SECOND YEAR PHYSICS TEST - MARCH, 2012

DIRECTIONS: For each statement or question, completely fill in the appropriate space on the answer sheet. Use the letter preceding the word or phrase or sketch which best completes the statement or answers the question. Each question is worth 4 points. Use **9.8 m/s²** as the value of the acceleration due to gravity. Unless otherwise stated assume ideal conditions including no friction with the air. Sketches are not to scale. All motion is to be treated as non-relativistic. All current, unless otherwise described, is traditional current in the direction of the flow of positive charge.

Charge on the electron = 1.6×10^{-19} Coul. Proton mass = 1.67×10^{-27} kg Electron mass = 9.1×10^{-31} kg $k = 9\times10^{+9}$ Newton-meter^{+2}/ Coul^{+2} Wires and switches have no resistance.

1. Given a charged particle moving in a circular path in a plain perpendicular to a uniform magnetic field. Of the following four quantities, which remain constant as the particle goes around in circular motion.

I. radius of its circle II. momentum III. energy IV. time for a revolution

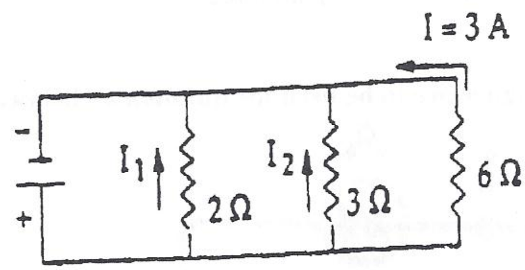
A) All four B) I, II, and III C) I, II, and IV D) I, III, and IV E) I only

2. The unit Farad could be expressed ___

A) Coulomb/Volt B) Volt Coulomb C) Ampere Volt

D) Ampere second E) Volt/Coulomb

The following description and figure are to be used for question #3 below.



3. Given three resistors, (2 ohms, 3 ohms, and 6 ohms , arranged in parallel with an ideal emf. The directions of the currents in the resistors are shown. The current is 3 amperes in the 6 ohm resistor.

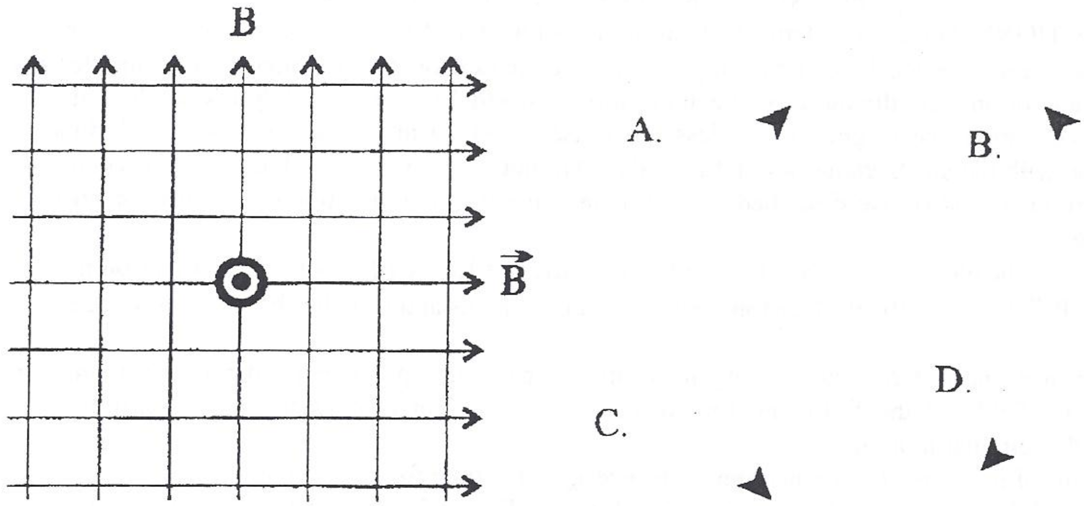
The equivalent resistance of the three resistors is ___ ohm(s) .

A) 18 B) 11 C) 9 D) 61 E) 1

4. Electric field lines ____ .

A) indicate the direction of electric force on a positive charge
B) cannot cross magnetic field lines
C) cannot be used to show relative electric field strength
D) form closed loops
E) are always drawn in red

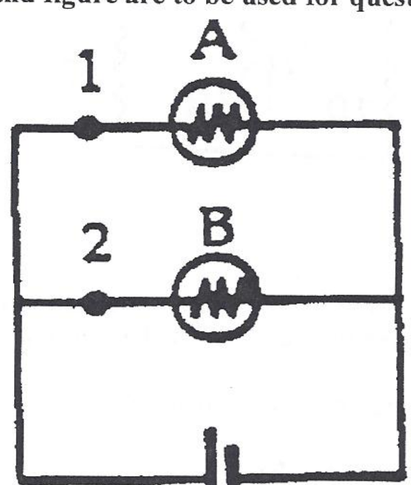
The following description and figures are to be used for question #5 below.



5. Given a vertical straight wire placed in a horizontal magnetic field. The wire has a constant current pointing upward perpendicular to the page. The magnetic field is formed by two horizontal uniform magnetic fields. One magnetic field points south to north while the other points west to east (they are perpendicular to each other). As a result, there is a force on the vertical wire. The force is in the direction indicated by arrow ___ .

A) A B) B C) C D) D E) no force

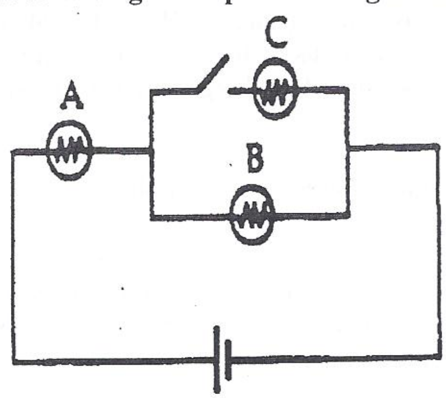
The following description and figure are to be used for question #6 below.



6. The figure above represents two identical light bulbs, A and B, that are connected to an ideal emf. Then, a very low resistance wire is attached joining points 1 and 2. As a result, ____.

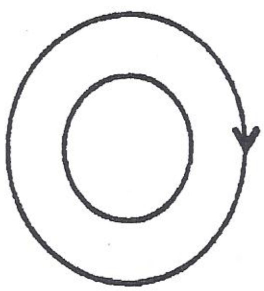
A) the brightness of the bulbs is unchanged
B) neither bulb lights
C) the brightness of A and B increases
D) the brightness of A and B decreases
E) the brightness of A increases and of B decrease

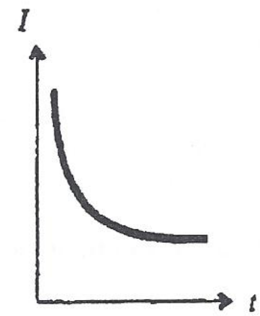
The following description and figure are to be used for the question below, question 7



7. Given three identical light bulbs connected with a switch and ideal emf as shown.
When the switch is closed, the brightness ____ .
A) of A decreases and of B decreases
B) of A increases and of B is unchanged
C) of A increases and of B increases
D) of A increases and of B decreases
E) of A and of B does not change

The following description and figures are to be used for the question #8





8. Given two concentric horizontal wire circles as shown. There is a clockwise current in the outer wire. The current is decreasing exponentially with time. As a result, a current is induced in the inner circle. The induced current is __

A) in the clockwise direction and increasing
B) in the counterclockwise direction and increasing
C) in the clockwise direction and decreasing
D) in the counterclockwise direction and decreasing
E) --- no current is induced ---

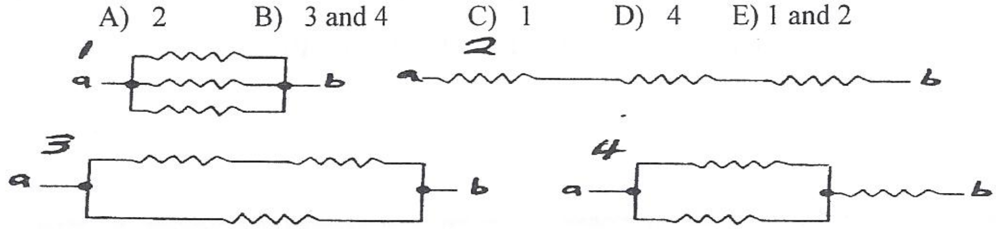
9. Given two parallel plate capacitors with a vacuum between the metal plates. The plates are squares with equal sides. Capacitor one, C1, has a plate separation half the plate separation between the plates of capacitor 2, C2 . Equal charges are placed on the capacitors. The potential difference across the plates of capacitor one is___ times the potential difference across the plates of capacitor two.

A) 4 B) 2 C) 1 D) 0.5 E) 0.25

The following description and figures are to be used for the question below, question 10

10. Given three identical resistors arranged in different circuits. If an ideal emf is applied across points a and b in each circuit, for which of the four arrangement(s) of the three resistors shown below will the potential difference be the same across each resistor in the circuit? Only circuit(s) ___

A) 2 B) 3 and 4 C) 1 D) 4 E) 1 and 2



The following description is to be used for questions 11, and 12

11, 12 Given three thin walled hollow metal spheres. Sphere one, S1, has a radius of 0.04 m. Sphere two, S2, has a radius of 0.08m, Sphere three, S3, has a radius of 0.12 m . They are in contact and charged so that each has a potential difference of V volts. The charge on S1 is Q . The spheres are separated.

11 At a point 0.04 m from the center of sphere two the potential difference is ___ Volts .

A) zero B) V/4 C) V/2 D) V E) 2V

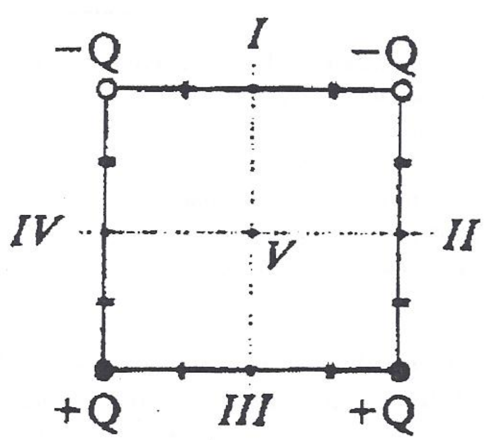
12. Determine the electric field strength 0.06 m from the center of each sphere. Rank order in descending order the magnitudes of the electric field strength, E1, E2, E3,of spheres S1, S2, S3, respectively, placing the largest first. Indicate a tie with an equals sign (=)

A) E1, E2, E3 B) E1 = E2 = E3 C) E1, E2 = E3 D) E1 = E2, E3 E) E2 = E3, E1

13. Two charged particles held close to each other are released. As they move, the force on each particle decreases. Therefore, the charges on the particles __

A) must both be positive
B) must both be negative
C) must both have the same sign, either both positive or both negative
D) must have opposite signs
E) could have opposite signs or only one is charged

The following description and figure are to be used for question #14 below,

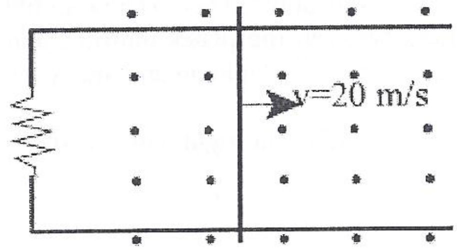


14. Given a square with charges of equal magnitude at its corners. The charges at the lower corners are positive, while those at the upper corners are negative. Given five points as shown. Four are at the midpoint of the sides of the square. Point V is at the center of the square. Rank order in descending order the magnitude of the electric field strength at each of the five points, placing the largest first. Indicate a tie with an equals sign (=)

A) V, IV, III , II, I B) IV = II, V, I = III

C) IV = III, V, I = II D) V, IV = II, III = I E) I = II = III = IV, V

The following description and figure are to be used for ques. 15 and 16



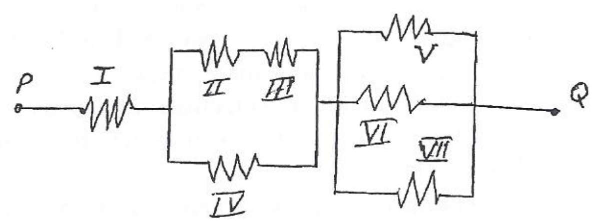
15, 16 Given a wire sliding to the right at a constant speed of 20 m/s. The wire lays across a pair of horizontal frictionless wires serving as "tracks" which are separated by 0.20 m. The wire is moving perpendicular to a vertical constant magnetic field of 2.5 Tesla pointing upward perpendicular to the page. **All** of the apparatus is in the magnetic field. The resistor in the circuit to the left is 10.0 ohms

15. The power dissipated by the 10 ohm resistor is ___ W .
A) 22 B) 10 C) 6 D) 2 E) 0.5

16. If the rails were twice as far apart and the wire joining them were twice as long, the power dissipated by the resistor would be ___ times as large as when the separation was 0.20 m .
A) 4 B) 2 C) 1 D) one-half E) one-quarter

The figure and description to the right are for questions 17 and 18

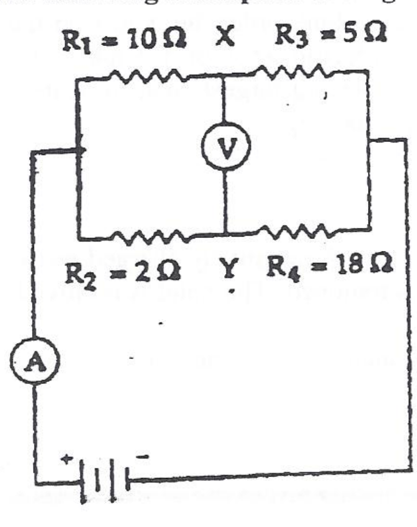
17 and 18 Given 7 resistors arranged as shown to the right. Resistors numbered 1 through 4 are ten ohm resistors. Resistors numbered 5 through 7 are twenty ohm resistors. An ideal emf of 140 volts is attached across the ends (across P and Q).of the arrangement of 7 resistors



17. The current from the emf is ___ A .
A) 3/140 B) 3/70 C) 1.4 D) 4.0 E) 6.0

18. If the potential difference across resistor IV (10 ohms) were 40 volts, the power dissipated by resistor VI, (20 ohms) would be ___ Watts.
A) 20 B) 40 C) 60 D) 80 E) 100

The following description and figure are to be used for the question below, question 19



19. Given four resistors joined in two parallel branches as shown. The voltmeter, V, reads 8.5 volts with point Y the plus or higher end. The current in the 2 ohm resistor is ___ A .

A) 0.5 B) 0.75 C) 1.0 D) 1.5 E) 2.0

The following description is used for questions 20, 21, and 22

20, 21, and 22 Given a vertical parallel plate capacitor. The plates are metal, square (0.05 m on a side) , and 0.02 m apart. The left plate is positive. The right plate is negative. There is a potential difference between the plates of 250 volts. Consider the field between the plates uniform and ignore any fringing at the edges. A tiny particle with a charge of 8×10^{-19} Coulomb and mass 10^{-20} kg and is initially at rest very near the left plate.

20. Under the effect of the field the particle moves from the left plate to the right and "crashes" into the right plate with a kinetic energy of approximately ___ J .

A) 10^{-6} B) 10^{-9} C) 10^{-12} D) 10^{-16} E) 10^{-19}

21. The magnitude of the electric field between the plates is ___ N/ Coul .

A) 12,500 B) 500 C) 120 D) 5.0 E) 0.5

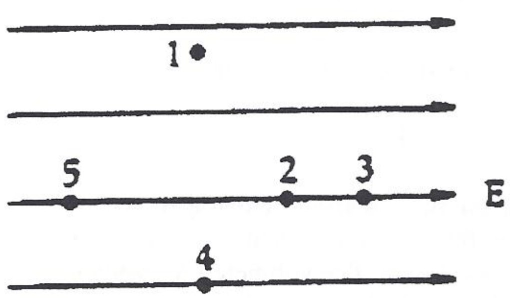
22. A proton is projected into the space between the plates. It is moving vertically downward and is perpendicular to the electric field. It enters the field just to the right of the left plate (positive) and exits the field just to the left of the negative plate. In its vertical path it descends 0.05 m while traveling a horizontal distance of 0.02 m. The proton enters the field moving at a minimum speed to achieve the path. Its speed is approximately ___ m/s The mass of the proton is 1.67×10^{-27} kg .

A) 10^{+7} B) 10^{+6} C) 10^{+5} D) 10^{+4} E) 10^{+3}

23. A proton and an electron are accelerated from rest by a potential difference of 1000 V.

A) The proton gains more energy than the electron and has a higher speed
B) The electron gains more energy than the proton and has a higher speed
C) The proton and the electron gain the same amount of energy and have the same speed.
D) The proton and the electron gain the same amount of energy and the electron has the higher speed
E) The proton and the electron gain the same amount of energy and the proton has the higher speed.

The figure and description below are to be used for question 24



24. Given a uniform electric field pointing from left to right, as shown in the figure. At point one, P1, there is a mass m. At point two, P2, there is a mass of 2m. At point three, P3, there is a mass of 3m. At point four , P4,there is a mass 4m. At point five, P5, there is a mass 5m. There is a charge q on each mass. Rank order the points on the basis of the electric force on the mass at a given point, placing largest first. Indicate a tie with an equals sign.

A) 1, 2, 3, 4, 5 B) 5, 1 =4, 2, 3 C) 3 = 2 = 5, 1 = 4
D) 1 = 4, 3 = 2 = 5 E) 1 = 2 = 3 = 4 = 5

25. Given a small metal sphere with a positive electric charge on it. A negatively charged rod is held near the sphere. A hand is placed on the sphere. The rod is removed. The hand is removed. The charge on the sphere is ___.

A) more positive than originally B) as positive as originally C) neutral
D) negative but equal in magnitude to the original positive
E) negative, but less in magnitude than the original positive

PHYSICS FORMULAE

MECHANICS

$\bar{v} = \frac{\Delta x}{\Delta t}$

$\bar{a} = \frac{\Delta v}{\Delta t}$

$v_f = v_i + at$

$\Delta x = v_i t + \frac{1}{2}at^2$

$2a\Delta x = v_f^2 - v_i^2$

$\Sigma F = ma$

$W = mg$

$F_g = G\frac{m_1 m_2}{r^2}$

$\rho = mv$

$F\Delta t = m\Delta v$

$\mu = \frac{F_f}{F_N}$

Δx = displacement (change of position)

$\bar{v}$ = average velocity

$\bar{a}$ = average acceleration

v_i = initial velocity

v_f = final velocity

F = force

F_f = force of friction

F_N = normal force

F_g = gravitational force

G = Universal Gravitational Constant

ρ = momentum

μ = coefficient of friction

r = distance between center of masses

W = weight

ELECTRICITY AND MAGNETISM

$F_e = k\frac{q_1 q_2}{r^2}$

$E = \frac{F}{q}$

$V = \frac{W}{q} = Ed$

$I = \frac{\Delta q}{\Delta t}$

$V = IR$

$P = VI = I^2 R = \frac{V^2}{R}$

SERIES CIRCUIT

$I_T = I_1 = I_2 = I_3 = \ldots$

$V_T = V_1 + V_2 + V_3 + \ldots$

$R_T = R_1 + R_2 + R_3 + \ldots$

PARALLEL CIRCUITS

$I_T = I_1 + I_2 + I_3 + \ldots$

$V_T = V_1 = V_2 = V_3 = \ldots$

$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$

E = electric field intensity

I = electric current

k = electrostatic constant

$k = 9 \times 10^9 \frac{Nm^2}{C^2}$

$G = 6.67x10^{-11} \frac{Nm^2}{kg^2}$

P = Power

q = charge

R = resistance

V = electric potential difference

W = Work

ENERGY

$W = F\Delta x$

$P = \frac{W}{\Delta t} = \frac{\Delta E}{\Delta t} = Fv$

$PE_g = mgh$

$KE = \frac{1}{2}mv^2$

$F = -kx$

$PE_s = \frac{1}{2}kx^2$

h = height

k = spring constant

KE = kinetic energy

PE_g = gravitational potential energy

PE_s = potential energy stored in a spring

P = power

W = work

x = change in spring length from the equilibrium position

MOTION IN 2-D

$a_c = \frac{v^2}{r}$

$F_c = m\frac{v^2}{r}$

$1rev = 2\pi rad = 360°$

$\tau = Fxr$

L = Iω

KE = $\frac{1}{2}$ I ω^2.

a_c = centripetal acceleration

F_c = centripetal force

τ = Torque

L = Angular Momentum

I = Moment of Inertia

ω = angular velocity

PHYSICS FORMULAE

HEAT ENERGY

$Q = mc\Delta T$

$Q = mL_f$

$Q = mL_V$

$\Delta L = \alpha L_o \Delta T$

c = specific heat

L_f = latent heat of fusion

L_V = latent heat of vaporization

Q = amount of heat

ΔT = change in temperature

α = coefficient of linear expansion

L_o = original length

$c_{water} = 4186 \frac{J}{kg^\circ K}$

1 cal = 4.184 joules

WAVE PHENOMENA

$T = \frac{1}{f}$

$v = f\lambda$ OR $= \nu\lambda$

$n = \frac{c}{v}$

$n_i \sin\theta_i = n_r \sin\theta_r$

$\lambda = \frac{xd}{L}$

$n\lambda = d \sin\theta$

$\sin\theta_c = \frac{1}{n}$

c = speed of light in a vacuum

d = distance between slits

$f = \nu$ = frequency

L = distance from slit to screen

n = index of absolute refraction

T = period

v = speed

x = distance from central maximum to first-order maximum

λ = wavelength

θ = angle

θ_c = critical angle relative to air

GEOMETRIC OPTICS

$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$

$\frac{h_i}{h_o} = \frac{d_i}{d_o}$

f = focal length

d_i = image distance

d_o = object distance

h_o = object size

h_i = image size

ELECTROMAGNETIC APPLICATIONS

F = Bqv

$F = BIL$

$V = BLv$

$\frac{N_P}{N_S} = \frac{V_P}{V_S}$

$V_P I_P = V_S I_s$ (ideal)

$efficiency = \frac{V_S I_S}{V_P I_P}$

B = magnetic field strength

I_P = current in primary

I_S = current in secondary

N_P = number of turns in primary coil

N_S = number of turns in secondary coil

V_P = voltage of primary

V_S = voltage of secondary

L = length of conductor

V = electric potential difference

SECOND YEAR PHYSICS TEST – MARCH 2012

Answer Key

1.	D	14.	B
2.	A	15.	B
3.	E	16.	A
4.	A	17.	E
5.	B	18.	D
6.	A	19.	B
7.	D	20.	D
8.	C	21.	A
9.	D	22.	C
10.	E	23.	D
11.	D	24.	E
12.	C	25.	C
13.	C		

PHYSICS II Second year, but not Physics C (Calculus) 25 multiple choice questions per exam.

JANUARY: Vectors, kinematics, Newton 's laws of motion, work, energy, power, systems of particles, linear momentum, conservation of linear momentum, collisions

FEBRUARY: (approx. 50% of the test) Uniform circular motion, torque and rotational statics, angular momentum, conservation of angular momentum, simple harmonic motion, mass on a spring, pendulum, Newton's law of gravity, circular orbits of planets and satellites, (approx. 50% of the test) Fluid mechanics including pressure, buoyancy, fluid flow continuity, and Bernoulli's equation, Temperature, heat, Ideal gases, 1st and 2nd laws of thermodynamics.

MARCH: Electricity and Magnetism: electrostatics, Coulomb's Law, electric field, electric potential, conductors, capacitors (no dielectrics), current, power, resistance, DC circuits (not Kirchhoff's Laws, not RC circuits), batteries, capacitors in steady state circuits, parallel plate capacitors, forces on moving charges, forces on current-carrying wires in magnetic fields, magnetic fields, induction, Faraday's law, and Lenz's law.

APRIL: Wave motion, sound, standing waves, superposition, geometric optics including reflection, refraction, mirrors and lenses. Physical optics including interference, diffraction, dispersion and spectrum

Testing Dates for 2012

Thursday March 8, 2012; *Thursday April 12, 2012

***The April 2012 exam can be changed based upon the School's spring break.**

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Testing Dates 2013

Thursday January 10, 2013, Thursday Feb 14, 2013; Thursday March 14, 2013; *Thursday April 11, 2013

***The April 2013 exam can be changed based upon the School's spring break.**