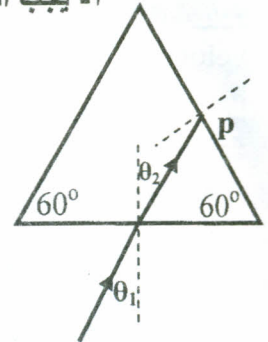


- ملاحظات هامة: ١- أجب عن أسئلة الضوء في الجهة اليمنى والكهربية في الجهة اليسرى من ورق الإجابة
 ٢- يجب المحافظة على ترتيب الأسئلة عند الإجابة عليها ولا تستخدم ورقة الرسم البياني في الرسم أو الحل
 ٣- يجب البدء في الإجابة على كل سؤال في بداية صفحة جديدة

Optics

- (1) (a) Light ray passes from air through a glass prism with incident angle $\theta_1=36.87^\circ$ as shown in figure. The light has a wavelength 400 nm in air and a wavelength of 333 nm in the glass prism. (i) Find the refractive index of the glass prism (ii) Find the speed of the light in the glass prism (iii) Does total internal reflection occur at point p? Why? (iv) Find the angle with the normal at which the light ray will leave the prism



[6 marks]

- (b) A beam of light of wavelength 650 nm is used to obtain interference fringes in a young's double slit experiment with slit separation 2 mm and slit-screen distance of 120 cm. (i) What is the distance of the third bright fringe on the screen from the central maximum? (ii) What is the intensity of the light at the center of the third bright fringe relative to maximum intensity I_0 (iii) Suppose that the 4th order bright fringe of wavelength 650 nm overlaps with the 5th order bright fringe of another wavelength. Find the other wavelength? [6 marks]

- (c) Sketch only ارسم فقط مع كتابة كافة البيانات

[6 marks]

- (i) Michelson Interferometer
 (ii) Polarization by double refraction
 (iii) The difference between multimode step index fiber and multimode graded index fiber

- (2) (a) A soap bubble 250 nm thick is illuminated by white light. The index of refraction of the soap film is 1.36 (i) What are the conditions for constructive and destructive interference? (ii) Are any wavelengths in the visible spectrum appeared strongly in the reflected light? [6 marks]

- (b) Unpolarized light is sent into a system of three polarizing sheets whose polarizing directions makes angles of $\theta_1=10^\circ$, $\theta_2=20^\circ$, $\theta_3=30^\circ$ with the direction of the Y axis. [6 marks]

- (i) What percentage of the light's initial intensity I_i is transmitted by the system?
 (ii) If $\theta_1=0$, $\theta_2=90^\circ$, $\theta_3=50^\circ$ with the direction of the Y axis, what percentage of the light's initial intensity is transmitted by the system?

- (c) A light ray in air is incident on the core region ($n_1=1.52$) of an optical fiber with cladding index ($n_2=1.48$) with incident angle θ . (i) Find the maximum value of the incident angle θ so that total internal reflection can occur along the fiber. (ii) Calculate the numerical aperture of the optical fiber. (iii) What are the reasons for light loss through the optical fiber? [6 marks]

- (3) (a) A spaceship of proper length L_0 travels away from the earth with speed v . At what speed, the relativistic length becomes half its proper length. [4 marks]

- (b) A spaceship travels with speed $0.75C$ relative to earth fires a small rocket in the forward direction with speed $0.95C$ relative to earth. How fast the rocket relative to the spaceship? [4 marks]

- (c) What are the applications of the

[6 marks]

- (i) Total internal reflection (ii) Polarized light (iii) Interference of light waves



ثانياً الكهربائية: أبدأ الإجابة من الجهة اليسرى من كراسة الإجابة. ممنوع الإجابة في ورق الرسم البياني
 $m_e = 9.1 \times 10^{-31} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ C}$, $K = 9 \times 10^9 \text{ Nm}^2/\text{C}^2$, $\epsilon_0 = 8.85 \times 10^{-12} \text{ F/m}$

Question four: electricity

4-a (i) Write the properties of electric charge, (ii) Define uniform electric field, and (iii) Define equipotential surface. (6 marks)

4-b-An electron enters midway through a uniform electric field of 200 N/C at an initial velocity of 400 m/s , fig. p(4-b). If the plates are separated by a distance of 2.0 cm , how far along the x-axis will the electron hit the bottom plate. (6 marks)

4-c- Find the electric field in front of an infinite sheet of charge carrying a surface charge density of $3.58 \times 10^{-12} \text{ C/m}^2$ (3 marks)

Question five: electricity

5-a- An insulating solid sphere of radius a has a uniform positive charge density with total charge Q . Find the electric field and electric potential at points inside and outside the sphere. (8 marks)

5-b-Two spherical conductors of radii 3 cm and 7 cm are separated by a distance much larger than the radius of either sphere. The sphere charges are initially $q_1 = +1.0 \text{ nC}$ and $q_2 = -5.0 \text{ nC}$. After that the spheres are connected by a conducting wire. Find the charges and the electric field strengths at the surfaces of the spheres. (6 marks)

Question six: electricity

6-a- Derive the capacitance for a spherical capacitor consists of a spherical conducting shell of radius b and charge $-Q$ that is concentric with a smaller conducting sphere of radius a and charge $+Q$. (8 marks)

6-b- A parallel-plate capacitor has plates of $2 \text{ cm} \times 3 \text{ cm}$, the plates are separated by a 1-mm , has a potential difference $V = 12 \text{ V}$ between its plates. The charging battery is now disconnected and a porcelain slab ($K = 6$) is slipped between the plates. What is the charge and the potential energy of the device, both before and after the slab is introduced? The dielectric strength of porcelain is $16 \times 10^6 \text{ V/m}$, what is the maximum energy that can be stored in the capacitor? (6 marks)

6-c-For the circuit shown fig. p(6-c), find (a) the equivalent capacitance, (b) the charge and potential difference for each capacitor. (7 marks)

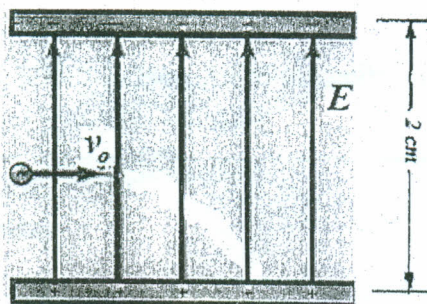


fig. p(4-b)

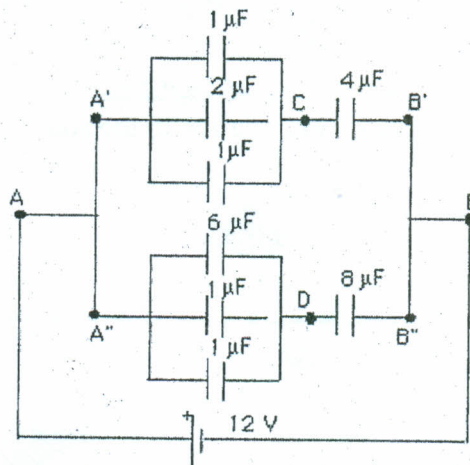


fig. p(6-c)



- أجب عن أسئلة الكهربية 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

Question 1 [19 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. [6 marks]
- b) In fig. 1, the electric field at point P is zero. (i) If $q = 2\mu\text{C}$, find the charge q_1 . (ii) If a charge q_2 is placed at the point P, what is the electric force acting on it? [7 marks]
- c) A charged conducting sphere of radius R and charge Q. (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 [20 marks]

- a) A conducting sphere of radius 10 cm has a charge of $1\mu\text{C}$. (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 center 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 12 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 $\epsilon_0=8.85 \times 10^{-12} \text{ C}^2/\text{Nm}^2$. [8 marks]
- c) Consider the circuit shown in figure 2. Find the currents I_1 , I_2 and ϵ . [5 marks]

Question 3 [16 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? [4 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 9 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 $e = 1.6 \times 10^{-19} \text{ C}$. [8 marks]

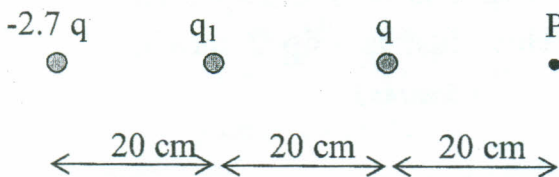


Figure 1 Problem 1.b

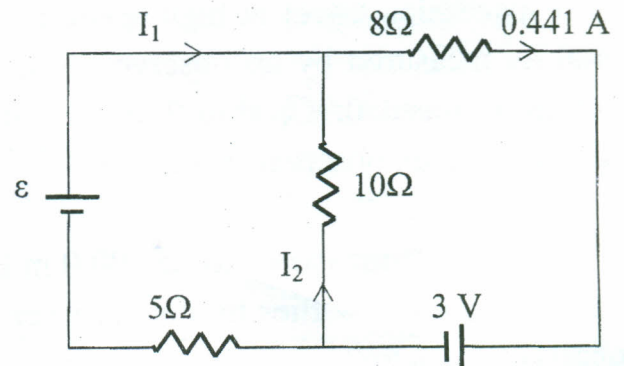


Figure 2 Problem 2.c



Optics & Atomic Physics

Question 4: (21 mark)

- a) A ray traveling in a transparent medium suffers total internal reflection at its interface with water ($n = 1.33$). The critical angle is 60° . (i) Calculate the speed of light in this medium (ii) the polarized angle. (8 marks)
- b) Describe the construction of Michelson interferometer. (وضح الاجابة بالرسم)
(5 marks)
- c) When light of wavelength 513 nm illuminates two slits separated by 0.5mm, five dark fringes per centimeter are seen on a screen. (i) What is the distance from the slits to the screen? (ii) What is the path difference required to produce a phase difference of $2\pi/3$ rad? (8 marks)

Question 5: (19 mark)

- a) Light of wavelength 602 nm is incident normally on an oil film ($n = 1.4$) on water ($n = 1.33$). What the minimum thickness of the film that will make the light appear. (5marks)
- b) Explain (وضح الاجابة بالرسم)
(9 marks)
- (i) Polarization by double refraction
- (ii) Intermodal dispersion
- (iii) Scattering in optical fiber
- c) Unpolarized light of intensity I_0 is incident on two sheet polarizers. The transmission axis of the first polarizer is vertical; that of the second makes a 30° angle with the vertical. What is the intensity of the light after passing through the two? (وضح الاجابة بالرسم)
(5 marks)

Question 6 : (10 marks)

- a) Two spaceships travel at high speed in the same direction along the same straight line. As measured by an observer on a nearby planet, ship 1 is behind ship 2 and moves at speed $0.9C$; ship 2 moves at speed $0.7C$. How fast is ship 2 moving according to an observer in ship 1? (5marks)
- b) A spacecraft is measured to be 100.0 m long while at rest relative to an observer. If this spacecraft now flies by the observer with a speed of $0.9C$, what length does the observer measure? (5 marks)

With my best wishes