Kafr Elshiekh University
Faculty of Engineering
Department of
Engineering Physics and Mathematics
Preparatory Year

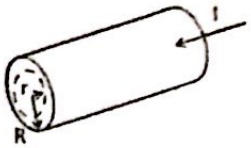
Engineering physics (1)

7 - 6 - 2017
3 Hours
90 Marks
Final Exam

Part One : Question(1) : ***(20 Marks)***

(a) A straight wire of length ($L=3m$) carries a current ($I= 4A$) toward the positive *x-axis*. A ($0.2\ T$) uniform magnetic field is directed along a positive *y- axis* .Find the magnitude and direction of the magnetic force acting on the wire.

(b) Use the *Ampere's law* to calculate the magnetic field a distance r from the center of the wire in the region $r < R$.

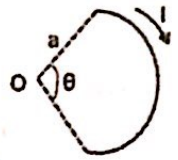


(c) A square coil of side ($d=18cm$) consists of (25) turns of wire and carries a current of ($15\ mA$). A ($0.35\ T$) magnetic field is applied parallel to the plane of the coil.

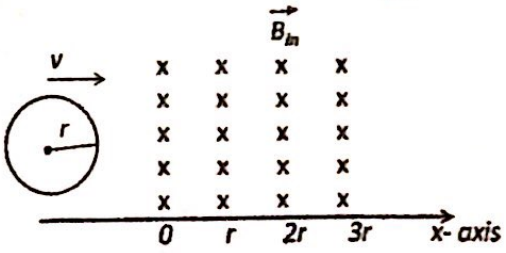
- Calculate the magnitude of the magnetic dipole moment of the coil.
- What is the magnitude of the torque acting on the loop?

Question(2) : ***(25 Marks)***

(a) Use the *Biot- Savart law* to calculate the magnetic field at a point O for the circular arc of radius a and angel θ carrying a constant current I.



(b) Plot as a function of x the magnetic flux through the area enclosed by the loop.



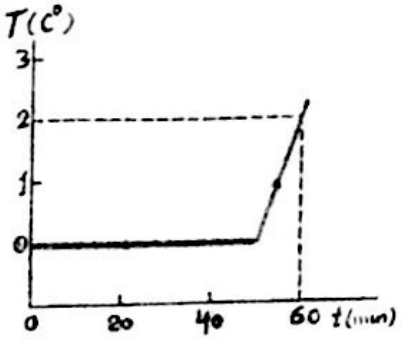
(c) A solenoid with ($68\ turns$) in ($8\ cm$) length and has a diameter of ($1.2\ cm$):

- Calculate the inductance of the solenoid.
- How much energy is stored in its magnetic field when it carries a current of $0.9\ A$?
- Calculate the self-induced emf in the solenoid if the current decreases at the rate of (0.5A/s). ($\mu_0=4\pi*10^{-7}$T.m/A)

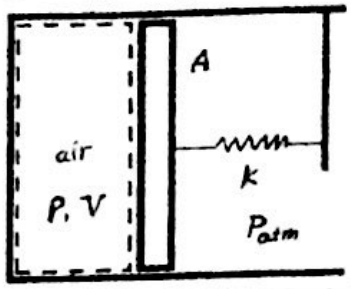
Part Two : Question(1) : ***(15 Marks)***

(a) State the assumptions of the kinetic theory of gases and find its mathematical expression.

(b) A cooking vessel on a slow burner contains 10 kg of water and an unknown mass of ice in equilibrium at 0°C at time t = 0. The temperature of the mixture is measured at various times, and the result is plotted in the Figure. During the first 50 min, the mixture remains at 0°C. From 50 min to 60 min, the temperature increases to 2°C. Ignoring the heat capacity of the vessel, determine the initial mass of ice.



(c) We are given air in the spring-restrained piston-cylinder arrangement of the Figure with P_1 = 100 kPa, V_1 = 0.002 m^3, x_1 = 0 m, no force on the piston at state 1, P_{atm} = 100 kPa, and A = 0.018 m^2. The air expands until V_2 = 0.003 m^3. We know the spring is linear with F_{spring} = kx with k = 16.2 kN/m. Find the final pressure of the air and the work done by the air on the piston.



Question(2) : ***(15 Marks)***

(a) Prove that violation of the Kelvin-Planck Statement leads to a violation of the Clausius Statement and vice versa.

(b) Discuss Carnot engine using its P-V diagram and T-S diagram.

(c) A multicylinder gasoline engine in an airplane, operating at 2500 rev/min, takes in energy 7.89 * 103 J and exhausts 4.58 * 103 J for each revolution of the crankshaft. (i) How many liters of fuel does it consume in 1h of operation if the heat of combustion is 4.03* 107 J/L? (ii) What is the mechanical power output of the engine? Ignore friction and express the answer in horsepower. (iii) What is the torque exerted by the crankshaft on the load? (iv)What power must the exhaust and cooling system transfer out of the engine?

Question(3) : ***(15 Marks)***

(a) State the general law of mirrors and prove it.

(b) State the lens aberrations.

(c) A converging lens of focal length 20 cm is placed to the right of a diverging lens of focal length 10 cm are separated by 20 cm. An object is placed 10 cm to the left of the diverging lens. Find the position and the magnification of the final image.

Useful data: For water $L_f = 3.33 * 10^5$ J/Kg, $L_v = 2.26 * 10^6$ J/Kg , C_w = 4186 J/Kg. °C

Best Wishes
Dr. Ahmed Saeed **Dr. Demyana Adel Abdel Masieh**