 1250 kilograms
- x) 2500 kilograms
- y) 5000 kilograms
- z) 10,000 kilograms

ANSWER: X -- 2500 KILOGRAMS

PHYS-91; Multiple Choice: A girl throws a 0.1 kilogram ball at a wall. The ball hits the wall perpendicularly with a velocity of 5 meters per second and then bounces straight back with a velocity of 4 meters per second. The change in the momentum of the ball is:

- w) 0.1 kilogram-meters per second
- x) 0.4 kilogram-meters per second
- y) 0.5 kilogram-meters per second
- z) 0.9 kilogram-meters per second

ANSWER: Z -- 0.9 KILOGRAM-METERS PER SECOND

PHYS-91; Multiple Choice: A satellite of mass "M" is in orbit around the earth. If a second satellite of mass "2M" is to be placed in the same orbit, the second satellite must have a velocity which is:

- w) half the velocity of the first satellite
- x) the same as the velocity of the first satellite
- y) twice the velocity of the first satellite
- z) four times the velocity of the first satellite

ANSWER: X -- THE SAME AS THE VELOCITY OF THE FIRST SATELLITE

PHYS-91; Multiple Choice: Which of the answers listed below best completes the statement: The rate at which any part of a wave travels from one place to another determines the wave's:

- w) propagation velocity
- x) period
- y) amplitude
- z) frequency

ANSWER: W -- PROPAGATION VELOCITY

## ***Science Bowl***

## PHYSICS

HYS-91; Multiple Choice: A spring with a force constant of 100 Newtons per meter is loaded with a mass of 1.0 kilogram. The period of vibration of this system is:

- w) .03 seconds
- x) .06 seconds
- y) .31 seconds
- z) .63 seconds

ANSWER: Z -- .63 SECONDS

PHYS-91; Multiple Choice: The first instrument used for measuring temperature was the gas thermometer invented by:

- w) Celsius
- x) Galileo
- y) Centigrade
- z) Fahrenheit

ANSWER: X -- GALILEO

PHYS-91; Multiple Choice: The first law of thermodynamics is concerned with the conservation of

- w) energy
- x) momentum
- y) charge
- z) matter

ANSWER: W -- ENERGY

PHYS-91; Multiple Choice: Which of the following best completes the statement: The calorie is the amount of heat needed to raise:

- w) 1 gram of water 1 degree Celsius
- x) 1 gram of water 1 degree Rankin
- y) 1 kilogram of water 1 degree Celsius
- z) 1 kilogram of water 1 degree Kelvin

ANSWER: W -- 1 GRAM OF WATER 1 DEGREE CELSIUS

## ***Science Bowl***

## **PHYSICS**

HYS-91; Multiple Choice: Units commonly used for entropy are:

- w) kilograms per degree Kelvin
- x) Joules per degree Kelvin
- y) Newtons per Coulomb
- z) ergs

ANSWER: X -- JOULES PER DEGREE KELVIN

PHYS-91; Multiple Choice: The amount of heat required to change a boiling liquid to a gas at the same temperature depends on one of the following properties of the liquid. Does it depend on the liquid's:

- w) heat of fusion
- x) heat of vaporization
- y) temperature
- z) density

ANSWER: X -- HEAT OF VAPORIZATION

PHYS-91; Multiple Choice: According to the second law of thermodynamics, energy tends to become more and more unavailable for conversion from:

- w) thermal to kinetic energy
- x) kinetic to thermal energy
- y) thermal to mechanical energy
- z) mechanical to thermal energy

ANSWER: Y -- THERMAL TO MECHANICAL ENERGY

PHYS-91; Multiple Choice: When a charge moves through an electric circuit in the direction of an electric force it does one of the following four things. Does it:

- w) lose potential energy and gain kinetic energy
- x) gain potential energy and lose kinetic energy
- y) lose both potential and kinetic energy
- z) gain both potential and kinetic energy

ANSWER: W -- LOSE POTENTIAL ENERGY AND GAIN KINETIC ENERGY



## *Science Bowl*

## PHYSICS

HYS-91; Multiple Choice: Which one of the following is the name of a device used to measure voltage without drawing ANY current from the circuit being measured? Is it:

- w) a wattmeter
- x) a galvanometer
- y) an ammeter
- z) a potentiometer

ANSWER: Z -- A POTENTIOMETER

PHYS-91; Multiple Choice: Lenz's law is an example of the law of conservation of one of the following. Is it conservation of:

- w) mass
- x) charge
- y) momentum
- z) energy

ANSWER: Z -- ENERGY

PHYS-91; Multiple Choice: After a projectile is fired horizontally near the earth's surface, the horizontal component of its velocity, neglecting any air resistance:

- w) increases steadily
- x) decreases steadily
- y) first decreases, then increases
- z) remains constant

ANSWER: Z -- REMAINS CONSTANT

PHYS-91; Short Answer: Two bodies are moving in circular paths of equal radii. If the speed of the first body is twice that of the second, the centripetal acceleration of the first body is how many times greater than that of the second body?

ANSWER: 4

## ***Science Bowl***

## PHYSICS

HYS-91; Multiple Choice: Two bodies of equal mass are moving in circular paths at equal speed. The first body moves in a circle whose radius is twice as great as that of the second. The ratio of the centripetal or radial acceleration of the first body to that of the second is:

- w) 1 to 4
- x) 1 to 3
- y) 1 to 2
- z) 1 to 1

ANSWER: Y -- 1 TO 2

PHYS-91; Multiple Choice: A force applied to a rocket gives it an upward acceleration equal to 2 times the acceleration of gravity. The magnitude of the force is equal to:

- w) the weight of the rocket
- x) twice the weight of the rocket
- y) three times the weight of the rocket
- z) four times the weight of the rocket

ANSWER: Y -- THREE TIMES THE WEIGHT OF THE ROCKET

PHYS-91; Multiple Choice: A satellite is observed to move in a circle about the earth at a constant speed. This means that the force acting upon it is:

- w) zero
- x) parallel to the direction of the satellite's instantaneous velocity
- y) perpendicular to the direction of the satellite's instantaneous velocity
- z) none of the above

ANSWER: Y -- PERPENDICULAR TO THE INSTANTANEOUS DIRECTION OF THE SATELLITE'S VELOCITY

PHYS-91; Multiple Choice: When a person stands on a scale in an elevator at rest, the scale reads 800 newtons. When the elevator is allowed to fall freely with acceleration of gravity, the scale reads one of the following. Does the scale read:

- w) 1600 newtons
- x) 800 newtons
- y) 400 newtons
- z) 0 newtons

ANSWER: Z -- 0 NEWTONS

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: A 10,000-watt motor operates an elevator weighing 5000 newtons. Assuming no frictional losses, how high is the elevator raised in 10 seconds. Is it raised:

- w) 2 meters
- x) 20 meters
- y) 50 meters
- z) 100 meters

ANSWER: X -- 20 METERS

PHYS-91; Multiple Choice: A machine's output is 4000 joules and its frictional losses are 1000 joules. Which of the following is its efficiency? Is it:

- w) 25%
- x) 30%
- y) 75%
- z) 80%

ANSWER: Z -- 80%

PHYS-91; Multiple Choice: A machine having an efficiency of 50% does 500 joules of work. Which of the following is the work input? Is it:

- w) 500 joules
- x) 250 joules
- y) 1000 joules
- z) 2500 joules

ANSWER: Y -- 1000 JOULES

PHYS-91; Multiple Choice: The relationship between kinetic energy and the potential energy of a swinging pendulum bob is one of the following. Is it:

- w) kinetic energy is greater than potential energy
- x) kinetic energy is less than potential energy
- y) kinetic energy is equal to potential energy
- z) kinetic energy plus potential energy equals a constant

ANSWER: Z -- KINETIC ENERGY PLUS POTENTIAL ENERGY EQUALS A CONSTANT

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: A 10 kilogram ball falls from a height of 5 meters and rebounds from the floor to a height of 3 meters. The energy lost by the ball is:

- w) 20 joules
- x) 98 joules
- y) 196 joules
- z) 294 joules

ANSWER: Y -- 196 JOULES

PHYS-91; Short Answer: What is the Celsius temperature corresponding to 100 degrees Kelvin?

ANSWER: -173 DEGREES CELSIUS

PHYS-91; Multiple Choice: A rise in temperature of 20 Kelvin degrees is equal to a rise of:

- w) 20 degrees Celsius
- x) 36 degrees Celsius
- y) 68 degrees Celsius
- z) 293 degrees Celsius

ANSWER: W -- 20 DEGREES CELSIUS

PHYS-91; Multiple Choice: A kilocalorie is equal to one of the following. Is it equal to:

- w) 4.2 Joules
- x) 1000 Joules
- y) 4200 Joules
- z) 10,000 Joules

ANSWER: Y -- 4200 JOULES

PHYS-91; Multiple Choice: An increase in the motion of the molecules of a gas confined in a steel tank will be observed in one of the following ways. Will it be observed as an increase in:

- w) the temperature of the gas only
- x) the pressure of the gas only
- y) both the temperature and pressure of the gas
- z) the temperature of the gas and a decrease in its pressure

ANSWER: Y -- BOTH THE TEMPERATURE AND PRESSURE OF THE GAS

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: According to the kinetic theory, the Kelvin temperature of an ideal gas is proportional to which one of the following. Is the temperature proportional to the gas's average molecular:

- w) velocity
- x) momentum
- y) kinetic energy
- z) potential energy

ANSWER: Y -- KINETIC ENERGY

PHYS-91; Multiple Choice: Under which of the following conditions does the behavior of a real gas resemble that of an ideal gas? Is it:

- w) under all conditions of temperature and pressure
- x) only at very high pressure
- y) only when the gas is near condensation
- z) only at low densities when the molecules are relatively far apart

ANSWER: Z -- ONLY AT LOW DENSITIES WHEN THE MOLECULES ARE RELATIVELY FAR APART

PHYS-91; Multiple Choice: Two waves of equal wavelength will interfere destructively most effectively under one of the following conditions. Will the interference be most effective when the waves are:

- w) in phase and have equal amplitudes
- x) in phase and have unequal amplitudes
- y) 180 degrees out of phase and have equal amplitudes
- z) 180 degrees out of phase and have unequal amplitudes

ANSWER: Y -- 180 DEGREES OUT OF PHASE AND HAVE EQUAL AMPLITUDES

PHYS-91; Multiple Choice: As the temperature of the air increases from 0 degrees C to 20 degrees C, the wavelength of a sound made by a tuning fork of fixed frequency does which of the following? Does the wavelength

- w) increase
- x) decrease
- y) remain the same
- z) increase up to a maximum, then remain constant

ANSWER: W -- INCREASE

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: The ENERGY associated with a photon depends upon the photon's:

- w) velocity
- x) frequency
- y) amplitude
- z) the brightness of the source from which it comes

ANSWER: X -- FREQUENCY

PHYS-91; Multiple Choice: When a beam of ordinary white light is passed through a Polaroid plate filter, the intensity of the beam that emerges is:

- w) equal to that of the incident beam
- x) about 0.9 that of the incident beam
- y) about one-half that of the incident beam
- z) practically zero

ANSWER: Y -- ABOUT ONE-HALF THAT OF THE INCIDENT BEAM

PHYS-91; Short Answer: Arrange the following group of colored lights in the order of INCREASING wavelength:

RED, ORANGE, GREEN, BLUE

ANSWER: BLUE, GREEN, ORANGE, RED

PHYS-91; Multiple Choice: A thin double-concave lens produces images which are:

- w) larger than the object
- x) smaller than the object
- y) the same size as the object
- z) one cannot tell from this information

ANSWER: X -- SMALLER THAN THE OBJECT

PHYS-91; Multiple Choice: When white light is passed through a double slit which of the following statements is TRUE:

- w) Each of the bright bands is dispersed into a spectrum
- x) Only the central band is dispersed into a spectrum
- y) All the bright bands except the central one are dispersed into a spectrum
- z) Each band has a single color different from its neighboring bands

ANSWER: Y -- ALL THE BRIGHT BANDS EXCEPT THE CENTRAL ONE ARE DISPERSED INTO THE SPECTRUM

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: A beam of white light is passed through a diffraction grating and the resulting spectrum is allowed to fall on a screen. Which one of the following is the color of light that undergoes the greatest deviation from its original direction. Is it:

- w) red
- x) yellow
- y) blue
- z) violet

ANSWER: W -- RED

PHYS-91; Multiple Choice: Which of the following are the parts of a DC generator that convert the AC in the armature to DC in the external circuit. Are these parts the:

- w) field poles
- x) slip rings and the brushes
- y) commutator and the brushes
- z) armature and the core

ANSWER: Y -- COMMUTATOR AND THE BRUSHES

PHYS-91; Multiple Choice: A P-type semiconductor is doped to produce one of the following. Will it produce:

- w) both holes and electrons
- x) positive electrons
- y) negative electrons
- z) holes

ANSWER: Z -- HOLES

PHYS-91; Multiple Choice: When an atomic nucleus emits a beta particle, one of its neutrons disintegrates into one of the following set of particles. Does it disintegrate into:

- w) a positron and an electron
- x) a proton, an electron, and an antineutrino
- y) a proton, an electron, and a positron
- z) a neutrino and an antineutrino

ANSWER: X -- A PROTON, AN ELECTRON AND AN ANTINEUTRINO

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: One of the following is a device that detects charged particles but does NOT show their tracks. Is this device the:

- w) spark chamber
- x) photographic plate
- y) scintillation counter
- z) bubble chamber

ANSWER: Y -- SCINTILLATION COUNTER

PHYS-91; Multiple Choice: The photomultiplier tube in the scintillation counter multiplies one of the following. Does it multiply:

- w) scintillations
- x) electrons
- y) ions
- z) photons

ANSWER: X -- ELECTRONS

PHYS-91; Multiple Choice: The emission of a positron from a radioactive atom is generally accompanied by the emission of one of the following. Is it accompanied by the emission of:

- w) a meson
- x) a baryon
- y) an antineutrino
- z) a neutrino

ANSWER: Z -- A NEUTRINO

PHYS-91; Short Answer: What term refers to the heat needed to change a unit mass of a substance at its melting temperature from a solid into a liquid?

ANSWER: HEAT OF FUSION or LATENT HEAT OF FUSION or ENTHALPY OF FUSION



## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: The gravitational constant for the universe was measured by which of the following?

- w) Kepler
- x) Einstein
- y) Newton
- z) Cavendish

ANSWER: Z -- CAVENDISH

PHYS-91; Multiple Choice: If you start with 24 grams of a radioactive element with a half-life of one month, how many grams of the radioactive element will be left after 2 months?

- w) 1.5 grams
- x) 3 grams
- y) 6 grams
- z) 12 grams

ANSWER: Y -- 6 GRAMS

PHYS-91; Multiple Choice: How many colors of quarks are believed to exist? Is it:

- w) 1
- x) 3
- y) 5
- z) 7

ANSWER: X -- 3

PHYS-91; Short Answer: A train is traveling 20 kilometers per hour. It is .5 kilometers behind you. You want to beat the train to a crossing that is .5 kilometers away. How fast must you run?

ANSWER: 10 KILOMETERS PER HOUR

PHYS-91; Multiple Choice: A child weighing 50 Newtons is on a swing. He goes from a minimum height of 0.2 meters to a maximum height of 1.5 meters. His maximum speed is closest to:

- w) 3 meters per second
- x) 5 meters per second
- y) 7 meters per second
- z) 9 meters per second

ANSWER: X -- 5 METERS PER SECOND

## Science Bowl

## PHYSICS

PHYS-91; Multiple Choice: A train locomotive whose mass is  $1 \times 10^6$  kilograms is traveling EAST at a speed of 100 kilometers per hour. A NORTHERLY wind is applying a force of 100 Newtons on the locomotive. How much work is the wind doing on the locomotive for each 10 meters it travels?

- w) 0 joules
- x) 1,000 joules
- y) 10,000 joules
- z) 100,000 joules

ANSWER: W -- 0 JOULES

PHYS-91; Multiple Choice: The density of seawater is greater than that of fresh water. A boat will float:

- w) Higher in fresh water than in seawater
- x) Lower in fresh water than in seawater
- y) At the same level in both
- z) Any of the above, depending upon its shape

ANSWER: X -- LOWER IN FRESH WATER THAN IN SEAWATER

PHYS-91; Multiple Choice: How many times more intense is an 80 decibel sound than a 40 decibel sound?

- w) 2
- x) 40
- y) 1000
- z) 10,000

ANSWER: Z -- 10,000

PHYS-91; Short Answer: The coefficient of linear expansion of steel is  $1.2 \times 10^{-5}/\text{oC}$ . (read: 1 point 2 times 10 to the minus 5 per degree Celsius). What is the increase in length of a steel girder that is 20 meters long at 10o C when its temperature is raised to 20o C?

ANSWER: 2.4 MILLIMETERS (accept 0.0024 meters or  $2.4 \times 10^{-3}$  meters)

## Science Bowl

## PHYSICS

PHYS-91; Multiple Choice: What law describes the force between two stationary electrically charged objects?

- w) Ampere's law
- x) Coulomb's law
- y) Kirchoff's Rules (pron: kir-koff rules)
- z) Ohm's law

ANSWER: X -- COULOMB'S LAW

PHYS-91; Multiple Choice: A circuit has a resistance of 200 ohms. The resistance of the circuit can be reduced to 120 ohms by adding which of the following to the circuit.

- w) 80 ohm resistor in series
- x) 150 ohm resistor in parallel
- y) 240 ohm resistor in series
- z) 300 ohm resistor in parallel

ANSWER: Z -- 300 OHM RESISTOR IN PARALLEL

PHYS-91; Multiple Choice: A spring with a force constant  $k$  is cut into thirds. The force constant of each of the new springs is

- w)  $k$
- x)  $3k$
- y)  $(1/3)k$  (read: one third  $k$ )
- z)  $9k$

ANSWER: X --  $3k$

PHYS-91; Multiple Choice: When a 2 kilogram mass is suspended from a spring, the spring stretches 4 cm. The force constant of the spring is approximately:+

- w) .5 newtons per meter
- x) 5 newtons per meter
- y) 50 newtons per meter
- z) 500 newtons per meter

ANSWER: Z -- 500 NEWTONS PER METER

PHYS-91; Short Answer: If a three farad capacitor and a six farad capacitor are connected in parallel, what is their equivalent capacitance?

ANSWER: 9 FARADS

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: Which of the following sets of 3 forces CANNOT have a vector sum of zero?

- w) 10, 10 and 10 Newtons
- x) 10, 10 and 20 Newtons
- y) 10, 20 and 20 Newtons
- z) 10, 20 and 40 Newtons

ANSWER: Z -- 10, 20 AND 40 NEWTONS

PHYS-91; Multiple Choice: A small cluster of stars appear, after many decades of observation, to be converging toward a common point in the sky. Does the light from these stars show a:

- w) red Doppler shift
- x) blue Doppler shift
- y) no Doppler shift

ANSWER: W -- RED DOPPLER SHIFT

PHYS-91; Short Answer: What name is given to those elementary particles for which there is a symmetry under intrapair production. Included are photons, pi mesons, and nuclei with an even number of particles.

ANSWER: BOSONS

PHYS-91; Multiple Choice: When a fast charged particle traverses a dielectric medium at a velocity exceeding the velocity of light in that medium, radiation is emitted. This radiation is known as:

- w) point radiation
- x) Cerenkov radiation
- y) Synchrotron radiation
- z) Bremsstrahlung

ANSWER: X -- CERENKOV RADIATION

## Science Bowl

## PHYSICS

PHYS-91; Multiple Choice: Which of the following statements dealing with simple harmonic motion of a mass-spring system is TRUE?

- w) The acceleration is largest when the oscillating mass is instantaneously at rest.
- x) The larger the spring force constant the larger the period.
- y) The period of the motion depends linearly on the amplitude of the motion.
- z) The acceleration is larger when the oscillating mass has its greatest velocity.

ANSWER: W -- THE ACCELERATION IS LARGEST WHEN THE OSCILLATING MASS IS INSTANTANEOUSLY AT REST

PHYS-91; Multiple Choice: An ice skater is rotating with her arms extended. When she pulls in her arms her rate of rotation increases. Which of the following statements dealing with the process is TRUE?

- w) Her moment of inertia is increased.
- x) Kinetic energy is conserved.
- y) The skater does work when pulling in her arms.
- z) Angular momentum is increased.

ANSWER: Y -- THE SKATER DOES WORK WHEN PULLING IN HER ARMS

PHYS-91; Multiple Choice: If viewed on an oscilloscope, the loudness of a sound wave would be associated with the wave's:

- w) frequency
- x) wavelength
- y) velocity
- z) amplitude

ANSWER: Z -- AMPLITUDE

PHYS-91; Multiple Choice: If a sled has a constant acceleration of 2 meters per second squared and starts from rest, the distance in meters that it will have covered after 5 seconds is:

- w) 10 meters
- x) 20 meters
- y) 25 meters
- z) 50 meters

ANSWER: Y -- 25 METERS

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: The neutrons in an atom:

- w) are part of the nuclear charge
- x) rotate about the nucleus in elliptical orbits
- y) vary in number with different isotopes
- z) are always equal in number to the total number of protons

ANSWER: Y -- VARY IN NUMBER WITH DIFFERENT ISOTOPES

PHYS-91; Multiple Choice: Which of the following phenomena suggest that light may be a transverse wave?

- w) reflection
- x) polarization
- y) photoelectric effect
- z) diffraction

ANSWER: X -- POLARIZATION

PHYS-91; Multiple Choice: In simple harmonic motion, the acceleration is:

- w) constant
- x) proportional to the distance from the central position
- y) greatest when the velocity is greatest
- z) none of the above

ANSWER: X -- PROPORTIONAL TO THE DISTANCE FROM THE CENTRAL POSITION

PHYS-91; Multiple Choice: When a liquid moves through a pipe having a varying diameter, the pressure against the inside walls of the pipe will be:

- w) the same throughout
- x) lowest where the diameter is smallest
- y) lowest where the diameter is largest
- z) lowest where the velocity of flow is lowest

ANSWER: X -- LOWEST WHERE THE DIAMETER IS SMALLEST

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: The gravitational potential energy of an object close to the ground varies:

- w) inversely as its distance from the ground
- x) directly as its distance from the ground
- y) inversely as the square of its distance from the ground
- z) directly as the square of its distance from the ground

ANSWER: X -- DIRECTLY AS ITS DISTANCE FROM THE GROUND

PHYS-91; Multiple Choice: When the image formed by a convex mirror is compared to its object, the image is usually:

- w) erect and smaller
- x) inverted and imaginary
- y) real and inverted
- z) real and erect

ANSWER: W -- ERECT AND SMALLER

PHYS-91; Short Answer: In optics, when the vibrations of light are limited to a single two dimensional plane, it is said that light has been what?

ANSWER: POLARIZED

PHYS-91; Multiple Choice: One nanometer is equal to:

- w)  $10^{-12}$  meters
- x)  $10^{-11}$  meters
- y)  $10^{-3}$  meters
- z)  $10^{-9}$  meters

ANSWER: Z --  $10^{-9}$  METERS

PHYS-91; Multiple Choice: In radioactive decay, the emission of an electron is characteristic of:

- w) Alpha decay
- x) Beta decay
- y) Gamma decay
- z) X-rays

ANSWER: X -- BETA DECAY

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: Energy is described as the capacity for:

- w) reactivity
- x) combustion
- y) transformation
- z) doing work

ANSWER: Z -- DOING WORK

PHYS-91; Multiple Choice: Kinetic energy is energy of:

- w) position
- x) radiation
- y) motion
- z) formation

ANSWER: Y -- MOTION

PHYS-91; Multiple Choice: The kinetic energy of a stone falling near the earth's surface through a vacuum increases with the:

- w) square root of its velocity
- x) cube root of its velocity
- y) square of its velocity
- z) cube of its velocity

ANSWER: Y -- SQUARE OF ITS VELOCITY

PHYS-91; Short Answer: What is the mass of a 60 kilogram astronaut in space, far from any planets?

ANSWER: 60 KILOGRAMS

PHYS-91; Short Answer: What is the weight of a 150 pound astronaut in space, far from any planets?

ANSWER: 0 POUNDS

PHYS-91; Short Answer: In what type of reference frame does Newton's law NOT hold true?

ANSWER: NONINERTIAL FRAMES



## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: Which of the following does NOT travel in a vacuum?

- w) radio waves
- x) gamma rays
- y) magnetic waves
- z) sound waves

ANSWER: Z -- SOUND WAVES

PHYS-91; Short Answer: What is the amplitude of a standing wave at its node?

ANSWER: 0

PHYS-91; Multiple Choice: An incident ray comes in parallel to the principle axis of a concave mirror. Is it reflected:

- w) back along the incident ray
- x) at 30 degrees to incident ray
- y) through the focal point
- z) through the center of curvature

ANSWER: Y -- THROUGH THE FOCAL POINT

PHYS-91; Short Answer: For small oscillations, what happens to the period of a simple pendulum when the mass of the pendulum bob is doubled?

ANSWER: NOTHING or PERIOD IS UNAFFECTED

PHYS-91; Short Answer: Why must soldiers break cadence when crossing a bridge?

ANSWER: SO THEY DON'T EXCITE A VIBRATIONAL RESONANCE IN THE BRIDGE.

PHYS-91; Short Answer: Who named the two kinds of electrical charges "positive" and "negative"?

ANSWER: BENJAMIN FRANKLIN

PHYS-91; Short Answer: What SI prefix is used to represent  $10^{-18}$ ?

ANSWER: ATTO

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: When a slingshot exerts a 10 Newton force on a rock, the rock accelerates at 50 meters per second squared. What force is required to accelerate the rock to 150 meters per second squared?

ANSWER: 30 NEWTONS

PHYS-91; Short Answer: How are work and power related?

ANSWER: POWER IS THE AMOUNT OF WORK PER UNIT TIME

PHYS-91; Short Answer: Heat transfer by mixing is more commonly known as what?

ANSWER: CONVECTION

PHYS-91; Short Answer: Sound waves are an example of what type of wave?

ANSWER: COMPRESSIONAL or LONGITUDINAL

PHYS-91; Short Answer: In physics, how is intensity defined?

ANSWER: POWER PER UNIT AREA

PHYS-91; Short Answer: What is the SI unit of inductance?

ANSWER: HENRY

PHYS-91; Short Answer: What is the SI unit of magnetic flux?

ANSWER: WEBER

PHYS-91; Short Answer: Who invented the electric battery?

ANSWER: (ALLESANDRO) VOLTA

PHYS-91; Short Answer: What is the resistance of an ideal voltmeter?

ANSWER: INFINITE RESISTANCE

PHYS-91; Short Answer: What is the resistance of an ideal ammeter?

ANSWER: ZERO

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: A hollow METALLIC sphere has an inner radius A and an outer radius B. If charge is placed on the inner surface, that is at radius A, where is the charge located after it has come to rest?

ANSWER: ON THE SPHERE'S OUTER SURFACE or OUTSIDE RADIUS B

PHYS-91; Multiple Choice: Two parallel wires carrying currents in opposite directions will:

- w) attract each other
- x) repel each other
- y) cause an electric arc to form
- z) not affect each other

ANSWER: X -- REPEL EACH OTHER

PHYS-91; Short Answer: In an electromagnetic wave, the ratio of the magnitudes of the electric field to the magnet field is equal to what?

ANSWER: THE SPEED OF LIGHT or C

PHYS-91; Short Answer: Suppose the power of a prescription lens is 4 diopters. What is the focal length of the lens?

ANSWER: = 25 CENTIMETERS

PHYS-91; Multiple Choice: Assuming all other parameters remain constant, what happens to the pressure of a gas when the volume of the gas is increased?

- w) increases
- x) decreases
- y) fluctuates sinusoidally
- z) remains the same

ANSWER: X -- DECREASES

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: If a metallic object is heated, its density generally:

- w) increases
- x) decreases
- y) fluctuates randomly
- z) remains the same

ANSWER: X -- DECREASES

PHYS-91; Multiple Choice: Which wave has the highest frequency?

- w) microwaves
- x) infrared waves
- y) ultraviolet waves
- z) radio waves

ANSWER: Y -- ULTRAVIOLET WAVES

PHYS-91; Multiple Choice: The characteristic that distinguishes a laser beam from an ordinary light beam is:

- w) the greater frequency of the laser beam
- x) the coherence of the laser beam
- y) the color of the laser beam
- z) the greater polarization of the laser beam

ANSWER: X -- THE COHERENCE OF THE LASER BEAM

PHYS-91; Multiple Choice: The mass spectrograph directly yields a value for which one of the following?

- w) mass of a photon
- x) mass of a neutron
- y) masses of isotopes of elements
- z) mass to charge ratio of ions

ANSWER: Z -- MASS TO CHARGE RATIO OF IONS

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: An alpha particle colliding with an electron loses:

- w) none of its energy
- x) little of its energy
- y) half of its energy
- z) all of its energy

ANSWER: X -- LITTLE OF ITS ENERGY

PHYS-91; Multiple Choice: The term "laminar flow" is most often associated with the description of:

- w) conduction of sound by waves
- x) current flow in transistors
- y) effects of viscosity of liquids
- z) passage of light rays through a liquid

ANSWER: Y -- EFFECTS OF VISCOSITY OF LIQUIDS

PHYS-91; Multiple Choice: Two point masses, M1 and M2, are 14 centimeters apart. M1 has a mass of 2 grams. M2 has a mass of 5 grams. Locate the center-of-mass of this system.

- w) 4 cm from M1
- x) 4 cm from M2
- y) 5 cm from M2
- z) 7 cm from M1

ANSWER: X -- 4 CM FROM M2

PHYS-91; Multiple Choice: The mass, in kilograms, of an object whose weight on earth at sea level is 490 newtons is:

- w) 50 kilograms
- x) 100 kilograms
- y) 225 kilograms
- z) 1,100 kilograms

ANSWER: W -- 50 KILOGRAMS

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: When the velocity of an object is tripled, another quantity which is tripled at the same time is the object's:

- w) momentum
- x) potential energy
- y) kinetic energy
- z) mass

ANSWER: W -- MOMENTUM

PHYS-91; Multiple Choice: What is the only non-metal element that is a liquid at room temperature and one atmosphere?

- w) bromine
- x) argon
- y) silicon
- z) selenium

ANSWER: W -- BROMINE

PHYS-91; Multiple Choice: Which of the following is NOT a noble gas?

- w) radon
- x) xenon (pron: zee-non)
- y) astatine (pron: as-tah-teen)
- z) krypton

ANSWER: Y -- ASTATINE

PHYS-91; Multiple Choice: What is the SI unit of pressure?

- w) Pascal
- x) Torr
- y) Dyne
- z) Kelvin

ANSWER: W -- PASCAL

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: What is 20 degrees Celsius in degrees Kelvin?

- w) 70 degrees
- x) 293 degees
- y) 100 degrees
- z) 212 degrees

ANSWER: X -- 293 DEGREES

PHYS-91; Multiple Choice: What is the value given to standard pressure in Torrs?

- w) 540
- x) 660
- y) 760
- z) 780

ANSWER: Y -- 760

PHYS-91; Multiple Choice: Who invented the barometer?

- w) Torricelli
- x) Avogadro
- y) Rutherford
- z) Becquerel

ANSWER: W -- TORRICELLI

PHYS-91; Multiple Choice: The random motion of particles suspended in a fluid is called:

- w) Boson Condensation
- x) Fermi Motion
- y) Brownian Motion
- z) Pauli Motion

ANSWER: Y -- BROWNIAN MOTION

PHYS-91; Multiple Choice: The most efficient heat engine that can operate between two temperature reservoirs T1 and T2 is:

- w) jet engine
- x) internal combustion engine
- y) Carnot engine (pron: car-no)
- z) steam engine

ANSWER: Y -- CARNOT ENGINE

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: The formation of pockets of gas in a liquid is called:

- w) absorption
- x) cavitation
- y) adsorption
- z) dissolving

ANSWER: X -- CAVITATION

PHYS-91; Multiple Choice: In the Compton effect, a photon of wavelength  $\lambda$  (read: lambda) collides with a stationary electron. The wavelength of the emitted photon is:

- w) longer than  $\lambda$
- x) shorter than  $\lambda$
- y) the same as  $\lambda$
- z) no photon is emitted

ANSWER: W -- LONGER THAN  $\lambda$

PHYS-91; Multiple Choice: The change of a gas to a liquid is called:

- w) vaporization
- x) sublimation
- y) condensation
- z) freezing

ANSWER: Y -- CONDENSATION

PHYS-91; Multiple Choice: A semiconductor device made up of a single p-n Junction is called a:

- w) transistor
- x) diode
- y) Fet
- z) integrated circuit

ANSWER: X -- DIODE

PHYS-91; Multiple Choice: The law that relates the electric field at the surface of a region to the amount of charge inside the region is called:

- w) Coulomb's Law
- x) Faraday's Law
- y) Gauss' Law
- z) Biot-Savart Law

ANSWER: Y -- GAUSS' LAW



## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: The four underlying equations in electromagnetic theory are called:

- w) Einstein's Equations
- x) Maxwell's Equations
- y) Newton's Equations
- z) Faraday's Law

ANSWER: X -- MAXWELL'S EQUATIONS

PHYS-91; Multiple Choice: The splitting of an atomic nucleus is called:

- w) fission
- x) fusion
- y) cleavage
- z) separation

ANSWER: W -- FISSION

PHYS-91; Multiple Choice: In an electromagnetic wave, what is the relative orientation of the magnetic and electric fields?

- w) 180 degrees
- x) 90 degrees
- y) 45 degrees
- z) 22.5 degrees

ANSWER: X -- 90 DEGREES

PHYS-91; Short Answer: In an electromagnetic wave, the E and B fields are both perpendicular to what?

ANSWER: THE DIRECTION OF THE WAVE or DIRECTION OF WAVE PROPAGATION

PHYS-91; Multiple Choice: When light is reflected from a surface, the angle of incidence is:

- w) 30 degrees
- x) equal to the angle of reflection
- y) 90 degrees
- z) 180 degrees

ANSWER: X -- EQUAL TO THE ANGLE OF REFLECTION

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: According to standard convention, the angles of incidence and reflection for a plane surface are measured from:

- w) the reflecting surface
- x) lines at 45 degrees to the reflecting surface
- y) a line at 90 degrees to the reflecting surface
- z) there is no standard

ANSWER: Y -- A LINE AT 90 DEGREES TO THE REFLECTING SURFACE

PHYS-91; Multiple Choice: A real image always appears:

- w) larger than object
- x) inverted
- y) erect
- z) same size as object

ANSWER: X -- INVERTED

PHYS-91; Multiple Choice: When light enters an optically denser medium, the light ray:

- w) bends away from a normal to surface
- x) passes through unbent
- y) bends towards a normal to surface
- z) none of the above

ANSWER: Y -- BENDS TOWARDS A NORMAL TO SURFACE

PHYS-91; Multiple Choice: The speed of light in vacuum "C" divided by the Index of Refraction "N" gives the:

- w) frequency of the light
- x) speed of the light in the medium
- y) energy of the light
- z) wavelength of the light

ANSWER: X -- SPEED OF THE LIGHT IN THE MEDIUM

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: In order for fiber optics to work, the incident light inside the fiber must hit the wall of the fiber at:

- w) 90 degrees
- x) 45 degrees
- y) an angle greater than the critical angle
- z) none of the above

ANSWER: Y -- AN ANGLE GREATER THAN THE CRITICAL ANGLE

PHYS-91; Multiple Choice: When light is traveling through a vacuum, what is the product of the light's wavelength and frequency equal to?

- w) speed of light
- x) Plank's constant
- y) momentum
- z) wave number

ANSWER: W -- SPEED OF LIGHT

PHYS-91; Multiple Choice: The inverse of wavelength is referred to as:

- w) wave number
- x) frequency
- y) velocity
- z) momentum

ANSWER: W -- WAVE NUMBER

PHYS-91; Multiple Choice: The GeV is a unit of:

- w) momentum
- x) energy
- y) velocity
- z) time

ANSWER: X -- ENERGY

PHYS-91; Multiple Choice: In AC Circuit Theory, the term that replaces the resistance is:

- w) inductance
- x) capacitance
- y) impedance
- z) reactance

ANSWER: Y -- IMPEDANCE

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: The anti-particle to an electron is:

- w) proton
- x) positron
- y) neutron
- z) anti-proton

ANSWER: X -- POSITRON

PHYS-91; Multiple Choice: The gravitational potential energy between two bodies is inversely proportional to:

- w) the cube of the distance
- x) the first power of the distance
- y) the square of the distance
- z) it has no relation to distance

ANSWER: X -- THE FIRST POWER OF THE DISTANCE

PHYS-91; Multiple Choice: An object is projected vertically upward near the surface of the earth. At the very top of its path, the object's velocity is zero, and its acceleration is:

- w) 0
- x) 9.8 meters per second squared DOWNWARD
- y) 9.8 meters per second squared UPWARD
- z) depends on the mass of the object

ANSWER: X -- 9.8 METERS PER SECOND SQUARED DOWNWARD

PHYS-91; Multiple Choice: Of the following choices, approximately how many times greater is the mass of a proton than the mass of an electron?

- w) 200
- x) 2000
- y) 20,000
- z) 200,000

ANSWER: X -- 2000

PHYS-91; Short Answer: How many quarks make up a neutron?

ANSWER: 3

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: A twin goes on a high speed space journey (near the speed of light) and returns to meet his twin who stayed on earth. At their meeting the traveling twin has:

- w) aged more than the earthbound twin
- x) aged less than the earthbound twin
- y) aged the same as the earthbound twin

ANSWER: X -- AGED LESS THAN THE EARTHBOUND TWIN

PHYS-91; Multiple Choice: Which of the following forces is nonconservative?

- w) gravitational force
- x) electrostatic force
- y) sliding frictional force
- z) restorative force of a spring

ANSWER: Y -- SLIDING FRICTIONAL FORCE

PHYS-91; Short Answer: What is the potential energy of a 10 kilogram cube 500 meters above the ground?

ANSWER: 49,000 JOULES (accept 50,000 joules, uses  $g = 10\text{m/s}^2$ )

PHYS-91; Short Answer: A 2 kilogram mass accelerates at 5 meters per second squared for 3 seconds. What impulse has acted on the mass?

ANSWER: 30 NEWTON-SECONDS or 30 KILOGRAM-METERS PER SECOND

PHYS-91; Short Answer: The driveshaft of a car rotates at 450 radians per second with a torque of 150 Newton-meters. How much power is produced?

ANSWER: 67,500 WATTS

PHYS-91; Short Answer: What is the initial velocity of an object if it is moving 10 meters per second after 2 seconds with a constant acceleration of 4 meters per second squared?

ANSWER: 2 METERS PER SECOND

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: If an object is in a state of equilibrium, what can be said about all of the forces acting on the object?

ANSWER: THE SUM OF ALL FORCES ACTING ON THE OBJECT IS ZERO

PHYS-91; Short Answer: The pressure placed on a square with 1/2 meter sides is 1000 Pascals. How much force is being applied to the square?

ANSWER: 250 NEWTONS

PHYS-91; Short Answer: What is the ratio of a substance's density to the density of water called?

ANSWER: SPECIFIC GRAVITY (also accept relative density)

PHYS-91; Multiple Choice: Which of the following is NOT closely associated with a non-magnetic Phase Diagram?

- w) Eutectic Temperature (pron: you-tek-tik)
- x) Curie Point
- y) Solidus
- z) Liquidus Curves

ANSWER: X -- CURIE POINT

PHYS-91; Multiple Choice: A bimetallic strip commonly found in home furnace thermostats works because of the difference in this property of the two metals. Is it:

- w) thermal shock
- x) thermal conductivity
- y) thermal expansion
- z) thermal diffusivity

ANSWER: Y -- THERMAL EXPANSION

PHYS-91; Multiple Choice: Which of the following physical properties is TRUE of most dense ceramic materials?

- w) high tensile strength
- x) good ductility
- y) high compressive strength
- z) high electrical conductivity

ANSWER: Y -- HIGH COMPRESSIVE STRENGTH

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: The Modulus of Elasticity for a material refers to:

- w) the ability of a material to resist corrosion
- x) the ratio of stress over strain
- y) the maximum load over the cross sectional area
- z) none of the above

**ANSWER: X -- THE RATIO OF STRESS OVER STRAIN**

PHYS-91; Multiple Choice: The rest mass of an electron is closest to:

- w) 10-15 kilograms
- x) 10-17 kilograms
- y) 10-30 kilograms
- z) 10-50 kilograms

**ANSWER: Y -- 10-30 KILOGRAMS (accept  $9.11 \times 10^{-31}\text{kg}$ )**

PHYS-91; Short Answer: Carbon-14 dating is based on the decay of  $^{14}\text{C}$  to  $^{14}\text{N}$ . What type of radioactive decay is associated with this nuclear reaction?

**ANSWER: b-RAY or b DECAAY or ELECTRON EMISSION**

PHYS-91; Short Answer: Normal sunlight is non-polarized. Why are polarized sunglasses worn?

**ANSWER: REFLECTED LIGHT FROM SMOOTH SURFACES IS POLARIZED**

PHYS-91; Short Answer: Many common household fluids, such as margarine, undergo a decrease in viscosity when subjected to a shearing force. What is this property called?

**ANSWER: THIXOTROPIC (pron: thik-sa-trop-ick)**

PHYS-91; Short Answer: How much energy is consumed if a 100 watt light bulb is operated for 10 MINUTES?

**ANSWER: 60,000 JOULES or 60kJ or  $6 \times 10^4\text{J}$**

PHYS-91; Short Answer: If the energy reaching your eyeball at 10 meters from a small light bulb is expressed as x, express the energy which would reach your eyeball at 20 meters?

**ANSWER:  $(1/4)x$**

## ***Science Bowl***

## PHYSICS

PHYS-91; Short Answer: How much current does a 1500 Watt heater draw if supplied with a 120 Volt source?

ANSWER: 12.5 AMPS

PHYS-91; Short Answer: The area of thermodynamics concerned with the measuring of thermal properties is called what?

ANSWER: CALORIMETRY

PHYS-91; Short Answer: The temperature and pressure at which a substance can exist in all three phases of matter simultaneously is called what?

ANSWER: TRIPLE POINT

PHYS-91; Multiple Choice: Refracting telescopes, if uncorrected, suffer from chromatic aberration. Chromatic aberration occurs because:

- w) red light is focused more strongly than blue light
- x) blue light is focused more strongly than red light
- y) the outer light rays are focused more strongly than the central rays,
- z) the central light rays are focused more strongly than the outer rays.

ANSWER: X -- BLUE LIGHT IS FOCUSED MORE STRONGLY THAN RED LIGHT

PHYS-91; Multiple Choice: Which of the following scientific instruments has the greatest resolving power?

- w) electron microscope
- x) light microscope
- y) phase-contrast microscope
- z) centrifuge

ANSWER: W -- ELECTRON MICROSCOPE

PHYS-91; Multiple Choice: One curie is equal to:

- w) the square root of the binding energy
- x) the energy of an alpha-particle
- y)  $3.7 \times 10^{10}$  disintegrations per second
- z)  $mc^2$

ANSWER: Y --  $3.7 \times 10^{10}$  DISINTEGRATIONS PER SECOND



## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: Isotopes of an element have different numbers of:

- w) electrons
- x) protons
- y) neutrons
- z) leptons

ANSWER: Y -- NEUTRONS

PHYS-91; Multiple Choice: Which one of the following particles travels at the speed of light?

- w) neutrons
- x) electrons
- y) photons
- z) muons

ANSWER: Y -- PHOTONS

PHYS-91; Multiple Choice: Heat is transferred from the sun to the earth primarily by:

- w) conduction
- x) convection
- y) radiation
- z) condensation

ANSWER: Y -- RADIATION

PHYS-91; Multiple Choice: A block of wood initially at rest slides down an inclined plane. Neglecting friction, the kinetic energy of the block at the bottom of the plane is:

- w) all converted into heat
- x) equal to its potential energy (with respect to the bottom of the plane) when it was at the top of the plane
- y) less than its kinetic energy at the top of the plane
- z) dependant on the materials of which the block is made

ANSWER: X -- EQUAL TO ITS POTENTIAL ENERGY (WITH RESPECT TO THE BOTTOM OF PLANE) WHEN IT WAS AT THE TOP OF THE PLANE.

## ***Science Bowl***

## **PHYSICS**

PHYS-91; Multiple Choice: When an atom undergoes beta decay, the atomic number of the nucleus:

- w) is unchanged
- x) increases by one
- y) decreases by one
- z) none of the above

ANSWER: X -- INCREASES BY ONE

PHYS-91; Short Answer: Name any three of the six quarks.

ANSWER: UP, DOWN, CHARM, STRANGE, TOP (or truth), BOTTOM (or beauty)

PHYS-91; Short Answer: There are four fundamental forces in nature. A particle has been associated with each of these four forces. Name any TWO of these particles.

ANSWER: GRAVITON (for gravity), PHOTON (for electromagnetiy), GLUONS for s

PHYS-91; Multiple Choice: The force on a charged particle moving parallel to magnetic field lines is:

- w) in the direction of the field
- x) zero
- y) perpendicular to the field
- z) in the opposite direction of the field

ANSWER: X -- ZERO

PHYS-91; Multiple Choice: In any collision, which of the following is conserved:

- w) kinetic energy
- x) velocity
- y) momentum
- z) potential energy

ANSWER: Y -- MOMENTUM

## ***Science Bowl***

## PHYSICS

PHYS-91; Multiple Choice: Which of the following will increase the ANGULAR MOMENTUM of a person spinning on a rotatable frictionless bar chair?

- w) moving the arms closer to the body
- x) moving the arms farther from the body
- y) moving one arm farther from the body and the other arm closer to the body with spastic repetition
- z) none of these

ANSWER: Z -- NONE OF THESE

PHYS-91; Multiple Choice: What is the relationship between the frequency and the period of a wave?

ANSWER: THEY ARE INVERSES OF EACH OTHER

PHYS-92; Multiple Choice: For the hydrogen atom, which series describes electron transitions to the  $N = 2$  orbit? Is it the:

- w) Lyman series
- x) Paschen series
- y) Balmer series
- z) Pfund series

ANSWER: Y -- BALMER SERIES

PHYS-92; Multiple Choice: The unit of mass in the English system of measure is which of the following?

- w) pound
- x) gram
- y) slug
- z) dyne

ANSWER: Y -- SLUG

PHYS-92; Short Answer: What law asserts that it makes no difference in what grouping we add vectors?

ANSWER: ASSOCIATIVE LAW OF VECTOR ADDITION

## ***Science Bowl***

## PHYSICS

PHYS-92; Short Answer: A ball is thrown vertically upwards from the ground with a speed of 80 feet/second. In the English system of units, what is the magnitude and direction of the acceleration of the ball?

ANSWER: 32 FEET PER SECOND SQUARED DOWN or TOWARDS THE EARTH

PHYS-92; Short Answer: A baseball bat strikes a ball with a force of 30 newtons. If the ball was in contact with the bat for 1/10 of a second, what impulse did the ball receive?

ANSWER: 3 NEWTON-SECONDS

PHYS-92; Multiple Choice: A pendulum which is suspended from the ceiling of a railroad car is observed to hang at an angle of 10 degrees to the left of vertical. Which of the following answers could explain this phenomena?

- w) The railroad car is at rest.
- x) The railroad car is accelerating to the left.
- y) The railroad car is moving with constant velocity to the right.
- z) The railroad car is accelerating to the right.

ANSWER: Z -- THE RAILROAD CAR IS ACCELERATING TO THE RIGHT.

PHYS-92; Short Answer: At time  $t=0$ , a body has a velocity of 5 meters per second, EASTWARD; at time  $t=2$  seconds, its velocity is 7 meters per second WESTWARD. What is the MAGNITUDE of the body's average acceleration?

ANSWER: 6 METERS PER SECOND SQUARED

PHYS-92; Short Answer: A man exerts a northward force of 100 newtons on a 50 kilogram box which sits on a level floor. If the frictional force is 80 newtons, what is the magnitude of the northward acceleration of the box?

ANSWER: 0.4 METERS PER SECOND SQUARED

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Newton's second law states that the net force acting on a body is equal to the body's time rate of change of:

- w) acceleration
- x) mass
- y) momentum
- z) inertia

ANSWER: Y -- MOMENTUM

PHYS-92; Short Answer: A girl throws a ball vertically upward, what is the MOMENTUM of the ball at its highest point?

ANSWER: ZERO

PHYS-92; Short Answer: A girl throws a 2 kilogram rock vertically upward. It reaches a maximum height of 5 meters. What is the kinetic energy of the rock the instant it leaves the girl's hand?

ANSWER: 100 JOULES (accept 98 joules)

PHYS-92; Short Answer: A spring with a force constant of 20 newtons per meter is known to obey Hooke's Law. The spring is attached to a mass of 5 kilograms and placed on a horizontal, frictionless surface. The mass is displaced 3 meters from its equilibrium position and released. What is the kinetic energy of the mass as it passes through its equilibrium position?

ANSWER: 90 JOULES

PHYS-92; Multiple Choice: The period of oscillation of a particle undergoing simple harmonic motion is:

- w) independent of the amplitude of the motion
- x) directly proportional to the frequency of oscillation
- y) independent of the frequency of oscillation
- z) none of the above

ANSWER: W -- INDEPENDENT OF THE AMPLITUDE OF THE MOTION

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: The angle between the velocity and acceleration of a body is:

- w) never 90 degrees
- x) never 180 degrees
- y) sometimes 180 degrees
- z) never 0 degrees

ANSWER: Y -- SOMETIMES 180 DEGREES

PHYS-92; Multiple Choice: In a collision, which of the following four quantities is always conserved?

- w) momentum
- x) kinetic energy
- y) torque
- z) moment of inertia

ANSWER: W -- MOMENTUM

PHYS-92; Multiple Choice: Of the following terms, which is the product of force and time? Is it:

- w) impulse
- x) power
- y) energy
- z) work

ANSWER: W -- IMPULSE

PHYS-92; Multiple Choice: In physics, a radian per second squared is a unit of:

- w) angular displacement
- x) angular velocity
- y) angular acceleration
- z) angular momentum.

ANSWER: Y -- ANGULAR ACCELERATION

PHYS-92; Short Answer: At what centigrade temperature will 1 mole of a gas under 1 atmosphere of pressure occupy 22.4 liters?

ANSWER: ZERO DEGREES CENTIGRADE

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Short Answer: A pitcher throws a baseball to his first-base man. As the ball flies through the air, assuming no air resistance, what is the shape of its trajectory?

ANSWER: PARABOLA

PHYS-92; Short Answer: Name the English physicist who discovered electromagnetic induction?

ANSWER: (MICHAEL) FARADAY

PHYS-92; Short Answer: What famous Scottish physicist died in the same year that Albert Einstein was born?

ANSWER: JAMES CLERK MAXWELL

PHYS-92; Short Answer: Who received the Nobel Prize in Physics in 1929 for his postulation of the wave nature of electrons?

ANSWER: (PRINCE LOUIS-VICTOR) De BROGLIE

PHYS-92; Short Answer: Name the three American physicists who received the Nobel Prize in 1972 for their development of a theory of superconductivity.

ANSWER: (JOHN) BARDEEN, (LEON N.) COOPER, (J. ROBERT) SCHRIEFFER

PHYS-92; Short Answer: Who first explained the billiard-ball-like collisions photons make with the free electrons in a scattering material? He received the Nobel Prize in Physics in 1927 for this work.

ANSWER: ARTHUR HOLLY COMPTON

PHYS-92; Short Answer: An electron is directly west of a proton. The force on the electron is in what direction: north, south, east, or west?

ANSWER: EAST or TOWARD THE PROTON

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: At a point halfway between two identical point charges, the electric field is equal to:

- w) zero
- x) half its maximum value
- y) its maximum value
- z) pointing away from the two charges

ANSWER: W -- ZERO

PHYS-92; Multiple Choice: Ten coulombs of positive charge are placed on an irregularly-shaped, solid piece of copper. Once the charge has stopped moving, the electric field inside the copper is:

- w) zero
- x) changes as one over the radius squared
- y) becomes smaller as you approach the center
- z) becomes larger as you approach the center

ANSWER: W -- ZERO

PHYS-92; Multiple Choice: Ten coulombs of charge are placed on a solid copper sphere. Once the charge has come to rest, the ELECTRIC POTENTIAL inside the sphere is found to be:

- w) zero
- x) uniform inside the sphere and equal to the electric potential on the surface of the sphere
- y) smaller than the electric potential outside the sphere
- z) varying as one over r squared

ANSWER: X -- UNIFORM INSIDE THE SPHERE AND EQUAL TO THE ELECTRIC POTENTIAL ON THE SURFACE OF THE SPHERE

PHYS-92; Short Answer: A current of 5 amps passes through a 10 ohm resistor. How many joules of energy will be generated by this resistor in 2 seconds?

ANSWER: 500 JOULES

PHYS-92; Short Answer: A charged particle is moving in a UNIFORM magnetic field. If the direction of motion of the charged particle is at right angles to the magnetic field, describe the shape of the charged particle's path.

ANSWER: CIRCULAR or CIRCLE



## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: Two infinitely long, parallel wires carry currents which are in opposite directions. The two wires:

- w) are attracted toward each other
- x) repel each other
- y) have no effect on each other.

ANSWER: X -- REPEL EACH OTHER

PHYS-92; Multiple Choice: Which one of the following laws best describes the operation of an electric generator?

- w) Ampere's Law
- x) Gauss' Law
- y) Ohm's Law for Conductors
- z) Faraday's Law of Induction

ANSWER: Z -- FARADAY'S LAW OF INDUCTION

PHYS-92; Short Answer: Capacitors and inductors are commonly used in circuits. Capacitors store electrical energy in the electric field between their plates. How do inductors store energy?

ANSWER: IN A MAGNETIC FIELD SURROUNDING THE INDUCTOR

PHYS-92; Multiple Choice: A wave and its reflection produce a standing wave with the distance from NODE to nearest ANTINODE of 4 meters. The wavelength of this wave is:

- w) 4 meters
- x) 8 meters
- y) 12 meters
- z) 16 meters

ANSWER: Z -- 16 METERS

PHYS-92; Multiple Choice: The wave nature of electrons was EXPERIMENTALLY verified by:

- w) Einstein
- x) Davisson and Germer
- y) Balmer
- z) Bohr.

ANSWER: X -- DAVISSON AND GERMER

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Diffraction and interference demonstrate which of the following?

- w) particle nature of light
- x) wave nature of light
- y) polarization of light
- z) refraction of light

ANSWER: X -- WAVE NATURE OF LIGHT

PHYS-92; Multiple Choice: An electromagnetic wave is ALWAYS:

- w) longitudinal
- x) polarized
- y) spherical
- z) transverse.

ANSWER: Z -- TRANSVERSE

PHYS-92; Multiple Choice: The crack of a bullwhip results from the bullwhip's tip:

- w) approaching the speed of sound
- x) exceeding the speed of sound
- y) moving with constant velocity
- z) none of the above

ANSWER: X -- EXCEEDING THE SPEED OF SOUND

PHYS-92; Multiple Choice: This planet's orbit gave proof of the superiority of Einstein's theory of gravity over Newton's:

- w) Mercury
- x) Earth
- y) Mars
- z) Pluto

ANSWER: W -- MERCURY

PHYS-92; Multiple Choice: The Weber and the Maxwell are units of measure of:

- w) conductance
- x) electrical current
- y) magnetic flux
- z) relative speed

ANSWER: Y -- MAGNETIC FLUX

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Short Answer: Who first showed that full color pictures can be formed from only two single color images?

ANSWER: JAMES H. LAND

PHYS-92; Multiple Choice: Carlos is pulling a 40 kilogram cart with a horizontal force of 100 newtons. The force of friction on the cart is 20 newtons. The acceleration of the cart is:

- w) 2 meters per second squared
- x) 2.5 meters per second squared
- y) 20 meters per second squared
- z) 200 meters per second squared

ANSWER: W -- 2 METERS PER SECOND SQUARED

PHYS-92; Multiple Choice: A car with a mass of 1000 kilogram is moving at a speed of 10 meters per second. The kinetic energy of the car is:

- w) 100 Joules
- x) 5000 Joules
- y) 10,000 Joules
- z) 50,000 Joules

ANSWER: Z -- 50,000 JOULES

PHYS-92; Multiple Choice: A 10 kilogram object falls from a cliff 100 meters high. At the midpoint of its fall its total energy is:

- w) 2450 Joules
- x) 4900 Joules
- y) 10,000 Joules
- z) 20,000 Joules

ANSWER: Y -- 10,000 JOULES

PHYS-92; Short Answer: How much time is needed for a force of 20 Newtons to change the velocity of a 5 kilogram mass by 4 meters per second?

ANSWER: 1 SECOND

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: During an INELASTIC collision, the colliding bodies

- w) lose kinetic energy
- x) keep the same amount of kinetic energy
- y) gains kinetic energy
- z) first lose, then gain kinetic energy

ANSWER: W -- LOSE KINETIC ENERGY

PHYS-92; Multiple Choice: A satellite travels at a constant speed in a circular orbit. The acceleration of the satellite is

- w) zero
- x) toward the center of the orbit
- y) away from the center of the orbit
- z) at a tangent to the orbit

ANSWER: X -- TOWARD THE CENTER OF THE ORBIT

PHYS-92; Short Answer: An 8 kilogram mass resting on a frictionless horizontal surface is attached to a spring with a force constant of 50 Newtons per meter. If the velocity of the mass through the equilibrium position is 5 meters per second, what is the mass's maximum displacement from equilibrium?

ANSWER: 2 METERS

PHYS-92; Multiple Choice: The TOTAL energy of a vertically vibrating block attached to a spring is the same:

- w) only at those points above the equilibrium position
- x) only at the equilibrium position
- y) only at those points below the equilibrium position
- z) at all points in its motion

ANSWER: Z -- AT ALL POINTS IN ITS MOTION

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: Compressional waves are

- w) transverse waves
- x) water waves
- y) longitudinal waves
- z) light waves

ANSWER: Y -- LONGITUDINAL WAVES

PHYS-92; Multiple Choice: In a charged hollow metal conductor, the charge is

- w) on the inside surface only
- x) on both the inside and outside surfaces
- y) on the outside surface only
- z) only between the inside and outside surfaces

ANSWER: Y -- ON THE OUTSIDE SURFACE ONLY

PHYS-92; Multiple Choice: Two negative point charges are 2 meters apart and repel each other with a force of 2 newtons. When the distance between the charges is doubled, the force between them is

- w) one fourth as great
- x) one half as great
- y) twice as great
- z) four times as great

ANSWER: W -- ONE FOURTH AS GREAT

PHYS-92; Multiple Choice: The rate at which electrical energy is used is measured in

- w) volts
- x) amperes
- y) joules
- z) watts

ANSWER: Z -- WATTS

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: For an electromagnetic wave traveling in a vacuum, if the magnitude of the intensity of the E field is zero, the magnitude of the intensity of the B field is:

- w) zero
- x) a negative maximum
- y) a positive maximum
- z) the square root of 2 times the positive maximum

ANSWER: W -- ZERO

PHYS-92; Multiple Choice: The effective capacitance of four, 5-microfarad capacitors connected in series is:

- w) 0.20 microfarad
- x) 0.5 microfarad
- y) 1.0 microfarad
- z) 1.25 microfarad

ANSWER: Z -- 1.25 MICROFARAD

PHYS-92; Multiple Choice: The terminal voltage of a cell supplying energy to a circuit is usually less than its emf because of the cell's

- w) size
- x) internal resistance
- y) mass
- z) energy

ANSWER: X -- INTERNAL RESISTANCE

PHYS-92; Multiple Choice: A light ray traveling in benzene strikes the benzene-air surface at the critical angle. The angle of refraction of the light ray is:

- w) 30 degrees
- x) 60 degrees
- y) 90 degrees
- z) 180 degrees

ANSWER: Y -- 90 DEGREES

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: Light bends around sharp corners as a result of

- w) refraction
- x) reflection
- y) diffraction
- z) dispersion

ANSWER: Y -- DIFFRACTION

PHYS-92; Multiple Choice: A light ray traveling from glass into air strikes the glass-air surface at an angle 50 degrees to the normal. If the critical angle for the glass-air combination is 42 degrees, the percentage of light reflected from the surface is

- w) 6
- x) 25
- y) 38
- z) 100

ANSWER: Z -- 100

PHYS-92; Multiple Choice: In the Millikan oil-drop experiment the UPWARD force on the drop is due to the:

- w) gravitational and electric fields
- x) gravitational field and the charge on the drop
- y) electric field and the size of the drop
- z) electric field and the charge on the drop

ANSWER: Z -- ELECTRIC FIELD AND THE CHARGE ON THE DROP

PHYS-92; Multiple Choice: In changing from an energy state of -1.51 electron-volts to -3.40 electron-volts, an atom emits a photon whose energy is:

- w) 1.51 electron-volts
- x) 1.89 electron-volts
- y) 3.40 electron-volts
- z) 4.91 electron-volts

ANSWER: X -- 1.89 ELECTRON-VOLTS

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: In an elastic collision, the RELATIVE velocities of separation of the two bodies after impact compared with the relative velocity of approach before impact is:

- w) always greater
- x) always smaller
- y) always the same
- z) first greater, then smaller

ANSWER: Y -- ALWAYS THE SAME

PHYS-92; Multiple Choice: Two hockey pucks, of unequal mass and connected by a spring of negligible mass, rest on a horizontal frictionless surface. The spring is released, and the pucks move apart. The center of mass of the two pucks does one of the following. Does it:

- w) move in a circle
- x) move in the direction of the greater mass
- y) remain stationary
- z) move in the direction of the smaller mass

ANSWER: Y -- REMAIN STATIONARY

PHYS-92; Multiple Choice: A 500 kilogram car moving at 20 meters per second strikes a stone wall and is brought to a halt in 0.1 second. The average force of the car on the wall during impact is:

- w) 10 Newtons
- x) 1000 Newtons
- y) 10,000 Newtons
- z) 100,000 Newtons

ANSWER: Z -- 100,000 NEWTONS

PHYS-92; Multiple Choice: A bullet is fired with a muzzle velocity of 1000 meters per second from a rifle clamped to a window 4.9 meters above ground level. Neglecting air resistance, the horizontal distance from the rifle at which the bullet will strike the ground is

- w) 4.9 meters
- x) 500 meters
- y) 1000 meters
- z) 4900 meters

ANSWER: Y -- 1000 METERS



## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: The acceleration due to gravity on the moon is 1.6 meters per second squared. If a pendulum whose length is 6.4 meters is placed on the moon, its period will be:

- w) 1.57 seconds
- x) 3.14 seconds
- y) 12.56 seconds
- z) 25.12 seconds

ANSWER: Y -- 12.56 SECONDS

PHYS-92; Multiple Choice: Of the following, the type of wave that CANNOT be polarized is

- w) electromagnetic
- x) light
- y) sound
- z) radio

ANSWER: Y -- SOUND

PHYS-92; Multiple Choice: Pressure is equal to:

- w) Area divided by force
- x) force divided by area
- y) area times force
- z) area minus force

ANSWER: X -- FORCE DIVIDED BY AREA

PHYS-92; Multiple Choice: The radiator of a room contains 10 kilogram of water. If the water gives off 50,000 calories of heat to the room, the drop in temperature of the water is:

- w) 1 degree Celsius
- x) 2 degrees Celsius
- y) 5 degrees Celsius
- z) 10 degrees Celsius

ANSWER: Y -- 5 DEGREES CELSIUS

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: In N-type semiconductors the majority of the carriers are:

- w) holes
- x) electrons
- y) protons
- z) neutrons

ANSWER: X -- ELECTRONS

PHYS-92; Multiple Choice: As a pendulum swings from its highest to its lowest point, it has the SMALLEST acceleration when it is:

- w) at its lowest point
- x) at its highest point
- y) at a point  $\frac{1}{3}$  the distance from the top of its swing
- z) at a point  $\frac{1}{2}$  the distance from the top of its swing.

ANSWER: W -- AT ITS LOWEST POINT

PHYS-92; Multiple Choice: Two cars collide head-on. They stop at the point of collision. Both cars must have one of the following. Do they have

- w) equal masses
- x) equal but opposite velocities before the collision
- y) equal but opposite momenta before the collision

ANSWER: Y -- EQUAL BUT OPPOSITE MOMENTA BEFORE THE COLLISION

PHYS-92; Multiple Choice: When the speed of a train moving on a circular track is doubled, the centripetal force acting on the train does one of the following. Does the force:

- w) remain the same
- x) increase by a factor of 2
- y) increase by a factor of 4
- z) increase by a factor of 8

ANSWER: Y -- INCREASE BY A FACTOR OF 4

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: It takes 500 watts to operate a machine whose power output is 480 watts. Which of the following is the efficiency of the machine? Is it

- w) 20%
- x) 48%
- y) 96%
- z) 98%

ANSWER: Y -- 96%

PHYS-92; Multiple Choice: Which of the following statements is TRUE about an ELASTIC collision between two particles? Is it true that:

- w) neither particle loses any of its kinetic energy
- x) neither particle loses any of its momentum
- y) the velocity gained by one particle is equal to that lost by the other
- z) the total kinetic energy before and after the collision remains constant

ANSWER: Z -- THE TOTAL KINETIC ENERGY BEFORE AND AFTER THE COLLISION REMAINS CONSTANT

PHYS-92; Multiple Choice: Ten calories of heat are added to 2 grams of water. The temperature of the water rises to a total of how many degrees? Is it:

- w) 2 degrees Celsius
- x) 5 degrees Celsius
- y) 10 degrees Celsius
- z) 20 degrees Celsius

ANSWER: X -- 5 DEGREES CELSIUS

PHYS-92; Multiple Choice: If water is warmed from 0 degrees Celsius to 6 degrees Celsius, which of the following things happen. Will the water:

- w) expand steadily
- x) contract steadily
- y) expand at first and then contract
- z) contract first then expand

ANSWER: Z -- CONTRACT FIRST THEN EXPAND

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: A gas at 0 degrees C and at normal atmospheric pressure has a volume of 273 cubic centimeters. If it is held at constant pressure until its volume is doubled, its temperature will be which one of the following? Will it be

- w) 2 degrees Celsius
- x) 200 degrees Celsius
- y) 273 degrees Celsius
- z) 546 degrees Celsius

ANSWER: Y -- 273 DEGREES CELSIUS

PHYS-92; Multiple Choice: Infrared rays are absorbed best by which one of the following. Is it:

- w) bodies of air
- x) white bodies with rough surfaces
- y) mirrors
- z) black bodies with rough surfaces

ANSWER: Z -- BLACK BODIES WITH ROUGH SURFACES

PHYS-92; Multiple Choice: Energy stored in a body as thermal or internal energy consists of one of the following. Does it consist of:

- w) heat in the form of radiant energy
- x) molecular kinetic energy only
- y) molecular potential energy only
- z) both kinetic and potential energy

ANSWER: Z -- BOTH KINETIC AND POTENTIAL ENERGY

PHYS-92; Multiple Choice: When white light passes through a red plate of glass and then through a green plate of glass which one of the following things occur?

- w) the light is totally absorbed
- x) the light that emerges is a combination of red and green
- y) the light that emerges lacks only its red and green components
- z) the light that emerges is green

ANSWER: W -- THE LIGHT IS TOTALLY ABSORBED

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: By which one of the following can a real image be produced? Can it be produced by a:

- w) concave mirror
- x) plane mirror
- y) diverging lens
- z) convex mirror

ANSWER: W -- CONCAVE MIRROR

PHYS-92; Multiple Choice: A metal ball on an insulated stand is touched by a positively charged glass rod. What happens to the metal ball? Does it

- w) gain protons and lose electrons
- x) gain protons
- y) gain more protons than electrons
- z) lose electrons

ANSWER: Z -- LOSE ELECTRONS

PHYS-92; Multiple Choice: A zinc plate is attached to the knob of a negatively charged electroscope. What will happen to the leaves of the electroscope when ultraviolet light is shown on the zinc plate. Will the leaves:

- w) collapse at once
- x) gradually come together
- y) gradually spread further apart
- z) remain unaffected

ANSWER: X -- GRADUALLY COME TOGETHER

PHYS-92; Multiple Choice: A high voltage applied to a gas discharge tube containing neon gas at very low pressure causes a current to flow through the tube. Which one of the following are the particles that flow towards the cathode? Are they

- w) electrons
- x) protons
- y) negatively charged neon ions
- z) positively charged neon ions

ANSWER: Z -- POSITIVELY CHARGED NEON IONS

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: Which of the following phrases completes the following statement:  
The strength of the electric field between two oppositely charged parallel plates is:

- w) a maximum midway between the plates
- x) a maximum near the positively charged plate
- y) constant between the plates except near the edges
- z) zero midway between the plates

ANSWER: Y -- CONSTANT BETWEEN THE PLATES EXCEPT NEAR THE EDGES

PHYS-92; Multiple Choice: Which one of the following is the advantage of connecting two dry cells in parallel instead of in series? Is it because the parallel arrangement:

- w) gives twice the EMF of one dry cell
- x) has no internal resistance
- y) generates heat in an external circuit half as fast as would a single cell
- z) has half the internal resistance of a single cell

ANSWER: Z -- HAS HALF THE INTERNAL RESISTANCE OF A SINGLE CELL

PHYS-92; Multiple Choice: Magnetic lines of force have all but one of the following characteristics. The one that they DO NOT have is:

- w) they go from the South-pole to the North-pole of a magnet outside of the magnet
- x) they are most concentrated at the poles of a magnet
- y) they pass through copper
- z) they never cross one another

ANSWER: W -- THEY GO FROM THE SOUTH-POLE TO THE NORTH-POLE OF THE MAGNET

PHYS-92; Multiple Choice: Which one of the following is the way in which a galvanometer is converted into a voltmeter? Is it by connecting:

- w) a high resistance coil in parallel with its moveable coil
- x) a low resistance coil in parallel with its moveable coil
- y) a high resistance coil in series with its moveable coil
- z) a low resistance coil in series with its moveable coil

ANSWER: Y -- A HIGH RESISTANCE COIL IN SERIES WITH ITS MOVEABLE COIL

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: An electron and a proton are moving at the same speed in circular paths in the same uniform magnetic field. The radius of the path of the proton is one of the following. Is this radius:

- w) the same as that of the electron
- x) about 2000 times larger than that of the electron
- y) a little larger than that of the electron
- z) smaller than that of the electron

ANSWER: X -- ABOUT 2000 TIMES LARGER THAN THAT OF THE ELECTRON

PHYS-92; Multiple Choice: In the mass spectrograph, two positively charged ions having the same velocity pass through a slit and enter a uniform magnetic field at right angles to their initial velocities. The ions will NOT be separated if:

- w) they have the same masses but different charges
- x) they have the same charges but different masses
- y) the products of their charges and their masses are equal
- z) the ratios of their charges to their masses are equal

ANSWER: Z -- THE RATIOS OF THEIR CHARGES TO THEIR MASSES ARE EQUAL

PHYS-92; Multiple Choice: A capacitor and a coil are connected in series. The capacitor is charged and allowed to discharge through the coil. The current that will then flow through the capacitor-coil combination will do one of the following things. Will it:

- w) flow in one direction, beginning at a maximum and decreasing rapidly to zero
- x) oscillate indefinitely
- y) oscillate but diminish steadily to zero
- z) oscillate at high frequency at first but then at slower frequency

ANSWER: Y -- OSCILLATE BUT DIMINISH STEADILY TO ZERO

PHYS-92; Multiple Choice: The energy associated with one photon of a light beam is proportional to one of the following. Is it proportional to:

- w) the intensity of the light source from which it came
- x) the number of photons in the beam
- y) the frequency of the photon
- z) the speed of the photon

ANSWER: Y -- THE FREQUENCY OF THE PHOTON

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: When a certain beam of light falls upon a metal surface, it ejects photoelectrons from it. The number of photoelectrons ejected per second by the beam of light depends upon one of the following. Is it proportional to:

- w) the threshold frequency of the metal
- x) the work function of the metal
- y) the frequency of the beam
- z) the intensity of the beam

ANSWER: Z -- THE INTENSITY OF THE BEAM

PHYS-92; Multiple Choice: In Rutherford's experiment involving the deflection of alpha particles by atomic nuclei, the fact that some of the alpha particles bombarding the thin gold foil were back-scattered, led to one of the following conclusions. It was concluded that:

- w) the charge of an electron is negative
- x) the nucleus of a gold atom carries all its charge
- y) most of the mass of a gold atom is in its nucleus
- z) the nucleus of a gold atom occupies nearly the entire space of the atom

ANSWER: Y -- MOST OF THE MASS OF A GOLD ATOM IS IN ITS NUCLEUS

PHYS-92; Multiple Choice: Standing waves are formed when two sets of waves of equal amplitude and frequency

- w) are in phase
- x) are in opposite phase
- y) move through each other in opposite directions
- z) are reflected from the same surface

ANSWER: Y -- MOVE THROUGH EACH OTHER IN OPPOSITE DIRECTIONS

PHYS-92; Multiple Choice: The common-emitter transistor circuit can amplify a small current signal because a small change in the signal current produces one of the following. Does the change in signal produce a large change in the:

- w) emitter-base voltage
- x) base current
- y) collector current
- z) collector voltage

ANSWER: Y -- COLLECTOR CURRENT



## *Science Bowl*

## PHYSICS

PHYS-92; Multiple Choice: The binding energy of a nucleus is defined as one of the following. Is this definition:

- w) the energy equivalent to its mass
- x) the mass difference between its neutrons and protons
- y) the energy needed to remove a neutron from the nucleus
- z) the difference between the mass of the nucleus and the sum of the masses of its protons and neutrons

ANSWER: Z -- THE DIFFERENCE BETWEEN THE MASS OF THE NUCLEUS AND THE UM

PHYS-92; Multiple Choice: In the equation of a nuclear reaction, all but one of the following quantities are equal to each other on both sides of the equation. Which quantity is NOT conserved:

- w) the net electric charge
- x) the total mass-energy
- y) the number of protons
- z) the number of nucleons

ANSWER: Y -- THE NUMBER OF PROTONS

PHYS-92; Multiple Choice: Which of the following terms refer to the amount of heat needed to raise the temperature of a unit mass of a substance through one degree?

- w) Heat of fusion
- x) Liquification heat
- y) Internal heat
- z) Specific heat

ANSWER: Z -- SPECIFIC HEAT

PHYS-92; Multiple Choice: There is evidence that quarks come in how many flavors? Is it:

- w) 1
- x) 3
- y) 5
- z) 7

ANSWER: Y -- 5

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: To develop the correct mathematical description of the distribution of radiated energy of a blackbody with respect to wavelength for a given temperature, Planck found it necessary to assume that the molecular oscillators of the blackbody emitted and absorbed:

- w) no radiant energy
- x) radiant energy in discrete units or quanta
- y) radiant energy in a continuous form
- z) none of the above.

ANSWER: X -- RADIANT ENERGY IN DISCRETE UNITS OR QUANTA

PHYS-92; Short Answer: How many torr are there in one atmosphere?

ANSWER: 760

PHYS-92; Short Answer: A stone weighing 10 Newtons is sitting on the side of a hill that is at a 30° angle with the horizontal. What is the magnitude of the component of the stone's weight parallel to the side of the hill.

ANSWER: 5 NEWTONS

PHYS-92; Multiple Choice: A curve in the road has a radius of 500 meters, and is banked at an angle of  $\theta$  (read: "theta") for a traffic speed of 90 kilometers per hour, or 25 meters per second. Is  $\theta$ :

- w) Less than 20°
- x) Between 20° and 50°
- y) Between 50° and 100°
- z) Greater than 100°

The tangent of 20° is 0.035, the tangent of 50° is 0.09 and the tangent of 100° is 0.18.

ANSWER: Y -- BETWEEN 50° AND 100°

PHYS-92; Short Answer: Laura weighs 50 Newtons and pushes against a stationary brick wall that weighs 1,000 Newtons. Her arm is two-thirds of a meter long. According to the laws of physics, how much work does she do?

ANSWER: NONE or ZERO

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Short Answer: A 45 kilogram bicyclist on a 5 kilogram bicycle rides down a 50 meter high hill with her brakes partially on. Her speed at the bottom of the hill is 10 meters per second. How many kilojoules of heat were dissipated by the cyclist's brakes?

ANSWER: 22.5 KILOJOULES or 22.0 KILOJOULES (based on 9.8 m/s<sup>2</sup>)

PHYS-92; Multiple Choice: A two-stage rocket attains a velocity of 3,000 meters per second when it drops the first stage and ignites the second. It consumes 1 kilogram of fuel per second and its exhaust speed is 2,000 meters per second. What is the thrust on the spacecraft?

- w) 2,000 Newtons
- x) 3,000 Newtons
- y) 2,000 Newton-seconds
- z) 3,000 Newton-seconds

ANSWER: W -- 2,000 NEWTONS

PHYS-92; Multiple Choice: A round viewing window with a 20 centimeter diameter is installed in a tank at the Shedd Aquarium. It is 5 meters below the water surface. The force on the window is approximately:

- w) 1,500 Newtons
- x) 10,000 Newtons
- y) 25,000 Newtons
- z) 50,000 Newtons

ANSWER: W -- 1,500 NEWTONS

PHYS-92; Multiple Choice: The density of lead is 12 grams per cm<sup>3</sup>. A lead brick has a mass of 1.5 kilograms. Its dimensions are 10 cm by 5 cm by 4 cm. Is it:

- w) More than 75% hollow
- x) Between 50 and 75% hollow
- y) Between 25 and 50% hollow
- z) Between 0 and 25% hollow

ANSWER: Y -- BETWEEN 25 AND 50% HOLLOW

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Ice skating is possible and practical because of a unique property of water. Is it because:

- w) The coefficient of kinetic friction of steel on frozen water decreases with decreasing temperature
- x) Ice readily sublimates
- y) The melting point decreases with increasing pressure
- z) Ice is a good thermal insulator

ANSWER: Y -- THE MELTING POINT DECREASES WITH INCREASING PRESSURE

PHYS-92; Multiple Choice: 1 kilogram of boiling water is poured into an empty thermos whose mass is 1 kilogram and whose temperature is 25o Celsius. No heat is lost from the thermos. The specific heats of water and the thermos are 1 and 0.5 kilocalories per kilogram degree Celsius, respectively. Their final temperature is:

- w) 50o Celsius
- x) 65o Celsius
- y) 75o Celsius
- z) 90o Celsius

(Read: "degrees Celsius")

ANSWER: Y -- 75o CELSIUS

PHYS-92; Multiple Choice: An aluminum rod at a temperature of 100o Celsius radiates energy at a rate of 10 watts. If its temperature is increased to 200o Celsius, at approximately what rate will it radiate energy?

- w) 15 watts
- x) 20 watts
- y) 26 watts
- z) 80 watts

ANSWER: Y -- 26 WATTS

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: The coating on the plastic tape you use in your cassette players is

- w) diamagnetic
- x) paramagnetic
- y) ferromagnetic
- z) a permanent magnet

ANSWER: Y -- FERROMAGNETIC

PHYS-92; Multiple Choice: Which color light has the highest frequency?

- w) green
- x) violet
- y) red
- z) yellow

ANSWER: X -- VIOLET

PHYS-92; Multiple Choice: Your Minolta camera has a 50 millimeter lens. The 50 millimeters is the lens'

- w) diameter
- x) focal length
- y) magnification
- z) aperture

ANSWER: X -- FOCAL LENGTH

PHYS-92; Multiple Choice: You want to put up a mirror at a blind corner in a building. Which of the following will give you the largest field of view? Is it a:

- w) convex mirror
- x) concave mirror
- y) cylindrical mirror
- z) plane mirror

ANSWER: W -- CONVEX MIRROR

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: Dr. Leon Lederman and two other physicists won the Nobel prize for discovering an elementary particle. That particle is the:

- w) positron
- x) meson
- y) muon
- z) neutrino

ANSWER: Z -- NEUTRINO

PHYS-92; Multiple Choice: Neutrinos are a subset of which of the following categories?

- w) photons
- x) leptons
- y) mesons
- z) baryons

ANSWER: X -- LEPTONS

PHYS-92; Multiple Choice: A flywheel rotating at 5 revolutions per second is brought to rest by a constant torque in 10 seconds. How many revolutions does the flywheel make while coming to a stop?

- w) 25
- x) 50
- y) 75
- z) 100

ANSWER: W -- 25

PHYS-92; Multiple Choice: A wooden board 2 meters long, 30 centimeters wide and 4 centimeters thick floats in water with 1 centimeter of its thickness above the surface. The mass of the board is:

- w) 1.8 kilograms
- x) 18 kilograms
- y) 24 kilograms
- z) 176 kilograms

ANSWER: X -- 18 KILOGRAMS

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: The minimum number of forces with unequal magnitudes whose vector sum can equal zero is:

- w) 1
- x) 2
- y) 3
- z) 4

ANSWER: Y -- 3

PHYS-92; Multiple Choice: A hiker stands at the bottom of steep hill. The hiker may follow a straight line path to the top of the hill, a distance of 300 feet, or she may follow a zig-zag path to the top of the hill and walk a distance of 600 feet. The work done by the force of gravity along the zig-zag path is how many times the work going along the straight path? Is it:

- w) equal
- x) twice
- y) 4 times
- z) 8 times?

ANSWER: W -- EQUAL

PHYS-92; Multiple Choice: A pendulum is displaced through an arc of  $10^\circ$ . When the pendulum is released, it takes the pendulum 1 second to swing through the  $10^\circ$  arc. How long would it take the pendulum to swing through a  $20^\circ$  arc? Is it:

- w)  $1/2$  second
- x) 1 second
- y) 2 seconds
- z) 4 seconds

ANSWER: X -- 1 SECOND

PHYS-92; Multiple Choice: A perfectly spherical bubble of air is suspended in a tank of water. A beam of light consisting of parallel rays passes through the bubble. As the light emerges from the opposite side of the bubble the light rays:

- w) diverge
- x) converge
- y) are unaffected

ANSWER: W -- DIVERGE

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: An explorer is riding his camel in the desert. Up ahead he sees what appears to be a pool of water. He can tell if it is a real pool of water or a mirage by putting on his polarized sun glasses because:

- w) the mirage is polarized and reflections from the water are not
- x) reflections from water are polarized while the mirage is not
- y) neither are polarized so one will not be able to discern a difference
- z) both are polarized so one will not be able to discern a difference

ANSWER: X -- REFLECTIONS FROM WATER ARE POLARIZED WHILE THE MIRAGE S NOT

PHYS-92; Short Answer: What name is given to the class of subatomic particles which include the proton, the neutron, and several heavier particles, such as the lambda, the sigma and the omega.

ANSWER: BARYONS

PHYS-92; Multiple Choice: What is the SI unit for pressure?

- w) Torr
- x) pounds per square inch
- y) Pascal
- z) Kelvin

ANSWER: Y -- PASCAL

PHYS-92; Multiple Choice: A virtual image always appears:

- w) larger than object
- x) inverted
- y) erect
- z) same size as object

ANSWER: Y -- ERECT

PHYS-92; Short Answer: How many quarks make up a proton?

ANSWER: 3



## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: A 50 kilogram ice skater glides across the ice in a straight line at 7 meters per second. If she bends down and scoops up a 20 kilogram child standing on the ice, what will be the final speed of the skater and the child?

- w) 1 meter per second
- x) 3 meters per second
- y) 5 meters per second
- z) 7 meters per second

ANSWER: Y -- 5 METERS PER SECOND

PHYS-92; Multiple Choice: What is the wavelength of red light emitted by a helium-neon laser?

- w) 122 nanometers
- x) 633 nanometers
- y) 2.43 picometers
- z) 1.37 micrometers

ANSWER: X -- 633 NANOMETERS (actually 632.8 nm)

PHYS-92; Short Answer: Name the German theoretical physicist who was awarded the Nobel prize for his principle of radiation which states that radiant energy is composed of tiny bits of energy called quanta, the magnitude of which can be calculated by multiplying the frequency of the radiation times a universal constant?

ANSWER: (MAX) PLANCK

PHYS-92; Short Answer: The law or principle which states that a body in a state of rest or motion at constant velocity will remain in that state is known as?

ANSWER: NEWTON'S FIRST LAW or THE LAW OF INERTIA

PHYS-92; Short Answer: An ice skater is spinning like a top on a frozen lake. She raises her arms from their initial horizontal position to a vertical position over her head. The skater will experience an increase in angular velocity due to what physical law?

ANSWER: LAW OF CONSERVATION OF ANGULAR MOMENTUM

PHYS-92; Short Answer: As an individual fires a shotgun, a recoil will be experienced. Which of Newton's laws would best describe this phenomena?

ANSWER: NEWTON'S THIRD LAW

## ***Science Bowl***

## PHYSICS

PHYS-92; Short Answer: A nuclear reaction in which small nuclei combine to produce a larger nucleus is known as:

ANSWER: FUSION or NUCLEAR FUSION

PHYS-92; Short Answer: Two atoms of the same element will have the same number of protons. If they have a different number of neutrons, what are they called?

ANSWER: ISOTOPES

PHYS-92; Multiple Choice: Consider a car driving around a circular bend in the road. Which of the following CANNOT be constant?

- w) velocity of car
- x) speed of car
- y) nonrelativistic mass of car
- z) angular momentum of the car about the center of the circle

ANSWER: W -- VELOCITY OF CAR

PHYS-92; Multiple Choice: A firecracker is placed in the middle of a cluster of stationary billiard balls. The firecracker-billiard ball system sits on a frictionless surface. As the firecracker explodes, the balls scatter. What is the momentum of the SYSTEM after the explosion of the firecracker?

- w) greater than the momentum of the system before the explosion
- x) equal to the combined speed of the balls
- y) equal to the mass of the balls
- z) zero

ANSWER: Z -- ZERO

PHYS-92; Multiple Choice: The equation,  $X = A \cos(\omega t + \phi)$  (read: X equals A times the cosine of omega t + phi (fee)), can represent an expression for:

- w) accelerating due to gravity
- x) uniform straight line motion
- y) dc current
- z) a simple harmonic oscillator

ANSWER: Z -- A SIMPLE HARMONIC OSCILLATOR

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: For a point charge to feel a net force in a homogeneous magnetic field, which one of the following statements is true? The charge must:

- w) move parallel to the magnetic lines of flux
- x) have a component of its motion perpendicular to the lines of flux
- y) be stationary
- z) be a positive charge

ANSWER: X -- HAVE A COMPONENT OF ITS MOTION PERPENDICULAR TO THE LINES OF FLUX

PHYS-92; Multiple Choice: According to Gauss' Law, the magnitude of the electric field is zero everywhere inside a conductor if:

- w) electrostatic equilibrium is achieved
- x) the surface is a metal
- y) the conductor is moving
- z) the conductor is a non-Gaussian surface

ANSWER: W -- ELECTROSTATIC EQUILIBRIUM IS ACHIEVED

PHYS-92; Short Answer: An air dielectric is replaced with a glass dielectric inside a capacitor of fixed dimensions. Relatively speaking, what will happen to the quantity of charge the capacitor can hold after the glass is inserted?

ANSWER: IT IS INCREASED WITH THE GLASS DIELECTRIC.

PHYS-92; Short Answer: In a simple dc circuit, voltage equals resistance multiplied by current. This is also considered true in an AC circuit if the what values of the current and voltage are used.

ANSWER: ROOT MEAN SQUARE (RMS) VALUES

PHYS-92; Multiple Choice: Gauss' law of electricity, Gauss' law of magnetism, Faraday's law of induction, and Amperes' law form the basic equations of electromagnetism. This combination is collectively known as:

- w) Coulomb's equations
- x) Volta's equations
- y) Fermi's equations
- z) Maxwell's equations

ANSWER: Z -- MAXWELL'S EQUATIONS

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: The index of refraction can be considered:

- w) a ratio of material thickness between substances
- x) a ratio of velocities of light in different materials
- y) a ratio of mass between materials
- z) to have the units of photons

ANSWER: X -- A RATIO OF VELOCITIES OF LIGHT OF DIFFERENT MATERIALS

PHYS-92; Short Answer: In an ideal case, if a point source of light is placed at the focal point in front of a concave reflector, where will the image form?

ANSWER: WILL NOT FORM or FORMS AT INFINITY

PHYS-92; Multiple Choice: You are sitting in a frictionless barber chair. The barber decides to have some fun with you, so he spins the chair. As you spin, you find that you can slow down by extending your arms and legs. You have:

- w) decreased your angular momentum
- x) increased your angular momentum
- y) increased your moment of inertia
- z) changed the direction of the momentum vector

ANSWER: Y --INCREASED YOUR MOMENT OF INERTIA

PHYS-92; Short Answer: A 10 kg mass initially sitting on the ground is placed on a ledge 3 meters above ground level. What is the increase in potential energy of the mass?

ANSWER: 294 JOULES (accept 300 JOULES, ASSUMES  $g=10\text{m/sec}^2$ )

PHYS-92; Multiple Choice: A person sees a lightning bolt in the distance and tries to guess the distance to the bolt based on the time between the flash and the thunder. What general time span should she use?

- w) 1 second equals 1 mile
- x) 5 seconds equal 1 mile
- y) 10 seconds equal 1 mile
- z) 20 seconds equal 1 mile

ANSWER: X -- 5 SECONDS EQUAL 1 MILE

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: A piano tuner notices a standing Lissajous (pron: Liss-a-jew) curve on his oscilloscope. The tone being projected is:

- w) out of harmony
- x) sharp
- y) resonating
- z) flat

ANSWER: Y -- RESONATING

PHYS-92; Multiple Choice: Photons and gravitons are names associated with a category of particles called:

- w) mesons
- x) bosons
- y) leptons
- z) baryons

ANSWER: X --BOSONS

PHYS-92; Short Answer: An electron is moved through a potential difference of 1 volt. How much energy in joules was used to move the electron?

ANSWER:  $1.6 \times 10^{-19}$  JOULES

PHYS-92; Short Answer: Who said this about alpha particles and the reflection of these particles from thin foils? "It was about as credible as if you fired a 15-inch shell at a piece of tissue paper and it came back at you."

ANSWER: RUTHERFORD

PHYS-92; Short Answer: A string of length L is fixed between two points. If a standing wave of 5 nodes is produced, what is the relationship between the string's length, L, and its wavelength?

ANSWER: WAVELENGTH =  $1/2$  L

PHYS-92; Short Answer: A freight car weighing 20 tons and moving at a speed of 7 miles per hour on a horizontal track collides and couples with a stationary car that weighs 15 tons. Neglecting friction, determine the velocity of the coupled cars.

ANSWER: 4 MILES PER HOUR

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: The Grand Unified Theory of the forces of nature combines three of the four forces. Which force is NOT included?

- w) gravitational
- x) electromagnetic
- y) weak nuclear
- z) strong nuclear

ANSWER: W -- GRAVITATIONAL

PHYS-92; Short Answer: A person who is nearsighted will need what type of lenses in his glasses in order to see correctly?

ANSWER: DIVERGING or CONCAVE LENSES

PHYS-92; Short Answer: If a car is traveling at 20 meters per second in a straight line, how many seconds will it take the car to stop if it decelerates at 5 meters per second squared?

ANSWER: 4 SECONDS

PHYS-92; Multiple Choice: Which of the following men was involved with the first controlled nuclear reaction?

- w) Linus Pauling
- x) Nelson Sartoris
- y) Edward Teller
- z) Enrico Fermi

ANSWER: Z -- ENRICO FERMI

PHYS-92; Multiple Choice: If the half-life of a radioisotope is 2 days, after how many days is the quantity reduced to 12.5% of its original amount?

- w) 4 days
- x) 6 days
- y) 8 days
- z) 10 days

ANSWER: X -- 6 DAYS

PHYS-92; Short Answer: What term which begins with the letter "A" is used to describe the reduction in intensity of radiation as it passes through matter?

ANSWER: ATTENUATION

## ***Science Bowl***

## PHYSICS

PHYS-92; Short Answer: What name is given to the visible light emitted when charged particles pass through a transparent medium with a velocity exceeding the velocity of light in the medium?

ANSWER: CERENKOV RADIATION

PHYS-92; Short Answer: What element was first discovered in the spectrum of the sun before it was discovered on earth?

ANSWER: HELIUM

PHYS-92; Short Answer: A gluon is the carrier of which force of nature?

ANSWER: STRONG FORCE or STRONG NUCLEAR FORCE.

PHYS-92; Multiple Choice: Close inspection of a failed metal part reveals artifacts on the fracture surface commonly referred to as "striations" or "beach marks". This indicates the component failed as a result of:

- w) Sudden overloading
- x) Cyclical loading
- y) Stress corrosion cracking
- z) None of the above

ANSWER: X -- CYCLICAL LOADING

PHYS-92; Short Answer: How many neutrons are present in the nucleus of an element with an atomic weight of 119 and an atomic number of 50?

ANSWER: 69

PHYS-92; Short Answer: Zero degrees Kelvin is equal to what temperature on the Celsius scale?

ANSWER: - 273 DEGREES CELSIUS or -273.15 DEGREES CELSIUS

PHYS-92; Short Answer: Dirac theoretically predicted the existence of the positron. Who experimentally identified positrons in 1932 in cloud chamber pictures of cosmic ray particle tracks?

ANSWER: (C. D.) ANDERSON

## Science Bowl

## PHYSICS

PHYS-92; Short Answer: These two chemical elements, named after two world-renowned scientists, were first formed in a thermonuclear explosion which occurred in the South Pacific in 1952. The atomic numbers of these elements are 99 and 100. Their chemical symbols are Es and Fm. Name these elements.

ANSWER: EINSTEINIUM AND FERMIUM

PHYS-92; Multiple Choice: The dark lines constituting the absorption spectrum exhibited by sunlight are frequently called:

- w) Fresnel lines
- x) Fraunhofer lines
- y) Fermi lines
- z) Franklin lines

ANSWER: X -- FRAUNHOFER LINES

PHYS-92; Multiple Choice: The temperature of a gas measures the:

- w) number of calories of heat present
- x) average kinetic energy of the particles in the gas
- y) exact number of particles in the gas
- z) potential energy of the gas

ANSWER: X -- AVERAGE KINETIC ENERGY OF THE PARTICLES IN THE GAS

PHYS-92; Multiple Choice: If two atoms exert equal attractions for electrons, they can form:

- w) a nonpolar covalent bond
- x) an ionic bond
- y) a polar covalent bond
- z) no bond

ANSWER: W -- A NONPOLAR COVALENT BOND

PHYS-92; Multiple Choice: An element has the following numbers of electrons in its shells: 2-8-8-2. Which of the following is true? The element:

- w) is a nonmetal
- x) forms an ion with a charge of +2
- y) can accept two electrons
- z) forms a negative ion

ANSWER: X -- FORMS AN ION WITH A CHARGE OF +2



## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: A characteristic of the noble gases is that they all:

- w) have eight electrons in the outer shell
- x) have low stability
- y) form many compounds
- z) have filled outer electron shells

ANSWER: Z -- HAVE FILLED OUTER ELECTRON SHELLS

PHYS-92; Multiple Choice: A reduction reaction always involves the:

- w) loss of electrons
- x) gain of electrons
- y) addition of oxygen
- z) removal of oxygen

ANSWER: X -- GAIN OF ELECTRONS

PHYS-92; Multiple Choice: The photoelectric effect is a demonstration of:

- w) the wave nature of light
- x) the particle nature of light
- y) Compton scattering
- z) the continuous spectrum of radiation

ANSWER: X -- THE PARTICLE NATURE OF LIGHT

PHYS-92; Multiple Choice: When a solid material is heated, it always:

- w) emits a discrete radiation spectrum
- x) glows red
- y) emits a continuous radiation spectrum
- z) emits only visible radiation

ANSWER: Y -- EMITS A CONTINUOUS RADIATION SPECTRUM

PHYS-92; Multiple Choice: An electron is classified as a:

- w) boson
- x) nucleon
- y) fermion
- z) meson

ANSWER: Y -- FERMION

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Laser radiation is:

- w) monochromatic
- x) directed in a narrow beam
- y) produced with large power densities
- z) all of the above

ANSWER: Z -- ALL OF THE ABOVE

PHYS-92; Multiple Choice: Which of the following implies the greatest precision?

- w)  $1.02 \times 10^5$
- x)  $102 \times 10^3$
- y)  $0.102 \times 10^6$
- z)  $1.020 \times 10^5$

ANSWER: Z --  $1.020 \times 10^5$

PHYS-92; Multiple Choice: Which of the following is NOT one of the fundamental quantities in physics?

- w) time
- x) length
- y) weight
- z) mass

ANSWER: Y -- WEIGHT

PHYS-92; Multiple Choice: A sphere which has half the radius but twice the density of another sphere has:

- w) more mass
- x) less mass
- y) the same mass
- z) the same weight

ANSWER: X -- LESS MASS

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: What process produces most of the energy that is radiated by the Sun?

- w) gravitational contraction
- x) chemical combustion
- y) nuclear fusion
- z) nuclear fission

ANSWER: Y -- NUCLEAR FUSION

PHYS-92; Multiple Choice: What is the hydrostatic pressure at the bottom of a pool 6 meters deep?

- w) 60,000 Newtons per meter squared
- x) 6,000 Newtons per meter squared
- y) 600 Newtons per meter squared
- z) 60 Newtons per meter squared

ANSWER: W -- 60,000 NEWTONS PER METER SQUARED

PHYS-92; Multiple Choice: What is a typical wavelength of an AM radio wave?

- w) 3000 meters
- x) 300 meters
- y) 30 meters
- z) 3 meters

ANSWER: X -- 300 METERS

PHYS-92; Multiple Choice: A ball is thrown upwards with an initial velocity of 5 meters per second. How many seconds will it take to reach maximum height?

- w) 0.5 seconds
- x) 1 second
- y) 1.5 seconds
- z) 2 seconds

ANSWER: W -- 0.5 SECONDS

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: Albert Einstein received the Nobel prize in physics for his work on:

- w) gravitation
- x) relativity
- y) photoelectric effect
- z) Brownian motion

ANSWER: Y -- PHOTOELECTRIC EFFECT

PHYS-92; Multiple Choice: A typical microwave oven produces microwave radiation with a wavelength of:

- w) 3 meters
- x)  $3 \times 10^{-2}$  meters (read: 3 times 10 to the minus 2 meters)
- y)  $3 \times 10^{-6}$  meters (read: 3 times 10 to the minus 6 meters)
- z)  $3 \times 10^{-9}$  meters (read: 3 times 10 to the minus 9 meters)

ANSWER: X --  $3 \times 10^{-2}$  METERS

PHYS-92; Multiple Choice: An ELECTRON moving horizontally along the +x axis enters a region of space with a horizontal uniform magnetic field pointing in the +y direction. The electron will be deflected:

- w) -y direction
- x) +y direction
- y) -z direction
- z) +z direction

ANSWER: Y -- -Z DIRECTION

PHYS-92; Multiple Choice: Entropy is a measure of:

- w) magnetization
- x) disorder
- y) temperature
- z) heat

ANSWER: X -- DISORDER

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: The magnetic field produced by a long straight wire carrying a current points:

- w) in the direction of the current
- x) toward the wire
- y) away from the wire
- z) circles around the wire

ANSWER: Z -- CIRCLES AROUND THE WIRE

PHYS-92; Multiple Choice: What is the molecular mass of a gas that effuses through a small hole at twice the rate as oxygen gas at the same temperature. (The molecular mass of O<sub>2</sub> is 32.)

- w) 8.0 atomic mass units
- x) 16 atomic mass units
- y) 48 atomic mass units
- z) 64 atomic mass units

ANSWER: W -- 8.0 ATOMIC MASS UNITS

PHYS-92; Multiple Choice: Liquid "X" is at equilibrium with its vapor in a cylinder and piston apparatus. When the volume of the space above the liquid is 50 ml and the temperature 25°C, the vapor pressure of "X" is 120 torr. What will the vapor pressure of "X" be when the volume above the liquid is 100 ml and the temperature 25°C? Some liquid is always present.

- w) 30 torr
- x) 60 torr
- y) 120 torr
- z) 240 torr

ANSWER: Y -- 120 TORR

PHYS-92; Short Answer: A bird weighing 2 pounds is inside a completely enclosed box weighing 3 pounds. There is no air exchange between the inside and outside of the box. If the box is placed on a scale, and the bird is flying inside the box, what weight does the scale read?

ANSWER: 5 POUNDS

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Mickey is fishing from his row boat at his favorite spot in the lake. He has a large rock in the bottom of the boat for stability and ballast. Mickey decides to call it quits. To lighten his load, he tosses the rock overboard before rowing to shore. Does the water level of the lake:

- w) go up
- x) go down
- y) remain the same

ANSWER: X -- GO DOWN

PHYS-92; Multiple Choice: An electrical discharge ionizing the air around a conductor is called:

- w) Flux
- x) Corona
- y) Ozone
- z) Field

ANSWER: X -- CORONA

PHYS-92; Multiple Choice: The speed of sound (at sea level) in air is:

- w) 340 meters per second
- x) 400 meters per second
- y) 500 meters per second
- z) 760 kilometers per second

ANSWER: W -- 340 METERS PER SECOND

PHYS-92; Multiple Choice: How many molecules are present in 2.5 liters of gas at STP?

- w)  $5.6 \times 10^{24}$  molecules
- x)  $1.5 \times 10^{24}$  molecules
- y)  $6.0 \times 10^{23}$  molecules
- z)  $6.7 \times 10^{22}$  molecules

ANSWER: Z --  $6.7 \times 10^{22}$  MOLECULES

PHYS-92; Multiple Choice: If  $^{64}\text{Cu}$  emits a beta particle, what would the product be?

- w)  $^{63}\text{Cu}$
- x)  $^{64}\text{Cu}+1$
- y)  $^{64}\text{Cu}-1$
- z)  $^{64}\text{Zn}$

ANSWER: Z --  $^{64}\text{Zn}$

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: Magnifying glasses are useful, because they create an enlarged:

- w) virtual image behind the actual object.
- x) real image behind the actual object.
- y) virtual image in front of the actual object.
- z) real image in front of the actual object.

ANSWER: W -- VIRTUAL IMAGE BEHIND THE ACTUAL OBJECT.

PHYS-92; Multiple Choice: Which pot of water will boil LAST when all are heated by the same source?

- w) aluminum pot
- x) iron pot
- y) brass pot
- z) titanium pot

ANSWER: Z -- TITANIUM POT

PHYS-92; Multiple Choice: How many atoms per unit cell are in a face-centered-cubic crystal?

- w) two
- x) four
- y) six
- z) eight

ANSWER: X -- FOUR

PHYS-92; Multiple Choice: Refractory metals are known for which of the following properties:

- w) lack of chemical reactivity
- x) low density
- y) high melting point
- z) high thermal conductivity

ANSWER: Y -- HIGH MELTING POINT

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: A small hole in a sheet of aluminum foil is used to diffract yellow light both under water and in a vacuum. Which is true?

- w) light diffracts less in the water because its wavelength is larger.
- x) light diffracts less in the water because its wavelength is smaller.
- y) light diffracts more in the water because its wavelength is larger.
- z) light diffracts more in the water because its wavelength is smaller.

ANSWER: X -- LIGHT DIFFRACTS LESS IN THE WATER BECAUSE ITS WAVELENGTH IS SMALLER

PHYS-92; Multiple Choice: A 20 ohm resistor and a 60 ohm resistor are connected in parallel to a voltage source. If the current in the 60 ohm resistor is one ampere, the current in the 20 ohm resistor will be:

- w) 1/3 ampere
- x) 2/3 ampere
- y) 1 ampere
- z) 3 amperes

ANSWER: Z -- 3 AMPERES

PHYS-92; Multiple Choice: An LED is operated on a 12 volt automobile circuit. The voltage drop across the LED is 2 volts and the current must be limited to 50 milliamps to prevent its overheating and destruction. What size resistor must be used?

- w) 60 ohms
- x) 100 ohms
- y) 120 ohms
- z) 200 ohms

ANSWER: Z -- 200 OHMS

PHYS-92; Multiple Choice: Which is NOT a characteristic of a series circuit?

- w) The current is the same throughout.
- x) The total resistance is the sum of the individual resistance.
- y) The voltage of the source equals the sum of the circuit's individual voltage drops.
- z) The total resistance is the sum of the reciprocals of the individual resistances.

ANSWER: Z -- THE TOTAL RESISTANCE IS THE SUM OF THE RECIPROCAL OF THE RECIPROCAL OF THE INDIVIDUAL RESISTANCES.



## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: If the distance between the centers of mass of two bodies is doubled, the gravitational force between the bodies will become what portion of the original force:

- w) double
- x) one half
- y) remain the same
- z) one quarter

ANSWER: Z -- ONE QUARTER

PHYS-92; Multiple Choice: The Doppler Effect predicts that the spectrum of light from a visible body moving AWAY from the Earth will experience a shift in frequency when viewed from Earth. This particular shift is known as the:

- w) Blue shift
- x) Neutral shift
- y) Red shift
- z) Dirac shift

ANSWER: Y -- RED SHIFT

PHYS-92; Short Answer: On a weather map, the lines that depict equal pressure are called what?

ANSWER: ISOBARS

PHYS-92; Multiple Choice: A far-sighted person, without optical correction, is typically able to see nearby objects more clearly in bright light. The reason for this phenomena is:

- w) bright light provides better illumination.
- x) the pupil of the eye narrows which increases the depth of focus.
- y) the pupil of the eye widens which increases the depth of focus.
- z) the bright light causes squinting which flattens the eyeball which tends to correct the far-sighted condition.

ANSWER: X -- THE PUPIL OF THE EYE NARROWS WHICH INCREASES THE DEPTH OF FOCUS

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: The first reflecting telescope was built by:

- w) Galileo
- x) Copernicus
- y) Tycho Brahe
- z) Isaac Newton

ANSWER: Z -- ISAAC NEWTON

PHYS-92; Multiple Choice: Ten Coulombs of charge flowing through a wire per second is equal to:

- w) 100 Amperes
- x) 10 Ampere
- y) 1 Amperes
- z) 0.1 Amperes

ANSWER: X -- 10 AMPERES

PHYS-92; Multiple Choice: Magnetic fields are produced by:

- w) resistance
- x) an electric potential difference
- y) electric current
- z) stationary charge

ANSWER: Y -- CURRENT

PHYS-92; Multiple Choice: A 10 ohm and a 20 ohm resistor are connected in parallel to a current source. What fraction of the current flows through the 20 ohm resistor?

- w) 1/2
- x) 1/3
- y) 2/3
- z) 3/4

ANSWER: X -- 1/3

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: One barrel of oil has about the same heat content as how much coal:

- w) 70 pounds
- x) 700 pounds
- y) 1,400 pounds
- z) 2,800 pounds

ANSWER: X -- 700 POUNDS

PHYS-92; Multiple Choice: Two identical resistors are connected in parallel and consume 200 watts together. A third identical resistor is added in parallel. The total power consumed is:

- w) 100 watts
- x) 200 watts
- y) 300 watts
- z) 400 watts

ANSWER: Y -- 300 WATTS

PHYS-92; Multiple Choice: The length of both sides of a square parallel plate capacitor are doubled. The capacitance is:

- w) halved
- x) the same
- y) doubled
- z) quadrupled

ANSWER: Z -- QUADRUPLED

PHYS-92; Multiple Choice: A series circuit consists of a two ohm RESISTOR and a one ohm INDUCTOR. The relationship between current and voltage is:

- w) current will lag by 30 degrees.
- x) current will lag by 26 degrees.
- y) current will lead by 26 degrees.
- z) current will lead by 30 degrees.

ANSWER: X -- CURRENT WILL LAG BY 26 DEGREES.

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: A transformer has a turns ratio of two to one. If a 100 ohm resistor is connected on the high side, its resistance as measured on the low side would be:

- w) 25 ohms
- x) 50 ohms
- y) 100 ohms
- z) 400 ohms

ANSWER: W -- 25 OHMS

PHYS-92; Short Answer: The doorbell on your house requires a 12 volt alternating current. A transformer having a primary winding of 1,600 turns is to be used to step down your house's 110-volt alternating current. How many turns are there on the secondary winding?

ANSWER: 175 TURNS

PHYS-92; Multiple Choice: What is the impedance of a one microfarad capacitor at 60 Hertz:

- w) 16,700 ohms
- x) 2,650 ohms
- y)  $3.8 \times 10^{-4}$  ohms
- z)  $6 \times 10^{-5}$  ohms

ANSWER: X -- 2,650 OHMS

PHYS-92; Multiple Choice: Which of the following instruments should never have their test leads connected directly to a wall outlet:

- w) ammeter
- x) voltmeter
- y) oscilloscope
- z) frequency counter

ANSWER: W -- AMMETER

PHYS-92; Multiple Choice: The speed of light through a single-mode optical fiber is approximately:

- w)  $c$  (equal to  $3 \times 10^8$  m/s)
- x) 70 percent of  $c$
- y) 80 percent of  $c$
- z) 90 percent of  $c$

ANSWER: X -- 70 PERCENT OF  $c$

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: The father of the atomic bomb is:

- w) Einstein
- x) Oppenheimer
- y) Faraday
- z) Strangelove

ANSWER: X -- OPPENHEIMER

PHYS-92; Multiple Choice: At what point is the temperature the same on the Celsius and Fahrenheit scales?

- w) Absolute zero
- x) Zero
- y) Negative 40 degrees
- z) Never

ANSWER: Y -- NEGATIVE 40 DEGREES

PHYS-92; Multiple Choice: What does the letter "s" stand for in the acronym laser?

- w) scientific
- x) simulated
- y) stimulated
- z) solar

ANSWER: Y -- STIMULATED (LIGHT AMPLIFICATION BY STIMULATED  
MISSI)

PHYS-92; Multiple Choice: What is the DeBroglie wavelength of a 1,200 kilogram corvette traveling at a rate of 25 meters per second? Planck's constant is equal to  $6.62 \times 10^{-34}$  Joule-seconds.

- w)  $5.3 \times 10^{-32}$  meters
- x)  $5.9 \times 10^{-34}$  meters
- y)  $2.1 \times 10^{-38}$  meters
- z)  $1.6 \times 10^{-40}$  meters

ANSWER: Y --  $2.1 \times 10^{-38}$  METERS

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: What property of a metal describes the onset of plastic deformation in a tensile test?

- w) tensile strength
- x) elongation
- y) yield strength
- z) reduction in area

ANSWER: Y -- YIELD STRENGTH

PHYS-92; Multiple Choice: It is a very hot day. You are in a special kitchen, in that there are no exits and the walls of this kitchen are thermally very well insulated. If you open the refrigerator door, the room will eventually:

- w) cool off.
- x) remain the same.
- y) heat up.

ANSWER: Y -- HEAT UP.

PHYS-92; Multiple Choice: Consider two water drops at a temperature  $T$ . These drops are NOT allowed to exchange energy with their environment. These two drops collide and combine. How does the temperature of these drops change when they combine? Does it:

- w) decrease
- x) remain the same
- y) increase

ANSWER: Y -- INCREASE

PHYS-92; Short Answer: A model airplane flies over the ocean in level flight at an altitude of 19.6 meters. How long does it take a bomb, dropped from under the wing, to impact the water?

ANSWER: 2 SECONDS

PHYS-92; Multiple Choice: A space ship traveling toward Mars at 0.6 times the speed of light  $c$  shoots an ELECTRON beam at Mars. If the electrons travel at 0.6  $c$  RELATIVE TO THE SPACE SHIP, at what speed do the electrons impact the surface of Mars?

- w) 0.6  $c$
- x) 0.88  $c$
- y) 1.2  $c$
- z) 1.34  $c$

ANSWER: X -- 0.88  $c$

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: An object dropped from rest near the Earth's surface will fall how far in the first second:

- w) 4.9 meters
- x) 9.8 meters
- y) 16.0 meters
- z) 32 meters

ANSWER: W -- 4.9 METERS

PHYS-92; Multiple Choice: To a person standing on shore, an object dropped from the mast of a passing sailboat will trace what path, assuming negligible air resistance. Is it:

- w) vertical straight line
- x) slanted straight line
- y) parabola
- z) hyperbola

ANSWER: Y -- PARABOLA

PHYS-92; Multiple Choice: The energy dissipated when a car hits a tree at 70 miles per hour is ABOUT how much greater than that dissipated at 50 miles per hour?

- w) 20 percent
- x) 40 percent
- y) 70 percent
- z) 100 percent

ANSWER: Z -- 100 PERCENT

PHYS-92; Multiple Choice: What happens to the period of a pendulum if the mass of the bob is quadrupled?

- w) it is cut in half
- x) it stays the same
- y) it is doubled
- z) it is quadrupled

ANSWER: X -- IT STAYS THE SAME

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: According to the theory of relativity, people who travel at relativistic velocities and then return home will be:

- w) shorter than if they had not made the trip.
- x) taller than if they had not made the trip.
- y) younger than if they had not made the trip.
- z) older than if they had not made the trip.

ANSWER: Y -- YOUNGER THAN IF THEY HAD NOT MADE THE TRIP.

PHYS-92; Multiple Choice: Which of the following units of energy is the smallest:

- w) calorie
- x) Joule
- y) erg
- z) electron-volt

ANSWER: Z -- ELECTRON-VOLT

PHYS-92; Multiple Choice: Which of the following quantities has the GREATEST influence on the overall efficiency of a conventional (Rankine cycle) electric generating station burning fossil fuels?

- w) steam temperature at the steam turbine inlet
- x) net heating value of the fuel
- y) steam pressure at the steam turbine inlet
- z) pounds of ash and sulfur per pound of fuel

ANSWER: W -- STEAM TEMPERATURE AT THE STEAM TURBINE INLET

PHYS-92; Multiple Choice: The index of refraction of a plastic material is 1.5. The speed of light in this material relative to that in a vacuum is:

- w) 2
- x) 1.5
- y)  $2/3$
- z)  $1/2$

ANSWER: Y --  $2/3$



## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Four identical samples of a metal are heated to different temperatures. Based on the colors of their incandescences, which sample is the hottest? The sample that is:

- w) blue-white
- x) bright red
- y) yellow
- z) orange

ANSWER: W -- BLUE-WHITE

PHYS-92; Multiple Choice: A 5 kilogram mass is lifted at constant velocity from a shop floor by a rope that passes through a pulley attached to the shop's ceiling. Neglecting the mass of the rope and friction in the pulley, what is the approximate tension in the rope?

- w) 100 newtons
- x) 50 newtons
- y) 25 newtons
- z) 5 newtons

ANSWER: X -- 50 NEWTONS

PHYS-92; Multiple Choice: Ball "A" ROLLS down an inclined plane without slipping. An identical ball, Ball "B", SLIDES down the same inclined plane without rolling. Which of the following statements is true?

- w) Ball "A" has more kinetic energy
- x) Ball "B" has more kinetic energy
- y) their kinetic energies are the same
- z) their rotational kinetic energies are equal just after release

ANSWER: Y -- THEIR KINETIC ENERGIES ARE THE SAME

PHYS-92; Short Answer: An object located four focal lengths in front of a thin, converging lens is moved to within two focal lengths of the lens. As a result, does the size of the image produced by the lens increase, decrease or remain the same?

ANSWER: INCREASE

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: What is the wavelength in millimeters of a sound wave whose frequency is 35 KILOHERTZ. Assume the speed of sound is 350 METERS PER SECOND?

- w) 100 millimeters
- x) 1,000 millimeters
- y) 10 millimeters
- z) 1/10 millimeters

ANSWER: Y -- 10 MILLIMETERS

PHYS-92; Multiple Choice: Heat from the sun reaches the Earth by:

- w) conduction
- x) convection
- y) radiation
- z) none of the above

ANSWER: Y -- RADIATION

PHYS-92; Multiple Choice: What is a calorie?

- w) amount of heat required to raise one gram of water one degree Celsius.
- x) amount of work required to move one gram of water by one centimeter.
- y) amount of heat required to melt ice.
- z) amount of heat required to raise one gram of water one degree Fahrenheit

ANSWER: W -- AMOUNT OF HEAT REQUIRED TO RAISE ONE GRAM OF WATER ONE DEGREE CELSIUS

PHYS-92; Short Answer: To within 1 pound per square inch, what is the nominal pressure due to water at a depth of 100 feet below the surface of a body of water?

ANSWER: 43.3 POUNDS PER SQUARE INCH (accept 42.3 to 44.3)

PHYS-92; Multiple Choice: The energy of molecular motion in a gas appears in the form of:

- w) friction
- x) internal energy
- y) temperature
- z) potential energy

ANSWER: Y -- TEMPERATURE

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: It has been said that the universe will die an "entropy death". This means that:

- w) the universe will eventually explode.
- x) the universe will be at the same temperature everywhere.
- y) the universe will collapse into a black hole.
- z) matter and antimatter will never combine.

ANSWER: X -- THE UNIVERSE WILL BE AT THE SAME TEMPERATURE EVERYWHERE.

PHYS-92; Short Answer: What is the color of light emitted from an Argon-Ion laser?

ANSWER: GREEN or BLUE-GREEN

PHYS-92; Short Answer: The type of radiative scattering commonly associated with the atmosphere and the reason the sky is blue is called what?

ANSWER: RAYLEIGH SCATTERING

PHYS-92; Short Answer: Radiant energy emitted from a blackbody is only a function of what?

ANSWER: TEMPERATURE

PHYS-92; Multiple Choice: Two coal trains, one southbound, the other westbound, reach an over and under crossing at the same instant and each proceed at 40 kilometers per hour on their respective courses. Approximately how far apart are the lead cars two hours later, to the nearest kilometer?

- w) 80
- x) 113
- y) 136
- z) 160

ANSWER: X -- 113

PHYS-92; Short Answer: State the unit of electromagnetic induction.

ANSWER: GAUSS OR TESLA

## ***Science Bowl***

## PHYSICS

PHYS-92; Short Answer: Which of the laws of Thermodynamics is often invoked to discredit attempts at perpetual motion?

ANSWER: SECOND LAW OF THERMODYNAMICS

PHYS-92; Short Answer: A ball is dropped from a height of 256 feet. The acceleration due to gravity is 32 feet per second squared. How many seconds will it take for the ball to reach the ground?

ANSWER: 4

PHYS-92; Multiple Choice: A resistor of value  $R/2$  is connected in parallel with a resistor of value  $R/3$ . The voltage drop across the parallel combination is  $V$ . The total current supplied by the voltage source is:

- w)  $2 V/R$  (read: 2 V over R)
- x)  $3 V/R$  (read: 3 V over R)
- y)  $4 V/R$  (read: 4 V over R)
- z)  $5 V/R$  (read: 5 V over R)

ANSWER: Z --  $5 V/R$

PHYS-92; Multiple Choice: The idea that we CANNOT know both the position and velocity of a subatomic particle at the same time was formulated by:

- w) Einstein
- x) Heisenberg
- y) Fermi
- z) Schroedinger

ANSWER: X -- HEISENBERG

PHYS-92; Short Answer: Suppose a crane lifts a 900 kilogram wrecking ball 12 meters above a concrete slab. 105,840 Joules of potential energy are stored in the wrecking ball. Now the ball is dropped. When the ball is 6 meters above the concrete slab, what is its potential energy in Joules?

ANSWER: 52,920 JOULES

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: To create an enlarged real image using a concave mirror, the object must be placed:

- w) beyond the center of curvature.
- x) between the center and the focus.
- y) at the focus.
- z) closer than the focus.

ANSWER: X -- BETWEEN THE CENTER AND THE FOCUS.

PHYS-92; Multiple Choice: Which of the following iron core electromagnets creates the greatest amount of magnetic flux:

- w) 1,000 coils, 2 amps of current
- x) 250 coils, 7 amps of current
- y) 700 coils, 3 amps of current

ANSWER: Y -- 700 COILS, 3 AMPS OF CURRENT

PHYS-92; Multiple Choice: A car traveling at a constant velocity of 20 meters per second passes a second car which is initially at rest. The car which was at rest starts accelerating at 10 meters per second squared the instant it is passed by the first car. They will meet again in:

- w) 2 seconds
- x) 4 seconds
- y) 6 seconds
- z) 8 seconds

ANSWER: X -- 4 SECONDS

PHYS-92; Multiple Choice: A projectile is fired into the air at an angle of 23 degrees. At what other angle would this projectile have the same range if air resistance is neglected?

- w) 46 degrees
- x) 60 degrees
- y) 67 degrees
- z) 68 degrees

ANSWER: Y -- 67 DEGREES

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: At one atmosphere, a cylinder with movable piston contains 2,000 milliliters of gas. If the pressure is increased to 5 atmospheres and the temperature remains unchanged, what is the new volume of the gas?

- w) 10,000 milliliters
- x) 400 milliliters
- y) 1,000 milliliters
- z) 4,000 milliliters

ANSWER: X -- 400 MILLILITERS

PHYS-92; Multiple Choice: At zero degrees Celsius and one atmosphere (STP), the volume of a gas is 1,000 milliliters. If the temperature is increased to 25 degrees Celsius and the pressure is doubled, what is the new volume of the gas?

- w) 546 milliliters
- x) 500 milliliters
- y) 1,000 milliliters
- z) 273 milliliters

ANSWER: W -- 546 MILLILITERS

PHYS-92; Multiple Choice: The region of the electromagnetic spectrum immediately above the frequencies to which the human eye is sensitive is called:

- w) ir
- x) ultra-violet
- y) rf
- z) gamma ray

ANSWER: X -- ULTRA-VIOLET

PHYS-92; Short Answer: What is the WAVELENGTH of the carrier wave, in meters, of a radio station which is broadcasting at a frequency of 100 megahertz?

ANSWER: 3 METERS

PHYS-92; Short Answer: A piece of metal weighing 55 grams weighs only 50 grams when suspended in water. What is its specific gravity?

ANSWER: 11

## Science Bowl

## PHYSICS

PHYS-92; Short Answer: A British Thermal Unit, or BTU, is the amount of heat required to raise one pound of what material one degree Fahrenheit?

ANSWER: WATER

PHYS-92; Multiple Choice: For which of the following reasons is plutonium-238 used for generating electricity on spacecraft?

- w) It is an alpha emitter with long half-life.
- x) It is a beta emitter with high specific power.
- y) It occurs abundantly in nature.
- z) It has low specific power.

ANSWER: W -- IT IS AN ALPHA EMITTER WITH LONG HALF-LIFE.

PHYS-92; Multiple Choice: Enrichment of uranium by gaseous diffusion relies on the fact that uranium-235 diffuses through holes in the barriers more readily than uranium-238 does because uranium-235 is:

- w) a different chemical compound.
- x) a different wavelength.
- y) resistant to magnetism.
- z) slightly lighter than uranium-238.

ANSWER: Z -- SLIGHTLY LIGHTER THAN URANIUM-238.

PHYS-92; Short Answer: In a light-water reactor, the coolant is ordinary water. What is the moderator?

ANSWER: WATER or THE SAME WATER

PHYS-92; Multiple Choice: Of the following, which non-fissioning element is used in the cooling water of nuclear power plants to help control the rate of the fission reaction by absorbing neutrons:

- w) zirconium
- x) boron
- y) krypton
- z) cesium

ANSWER: X -- BORON

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: The part of a nuclear power plant that prevents thermal pollution of lakes or rivers is the:

- w) reactor
- x) coolant/moderator
- y) cooling tower
- z) control rod

ANSWER: Y -- COOLING TOWER

PHYS-92; Multiple Choice: The form of the fuel in U.S. commercial nuclear power plants is which of the following:

- w) uranium oxide ceramic pellets
- x) atomic vapor
- y) uranium metal tubes
- z) uranium solution in water

ANSWER: W -- URANIUM OXIDE CERAMIC PELLETS

PHYS-92; Multiple Choice: Which of the following is NEVER used as a coolant in nuclear reactors:

- w) liquid nitrogen
- x) liquid sodium
- y) water
- z) helium gas

ANSWER: W -- LIQUID NITROGEN

PHYS-92; Multiple Choice: In a breeder reactor, new fuel is formed as non-fuel uranium-238 absorbs a neutron and ultimately becomes which of the following fissionable atoms:

- w) uranium-235
- x) plutonium-239
- y) uranium-239
- z) neptunium-239

ANSWER: X -- PLUTONIUM-239



## ***Science Bowl***

## **PHYSICS**

PHYS-92; Multiple Choice: Of the following, which is the best fuel for a nuclear fusion reactor:

- w) hydrogen
- x) lithium
- y) deuterium
- z) helium

ANSWER: Y -- DEUTERIUM

PHYS-92; Multiple Choice: In a spent fuel assembly, the radioactive elements having the longest half-lives are the:

- w) fission products
- x) actinides
- y) activation products
- z) radioisotopes of lead

ANSWER: X -- ACTINIDES

PHYS-92; Multiple Choice: Reactors in commercial nuclear power plants in the U.S. are often referred to as thermal reactors. A thermal reactor uses:

- w) fissionable plutonium-239 as fuel.
- x) a relatively low heat output.
- y) neutrons moderated to relatively low energies.
- z) liquid sodium as a coolant.

ANSWER: Y -- NEUTRONS MODERATED TO RELATIVELY LOW ENERGIES.

PHYS-92; Multiple Choice: A fast reactor uses:

- w) an extremely short time to get to the maximum operating reactivity.
- x) uranium-235 as fuel.
- y) heavy water as a coolant.
- z) essentially unmoderated neutrons.

ANSWER: Z -- ESSENTIALLY UNMODERATED NEUTRONS.

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Most of the new atoms formed when atoms in a nuclear reactor capture neutrons without fissioning are:

- w) fission products
- x) activation products
- y) actinides
- z) lead isotopes

ANSWER: Y -- ACTINIDES

PHYS-92; Short Answer: Most of what we call background radiation comes from two sources. One is the naturally radioactive elements around us. What is the other source?

ANSWER: COSMIC RADIATION

PHYS-92; Short Answer: In 1932, the first ARTIFICIAL source of radiation was created in France by two famous scientists. Name the TWO scientists.

ANSWER: IRENE and FREDERIC (JOLIOT-)CURIE

PHYS-92; Multiple Choice: The average annual dose of NATURAL radiation by the average American is about:

- w) 3 millirems
- x) 30 millirems
- y) 300 millirems
- z) 3,000 millirems

ANSWER: Y -- 300 MILLIREMS

PHYS-92; Multiple Choice: In the fission of U235, what is the average number of neutrons produced in the fission reaction?

- w) 1.5
- x) 2.5
- y) 3.5
- z) 4.5

ANSWER: X -- 2.5

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Of the following, the most energetic form of NON-IONIZING radiation is:

- w) ultra-violet light
- x) infra-red light
- y) radar
- z) microwaves

ANSWER: W -- ULTRA-VIOLET LIGHT

PHYS-92; Short Answer: To within one minute, what is the half-life of the neutron?

ANSWER: 11.7 MINUTES (accept: 10.7 to 12.7 minutes)

PHYS-92; Multiple Choice: When radiation breaks an electron pair bond in a molecule and each fragment of the molecule gets one of the bond electrons, the molecular fragments that are formed are called:

- w) ions
- x) free radicals
- y) stable molecules
- z) gases

ANSWER: X -- FREE RADICALS

PHYS-92; Multiple Choice: The ability of an atom to absorb neutrons is its neutron capture cross section. The unit of measurement for neutron capture cross section is:

- w) the nucleus volume
- x) capture capacity
- y) resonance quotient
- z) barn

ANSWER: Z -- BARN

PHYS-92; Multiple Choice: In EXTRA-TERRESTRIAL SPACE, heat is transferred by:

- w) conduction
- x) convection
- y) conduction and convection
- z) radiation

ANSWER: Z -- RADIATION

## ***Science Bowl***

## PHYSICS

PHYS-92; Short Answer: A 100-watt light bulb is left on for 10 hours. Electricity is 10 cents per kilowatt-hour. How much did it cost to operate the light bulb?

ANSWER: 10 CENTS

PHYS-92; Short Answer: The position of a particle with respect to time is given by the equation:  $x = t^3 + 2$  where  $x$  is in feet and  $t$  is in seconds. What is the acceleration of the particle at a time of 2 seconds?

ANSWER: 12 FEET PER SECOND SQUARED

PHYS-92; Multiple Choice: The principle that energy may be converted from one form to another but it cannot be either created or destroyed is:

- w) First Law of Thermodynamics.
- x) Second Law of Thermodynamics.
- y) Third Law of Thermodynamics.
- z) Principle of photoelectricity.

ANSWER: W -- FIRST LAW OF THERMODYNAMICS.

PHYS-92; Multiple Choice: Photoelectric electricity is produced directly from solar energy when which of the following are absorbed in a semiconductor to create an electric current?

- w) protons
- x) electrons
- y) neutrons
- z) photons

ANSWER: Z -- PHOTONS

PHYS-92; Multiple Choice: A solar cell does NOT respond to red light, but DOES respond to green light. The solar cell will be able to respond to:

- w) microwaves
- x) infra-red light
- y) ultraviolet light
- z) all of the above

ANSWER: Y -- ULTRAVIOLET LIGHT

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: What is the theoretical limit of the efficiency of a single-crystal single-junction cell in a photovoltaic system?

- w) 9 percent
- x) 29 percent
- y) 79 percent
- z) 99 percent

ANSWER: X -- 29 PERCENT

PHYS-92; Short Answer: What is the ideal efficiency of a reversible heat engine cyclically operating between a source temperature of 600 degrees Kelvin and a sink temperature of 150 degrees Kelvin?

ANSWER: 75 PERCENT

PHYS-92; Multiple Choice: A four cycle internal combustion automobile engine operates on what kind of cycle?

- w) Rankine
- x) Otto
- y) Brayton
- z) Joule

ANSWER: X -- OTTO

PHYS-92; Multiple Choice: If materials become superconducting when cooled, any magnetic field will be expelled. This is called:

- w) diamagnetism
- x) repulsion
- y) the Landow Effect
- z) the Meissner effect

ANSWER: Z -- THE MEISSNER EFFECT

## ***Science Bowl***

## **PHYSICS**

PHYS-92; Short Answer: A kilogram of water goes from 90 degrees Celsius to 10 degrees Celsius in a period of 2 hours. If the specific heat of water is 4 kilojoules per kilogram per degree Celsius, how much heat has the water lost?

ANSWER: 320 KILOJOULES or 320,000 JOULES

PHYS-92; Short Answer: What is the total resistance of three 15-ohm resistors connected in parallel?

ANSWER: 5 OHMS

PHYS-92; Multiple Choice: A proton and an alpha particle pass through the gap of a strong magnet. If both particles have the same initial velocity, how many times greater will the deflection of the proton be relative to the deflection of the alpha particle? Will it be:

- w) the same
- x) 2 times
- y) 4 times
- z) 8 times

ANSWER: X -- 2 TIMES

PHYS-92; Short Answer: Pendulum "A" swings through one complete oscillation in one second. If Pendulum "B" is four times as long as Pendulum "A", how long does it take Pendulum "B" to swing through one complete oscillation?

ANSWER: 2 SECONDS

PHYS-92; Short Answer: An electric clothes dryer is connected to a 100-volt source. How much current does it use if it requires 2,000 watts of electric power?

ANSWER: 20 AMPERES

PHYS-92; Short Answer: The actual mechanical advantage of a block and tackle is 5. The ideal mechanical advantage is 6. How many strands support the mass to be lifted?

ANSWER: 6

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Planck's constant was first introduced in order to obtain a correct theoretical prediction of:

- w) the distribution of frequencies occurring in black body radiation.
- x) the energy produced by the transformation of mass into energy.
- y) the speed of light.
- z) lifetime of the neutron.

ANSWER: W -- THE DISTRIBUTION OF FREQUENCIES OCCURRING IN BLACK BODY RADIATION

PHYS-92; Multiple Choice: The theory which ascribes wave-like properties to particles is called:

- w) general relativity
- x) quantum mechanics
- y) special relativity
- z) classical mechanics

ANSWER: X -- QUANTUM MECHANICS

PHYS-92; Multiple Choice: The magnitude of the quarks' electric charge is:

- w) zero.
- x) greater than the electron's charge.
- y) equal to the electron's charge.
- z) less than the electron's charge.

ANSWER: Z -- LESS THAN THE ELECTRON'S CHARGE.

PHYS-92; Short Answer: What important property of light is demonstrated by the photoelectric effect?

ANSWER: PARTICLE NATURE OF LIGHT

PHYS-92; Short Answer: The magnetic pressure of a 0.5 Tesla field is about one atmosphere. What is the pressure of a 4 Tesla field?

ANSWER: 64 ATMOSPHERES (PROPORTIONAL TO B<sup>2</sup>)

## ***Science Bowl***

## PHYSICS

PHYS-92; Multiple Choice: Weather satellites transmit cloud cover and temperature-humidity profiles back to Earth using images of which combination of the electromagnetic radiation types?

- w) infra-red and visible light
- x) ultraviolet and nuclear magnetic
- y) ultraviolet and infra-red
- z) ultraviolet and visible light

ANSWER: W -- INFRA-RED AND VISIBLE LIGHT

PHYS-92; Short Answer: In a nuclear power reactor, fission produces heat which is used to produce electricity. A reactor producing more fissionable material than it consumes is known as what kind of reactor?

ANSWER: BREEDER REACTOR

PHYS-92; Short Answer: Processes which occur without the addition or withdrawal of heat from the surrounding are called what?

ANSWER: ADIABATIC

PHYS-92; Short Answer: The velocity of a ball tossed vertically into the air is expressed by the equation  $v(t) = -32t + 4$ , where  $t$  is given in seconds. Give the velocity of the ball when it reaches its highest point.

ANSWER: 0

PHYS-92; Multiple Choice: An object is located 1 meter in front of a converging lens having a focal length of 20 centimeters. At what distance behind the lens (whose thickness is negligible) will the image be formed?

- w) 18 centimeters
- x) 20 centimeters
- y) 22 centimeters
- z) 25 centimeters

ANSWER: Z -- 25 CENTIMETERS



## ***Science Bowl***

## **PHYSICS**

PHYS-92; Short Answer: A 50 millimeter focal length camera lens photographs a 4 meter tall tree at a distance of 20 meters. How tall is the image of the tree?

ANSWER: 10 MILLIMETERS

PHYS-92; Multiple Choice: What reflecting surface forms a geometrically perfect image of a point source located at infinity (such as that approximated by a star)?

- w) Paraboloid
- x) Ellipsoid
- y) spherical
- z) Hyperboloid

ANSWER: W -- PARABOLOID

PHYS-92; Multiple Choice: The dominant charge carriers in p-type semiconductors are:

- w) neutrons
- x) electrons
- y) protons
- z) holes

ANSWER: Z -- HOLES

PHYS-92; Multiple Choice: Imagine that a 20 mile diameter hole is bored along the diameter of the Earth extending from the North Pole to the South Pole, that all air and gases are pumped out of this hole, and that the temperature throughout this hole is maintained at 300 Kelvins. A boy throws a ping pong ball into this hole. The ping pong ball would:

- w) fall to the center of the Earth and remain forever suspended there.
- x) fall to the opposite side of the Earth's surface and remain forever suspended there.
- y) forever oscillate in simple harmonic motion along the hole between the loci of the hole with the opposite surfaces of the Earth.
- z) none of the above.

ANSWER: Y -- FOREVER OSCILLATE IN SIMPLE HARMONIC MOTION ALONG THE HOLE

## Science Bowl

## PHYSICS

PHYS-92; Multiple Choice: An automobile needs an antenna for its radio to play properly because:

- w) the automobile's tires insulate it from the ground.
- x) the automobile's body acts as a Faraday cage.
- y) when the automobile moves, the velocity of the radio signal appears changed with respect to when it is at rest.
- z) the transmitter also uses an antenna.

ANSWER: X -- THE AUTOMOBILE'S BODY ACTS AS A FARADAY CAGE.

PHYS-92; Short Answer: Name any THREE of the four elements that are ferromagnetic at room temperature (25 degrees Celsius).

ANSWER: IRON (FE); COBALT (CO); NICKEL (NI); GADOLINIUM (GD)

PHYS-92; Short Answer: Estimate the number of atoms comprising a silicon chip that is 0.2 millimeters by 0.2 millimeters by 0.1 millimeters, given that the density of silicon is 2.34 grams per cubic centimeter, the number of atoms in a gram-weight is approximately  $6 \times 10^{23}$  atoms, and the atomic weight of silicon is 28:

ANSWER:  $2 \times 10^{17}$

PHYS-92; Multiple Choice: A man picks up a 50 kilogram block and carries it up a flight of stairs 10 meters high. He then carries the block back down the stairs and places the block in its original position. What is the NET work done on the block?

- w) 1,000 joules
- x) 750 joules
- y) 500 joules
- z) 0 joules

ANSWER: Z -- 0 JOULES

PHYS-92; Multiple Choice: What is the atomic number of Antimony?

- w) 33
- x) 51
- y) 85
- z) 122

ANSWER: X -- 51

## ***Science Bowl***

## PHYSICS

PHYS-92; Short Answer: What kind of particles will be accelerated in the Superconducting Super Collider?

ANSWER: PROTONS

PHYS-92; Multiple Choice: The Superconducting Super Collider will produce collisions with an energy of:

- w) 40 joules
- x) 40 MeV
- y) 40 TeV
- z) 200 TeV

ANSWER: Y -- 40 TeV

PHYS-92; Multiple Choice: Superconducting materials are being used in the Superconducting Super Collider to:

- w) cool the particles.
- x) minimize electrical power consumption.
- y) maximize the acceleration potentials.
- z) provide radiation shielding.

ANSWER: X -- MINIMIZE ELECTRICAL POWER CONSUMPTION.

PHYS-92; Multiple Choice: One of the particles expected to be discovered at the Superconducting Super Collider is the:

- w) Higg's boson.
- x) tau meson.
- y) tachyon.
- z) anti-proton.

ANSWER: W -- HIGG'S BOSON.

PHYS-93; Multiple Choice: For a parallel connection of light bulbs, which of the following statements is correct?

- w) The resistance of each light bulb must be the same.
- x) If one goes out they all go out.
- y) Each of the light bulbs operates independently.

ANSWER: Y -- EACH OF THE LIGHT BULBS OPERATES INDEPENDENTLY.

## ***Science Bowl***

## **PHYSICS**

PHYS-93; Multiple Choice: Which of the following pair are vector quantities?

- w) time and space
- x) force and momentum
- y) energy and time
- z) momentum and mass
- e) mass

ANSWER: X -- FORCE and MOMENTUM

PHYS-93; Short Answer: A force of 15 newtons is acting on an object which has a mass of 3 kilograms. If this is the only force acting on the object, what is the acceleration of the object?

ANSWER: 5 METERS PER SECOND SQUARED

PHYS-93; Multiple Choice: An object with a mass of 5 kilograms is a distance of 5 meters above the surface of the earth. If the acceleration due to gravity is 10 meters per second squared, the potential energy of the object relative to the surface of the earth is:

- w) 10 joules
- x) 20 joules
- y) 100 joules
- z) 250 joules
- e) none of the above

ANSWER: Z -- 250 JOULES

PHYS-93; Multiple Choice: For a body to be in equilibrium, which of the following conditions must exist?

- w) no forces may be acting on the body.
- x) the body must be accelerating.
- y) the velocity of the body must be zero.
- z) the sum of the forces acting on the body must be equal to zero.

ANSWER: Z -- THE SUM OF THE FORCES ACTING ON THE BODY MUST BE EQUAL TO ZERO.

## ***Science Bowl***

## PHYSICS

PHYS-93; Multiple Choice: Newton's first law is often referred to as which of the following?

- w) The law of straight-line motion.
- x) The law of momentum
- y) The law of inertia
- z)  $F = ma$  (Spell out M-A)

ANSWER: Y -- THE LAW OF INERTIA

PHYS-93; Multiple Choice: The statement, "In regions where fluid velocity is smaller, the pressure is higher, and vice versa", is known as the principle of:

- w) Pascal
- x) Bernoulli
- y) Torricelli
- z) Archimedes

ANSWER: X -- BERNOULLI

PHYS-93; Multiple Choice: Relative to its period on the earth, is the period of a pendulum on the moon:

- w) shorter
- x) longer
- y) remain unchanged

ANSWER: X -- LONGER

PHYS-93; Multiple Choice: Two bodies each have a mass 'M'. If the mass of each body is doubled, the force of attraction between the two bodies is:

- w) twice the original force
- x) 1/4 the original force
- y) 4 times the original force
- z) unchanged

ANSWER: Y -- 4 TIMES THE ORIGINAL FORCE

## ***Science Bowl***

## **PHYSICS**

PHYS-93; Multiple Choice: An object in equilibrium always has zero:

- w) velocity
- x) momentum
- y) mass
- z) acceleration.

ANSWER: Z -- ACCELERATION

PHYS-93; Multiple Choice: Which of the following is NOT an SI unit of measure?

- w) watt
- x) newton
- y) joule
- z) erg
- e) second

ANSWER: Z -- ERG

PHYS-93; Multiple Choice: A body which is attached to a spring undergoes simple harmonic motion. The magnitude of the body's acceleration is:

- w) constant
- x) proportional to its displacement from its equilibrium position
- y) zero
- z) always increasing.

ANSWER: X -- PROPORTIONAL TO ITS DISPLACEMENT FROM ITS EQUILIBRIUM POSITION

PHYS-93; Multiple Choice: If the resultant force acting on a body of constant mass is zero, the body's acceleration is:

- w) increasing
- x) decreasing
- y) always zero
- z) negative.

ANSWER: Y -- ALWAYS ZERO

PHYS-93; Short Answer: What is the name of the Scottish physicist who developed the mathematical explanation of the theory of light?

ANSWER: (JAMES CLERK) MAXWELL

## ***Science Bowl***

## **PHYSICS**

PHYS-93; Short Answer: Who received the Nobel Prize in Physics in 1923 for his experiment which measured the charge of the electron. The experiment consisted of allowing drops of oil which had become charged to fall in an electric field.

ANSWER: (ROBERT ANDREWS) MILLIKAN

PHYS-93; Short Answer: Who received the Nobel Prize in Physics in 1922 for his theory which predicted the electron orbits of the Hydrogen atom?

ANSWER: (NIELS) BOHR

PHYS-93; Short Answer: Who was the first female to be awarded the Nobel Prize in Physics?

ANSWER: MARIE SKLOWDOWSKA-CURIE or MADAM CURIE

PHYS-93; Short Answer: A current of 6 amperes flows through a 2 ohm resistor for 30 seconds. How many coulombs of charge have passed through the resistor?

ANSWER: 180 COULOMBS

PHYS-93; Short Answer: The potential difference across a 4 ohm resistor is 20 volts. What is the current in the resistor?

ANSWER: 5 AMPS

PHYS-93; Short Answer: At a point directly east of a negative point charge, the electric field points in what direction?

ANSWER: WEST

PHYS-93; Multiple Choice: The temperature of a gas is held constant while its volume is reduced. The pressure the gas exerts on the walls of its container increases because its molecules:

- w) strike the container walls more often
- x) strike the container walls with higher speeds
- y) strike the container walls with greater force
- z) all of the above

ANSWER: W -- STRIKE THE CONTAINER WALLS MORE OFTEN

## ***Science Bowl***

## PHYSICS

PHYS-93; Multiple Choice: The electric field of a point charge varies:

- w) linearly with distance and inversely with charge
- x) linearly with distance and inversely with charge squared
- y) linearly with charge and inversely with distance squared
- z) linearly with charge and inversely with distance

ANSWER: Z -- LINEARLY WITH CHARGE AND INVERSELY WITH DISTANCE

PHYS-93; Short Answer: A two farad and a four farad capacitor are connected in parallel. What single capacitance is "equivalent" to this combination?

ANSWER: 6 FARADS

PHYS-93; Short Answer: A current of 5 amps passes through a 10 ohm resistor. What power is dissipated by this resistor under these conditions?

ANSWER: 250 WATTS

PHYS-93; Short Answer: Is the filament resistance lower or higher in a 500 watt light bulb than in a 100 watt light? Assume that both bulbs have been designed to operate at 110 volts.

ANSWER: LOWER

PHYS-93; Short Answer: A five ohm and a ten ohm resistor are connected in parallel, what single resistance is "equivalent" to this combination?

ANSWER: 3 AND 1/3 OHM

PHYS-93; Multiple Choice: Three resistors which have different values are connected in series. Which one of the following statements is correct?

- w) The potential drop across all three resistors is the same.
- x) The same current passes through all three resistors.
- y) The same power is dissipated by all three resistors.

ANSWER: X -- THE SAME CURRENT PASSES THROUGH ALL THREE RESISTORS.



## ***Science Bowl***

## PHYSICS

PHYS-93; Multiple Choice: A beam of light is incident on a perfectly smooth body of water. The angle that the REFLECTED ray makes with the normal is:

- w) greater than
- x) smaller than
- y) the same as the angle the incident ray makes with the normal.

ANSWER: Y -- THE SAME AS

PHYS-93; Multiple Choice: A beam of light is incident on a large block of glass. The index of refraction of the glass is greater than one. Is the wavelength of the light in the glass:

- w) longer than
- x) shorter than
- y) the same as the wavelength of the light in the air?

ANSWER: X -- SHORTER THAN

PHYS-93; Short Answer: The focal length of a concave mirror is 2 meters. An object is positioned 8 meters in front of the mirror. Is the image of this object real or virtual?

ANSWER: REAL

PHYS-93; Short Answer: A converging thin lens has a focal length of 27 centimeters. An object is placed 9 centimeters from the lens. Is the image of the object real or virtual?

ANSWER: VIRTUAL

PHYS-93; Short Answer: Light has wavelength, frequency, and speed. Which, if any, of these quantities remains unchanged when light passes from a vacuum into a block of glass?

ANSWER: FREQUENCY

PHYS-93; Multiple Choice: Which of the following waves is not a transverse wave?

- w) a wave traveling on a string
- x) an electromagnetic wave
- y) a sound wave

ANSWER: Y -- A SOUND WAVE

## ***Science Bowl***

## PHYSICS

PHYS-93; Short Answer: Assume that a ray of light passes from glass into air at an angle of incidence greater than zero degrees. Will the ray of light be bent toward or away from the normal as it passes into the air?

ANSWER: AWAY FROM

PHYS-93; Short Answer: If one looks at a point P on the bottom of a swimming pool, one sees an image point P prime. Is the image point, P prime, a real or a virtual image?

ANSWER: VIRTUAL

PHYS-93; Multiple Choice: A real image can be formed by which of the following single mirrors?

- w) a plane mirror
- x) a concave spherical mirror
- y) a convex spherical mirror

ANSWER: X -- A CONCAVE SPHERICAL MIRROR

PHYS-93; Multiple Choice: If two different gases have the same volume, temperature, and pressure and behave like ideal gases, they will also be identical in which one of the following ways?

- w) average molecular velocity
- x) total mass
- y) total molecular kinetic energy
- z) average momentum per molecule

ANSWER: Y -- TOTAL MOLECULAR KINETIC ENERGY

PHYS-93; Short Answer: The frequency of a wave is 2/10 Hertz. What is the period of this wave?

ANSWER: 5 SECONDS

## ***Science Bowl***

## PHYSICS

PHYS-93; Multiple Choice: As a source of sound approaches a stationary listener, the apparent wavelength:

- w) increases
- x) decreases
- y) stays the same.

ANSWER: X -- DECREASES

PHYS-93; Multiple Choice: The particle nature of light is demonstrated by which of the following?

- w) the photoelectric effect
- x) the various colors of light
- y) the speed of light
- z) diffraction.

ANSWER: W -- THE PHOTOELECTRIC EFFECT

PHYS-93; Multiple Choice: A wavelength is commonly measured in which one of the following units?

- w) radians
- x) angstroms
- y) electron volts
- z) seconds

ANSWER: X -- ANGSTROMS

PHYS-93; Multiple Choice: Which of the following three nuclear radiations is the most penetrating?

- w) alpha
- x) beta
- y) gamma

ANSWER: Y -- GAMMA

## *Science Bowl*

## PHYSICS

PHYS-93; Multiple Choice: An electrical current in a superconducting ring will theoretically flow unchanged for:

- w) several milliseconds
- x) a second
- y) several weeks
- z) forever

ANSWER: Z -- FOREVER

PHYS-93; Short Answer: What three colors form the picture in a color tv?

ANSWER: RED GREEN BLUE

PHYS-93; Short Answer: What is the name of the process whereby waves travel around corners and obstacles in their paths?

ANSWER: DIFFRACTION

PHYS-93; Multiple Choice: The physicist Chadwick is known for his association with:

- w) the alpha particle
- x) the neutron
- y) the cloud chamber
- z) the electron

ANSWER: X -- THE NEUTRON

PHYS-93; Multiple Choice: A color with a wavelength longer than that of yellow is:

- w) red
- x) blue
- y) violet
- z) green

ANSWER: W -- RED

## ***Science Bowl***

## PHYSICS

PHYS-93; Multiple Choice: The knot is a nautical measure of:

- w) length
- x) speed
- y) acceleration
- z) displacement

ANSWER: X -- SPEED

PHYS-93; Multiple Choice: Assuming constant gravity and no air resistance, the path of a cannonball fired from a cannon is:

- w) a semi-circle
- x) an ellipse
- y) a parabola
- z) a hyperbola

ANSWER: Y -- A PARABOLA

PHYS-93; Multiple Choice: As you go up a mountain top, your weight:

- w) increases slightly
- x) decreases slightly
- y) remains exactly the same.

ANSWER: X -- DECREASES SLIGHTLY

PHYS-93; Multiple Choice: The shape of a magnetic field around a long straight current carrying wire is:

- w) elliptical.
- x) square
- y) varies depending on the magnitude of the current
- z) circular

ANSWER: Z -- CIRCULAR

PHYS-93; Short Answer: What number represents the ratio of speed of an object to the speed of sound in the surrounding air?

ANSWER: MACH NUMBER

## ***Science Bowl***

## PHYSICS

PHYS-93; Multiple Choice: Of the following answers, which is the frequency closest to middle-C on a piano?

- w) 20
- x) 256
- y) 2520
- z) 25200

ANSWER: X -- 256

PHYS-93; Multiple Choice: The non-relativistic mass of an object

- w) must be the same as its weight
- x) depends on where you measure it
- y) does not change with increasing velocity
- z) is greatest at the poles

ANSWER: Y -- DOES NOT CHANGE WITH INCREASING VELOCITY

PHYS-93; Multiple Choice: A ball is thrown horizontally from the top of a cliff. Assuming no air resistance, the acceleration of the ball while it is in flight is:

- w) in the vertical direction only
- x) in the horizontal direction only
- y) in the vertical and horizontal directions
- z) zero.

ANSWER: W -- IN THE VERTICAL DIRECTION ONLY

PHYS-93; Multiple Choice: While traveling in a straight line, a car uniformly changes its speed from 50 kilometers per hour to 110 kilometers per hour in 5 seconds. The acceleration of the car during this time is:

- w) 5 kilometers per hour per second
- x) 12 kilometers per hour per second
- y) 50 kilometers per hour per second
- z) 60 kilometers per hour per second

ANSWER: X -- 12 KILOMETERS PER HOUR PER SECOND

***Science Bowl***

**PHYSICS**

PHYS-93; Multiple Choice: If there is to be a change in velocity, there MUST be a change in

- w) speed only
- x) direction only
- y) either speed or direction
- z) both speed and direction

ANSWER: Y -- EITHER SPEED OR DIRECTION

PHYS-93; Multiple Choice: Susan pushes against a 100 kilogram rock with a force of 5 Newtons, but the rock doesn't move. The force the rock exerts on Susan is

- w) 0 Newtons
- x) 5 Newtons
- y) 20 Newtons
- z) 100 Newtons

ANSWER: X -- 5 NEWTONS