Assuit University Faculty of Science Physics Department Final Exam: 50 Marks	First Semester - 2019 Electricity & AC Current (226) P Time Allowed: 2 hours Date: 18 January, 2020

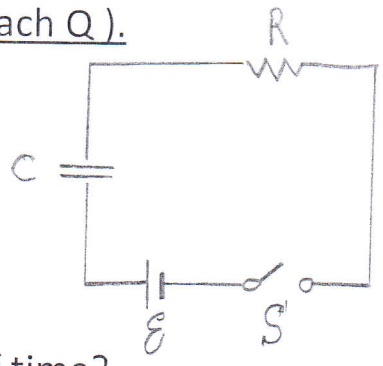
Answer the following questions: (5 Marks for each Q).

Q.1. An uncharged capacitor and resistors are Connected in series to a battery

If $\varepsilon = 12$ V, $C = 5.0$ μf and $R = 8 \times 10^5\ \Omega$

a) find the time constant of the circuit, the maximum charge and the maximum current?

b) Find the charge and the current as function of time?



Q.2. Find the inductance of a uniformly wound solenoid having N turns and length ℓ . Assume that ℓ is much longer than the radius of the windings and that the core of the solenoid is air?

Q.3. A coil with zero resistance has its ends labeled a and b. The potential at a is higher than at b. Which of the following could be consistent with this situation? (a) The current is constant and is directed a to b; (b) The current is constant and directed from b to a; (c) The current is increasing and is directed from a to b; (d) The current is decreasing and is directed from a to b; (e) The current is increasing and is directed from b to a; (f) The current is decreasing and is directed from to b to a.

Q.4. Conceder an LC circuit in which L = 500 mH and C = 0.1 μf. (a) What is the resonance frequency ω_o ? (b) If a resonance of 1kΩ is introduced into this circuit, what is the frequency of the damped oscillation? (c) By what percentage does the frequency of the damped oscillations differ from the resonance frequency?

Q.5. An AC generator supplies a peak (not rms) voltage of 150V at 60 Hz. It is connected in series with a 35 mH inductor, 45 μf capacitor. Determine the following: (a) The rms voltage of the generator (b) The impedance of the circuit(c) The power factor of this circuit. (d) The resonant frequency of this circuit.

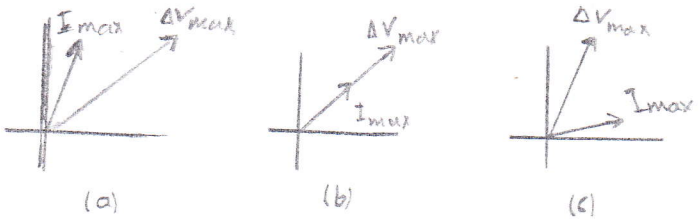
Q.6. The RLC circuit has capacitance of 12 μf, an inductance at 25 mH, and a resistance of 60 Ω. The current oscillation with an angular frequency of: (a) 2.9×10^2 rad/s (b) 1.4×10^3 rad/s (c) 1.8×10^3 rad/s (d) 2.2×10^3 rad/s

Q.7. An RLC series circuit has L= 100 and C= 1 μf . They are connected to 10^3 Hz source and the source emf is found to lead the current by 75°. Then the value of R is:

a- 10 Ω b- 75 Ω c- 95 Ω d- 126 Ω .

Q.8. Consider a series RLC circuit for which R = 150 L = 2 Ω mH, ΔV rms = 20V, and $\omega = 5000\ s^{-1}$, Determine the value of the capacitance for which the current is a maximum?

Q.9. Label each part of following figure as being $X_L > X_C$, $X_L = X_C$ or $XL < X_C$



Q.10. Draw to scale a phasor diagram showing Z, XL, XC and o for a series circuit for which R =300 Ω, C = 11.0 μf, L = 0.200 H, and f = (500\π) Hz.

---------- GOOG LUCK ----------

Physics department
Faculty of science
Assiut university

1st term exam 2019/2020

2nd year students: Physics | Subject: Optics (P271) | Time : 3 hours | Total degree: 50

Answer the following questions (each question 5 points)

Question 1

a) Find the energy of (a) a photon having a frequency of 5.00×10^{17} Hz and (b) a photon having a wavelength of 3.00×10^{2} nm. Express your answers in units of electron volts, noting that 1 eV = 1.60×10^{-19} J.

b) In figure 1 a refracted light beam in linseed oil making an angle of $\phi = 20.0°$ with the normal line NN'. The index of refraction of linseed oil is 1.48. Determine the angles (a) θ and (b) θ'.

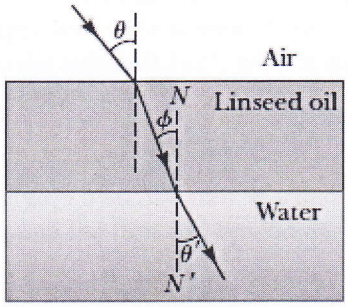


Figure 1

Question 2

In the double-slit arrangement (Figure 2), d =0.150 mm, L = 140 cm, λ= 643 nm, and y = 1.80 cm.
(a) What is the path difference δ for the rays from the two slits arriving at P?
(b) Express this path difference in terms of λ.
(c) Does P correspond to a maximum, a minimum, or an intermediate condition? Give evidence for your answer.

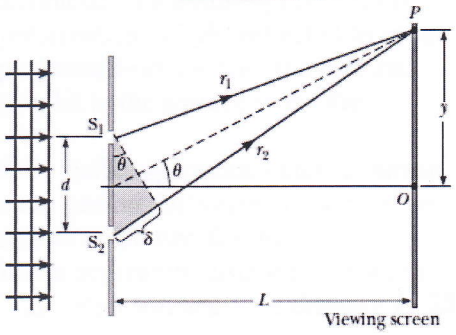


Figure 2

Question 3

a) Is it possible to have total internal reflection for light incident from air on water? Explain.

b) An underwater scuba diver sees the Sun at an apparent angle of 45.0° above the horizon. What is the actual elevation angle of the Sun above the horizon?

Question 4

How many times will the incident beam shown in Figure 3 be reflected by each of the parallel mirrors?

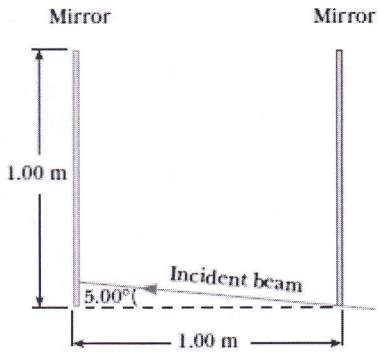


Figure 3

Question 5

a) Consider a concave spherical mirror with a real object. Is the image always inverted? Is the image always real? Give conditions for your answers.

b) A concave mirror has a focal length of 40.0 cm. Determine the object position for which the resulting image is upright and four times the size of the object.

Question 6

A converging lens has a focal length of 20.0 cm. Locate the image for object distances of (a) 40.0 cm, (b) 20.0 cm, and (c) 10.0 cm. For each case, state whether the image is real or virtual and upright or inverted. Find the magnification in each case.

Question 7

a) What is the necessary condition on the path length difference between two waves that interfere (a) constructively and (b) destructively?

b) A laser beam is incident on two slits with a separation of 0.200 mm, and a screen is placed 5.00 m from the slits. An interference pattern appears on the screen. If the angle from the center fringe to the first bright fringe to the side is 0.181°, what is the wavelength of the laser light?

Question 8

Light of wavelength 530 nm illuminates a pair of slits separated by 0.300 mm. If a screen is placed 2.00 m from the slits, determine the distance between the first and second dark fringes.

Question 9

a) Why is the following situation impossible? A technician is measuring the index of refraction of a solid material by observing the polarization of light reflected from its surface. She notices that when a light beam is projected from air onto the material surface, the reflected light is totally polarized parallel to the surface when the incident angle is 41.0.

b) Light of wavelength 500 nm, near the center of the visible spectrum, enters a human eye. Although pupil diameter varies from person to person, let's estimate a daytime diameter of 2 mm. (A) Estimate the limiting angle of resolution for this eye, assuming its resolution (B) Determine the minimum separation distance d between two point sources that the eye can distinguish if the point sources are a distance L=25 cm from the observer.

Question 10

Explain How Michelson Interferometer work. In Michelson Interferometer if the Mirror M1 is moved through a displacement ΔL. During this displacement, 250 fringe reversals (formation of successive dark or bright bands) are counted. The light being used has a wavelength of 632.8 nm. Calculate the displacement ΔL.

Good Luck

Assiut University	First semester final examination	Allowable time:3 hours
Faculty of Science	Thermodynamics (P223)	Date: 14/1/2020
Physics Department	2nd level (physics) 2019/2020	Total marks: 50 degree

Answer the following questions

1 a-i)Prove that the pressure of gas molecules on the wall of the gas container is equal to third of the gas density ρ multiplied by mean square velocity $\overline{C^2}$ of the gas molecules. Deduce an expression for the gas isothermal elastic coefficient and the gas expansion coefficient at constant pressure.

ii) Show that the air pressure at infinite altitude measured from the ground center is not equal zero. Find the value of this pressure at x=∞

b-i) Prove that the molecular velocity distribution function depends upon the gas absolute temperature "T". Indicate on a diagram and explain the effect of this temperature on that function

ii) Drive an expression for: - the average velocity $\overline{C}$ and the most probable velocity C_m of gas molecules. Find the relation between these two velocities and the root mean square velocity $\overline{\overline{C}}$ of these molecules.

c)Calculate the number of oxygen molecules per unit volume at one atmospheric pressure and absolute zero temperature where the most probable velocity of these molecules C_m equals 3.8×10^{4} cm.sec^{-1} and the mass of the oxygen molecules 52.8×10^{-24}gm

2 a) Prove that the slope of relation curve between the ideal gas pressure P and its volume V in the case of adiabatic variation is greater than the slope of this relation in the case of isothermal variation for the ideal gas

b) Deduce an expression for the work done during the adiabatic variation of the ideal gas. Deduce the relations govern the adiabatic variation of this gas.

c) Calculate the work done when one gram of oxygen gas is compressed adiabatically at atmospheric pressure and absolute zero temperature till a final volume V_f equals to half of its initial volume V_i where R=8.314 J/mol.K and R_{O2} for one gram of oxygen equals R/32

3 a) Prove that the mean free path of a gas spherical molecule is inversely proportional to the number of gas molecules per unit volume n

b) Drive an expression for the following: the critical volume, the critical temperature, the critical pressure and the temperature at which the real gas changes to an ideal gas.

c)A gas molecule of diameter 3×10^{-10} m at 27 C° and one atmospheric pressure , calculate: i- the mean free path of this molecule, ii- the average number of collisions per second occurred between two molecules (collision frequency) where the most probable velocity of molecules C_m in this case equals to 473 m/s. Assuming that the mass of the gas molecules equals 46.23×10^{-27} kg, calculate the viscosity coefficient of this gas

4 a-i) Explain on a diagram how the heat engine can complete one Carnot cycle

ii)Deduce an expression for the total work done during this cycle and the efficiency of the heat engine.

b-i) Put an expression for i-Maxwell`s equations in thermodynamics, ii- the entropy change in terms of C_P and C_V of the real gas

ii) Deduce an expression for $C_P - C_V$ in terms of isothermal elastic and thermal expansion coefficients and from this expression, prove that $(C_P - C_V)=R$

c) Calculate the entropy change during the gas isothermal expansion from initial volume V_i to a final volume $V_f = 4\ V_i$ where R=8.314 J/mol K.

With my best wishes

Prof. Dr. Abdel-Haleem Turky

'Assiut University
Faculty of Science
Department of Physics
First semester 2019-2020

Course: Modern Physics
Code: P215
Time: 3 Hour
Final Exam (50%)

The exam is written in two pages

Answer five (5) only of the following questions:

Question (1): *(10 Marks)*

a- Verify that the law of conservation of linear momentum is invariant under Galilean transformation. *(5 Marks)*

b- Photon emitted from transition of electron from $n_i = 5$, the wavelength of emitted photon is $12.9 \times 10^{-7}\ m$. Calculate n_f and the frequency of emitted photon. What is the series of this photon? *(5 Marks)*

Question (2): *(10 Marks)*

a- Write Bohr's hypotheses for his atomic model. Using these assumptions, prove that the fine-structure constant α is very nearly equal to 1/137. (5 Mark)

b- The threshold wavelength of potassium is 558 nm. What is the work function for potassium? What is the stopping potential when light of 400 nm is incident on potassium? *(5 Marks)*

Question (3): *(10 Marks)*

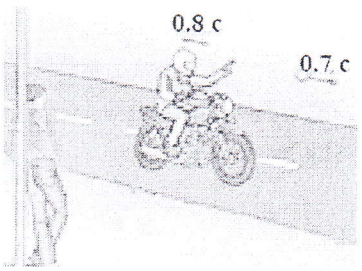
a- Prove that any particle having zero rest mass "such as photon or neutrino" always move with speed of light *c*. *(5 Marks)*

b- X-ray tubes currently used by dentists often have accelerating voltages of 80 kV. What is the minimum wavelength of the x rays they produce? *(5 Marks)*

Question (4): *(10 Marks)*

c- Discuss the radiation properties of the blackbody, and derive the Planck's expression for the density of radiation. *(5 Marks)*

d- Imagine a motorcycle rider moving with a speed of 0.800*c* past a stationary observer, as shown in the figure. If the rider tosses a ball in the forward direction with a speed of 0.700*c* with respect to himself, what is the speed of the ball as seen by the stationary observer?



Suppose that the motorcyclist turns on a beam of light that moves away from him with a speed of *c* in the same direction as the moving motorcycle. What would the stationary observer measure for the speed of the beam of light? *(5 Marks)*

Question (5): *(10 Marks)*

a- Although the classical Physics failed to explain the scattering of hard x-rays by free electrons in atoms of low atomic number, Compton succeeded to explain that by using the modern physics. Discuss that. Derive the Compton shift $\Delta\lambda$. *(5 Marks)*

b- Compute the de Broglie wavelength of an electron whose kinetic energy is 10 eV. *(5 Marks)*

Question (6): *(10 Marks)*

a- Derive the time dilation relation. (5 Mark)

b- In the Frank Hertz experiment, the mercury atoms were replaced by hydrogen atoms. If a stable hydrogen atom collides with an electron, its moving energy:

I- 10.0 eV II- 10.3 eV

Calculate the lowest electron kinetic energy in both cases after the collision? What kind of collision in each case? (5 Mark)

Electron chaege e	1.6×10^{-19} C		Plank's constant h	6.626×10^{-34} Joul.sec
Electron mass m_e	9.1×10^{-31} kg		Light velocity c	3×10^{8} m.sec^{-1}
Proton mass m_p	1.672×10^{-27} kg		Coulomb constant k	9×10^{9} J.m.C^{-2}
Bohr radius a_o	0.529×10^{-10} m		Rydberg constant R	1.097×10^{7} m^{-1}
Wien's displacement constant	2.8977×10^{-3} m·K		Ionization energy of the hydrogen atom E_o	13.6 eV

WITH MY BEST WISHES

Hesham Al-Attar

Assiut University **Faculty of Science** **Physics Department**		**Final Exam** 2019-2020 **Date**: January 11th, 2020 **Time**: 3 hours

Course Name: Elect. Magn. & AC **Course Code**: P261 **Coordinator:** Dr. Alaa Abd-Elnaiem

Part I: In the following multiple-choice questions, please choose the correct answer. You must write down the steps to get the correct answer (15 Grade/1.5 points each)

1. A charged capacitor and an inductor are connected in series. At time **t = 0** the current is zero, but the capacitor is charged. If **T** is the period of the resulting oscillations, the next time after **t = 0** that the voltage across the inductor is a maximum is:
   a. T **b.** T/4 **c.** T/2 **d.** 2T
2. We desire to make an **LC** circuit that oscillates at **100 Hz** using an inductance of **2.5 H**. We also need a capacitance of:
   a. 1 F **b.** 1 mF **c.** 1 μF **d.** 1 pF
3. A capacitor in an **LC** oscillator has a maximum potential difference of **15 V** and a maximum energy of **360 μJ**. At a certain instant, the energy in the capacitor is **40 μJ**. At that instant what is the ***emf*** induced in the inductor?
   a. zero **b.** 5 V **c.** 10 V **d.** 15 V
4. An **RLC** series circuit is connected to an oscillator with a maximum ***emf*** of **100 V**. If the voltage amplitudes V_R, V_L, and V_C are all equal to each other, then V_R must be:
   a. 50 V **b.** 75 V **c.** 100 V **d.** 125 V
5. A **45 mH** inductor is connected to a source of sinusoidal ***emf*** with a frequency of **400 Hz** and a maximum ***emf*** of **20 V**. The maximum current is:
   a. 0.28 A **b.** 0.18 A **c.** 2.3 A **d.** 1.4 A
6. Solenoid #2 has twice the radius and six times the number of turns per unit length as solenoid #1. The ratio of the magnetic field in the interior of #2 to that in the interior of #1 is:
   a. 2 **b.** 4 **c.** 6 **d.** 8
7. The graph in **Figure 1** shows the magnitude ***B*** of a uniform magnetic field that is perpendicular to the plane of a conducting loop. The rank of the five regions indicated on the graph according to the magnitude of the emf induced in the loop, from least to greatest, is:
   a. 2, 3, 4, 1 **b.** 4, 3, 1, 2 **c.** 4, 3, 2, 1 **d.** 2, 4, 3, 1
8. The segment of wire is formed into the shape shown in **Figure 2** and carries a current **I=3 A**. The resulting magnetic field at the point **P** (center of the circle) is:
   a. 1.5 μT **b.** 4.7 μT **c.** 9.43 μT **d.** 12 μT
9. A **10** turn ideal solenoid has an inductance of **4 mH**. To generate an ***emf*** of **2 V** the current should change at a rate of:
   a. 5 A/s **b.** 50 A/s **c.** 250 A/s **d.** 500 A/s
10. The total impedance of the circuit shown in **Figure 3** is:
    a. 21 Ω **b.** 50 Ω **c.** 60 Ω **d.** 173 Ω

Figure 1

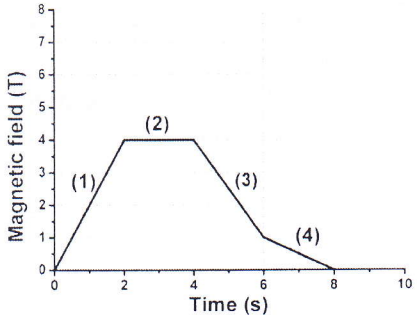


Figure 2

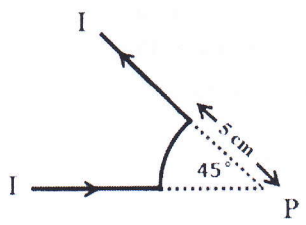
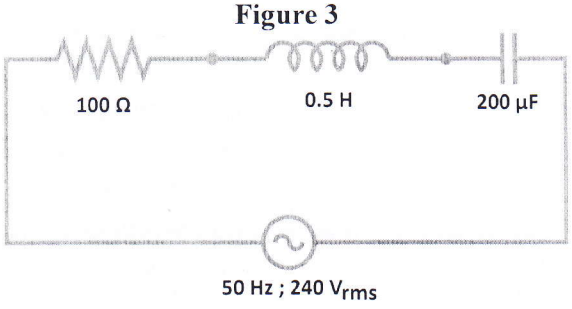


Figure 3

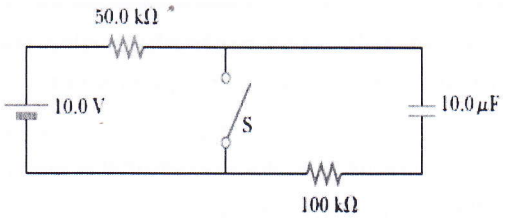


Part II: Answer all the following problems **(35 Grade/ 7 points each)**

Question 1:

i. An uncharged capacitor (**C**) and a resistor (**R**) are connected in series to a battery (ε), where ε= **12 V**, **C =5 μF**, and **R=8×10^5 Ω**. Find **(a)** the time constant of the circuit, **(b)** the maximum charge on the capacitor, **(c)** the maximum current in the circuit, and **(d)** the charge and current as functions of time.

ii. In the shown circuit, the switch **S** has been open for a long time. It is then suddenly closed. Determine the time constant **(a)** before the switch is closed and **(b)** after the switch is closed. **(c)** Let the switch be closed at **t=0**. Determine the current in the switch as a function of time.



Question 2:

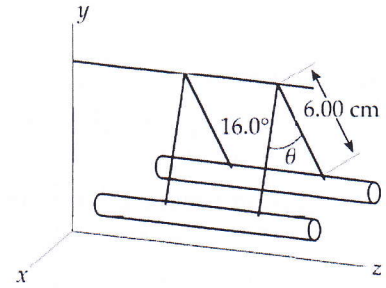
i. **(a)** Calculate the inductance of an air-core solenoid containing **300 turns** if the length of the solenoid is **25 cm** and its cross-sectional area is **4 cm^2**; **(b)** calculate the self-induced *emf* in the solenoid if the current it carries is decreasing at the rate **50 A/s**.

ii. Consider an **LC** circuit in which **L= 500 mH** and **C=0.1 μF**. **(a)** What is the resonance frequency ω_0? **(b)** If a resistance of **1 kΩ** is introduced into this circuit, what is the frequency of the damped oscillations? **(c)** By what percentage does the frequency of the damped oscillations differ from the resonance frequency?

Question 3:

i. Two coils are close to each other. The first coil carries a current given by **i(t)=8e$^{-2.8t}$**, where ***i*** is in amperes and **t** is in seconds. At **t= 0.75 s**, the *emf* measured across the second coil is **-6.5 V**. What is the mutual inductance of the coils?

ii. Two long, parallel wires, each having a mass per unit length of **40 g m^{-1}**, are supported in a horizontal plane by strings **6 cm** long. When both wires carry the same current, **I**, the wires repel each other so that the angle, **θ**, between the supporting strings is **16°**. Find the magnitude and direction of the current in both parallel wires.



Question 4:

i. A conductor in the shape of a square loop of edge length **ℓ = 0.4 m** carries a current **I =10 A**, **(a)** Calculate the magnitude and direction of the magnetic field at the center of the square. **(b)** If this conductor is formed into a single circular turn and carries the same current, what is the value of the magnetic field at the center?

ii. An AC generator supplies a peak (not **rms**) voltage of **150 V** at **60 Hz**. It is connected in series with a **35 mH** inductor, **45 μF** capacitor and **85 Ω** resistor. Determine the following:

(a) The **rms** voltage of the generator
(b) The impedance of the circuit
(c) The power factor for this circuit
(d) The resonant frequency of this circuit

Question 5:

i. The planetary model of the hydrogen atom consists of an electron in a circular orbit about a proton. The motion of the electron of charge **1.6×10^{-19} C** creates an electric current. The radius of the electron orbit is **5.3×10^{-11} m** and the electron's velocity is **2.2×10^6 m/s**. What is the magnetic field strength at the location of the proton?

ii. Coil 1 has **L_1 = 25 mH** and **N_1 = 100 turns**. Coil 2 has **L_2 = 40 mH** and **N_2 = 200 turns**. The coils are fixed in place; their mutual inductance **M** is **3 mH**. A **6 mA** current in coil 1 is changing at the rate of **4 A/s**.

(a) What is the magnetic flux Φ_{12} links coil 1?
(b) What is the self-induced *emf* appears in coil 1?
(c) What is the magnetic flux Φ_{21} links coil 2?
(d) What is the mutually induced *emf* appears in coil 2?

Constants: $\mu_0=4\pi\times10^{-7}$ T.m/A; $\varepsilon_0=8.85\times10^{-12}$ F/m; g=9.8 m/s^2==========Best Wishes,,,