Prince Sultan University

Department of Mathematics & Physics

PHY 205- General Physics2

Final Exam

First Semester, Term 142

Saturday May.30/2015

Examination Time: 2 Hours

Name ..... Instructor.----------

Student I.D. ..... Class Time----------

Important Instructions:

1. *You can use a scientific calculator that does not have programming or graphing capabilities.*
2. *You may **NOT** borrow a **calculator** from anyone.*
3. *Do not use **RED pen**.*
4. *This is a closed books and notes exam. Do **NOT** use notes or textbooks.*
5. *There should be **NO** talking during the examination.*
6. *You will be **expelled** immediately from the exam if your mobile phone is seen or heard.*
7. *Any signs of **cheating** may cause you being expelled from the exam.*
8. *This examination has **3 parts**. **Part 1** has 10 **multiple choice** questions, each question worth 1 **point**. **Part 2** has 3 **multiple choice** questions, each question worth 2 **points**. **Part 3** has **four** workout problems each problem worth 6 **points.***

Make sure your paper has all the questions and problems.

	Possible Score	**Student's Total Score**
Part 1 Questions	**10**	
Part 2 Questions	**6**	
P. # 1	**6**	
P. # 2	**6**	
P. # 3	**6**	
P. # 4	**6**	
Total	**40**	**/40**

GIVEN DATA (Do not Remove)

CONSTANTS:

$$k=9\times10^{9}\frac{N.m^2}{C^2}\ ,\quad \varepsilon_o=8.85\times10^{-12}\frac{C^2}{N.m^2}\ ,\quad \mu_o=4\pi\times10^{-7}\frac{T.m}{A}$$

Velocity of light = c= 3 x 10^8 m/s

Proton mass = 1.67x10^{-27} kg, *Proton charge = 1.6x10^{-19} C*

Electron mass = 9.1x10^{-31} kg, *Electron charge = - 1.6x10^{-19}C*

1 eV = *1.6x10^{-19}*J 1nm = 1nano meter = 10^{-9} m

Dielectric constant of Air & Vacuum = 1

Refractive index of air = 1

Charges and currents in RC circuit.

$q(t) = q_o(1 - e^{-t/RC})$; $I(t) = I_o e^{-t/RC}$

Magnetic field of a solenoid.

$$B = (\mu o\ n\ I)$$

Good Luck

Part 1: 10 Multiple Choice Questions (1 mark each)

1- A wire carries a steady current of 0.1 A over a period of 20 s. What total charge passes through the wire in this time interval?

a) 200 C b) 20 C c) 2 C d) 0.2 C

2- When an electric current exists within a conducting wire, which of the following statements describes the condition of any accompanying electric field?

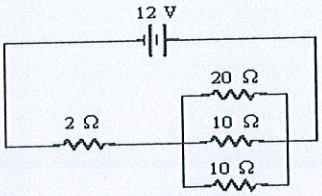
a) E field must be zero b) E field must be parallel to current

c) E field must be opposite in direction to current d) E field must be perpendicular to current

3- An electric dipole has two charges, separated by 10.0 cm, charges are of +5 μC and −5 μC, respectively. What is the electric field at a point midway between the two charges?

a) 18×10^6 N/C b) 36×10^6 N/C c) 90×10^6 N/C d) Zero

4- How much power is being dissipated by the 20-Ω resistors?



a) 3.2 W b) 6.4 W c) 16 W d) 24 W

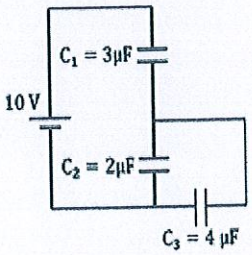
5-: A Nichrome wire has radius of 0.321 mm. When 10 V is applied across 1 m of this wire a current of 2.2 A was observed on ammeter. What is the resistivity of Nichrome?

a) 1×10^{-6} Ω. m b) 1.56×10^{-6} Ω. m c) 2.2×10^{-6} Ω. m d) None

6- A proton moves 10 cm on a path in the direction of a uniform electric field of strength 3.0 N/C. How much work is done on the proton by the electrical field?

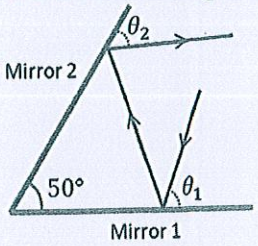
a) 0.3 eV b) 1.3 eV c) 1.6 eV. d) Zero

7- How much charge is stored by capacitor C_1 in this combination?



a) 6.6 μC b)14 μC c) 20 μC. d) None

8- Two plane mirrors are at an angle of 50° with each other. A light ray is incident on mirror 1 as



shown, where $\theta_1 = 60$ °. What is the angle θ_2?

a) 50° b) 60° c) 70°. d) None.

9- If a bar magnet is falling through a conducting loop of wire, the induced current in the loop of wire sets up a field which exerts a force on the magnet. This force between the magnet and the loop will be attractive when:

a) the magnet enters the loop b) the magnet is halfway through
c) The magnet is leaving the loop d) none of these

10-The magnetic domains in a magnetized iron bar are characterized by which orientation?

a) Random b) Anti-parallel to magnetic axis c) Parallel to magnetic axis. d) None

Part 2: Multiple Choice Questions (2 mark each)

1- A square frame with sides of 18 cm has 200 turns of wire on it. Each turn has the same area equal to that of the frame, and total resistance of the coil is 2 ohms. A magnetic field linked perpendicular with the coil changes at a constant rate from 0 to 0.5T in a time of 0.8 seconds. What is the induced current in the coil when field is changing?

a) 2 A b) 4.1 A c) 4.7 A d) None

2- A series RC circuit has capacitor 'C' discharging through a resistor 'R'. After how many time constants is the charge on the capacitor one fourth of the initial value?

a) 0.25 RC b) 1.39 RC c) 4 RC . d) None

3- Refractive index of water is 1.33. What is the critical angle of air – water media?

a) 40° b) 48.8° c) 55° d) none of these.

Part 3: Solve the following four problems in the space provided in between showing all your steps, Also write your final answer in box. (6 marks each)

Question 1(6 marks):

Three charges are placed such as charges form an equilateral triangle (see diagram),

$a = 30$ cm; $q_1 = 10 \times 10^{-6}$ C $q_2 = -10 \times 10^{-6}$ C $q_3 = 2 \times 10^{-6}$ C

a) What is the magnitude and direction of force on charge q_3?

b) Calculate mutual potential energy of this system of part (a), Is this system bound?

c) Remove q_3 from above diagram and calculate electrical potential at the place of q_3

Question 2. (6 marks):

A parallel plate capacitor has plate area of 2000 cm^2 and plates are 1 cm apart. The capacitor is connected to a power supply and charged to a potential difference of $V_o = 3000$ V. It is then disconnected from the power supply, and plastic is inserted between plates to completely fill the space. It is found that the potential difference decreases to 1000 V but charge on plates remains constant.

a) How much charge this capacitor stored before the dielectric was inserted?

b) What is dielectric constant of plastic?

c) If $\mathbf{E_o}$ is the electric field before putting dielectric and $\mathbf{E}$ after inserting dielectric material, show by your calculations that

$$\mathbf{E_o > E}$$

Question 3 (6 marks): (A & B are independent)

(A) Design a solenoid that must produce a magnetic field 20 times earths' magnetic field given as ($B_{earth} = 5 \times 10^{-5}$ T). However stable power supply can only provide 0.16 A. The length of solenoid should be 10 cm and radius can be 1 cm.

How many number of turns are needed in your design?

(B) Electrons and protons enter in a constant magnetic field "B" and move in a circular orbit. If both particles enter in magnetic field with the same velocity "v". What is the ratio of radius of proton orbit to radius of electron orbit?

Question 4 (6 marks):

An object 8 cm high is placed 12 cm to the left of a converging lens of focal length 8 cm. A second converging lens of focal length 6 cm is placed 36 cm to the right of the first lens. Both lenses have the same optic or principal axis.

a) Find location of the final image with respect to the position of the first lens.

d) What is the nature and magnification of the final image?

c) What is the size of final image?