*Final Exam – Second Term: (2014/2015) - Course Title: Principle of Modern Physics - Code P- 225 - Time: 2 h - Prof. Dr. Ahmed Sedky*

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**Answer the following questions:**

**Q1(14 marks):**

**1.** The expected shift in the fringes of M-M experiment is given by _____ , and it is really equal _____, when they rotated the apparatus by $90^{o}$.

**2.** Consider an object moves with v = c, then its proper length equal _____ , and its proper time equal _____

**3.** The relativistic expression between E and P for an electron is given by _____ , and it is given by_____for a photon

**4.**The stopping voltage for photoelectric effect occurs when _____ ,and it is related to the kinetic energy by the relation _____

**5.** The $\lambda_{min}$ (Å) of the x-ray photons is given by _____, and it is equal_____Å at V = 6.2 KV.

**6.** If the energy of γ-rays equal 5.022 MeV in pair production, the kinetic energy of the pairs is given by _____, and it is equal _____MeV

**7-** The $x_{1/2}$ of photon absorption in metals is given by_____ , and its equal _____when $\mu_\ell = 78\ m^{-1}$

**Q2(9 marks):**

**(a)** Explain with drawing how you can determine Planck's constant from photoelectric effect.

**(b)** Calculate the equivalent values of mass and energy by MeV of atomic mass unit.

**(c)** An electron's speed is increased from 0.2c to 0.8c. By what ratio does its momentum increase in terms of $m_0c$.

**Q3(9 marks):**

(a) Derive an expression for time dilation in special relativity.

(b) Define the binding energy of a nucleus of mass $M_A$, and then calculate $E_b$ by MeV for Helium atom ($M_{He}$ = 4.082 amu, $m_p$ = 1.0073 and $m_n$ = 1.0087 amu).

(c) Calculate the minimum and maximum shift of the x-ray wave length by Å for Compton effect.

**Q4(9 marks):**

**(a)** By using two different methods, calculate only the wave length of accelerating electron directed onto a nickel crystal (V = 54 Volt, $\Theta = 65^{o}$ , d = 0.91 Å and $m_o = 9.1\times10^{-31}$ Kg).

**(b)** Explain in details how the radioactive nucleus can undergoes two types of β decay.

**(c)** Write the uncertainty principle, and then calculate the uncertainty in the position of an electron if the uncertainty of its wave length is $3.75\times10^{-5}$ m ($\hbar = 1.05\times10^{-34}$ (J.s).

**Q5(9 marks):**

**(a)** Sketch only the diagram of Rutherford's experiment for radioactivity, and then calculate the activity of $_{88}Ra^{226}$ at t = 0 ($T_{1/2} = 5 \times 10^{-10}$ s and $N_0 = 3 \times 10^{16}$ nucleus).

**(b)** Calculate by Å the shorter wave length of Ballmer series for the hydrogen atom ($R_h = 1.097 \times 10^{-3}$ Å$^{-1}$).

**(c)** In terms of the required reactions and diagrams write short account about nuclear fission.

Assiut University
Faculty of Science
Department of Physics

Undergraduate
Final Exam (50%)

Second semester 2014-2015

Course : Modern Physics
Code : P215
Section : Phys. and Phys./Chem.
Time : 3 Hours
Date : 10/6/2015

## Answer the following question:

**Question (1):** **(10 Mark)**

Write number of each statement and put [√] or [×], then discuss your answer (if √ or × ):

1- The matter wave should have localization property.

2- Particle model can be used exclusively to describe matter.

3- Galilean transformation is a set of equations connecting space-time coordinates of an event in two different inertial frames.

4- In spacetime diagram, any events have same value of $x$ do not occupr simultaneously.

5- Proper time occurs between two simultaneous events.

6- In relativistic Doppler effect, the frequency shift decreases by increasing relative velocity between observer and source.

7- According to EM classical theory, the existence of threshold frequency has no explanation in photoelectric effect.

8- Bohr's corresponding principle says "the smaller quantum number, the closer quantum physics approaches classical physics"

9- The red line in Balmar series is produced as electron transition from $n = 3$ to $n=2$.

10- According to Rutherford's atomic model, $\alpha$–particles will scatter from thin gold foil through small scattering angles only.

## Answer four (4) only of the following questions:

**Question (2):** **(10 Mark)**

a) Derive Lorentz velocity transformation equations. (7 points)

b) The half life of a particle, as measured in the laboratory, is $4\times10^{-8}$ second when its speed is $0.8c$. Calculate the half life in the frame of the particle. What is the speed of the particle when its half life is $3\times10^{-8}$ second. (3 points)

**Question (3):**

a) Derive the total energy $E$ of electron in stationary state of Hydrogen atom according to Bohr Model. ($r_n = \frac{h^2 \varepsilon_0}{\pi m e^2} n^2$). (5 points)

b) Discuss the physical meaning of negative sign of $E$ . (2 points)

c) What is the emitted photon energy for second line of the Balmer series? (3 points)

**Question (4):** **(10 Mark)**

a) Discuss how de Broglie Explained Bohr's Quantization Condition. (5 points)

b) Calculate the wavelength of the wave associated to the electron in second orbit of Hydrogen atom ($r_n = a_0 n^2$, $a_0 = 5.32 \times 10^{-11}$ m). (3 points)

c) Calculate the possible states for the principle quantum number $n$ = 3 according to Sommerfeld model. (2 points)

**Question (5):** **(10 Mark)**

a) Discuss how Einstein explained the six facts of photoelectric effects. (6 points)

b) A certain metal has a threshold wavelength of 600 nm. Find:

1) The work function of this metal in eV. (2 points)

2) Stopping potential when the metal is illuminated with:

2-1) light of wavelength 400 nm. (1 points)

2-2) light having same frequency and twice the intensity of that in (2-1). (1 points)

Constants: $c = 3\times10^8$ m/s , $h = 6.6261\times10^{-34}$ J.s , $e = 1.6 \times10^{-19}$ C

**Question (6):** **(10 Mark)**

a) If a particle could move with the velocity of light, how much its relativistic kinetic energy. (4 points)

b) A particle of rest mass $m_0$ moves with speed $c/\sqrt{2}$. Calculate its relativistic mass, total energy and kinetic energy. (3 points)

c) The total energy of a particle is exactly twice its rest energy. Calculate its speed. (3 points)

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| **Assiut University**<br>**Faculty of Science**<br>**Physics Department** | | **Final Exam 2015**<br>**Date:** June 15th, 2015<br>**Allowed time:** 3 hours |

**Course Name:** ***Introduction to Physics of Metals, Alloys and Ceramics*** **Course Code:** P256
**(50 Marks)** **Coordinator:** Dr. Alaa Abd-Elnaiem

## Answer all the following questions

**Question (I):** **(14 Marks)**

**In the following multiple choice questions, circle the correct answer(s). You must write down the steps to get the correct answer (for part 2 ONLY).**

**I-Part 1** **(6 Marks)**

1. **The boundary line between (liquid) and (liquid+solid) regions must be part of:**

   **A.** Solvus. **B.** Solidus. **C.** Liquidus. **D.** Tie-line. **E.** None of these.

2. **Metals are generally:**

   **A.** Soft and ductile
   **B.** Hard and brittle.
   **C.** Non-reactive and malleable.
   **D.** Hard, ductile and malleable.
   **E.** None of the above.

3. **Which of the following is NOT the two dimensional imperfection:**

   **A.** Twin boundary.
   **B.** Dislocation.
   **C.** External surface.
   **D.** Grain boundary.
   **E.** Vacancy.

4. **A solid + a liquid result in a solid up on cooling during.....reaction:**

   **A.** Eutectic. **B.** Peritectic. **C.** Monotectic. **D.** Syntectic. **E.** Peritectoid.

5. **Coordination number in hexagonal crystal structure is:**

   **A.** 2. **B.** 4. **C.** 6. **D.** 8. **E.** 12.

6. **The ability of the material to resist stress without failure is called:**

   **A.** Strength. **B.** Hardness. **C.** Stiffness. **D.** Toughness. **E.** None of these.

(٢)

**I-Part 2** **(8 Marks)**

7. **Iron (Fe) has a BCC crystal structure, an atomic radius of 0.124 nm, and an atomic weight of 55.85 g/mole, then its theoretical density is: [$N_A = 6.022 \times 10^{23}$ atoms/mole)]**

**A. 3.8 g/cm$^3$** **B. 6.5 g/cm$^3$** **C. 7.9 g/cm$^3$** **D. 10.2 g/cm$^3$** **E. 15.4 g/cm$^3$**

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8. **Miller indices for the indicated plane, below figure, are :**

**A. (001)** **B. (110)** **C. (101)** **D. ($\bar{1}$01)** **E. (0$\bar{1}$1)**

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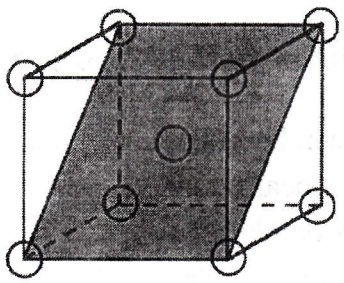

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9. **The linear density expression for FCC [100] direction in terms of the atomic radius R is:**

**A.** $\frac{1}{2\sqrt{2}R}$ **B.** $\frac{1}{\sqrt{2}R}$ **C.** $\frac{1}{2\sqrt{6}R}$ **D.** $\frac{1}{6R}$ **E.** $\frac{1}{2\sqrt{3}R}$

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0. A cylindrical specimen of a titanium (Ti) alloy having an elastic modulus of 107 GPa and an original diameter of 3.8 mm will experience only elastic deformation when a tensile load of 2000 N is applied, what is the maximum length of the specimen before deformation if the maximum allowable elongation is 0.42 mm ?:

A. 25 mm B.75 mm C. 125 mm D. 255 mm E.275 mm

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**Question (II):** **(4 Marks)**

**Define, in brief, the following:**

**1. Tension test:**

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**2. Frenkel defect:**

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**3. Segregation process:**

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**4. Isomorphous phase diagram:**

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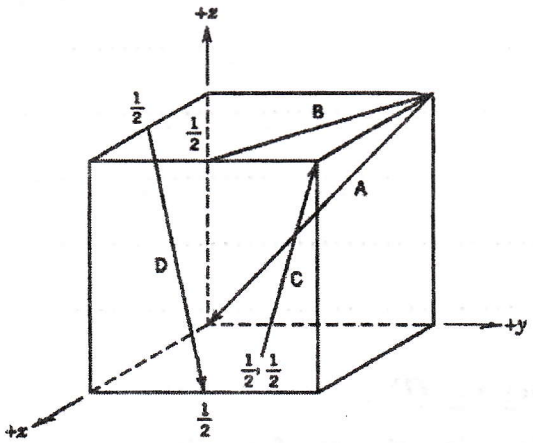
**Question (III):** **(6 Marks)**

Determine the indices for the directions shown in the following cubic unit cell, and sketch within a cubic unit cell the following planes (110), (010):

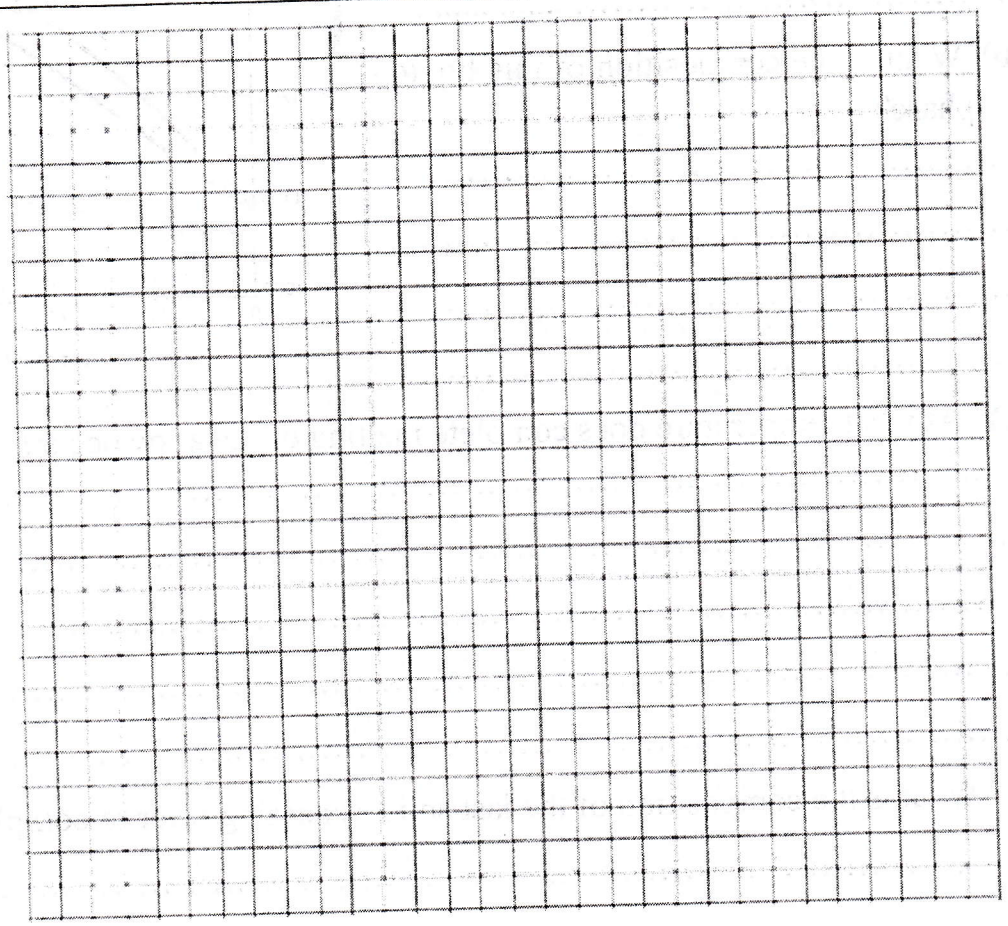


(05)

**Question (IV):** **(6 Marks)**

Given here are the solidus and liquidus temperatures for the copper-gold (Cu-Au) system. Construct the phase diagram for this system and label each region.
What is the name of this phase diagram and describe it briefly?

| *Composition (wt% Au)* | *Solidus Temperature (°C)* | *Liquidus Temperature (°C)* |
|---|---|---|
| 0 | 1085 | 1085 |
| 20 | 1019 | 1042 |
| 40 | 972 | 996 |
| 60 | 934 | 946 |
| 80 | 911 | 911 |
| 90 | 928 | 942 |
| 95 | 974 | 984 |
| 100 | 1064 | 1064 |



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**Question (V):** **(6 Marks)**

A copper (Cu)-nickel (Ni) alloy of composition 40 wt% Ni-60 wt% Cu is slowly heated from a temperature of 1500 °C, *using below phase diagram*:

**(a)** At what temperature does the first liquid phase form?

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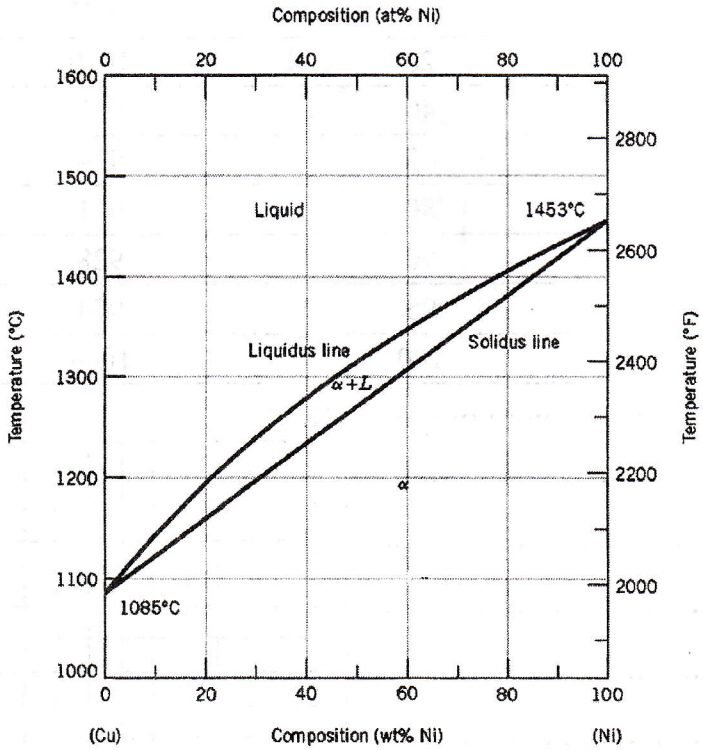


**(b)** What is the composition of this liquid phase?

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**(c)** At what temperature does complete melting of the alloy occur?

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**(d)** What is the composition of the last solid remaining prior to complete melting?

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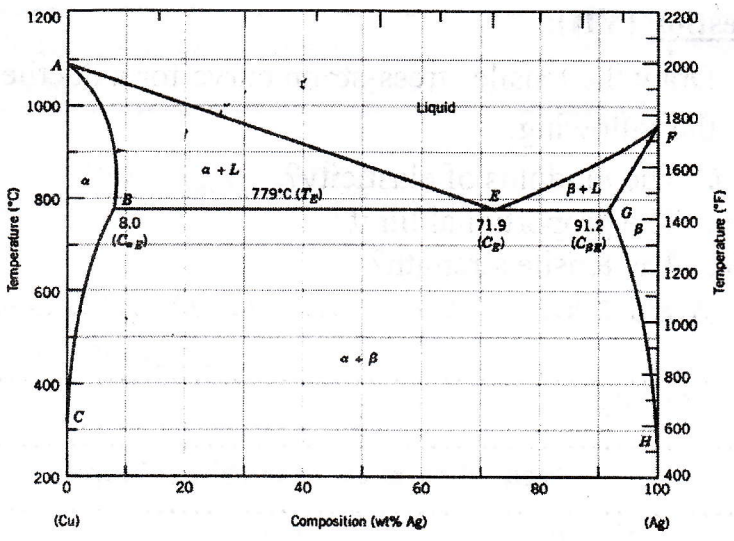
(V)

**Question (VI):** **(8 Marks)**

For a 30 at% Ag-70 at% Cu alloy at 920°C, *in below phase diagram* ($A_{Cu}$=63.54 g/mol, $A_{Ag}$=107.87 g/mol):




**(a)** What phase(s) is (are) present?

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**(b)** What is (are) the composition(s) of the phase(s)?

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**(c)** Calculate the relative amount of each phase present in terms of mass fraction?

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**(d)** State eutectic reaction, temperature and composition of this system.

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**Question (VII):** **(6 Marks)**

**(a)** Draw the tensile stress-strain curve for a ductile alloy and show how you can estimate the following:

*i.* The modulus of elasticity?
*ii.* The proportional limit?
*iii.* The tensile strength?

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**(b)** A 10 mm diameter Brinell hardness indenter produced an indentation 2.5 mm in diameter in a steel alloy when a load of 1000 kg was used. Compute the HB of this material.

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BEST WISHES,,,

Assiut University
Faculty of Science
Department of Physics

Vibrations and
Waves (212 Phys)

Final Exam
June, 2015
Time Allow: Three hours

Answer all the following (10 marks for each question)

1-a) Deduce an expression for the energy of a simple harmonic oscillator (spring).

b) A mass of 2.5 kg is attached to a horizontal spring of force constant of 4.5 kN/m. The spring is stretched 10 cm from equilibrium and released. Find:

i) the maximum acceleration – the maximum speed.

ii) When does the mass first reach its equilibrium position?

2-a) Study the oscillation of the light damped unforced oscillator to deduce the relation between the oscillating angular frequency and damping factor.

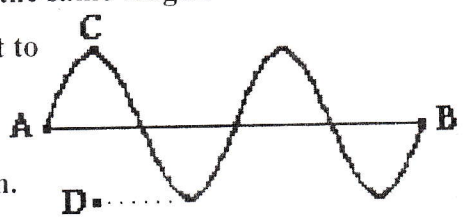
b) In forced RLC circuit, R= 20 Ohm, L= 10 mH and C=2 nF. If the initial driving voltage is 5 V, calculate: i) the initial charge. ii) the phase angle.

3-a) Deduce expressions for the displacements of two simple pendulums moving by an equal amount but in opposite directions through the connection by a horizontal spring.

b) Two mass-spring oscillators couple together by a third spring. If the three springs have a same constant of 180 N/m and the mass is 0.1 kg, calculate the ratio of the amplitudes in the case of first and second normal modes of longitudinal vibration.

4-a) Deuce the first and second normal modes of transverse vibration for a system consists of two masses-string of length $\ell$ connected by third string of the same length.

b) A wave with a frequency of 12.3 Hz is traveling from left to right across a rope as shown in the diagram. Positions A and B are separated by a horizontal distance of 42.8 cm. Positions C and D are separated by a vertical distance of 12.4 cm.




i) Determine the amplitude, wavelength, period and speed of this wave.

ii) Express the wave as $y = A\cos(\omega t - kx)$ with writing the values of $A$, $\omega$ and $k$.

5-a) Deduce the transmission and reflection coefficients of amplitude for a wave incident from a medium to different one.

b) A sound source moving north with 50 km/h emits a frequency of 900 Hz. An observer in a car speeds north at 70 km/h. what frequency does the observer hear?

Best wishes
Prof. Dr. Mostafa Boudi

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|---|---|---|
| Assiut University | | Term: 2nd Semester 2015 |
| Faculty of Science | Final Exam | Date: June 8th, 2015 |
| Department of Physics | (Grade 50) | Time: 2 hours |
| Course: Electricity and AC Current- Phy226 | ⚠ pages (6) | |

**Part I: Choose the correct answer and justify your answer** **(15 Marks)**

1. **The total energy in a circuit contains a resistor, inductor and capacitor……..with time.**

(a) is constant (b) decreases (c) increases

**Why?** .....

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2. **For a sinusoidal applied voltage on an inductor,**

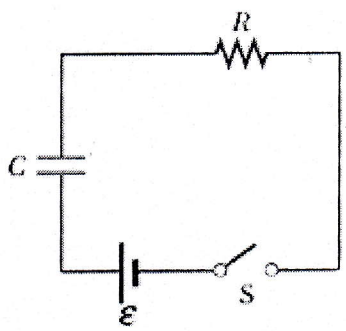
*(a) the current and voltage across the inductor are in phase*

*(b) the current lags behind the voltage by 90°*

*(c) the voltage lags behind the current by 90°*

3. **Consider the circuit in the Figure and assume that the battery has no internal resistance. Just after the switch is closed, the potential difference across which of the following is equal to the emf of the battery?**

*(a) C* *(b) R* *(c) neither C nor R*




**After a very long time, the potential difference across which of the following is equal to the emf of the battery?**

*(d) C* *(e) R* *(f) neither C nor R*

4. **At an instant of time during the oscillations of an LC circuit, the current is at its maximum value. At this instant, the voltage across the capacitor**

*(a) is different from that across the inductor* *(b) is zero*

*(c) has its maximum value* *(d) is impossible to determine*

**Why?** .....

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(C)

5. If the current in an inductor is doubled, by what factor does the stored energy change?

(a) Two times (b) Three times

(c) Four times (d) Remain as the same

Why? .....

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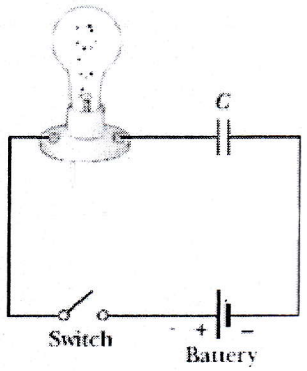
6. Referring to the shown Figure, assume that the capacitor has a large capacitance and is initially uncharged, and assume that the light illuminates when connected directly across the battery terminals. What happens to the lightbulb after the switch is closed?




(a) will glow and then its intensity decreases

(b) will not glow at all

(c) will glow and its intensity increases

(d) will glow and its intensity remain with time

Why? .....

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7. The impedance of a series RLC circuit at the resonance is

(a) Zero (b) equal to $X_C$

(c) equal to R (d) equal to $X_L$

Why? .....

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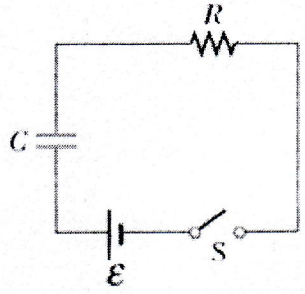
8. An uncharged capacitor (C) and resistor are connected in series to a battery (ε) as shown in the Figure, if the switch (S) is just closed




The instantaneous charge on the capacitor is ...

(a) ε C (b) Zero (c) infinity

Why? .....

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The instantaneous current in the circuit is ...

(a) ε/R (b) Zero (c) infinity

Why? .....

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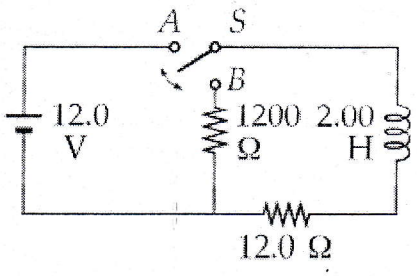
## Part II: Answer the following: (35 Marks)

P1. One application of an RL circuit is the generation of time varying high voltage from a low-voltage source, as shown in the Figure. (6 Marks)

(a) What is the current in the circuit a long time after the switch has been in position A?




(b) Now the switch is thrown quickly from A to B. Compute the initial voltage across each resistor and across the inductor.

(c) How much time elapses before the voltage across the inductor drops to 12 V?

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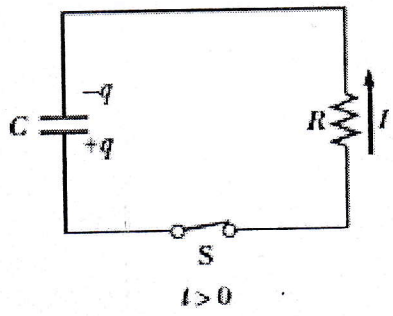
P2. A 10-mH inductor carries a current $I = 5 \sin \omega t$, with $\omega/2\pi = 60$ Hz. What is the back emf as a function of time? (4 Marks)

(٤)

P3. Consider a series circuit composed of a resistor R and capacitor C, shown in Figure.

(a) Drive the instantaneous charge on the capacitor during the discharging. (6 marks)




(b) and then drive the instantaneous current in the circuit.

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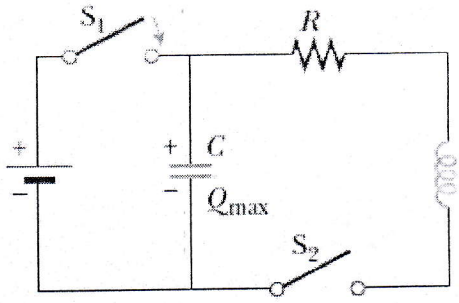
P4. A 5-μF capacitor is charged to a potential difference of 800 V and then discharged through a 25-kΩ resistor. How much energy is delivered to the resistor in the time interval required to fully discharge the capacitor? (3 Marks)

(05)

**P5. In RLC circuit shown in the Figure, let R =7.6 Ω, L = 2.2 mH, and C = 1.8 μF.**

**(a) Calculate the frequency of the damped oscillation of the circuit.** **(4 marks)**




(b) What is the critical resistance?

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**P8. Draw to scale a phasor diagram showing the value of Z, $X_L$, $X_C$, and Φ for an AC series circuit for which R = 300 Ω, C = 11 μF, L = 0.2 H, and f = (500/π) Hz.** **(4 marks)**

(7)

P9. The tuning circuit of an AM radio contains an LC combination. The inductance is 0.2 mH, and the capacitor is variable, so that the circuit can resonate at any frequency between 550 kHz and 1650 kHz. Find the range of values required for Capacitor. **(4 marks)**

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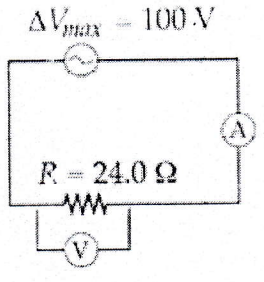
P10. An AC power supply produces a maximum voltage $V_{max}$ =100 V. This power supply is connected to a 24-Ω resistor, and the current and resistor voltage are measured with an ideal AC ammeter and voltmeter, as shown in the Figure. <u>What does each meter read?</u>

Note: an ideal ammeter has zero resistance and that an ideal voltmeter has infinite resistance.

**(4 marks)**




GOODLUCK

Nagih Shaalan