Menoufia University
Faculty of Engineering,Shebin El-Kom
Basic Engineering Science Department
Total Marks:90 marks

Subject:فيزياء اولى مدني
Date of Exam: 17/6/2019
Time Allowed:3 hours

Answer the following questions:

First question 15 Marks

a-An object executing simple harmonic motion has a maximum speed v_{max} and a maximum acceleration a_{max} .Find (i) the amplitude and (ii) the period of the motion .Express your answers in terms of v_{max} and a_{max}.

b-Explain why waves that are not coherent cannot give rise to easily observable interference patterns.

c-An object of unknown mass is hung on the end of an unstretched spring and is released from rest .If the object falls 3.42 cm before first coming to rest, find the period of motion .

d- A vertical spring with a 20-g mass at its end is at rest when another 30 g is carefully added and released .The masses fall 12.0 cm before stopping . (i) What will be the frequency of the motion with both masses attached ? (ii) What will be the amplitude of the motion ?

Second question 15 Marks

a- How can you obtain electromagnetic waves (EMW) .

b-Define : 1-Wave front 2- Restoring force 3-Doppler effect (4) – decibel scale .

c-A 0.85 –kg mass attached to a vertical spring of the force constant 150 N/m oscillates with a maximum speed of 0.35 m/s .Find the following quantities related to the motion of the mass : (a) the amplitude, (b)the period ,(c) the maximum magnitude of the oscillation

d-A mass m attached to the end of a spring is released from rest at t=0 s from an extended position x_{max} .The mass m= 0.2 kg and k= 1 N/m .After0.5 s, the speed of the mass is measured to be 1.5m/s .Calculate x_{max} ,the maximum speed of the motion , and the total energy.

Third question 15 Marks

a- Explain why the kinetic and potential energies of an object-spring system can never be negative ?

b- How is a transverse wave different from longitudinal wave ? Name two examples of each kind of wave .

c- In a certain Young`s double –slit experiment, the bright fringes are 5.0×10^{-7} m apart when 540-nm light is used . How far apart will they be when 640-nm light is used?

d- Sunlight just outside Earth`s atmosphere has an intensity of 1.4 kW/m^2 .Calculate (a) E_m and (b) B_m for sunlight there, assuming it to be a plane wave C=3×10^8 m/s , $\mu_0 = 4\pi \times 10^{-7}$ N.s^2/c^2

Question four 15 Marks

a-What are the frequencies at the first and second overtones produced by an air column in case : (i) one end closed and one open .(ii) both end open .

b –State the mathematical relation between the magnitudes of E and B in an EM wave. And compare the relative amounts of energy carried by the electric and magnetic portions of an EM wave.

c– A 3 – kg object attached to a horizontal spring oscillates with an amplitude A = 10 cm and a frequency f =2.4 Hz. (a) What is the force constant of the spring ? (b) What is the period of the motion ? (c) What is the maximum speed of the object ? (d) What is the maximum acceleration of the object ?

d – [i]- What is the intensity level in decibels for a sound that has an intensity of 0.50 W/m^2 ?

{ii} –What is the intensity of a 48-dB sound ? ($I_0 = 1.0 \times 10^{-12}$ W/m^2)

Part 2

Question (5) **(15 Marks)**

a) Derive an expression for the position of a diffraction dark fringe on the viewing screen (y_m) as a function of its order (m).

b) A screen is placed 1 m from a single slit, which is illuminated with 690 nm light. If the distance between the first and third minima in the diffraction pattern is 3 mm, what is the width of the slit? (ii) What is the width of the second bright fringe?

c) Determine the four quantum numbers of all the electrons in the orbit of the principle quantum number n = 2

d) Write short notes about an engineering application of the studied waves and optics in the field of civil engineering.

Question(6) **(15 Marks)**

a) Derive Brewster's equation ($\tan\theta_p = n_2/n_1$) of the reflected polarized light

b) An impure sample of sugar of mass 4.5 gm is dissolved in distilled water to give 50 cm^3 of solution. If the angle of rotation of the plane of polarization of sodium light, caused by this solution when filling a polarimeter tube of length 20 cm, was found to be 11.3°, find the percentage of this sample (specific rotation of sugar for sodium light is 66.5° cm^2 gm^{-1}).

c) Photoelectrons are ejected with maximum speed 6×10^5 m/s when monochromatic light of a frequency 8×10^{14} Hz irradiates a photocathode. Determine the threshold wavelength of the photocathode and the stopping potential of the photoelectrons.
($h = 6.63\times10^{-34}$J.s, $c = 3\times10^8$m/s, $e = 1.6\times10^{-19}$C, $m = 9.11\times10^{-31}$kg,)