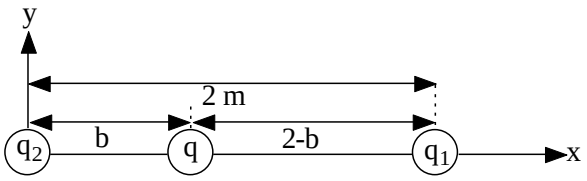
COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Basic and Applied Science
Lecturers : Physics Staff
Course : Physics 1
Course Code : BA113 **Marks: 40**
Date : 3 / 6 /2013 **Time : 2 hours**

Final Exam

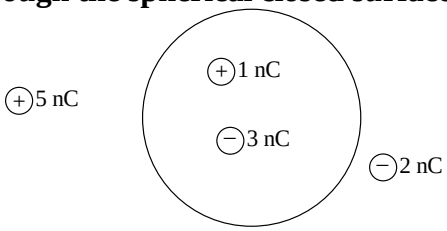
Answer the following Questions

1- a) Three point charges lie along the x axis as shown in the figure below. The positive charge q_1 = 16.0 μC is at a distance 2.00 m from the origin, the positive charge q_2 = 4.00 μC is at the origin, and the net force acting on q is zero. What is the x coordinate of q?



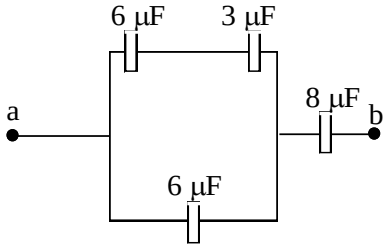
[4 marks]

b) Find the net electric flux through the spherical closed surface shown in the figure below.



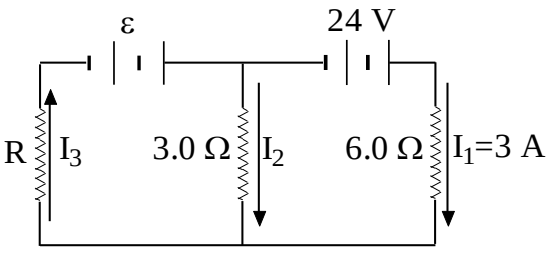
[2 marks]

c) Four capacitors are connected as shown in the figure below. (i) Find the equivalent capacitance between points a and b. (ii) Calculate the charge on each capacitor, taking ΔV_{ab} = 10.0 V.



[4 marks]
[Total 10 marks]

2- a) In the circuit of the figure below, the current I_1 = 3.00 A and the values of ε for the ideal battery and R are unknown. What are the currents (i) I_2 and (ii) I_3? (iii) Can you find the values of ε and R? If so, find their values. If not, explain.



[4 marks]

b) A light bulb has a tungsten filament with a resistance of 19 Ω when at 20 °C and 140 Ω when hot. Assume the resistivity of tungsten varies linearly with temperature even over the large temperature range involved here. Find the temperature of the hot filament. Given that the temperature coefficient of resistivity of tungsten (α) equals 4.5×10^{-3} °C^{-1}.

[2 marks]

c) A wire 2.80 m in length carries a current of 5.00 A in a region where a uniform magnetic field has a magnitude of 0.390 T. what is the magnitude of the magnetic force on the wire assuming the angle between the magnetic field and the current is (i) 60.0^o and (ii) 90.0^o?

[2 marks]

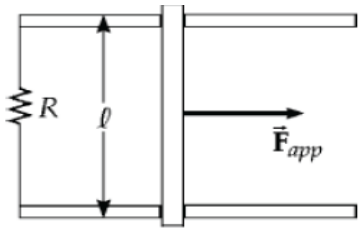
[Total 8 marks]

3- a) A long solenoid that has 1000 turns uniformly distributed over a length of 0.400 m produces a magnetic field of magnitude 1.00×10^{-4} T at its center. What current is required in the windings for that to occur?

[2 marks]

b) The figure below shows a top view of a bar that can slide on two frictionless rails. The resistor is R = 6.00Ω, and a 2.50-T magnetic field is directed perpendicularly downward, into the paper. Let, ℓ = 1.20 m. (a) Calculate the applied force required to move the bar to the right at a constant speed of 2.00 m/s. (b) At what rate is energy delivered to the resistor?

[4 marks]



c) Light of wavelength 530 nm illuminates a pair of slits separated by 0.300 mm. If a screen is placed 2.00 m from the slits, determine the distance between the first and second dark fringes.

[4 marks]

[Total 10 marks]

4- Choose the correct answer:

a) Materials having resistance constant over a wide range of voltages and the relationship between current and voltage is linear are called;

i. Nonohmic. ii. Ohmic. iii. Inohmic. iv. none of them.

[1 mark]

b) Two isolated identical conducting spheres have a charge of q and −3q, respectively. They are connected by a conducting wire, and after equilibrium is reached, the wire is removed (such that both spheres are again isolated). What is the charge on each sphere?

i. -q and -q ii. +q and -3q iii. 0 and -2q iv. 0 and +2q

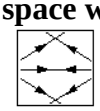
[1 mark]

c) The self inductance "L" of a solenoid is given by;

i. $L = \frac{\mu_o NA}{\ell}$ ii. $L = \frac{N^2 A}{\ell}$ iii. $L = \frac{\mu_o N^2 A}{\ell}$ iv. $L = \frac{\mu_o N^2}{\ell}$

[1 mark]

d) Which one of the diagrams below is *not* a possible electric field configuration for a region of space which does *not* contain any charges?

i.  ii.  iii. None of them.

[1 mark]

e) Two resistors (R_1 and R_2) are connected in series, the equivalent resistor (R_{eq}) is

i. $R_{eq} = R_1 \times R_2$ ii. $R_{eq} = R_1 + R_2$ iii. $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ iv. $\frac{1}{R_{eq}} = \frac{1}{R_1} \times \frac{1}{R_2}$

[1 mark]

f) If a wave from one slit of a Young's double-slit set-up arrives at a point on the screen one wavelength behind the wave from the other slit, what is observed at that point?

i. Dark fringe. ii. Bright fringe. iii. Multi-colored fringe. iv. Gray fringe.

[1 mark]

g) The potential difference across a resting neuron in the human body is about 75.0 mV and carries a current of about 0.200 mA. How much power does the neuron release?

i. 375 μW ii. 15 mW iii. 2.67 nW iv. 15 μW

[2 marks]

h) A current of 17 A has passed through a surface of area 2.00 cm^2, what is the value of the current density?

i. 2 A/m^2 ii. 8.5 A/m^2 iii. 34 A/m^2 iv. 85 kA/m^2

[2 marks]

i) An emf of 96.0 mV is induced in the windings of a coil when the current in a nearby coil is increasing at the rate of 1.20 A/s. What is the mutual inductance of the two coils?

i. 80 H ii. 115.2 H iii. 115.2 mH iv. 80 mH

[2 marks]

[Total 12 marks]

Useful Constants

Quantity	Symbol	Constants	
Electron charge	e	1.6×10^{-19}	C
Coulomb constant	k	9×10^{9}	$N.m^2/C^2$
Electron mass	m_e	9.109×10^{-31}	Kg
Proton mass	m_p	1.673×10^{-27}	Kg
Neutron mass	m_n	1.675×10^{-27}	Kg
Permittivity of free space	ε_o	8.85×10^{-12}	$C^2/ N.m^2$
Permeability of free space	μ_0	$4\pi \times 10^{-7}$	T.m/A

Good Luck

Members of Course Examination Committee	Signature	Date