



- أجب عن أسئلة الكهربائية والمغناطيسية في نصف منفصل من كراسة الإجابة، وأجب عن أسئلة الضوء في النصف الآخر
- افهم السؤال أولاً وأجب عن المطلوب فقط ولا تزيد - ممنوع الرسم أو الإجابة في ورق الرسم البياني

Electricity and Magnetism [50 marks]

Question 1 [17 marks]

- a) Write down only the following: (i) the relation between electric force and electric field, (ii) the mathematical relation of Gauss' law, (iii) The relation between electric potential and potential energy and (iv) the relation between electric potential and electric field. [4 marks]
- b) In fig. 1, the electric field at point P is zero. (i) Find the charge q_1 in terms of q . (ii) If a charge q_2 is placed at the point P, what is the electric force acting on it? [7 marks]
- c) A hollow sphere of radius R has a charge Q distributed uniformly on its surface. (i) Plot the electric field E versus the distance, r, from its center. (ii) Plot the electric potential V versus r. [6 marks]

Question 2 [19 marks]

- a) An insulating sphere has a charge of $1\mu\text{C}$ which is distributed uniformly on its volume. If the maximum value of the electric field due to this charge is $9 \times 10^5 \text{ N/C}$. (i) Find the electric field at 5 cm from the center. (ii) Find the electric field at 15 cm from the center. (iii) What the electric potential at the surface of the sphere? Take $K=9 \times 10^9 \text{ Nm}^2/\text{C}^2$. [7 marks]
- b) A parallel-plate capacitor is constructed of two metal sheets $5\text{cm} \times 6\text{cm}$ and separated by 2.0 mm air gap. (i) What is the charge on this capacitor when it is connected with 24 V battery? (ii) How much energy is stored? (iii) If the battery is disconnected and the gap between the two plates is then decreased to 1.0 mm, How much energy is then stored? Take $\epsilon_0=8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$. [7 marks]
- c) Consider the circuit shown in figure 2. Find the currents I_1 , I_2 and ϵ . [5 marks]

Question 3 [14 marks]

- a) (i) Draw the path of the motion of a charged particle moving perpendicular to a uniform magnetic field. (ii) Write down the radius and the period of the motion (اكتب المعادلتين فقط بدون إثبات). [4 marks]
- b) What is the magnetic force acting on a proton traveling with a speed of $2 \times 10^6 \text{ m/s}$ parallel to a magnetic field of 0.3 T? [3 marks]
- c) In an experiment for determination a uniform magnetic field, the circular path of an electron beam moves perpendicular to the field is measured to be 18 mm. If the electron beam is accelerated from rest through 1000 V potential difference. (i) Find the intensity of the magnetic field. (ii) Find the period of the orbit. For electron, $m = 9.1 \times 10^{-31} \text{ Kg}$ and $e = 1.6 \times 10^{-19} \text{ C}$. [7 marks]

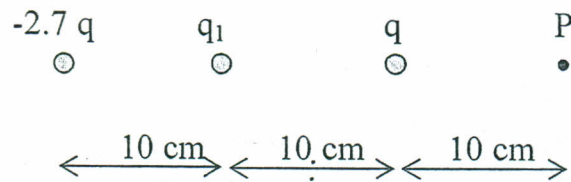


Figure 1 Problem 1.b

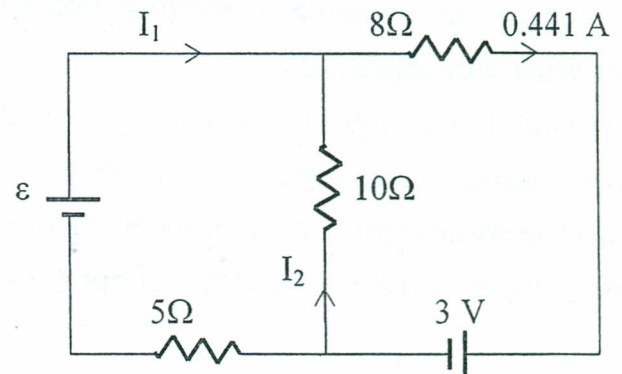


Figure 2 Problem 2.c



Optics and atomic physics

Question 4 (15 marks)

- (a) The refractive indices of core and cladding of an optical fiber are 1.55 and 1.5 respectively. Calculate (i) the numerical aperture (NA), (ii) the acceptance angle. (4marks)
- (b) How does Lloyd obtain the interference pattern? What is the difference between this interference pattern and the other interference patterns? (وضح اجابتك بالرسم) (6 marks)
- (c) Light traveling through water falls on a glass plate of refractive index 1.646, which is immersed in water. (i) Find the angle of refraction of glass for which the reflected rays will be polarized. The refractive index of water is $4/3$. (ii) Find the critical angle of the light. (5 marks)

Question 5 (16 marks)

- (a) Coherent light with wavelength 500nm passes through narrow slits separated by 0.34mm. At a distance from the slits large compared to their separation find (i) the phase difference (in radians) in the light from the two slits at an angle of 23.0° from the centerline. (ii) the intensity relative to the maximum intensity. (6 marks)
- (b) A thin film of polystyrene ($n = 1.49$) is used as a nonreflecting coating for fabulite ($n = 2.409$). What is the minimum thickness of the film required? Assume that the wavelength of the light in air is 480nm. (5 marks)
- (c) Unpolarized light with an intensity of 25W/m^2 is sent into a system of three polarizing sheets, whose polarizing directions make angles $\theta_1 = 30^\circ$, $\theta_2 = -30^\circ$ with the direction of the y axis and $\theta_3 = 30^\circ$ with the direction of the x axis. What is the intensity of the light that emerges from the system? (وضح اجابتك بالرسم) (5 marks)

Question 6 (19 marks)

- (a) A rocket is chasing an enemy's space ship. An observer on the earth observes the speed of the rocket to be $2.5 \times 10^8 \text{m/s}$ and that of space ship to be $2 \times 10^8 \text{m/s}$. Calculate the velocity of the enemy's ship as seen by the rocket. (5 marks)
- (b) A vector in system S' is represented by $(8\hat{i} + 6\hat{j})$. How can the vector be represented in the system S when S' is moving with a velocity $(0.8C)\hat{i}$ with respect to S . (4 marks)
- (c) What will happen if (وضح اجابتك بالرسم)
- (i) Unpolarized light is incident on a calcite crystal.
- (ii) Polarized light is incident on a sheet of plastic under- stress.
- (iii) The white light is used in the experiment of interference. (6 marks)
- (d) Compare between the types of optical fibers. (4 marks)

Best Wishes
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