Assiut University
Faculty of Science
Department of Physics

Undergraduate
Final Exam (50%)

First semester 2018-2019

Course: Quantum Mechanics (1)
Code : P311
Section: Phys. and Phys./Chem.
Time : 3 Hours
Date : 9/1/2019

Answer the following two (2) questions:

Question (1): (10 Mark)

Choose the correct answer(s) and then discuss your answer (Note that there may be more than one correct choice):

1- The results of Davisson and Germer experiment lead to confirmation of:

A) the wave nature of electrons
B) the quantization of energy levels
C) the Bohr model of the atom
D) the particle nature of light

Discussion: .....

.....

.....

2- The results of Compton scattering lead to confirmation of:

A) the wave nature of electrons
B) the quantization of energy levels
C) the Bohr model of the atom
D) the particle nature of light

Discussion: .....

.....

.....

3- The probability of finding the particle in somewhere in space is:

A) independent of time
B) dependent of time
C) independent of position
D) dependent of position

Discussion: .....

.....

.....

4- The energy of a photon is equal to the kinetic energy of a nonrelativistic electron. Which one of the following statements is accurate?

A) The de Broglie wavelength of the electron is equal to the wavelength of the photon

B) The electron and photon have the same speed

C) The momentum of the photon is equal to the momentum of the electron

D) None of the above statements are correct

Discussion: .....

.....

.....

5- The eigenvalue:

A) must be real **B) must be complex**

C) can be real or complex **D) can be discrete numbers only**

Discussion: .....

.....

.....

6- The total probability of finding the particle is:

A) independent of time **B) dependent of time**

C) independent of position **D) dependent of position**

Discussion: .....

.....

.....

7- According to the interpretation of Max Born, the wavefunction for individual particle:

A) cannot interfere with itself **B) can interfere with itself**

C) has physical meaning **D) are electromagnetic waves**

Discussion: .....

.....

.....

8- The wavefunction for a particle must be normalized because:

A) the particle's charge must be conserved

B) the particle's momentum must be conserved

C) the particle cannot be in two places at the same time

D) the particle must be somewhere

Discussion: .....

.....

.....

9- The operator of eigenvalue equation must be Hermitian because:

A) the eigenvalue must be real

B) the eigenfunctions must be orthogonal

C) both A) and B)

D) None of the above

Discussion: .....

.....

.....

10- Which of the following is accurate statement concerning particle in infinite square well:

A) The space between energy levels decreases with increasing energy

B) The space between energy levels increases with increasing energy

C) The wavefunctions are not continuous inside and outside the well

D) The number of nodes of the wave function increases with increasing energy

Discussion: .....

.....

.....

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

Solve the following and choose the correct answer

1- An electron has the same de Broglie wavelength as an 810 nm photon. The speed of the electron is closest to: **(2 points)**

A) 720 m/s **B) 900 m/s** **C) 990 m/s** **D) 800m/s** **E) 260 m/s**

Solution: .....

.....

.....

.....

.....

.....

.....

2- A wave function is given by: $\psi(x) = \begin{cases} 0 & x < 0 \\ Ax(L-x) & 0 \geq x \geq L \\ 0 & x > 0 \end{cases}$ **(2 points)**

The product of the normalization constant A is equal to:

A) $\sqrt{\frac{24}{L^5}}$ **B)** $\sqrt{\frac{12}{L^5}}$ **C)** $\sqrt{\frac{30}{L^5}}$ **D)** $\sqrt{\frac{15}{L^5}}$ **E)** $\sqrt{\frac{20}{L^5}}$

Solution: .....

.....

.....

.....

.....

.....

.....

.....

3- Normalized value of A for the wavefunction $\psi(x) = Ae^{x}$, $0 \le x \le L$ is: (2 points)

A) $\frac{2}{e^{2L}-1}$ B) $\sqrt{\frac{1}{e^{L}-1}}$ C) $\sqrt{\frac{2}{e^{2L}}}$ D) $\frac{1}{\sqrt{e^{L}}}$ E) $\sqrt{\frac{2}{e^{2L}-1}}$

Solution: .....

4- A particle is confined to infinite square well potential on the x-axis of width a. The normalized wavefunction of the particle in the ground state, is given by: (4 points)

$\psi(x) = i\sqrt{\frac{2}{a}}\, sin\left(\frac{\pi}{a}x\right)$. The probability of finding the particle between $x = 0$ and $x = a/3$, is closest to:

A) 0.20 B) 0.22 C) 0.24 D) 0.26 E) 0.28

olution: .....

Answer only three (3) of the following questions:

Question (3): **(10 Mark)**

a) If you know that the average internal energy of oscillator is: $\langle u_1 \rangle = \frac{hf_0}{(e^{hf_0/k_BT}-1)}$.

Derive an expression of Einstein's molar heat capacity of solids. **(4 points)**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

b) Prove that at high temperature the Einstein expression for molar heat capacity is reduced to classical form. **(2 points)**

.....

c) Consider the wave function $\psi(x,t) = Ae^{-(\lambda x + i\omega t)}$, where A, λ, and ω are positive real constants. Normalize $\psi(x,t)$ and determine the uncertainty Δx. (4 points)

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

a) **Prove that the motion of free particle described by Schrödinger equation obey to continuity equation** $\frac{\partial P(\vec{r},t)}{\partial t} + \vec{\nabla} \cdot S(\vec{r},t) = 0$ **, where** $P(\vec{r},t)$ **is probability density and** $S(\vec{r},t)$ **is probability current density.** **(7 points)**

b) **A wavefunction of a free particle is described by:** **(3 points)**

$\Psi(x,t) = A\, e^{i(p_x x - Et)/\hbar}$. **Calculate the value of probability current density.**

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

a) **Prove that the eigenfunctions of a Hermitian operator are orthogonal.** **(3 points)**

b) **Find the eigenfunction of momentum operator** $\hat{p}_x = -i\hbar\frac{\partial}{\partial x}$ **(3 points)**

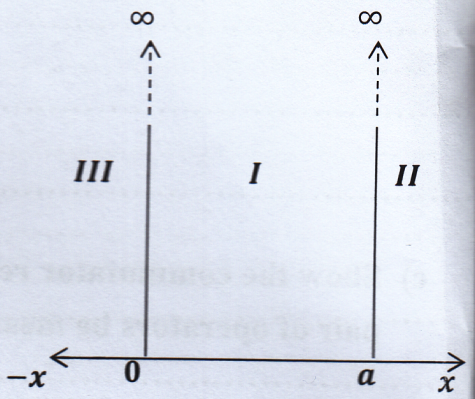
c) **Show the commutator relation for: 1) $[\hat{H}_x, \hat{p}_x]$, 2) $[\hat{y}, \hat{p}_y]$, and then discuss can each pair of operators be measured simultaneously or not?** **(4 points)**

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

a) **Consider the particle is in infinite square well potential:** **(6 points)**

the potential $V(x)$ is defined to be:

$$V(x) = \begin{cases} 0 & 0 < x < a \quad \text{inside the well} \\ \infty & x \leq 0,\ x \geq a \quad \text{outside the well} \end{cases}$$



Solve time independent Schrödinger equation to find the wavefuction and energy of the particle.

b) Draw the wavefunction and find a form of its normalization. **(4 points)**

Draft Pages:

1)

Constants and Important Equations:

- The speed of light: $c = 3\times10^{8}$ m/s
- Planck's constant: $h = 6.6261\times10^{-34}$ J.s
- Charge of electron: $e = 1.6\times10^{-19}$ C
- Rest mass of electron: $m_e = 9.109\times10^{-31}$ kg
- Rest mass of proton: $m_p = 1.672\times10^{-27}$ kg
- Rest mass of neutron: $m_n = 1.675\times10^{-27}$ kg
- Energy conversion: 1 eV $\equiv 1.6\times10^{-19}$ J
- 1 nm = 10^{-9} m
- Time independent Schrödinger equation: $\left[-\frac{\hbar^2}{2m}\frac{d^2}{dx^2}+\hat{V}(x)\right]\psi(x) = E\,\psi(x)$
- Time dependent Schrödinger equation: $\left[-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}+\hat{V}(x,t)\right]\psi(x,t) = i\hbar\frac{\partial\psi(x,t)}{\partial t}$

Useful Relations:

- $\sin^2\theta = \frac{1}{2}(1-\cos 2\theta)$
- $\int \cos 2kx\ dx = \frac{1}{2k}\int \cos 2kx\ d2kx = \frac{1}{2k}\sin 2kx + C$
- $\vec{\nabla}\cdot\left[f(\vec{\nabla}g) - g(\vec{\nabla}f)\right] = f(\nabla^2 g) - g(\nabla^2 f)$ for any two scalar quantity f and g.
- $\int_{-\infty}^{+\infty} e^{-qx^2}\,dx = 2\int_{0}^{+\infty} e^{-qx^2}\,dx = \sqrt{\frac{\pi}{q}}$
- $\int_{-\infty}^{+\infty} x^2 e^{-x^2}\,dx = \frac{\sqrt{\pi}}{2}$
- $\int_{-\infty}^{+\infty} x^2 e^{-qx^2}\,dx = 2\int_{0}^{+\infty} x^2 e^{-qx^2}\,dx = 2\frac{1}{4q}\sqrt{\frac{\pi}{q}}$
- For odd integrals $\int_{-\infty}^{+\infty} x^n e^{-qx^2}\,dx = 0\,, n = 1,3,5,\ldots$
- $\int_{-\infty}^{+\infty} e^{-qx}\,dx = 2\int_{0}^{+\infty} e^{-qx}\,dx = \frac{1}{q}$
- For odd integrals $\int_{-\infty}^{+\infty} x^n e^{-qx}\,dx = 0\,, n = 1,3,5,\ldots$
- For even integrals $\int_{-\infty}^{+\infty} x^n e^{-qx}\,dx = 2\int_{0}^{+\infty} x^n e^{-qx}\,dx = 2\frac{n!}{q^{n+1}}\ ,\ n = 2,4,6,\ldots$

Assiut University **Faculty of Science** **Department of Physics**		**Term: 1st Semester, 2018 - 2019** **Date: January 20th, 2019** **Exam duration: 3 hours**

Course Title: Environmental Physics- Code: P383 -
Final Exam (50 Marks)

I. Choose the correct answer. (23 Marks)

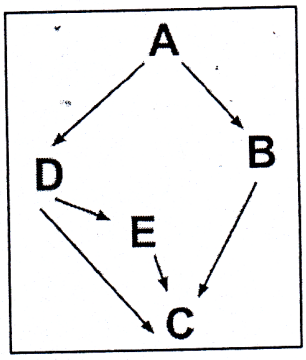
1. Direct conversion of solar radiation into electricity.
(a) Photosynthesis
(b) Photovoltaic
(c) concentrating solar power systems
(d) None of these are correct.

2. Exposure to solar UV may lead to a sever damage in the biological cells, and in the case of humans, to skin cancer. The .....range will be of prime importance in these processes.
(a) UV-A wavelength
(b) UV-B wavelength
(c) UV-C wavelength
(d) All

3. The process of converting nitrate to nitrogen gas and nitrous oxide is called .....
(a) nitrogen fixation
(b) Ammonification
(c) Denitrification
(d) None of these

4. Which is the opposite of condensation?
(a) runoff
(b) evaporation
(c) precipitation
(d) transpiration

5. A food web including five species is shown in the following figure. Food web showing relationship between five species. Which of the following is most likely to cause the greatest decrease in the species B population?
(a) A decrease in species D
(b) A decrease in species A
(c) An increase in species E
(d) A decrease in species C



6. What is the Nitrogen Cycle?
(a) The process where nitrogen passes from air to soil to organisms and back to air or soil
(b) The process where nitrogen is distributed to us
(c) The process where Nitrogen is made to help plants and animals

7. A rapid growth of algae could lead to ....
(a) A reduction of oxygen levels in the water.
(b) Water that can support more life.
(c) Waters that are devoid of life.
(d) An increase in oxygen levels.

8. The stratosphere ....
(a) is where the Asian Brown Cloud forms
(b) has more water vapor than the troposphere
(c) is where weather occurs
(d) is characterized by temperatures that decrease with altitude
(e) contains the ozone layer

9. What causes acid rain?
(a) High concentrations of sulfuric or nitric acid from pollution
(b) Fertilizer use (c) Pesticide use (d) CFCs

10. How nitrogen is "fixed" into useable form for plants .....
(a) through action of bacteria only (b) through lightning only
(c) through action of bacteria & lightning (d) through photosynthesis

11. Flocculation is defined as.....
(a) the gathering of fine particles after coagulation by gentle mixing
(b) clumps of bacteria
(c) the capacity of water to neutralize acids
(d) a high molecular weight of compounds that have negative charges

12. A population is .....
(a) any group of organisms of different species living in and depending on a specific area for all of its needs.
(b) any group of organisms of the same species living in and depending on each other for all of its needs.
(c) any group of organisms of the same species living in and depending on a specific area for all of its needs.
(d) a word that can only be used when referring to humans.

13. A pH of 3 is how many times more acidic than a pH of 5?
(a) 2 (b) 20 (c) 10 (d) 100

14. ***Who is it?*** It is colorless and odorless, is formed from the incomplete combustion of fossil fuels, and has the ability to bind chemically to hemoglobin molecule (by taking oxygen's place on the hemoglobin, disrupting its transport).

(a) NOx (b) SO_2 (c) CO (d) CO_2

15. What does the ozone layer protect us from?

(a) carbon monoxide poisoning (b) heat from the sun

(c) UV rays from the sun (d) smog

16. What is an example of natural air pollution?

(a) Acid rain (b) Vehicle emission of harmful gases

(c) Volcanic eruption (d) Burning fuels

17. Density is a .....

(a) Chemical Property (b) Physical Property

18. Sour Taste is .....

(a) Chemical Property (b) Physical Property

19. The atmosphere is divided into spherical layers based upon the .....

(a) density of each layer

(b) concentration of ozone in each layer

(c) temperature changes from variations in absorption of solar energy

(d) concentration of oxygen in each layer

(e) precipitation in each layer

20. The temperature of water affects:

(a) The physical properties and characteristics of water

(b) Chemical and biological reaction rates.

(c) Both (a) and (b)

(d) None of these

21. The chemical oxygen demand measures the .....

(a) Amount of oxygen required for growth of microorganism in water

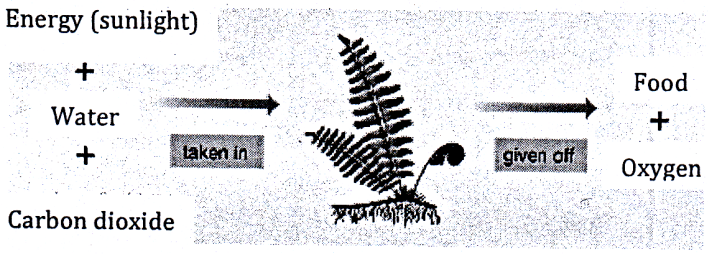
(b) Amount of oxygen needed to chemically oxidize pollution in water.

(c) Amount of oxygen required to oxidize the calcium present in waste water

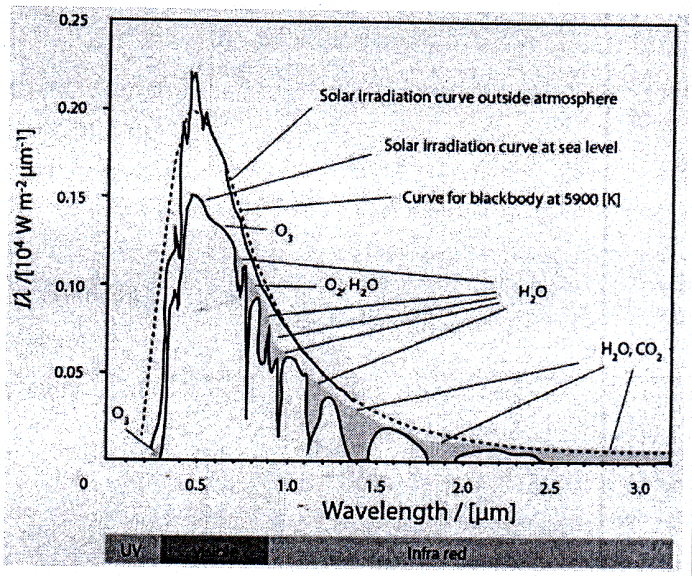
(d) None of the above.

22. A basic (alkaline) solution has a
(a) higher concentration of hydrogen ions than hydroxide ions
(b) equal concentration of hydroxide ions and hydrogen ions
(c) higher concentration of hydroxide ions than hydrogen ions

23. The process shown in this diagram is
(a) waste elimination
(b) cellular respiration
(c) a food chain
(d) photosynthesis



II. The spectral distribution of incident solar radiation outside the atmosphere and at sea level is shown in the following figure, mention the main three differences between the solar radiation curve outside the atmosphere and that at the sea level, and explain the reasons for each. (4.5 Marks)



(1)

(2)

(3)

III. Green house effect is essential in maintaining the heat balance, why? (2 Marks)

IV. Consider the emission spectra of a black body as a function of wavelength, explain the following phenomena: **(4 Marks)**

(1) The peak of the emitted radiation at high temperature is many order magnitude higher than that at low temperature.

(2) The position of the curve peak shifts to larger wavelengths for lower temperatures.

V. In the air pollution control, the efficiency of fabric filter depends on several factors. Name four of these factors. **(3 Marks)**

(a)

(b)

(c)

(d)

VI. List the main problems in the implementation of wind energy. **(3 Marks)**

VII. Solve the following problems: **(6 Mar**

1. A leaf containing chlorophyll has in its absorption maximum at 680 [nm] an extinction coefficient $\varepsilon = 10^4$ [$dm^3\ mol^{-1}\ cm^{-1}$]. The chlorophyll concentration in the leaf is about 10^{-2} [$mol\ dm^{-3}$] and its path length for light passing through the leaf about 0.022 [cm]. Calculate the optical density (OD) and the reduction of intensity.

3. How tall a dam should be to generate 11 GW electricity from a river has a flow rate is about 1.1×10^4 m^3/s? (Hint: water density=1000 kg/m^3).

4. Suppose you are considering constructing a wind turbine in a region where the wind has an average speed of 3 m/s at a height of 5 m. You decide to build a turbine with a 50-m-diameter rotor with its hub 30 m high. What is the maximum possible power that can be generated? What would this number be after the blade becomes soiled?
(Hint: air density=1.225 kg/m^3, and the wind speed at height 30 is 1.3 faster than that at 5 m)

VIII. Describe in details the mechanism of the process used to remove the turbidity in water treatment system? **(4.5 Marks)**

"Best of luck for your exam"
Dr. Ayman A. Abdelaziz

Assiut University

Faculty of Science

Date: 30/8/2018
Time: 3 hours

Final Exam : Electronics
Code:361P

Physics Department

First Question (20 Marks)

True or false (answer only 10 points of the following)

1. A semiconductor material that has been subjected to the doping process is called an intrinsic material.
2. The transformer converts A.C to D.C.
3. A P-type semiconductor is created by doping Si, Ge or GaAs with three valence-impurities called acceptor atoms.
4. In an N-type material, the electron is the majority carrier and the hole is the minority carrier.
5. Forward bias is applying an external potential across the PN-junction such that the positive terminal is connected to the N-type material and the negative terminal is connected to the P-type material.
6. The maximum reverse-bias potential that can be applied before entering the breakdown region is called the peak inverse voltage or the peak reverse voltage.
7. The wavelength and frequency of light emitted by the LED are not related to the energy band gap of the material.
8. When the diode is used as a rectifier, the PIV rating must equal or exceed the peak value of the applied voltage.
9. In the NPN bipolar junction transistor, the emitter is the P-type layer.
10. In the common emitter configuration, there are both a current gain and a voltage gain.
11. The collector current can be approximated to be equal to the emitter current in both NPN and PNP bipolar junction transistors.
12. To operate the transistor in the active region, the base-emitter junction should be forward biased and the collector-base bias should be reversed-biased.
13. The terminal with an arrow in the bipolar junction transistor represents the collector of this transistor.

Second Question (10 marks)

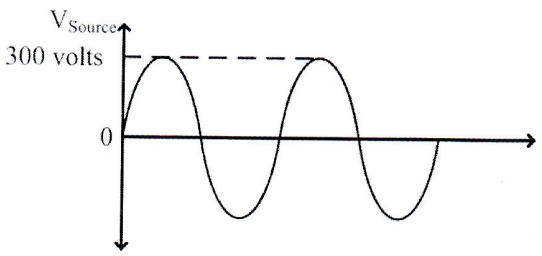
Considering the source sinusoidal waveform is as shown (V_{max}=300V), what are the **DC** and **AC** potential differences measured by the multi-meter for $\mathbf{V_{ab}}$, $\mathbf{V_{cd}}$, $\mathbf{V_{ed}}$, and $\mathbf{V_{fd}}$?

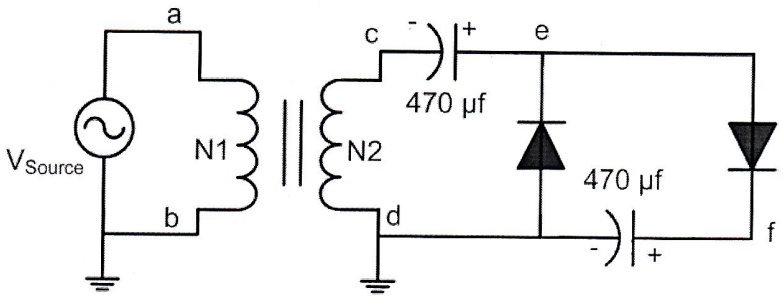
Consider N1=1000 turns and N2=10 turns; consider all the diodes are ideal; consider the transformer power efficiency to be 100%.

(Hint: the AC measured by the multi-meter is the rms value)

(Hint: $V_{P-P} = 2\,V_{max} = 2\sqrt{2}V_{rms}$)

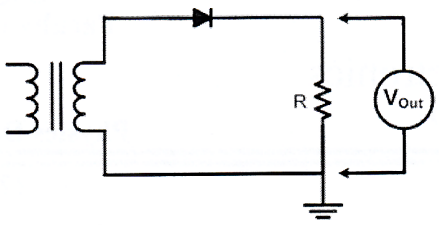
(Hint: for any transformer $V_{sec} = \frac{N_{sec}}{N_{prim}} V_{prim}$)



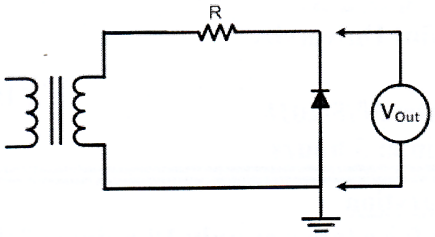


Third Question **(10 marks)**

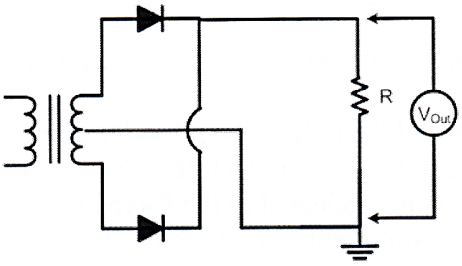
Draw V_{Out} in each of the following circuits, if the potential difference across the output terminals of the transformer is a sinusoidal waveform.



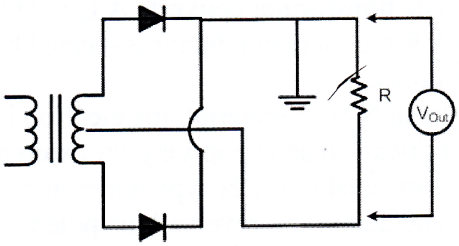
(a)



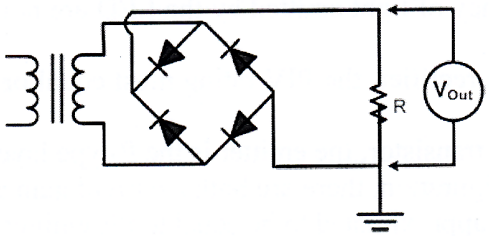
(b)



(c)



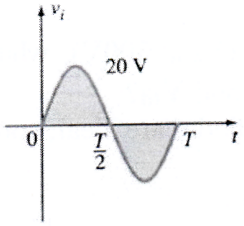
(d)

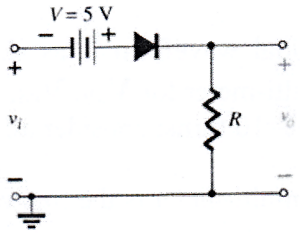


(e)

Fourth Question **(5 Marks)**

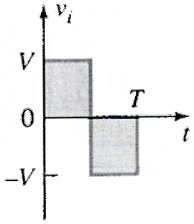
Determine the output waveform for the sinusoidal input in the following Fig.
(Denote to the maximum and minimum values of the output waveform)

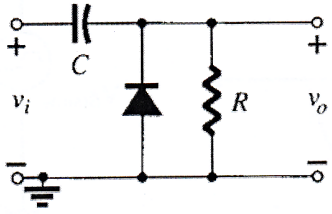




Fifth Question **(5 Marks)**

Assuming $RC >> T$, determine the output waveform for the square input in the following Fig.
(Denote to the maximum and minimum values of the output waveform)





GOOD LUCK

كلية العلوم- قسم الفيزياء

جامعة اسيوط

Summer Course "Diffraction rays & its applications" (352 P)

Sep: 2018 Time: 3 hours

Answer only Five Questions:

1. a) Drive the Bragg's low of X-ray diffraction from a crystal, show the essential condition for Bragg's low application.

b) A certain crystal reflect monochromatic X-rays strongly when Bragg's angle of the 1st order is 15^0, satisfy the Bragg's reflection for the 2nd and 3d order spectrum.

---

2. a) Explain with the eqns. the required conditions for studying the crystal structure by neutron beam.

b) Sodium crystallizes in a cubic lattice with lattice constant 4.3 A^0. How many atoms are contained in one unit cell, what type of cubic unit cell does sodium form (ρ =963 kg/m^3 and its atomic weight is 23).

---

3. a) Find the dependence of the d-spacing in terms of lattice constant and M. indices.

b) Show that for a simple cubic lattice: $d_{100} : d_{110} : d_{111} = \sqrt{6} : \sqrt{3} : \sqrt{2}$.

---

4. a) Explain in detail one of the X-ray spectrum resulting in the pattern of X-ray diffraction.

4) Use the XRD to explain an identification of the crystallographic planes. If the Miller indices satisfy: $h^2 + k^2 + \ell^2 = 3, 7, 15,$ respectively. Determine the different available crystalline planes.

---

5. a) State what do you understand by: (i) Absorption of x-ray, and (ii) Bragg's reflections.

b) Aluminum has FCC structure with the atomic radius 1.43 A^0, If energetic X-ray beam of 7.38 KeV incident on (100) plane, calculate the Bragg's angle considering the1st order reflection (h = 6.62×10^{-34} J.sec),

---

6. a) Draw a schematic diagram of an experiment for measuring the wavelength of the electron-diffraction, find an expression of the diffraction diameter in terms of the d-spacing and accelerating high voltage.

b) Determine the wavelength of X-ray beam when the Bragg's angle of 19.21^0 is observed during the 1st order reflection in (111) plane of Aluminum of FCC structure (atomic weight =27, density 2.7 gm/cm^3, $N_A = 6.023 \times 10^{23}$)

انتهت الأسئلة

تمنياتي بالتوفيق والتفوق ..... ا.د.عبد المنعم سلطان .....

Faculty of Science
Physics Department

Date: 4 September, 2018
Time: 2 hours

Final Examination in (Introduction to Solid State Physics 350P)- Summer Course
Teaching Staff: Prof. Dr. Abdulaziz Abualfadl

Constants: h= 6.626 x 10^{-34}J.s, 1 eV= 1.6 x 10^{-19} J, k_B= 1.38 x 10^{-23}J/K, e=1.6 x 10^{-19}c, C= 3 x 10^{8}m/s, N_A= 6.02 x1 0^{23} atom/mole, m_e=9.1x10^{-31} kg, m_n=6.7x10^{-27} kg

Answer 4 questions from the following: [12.5 marks for each]

1- (a): Write on: (i)-The possible point *defects* (Vacancies, interstitials, foreign atoms. (ii) One dimensional defects (dislocations). (iii)- Two dimensional defects (grain boundaries).

(b): What is the meaning of Linear and planar densities? Then Show that for the body centered cubic crystal structure, the unit cell edge length *a* and the atomic radius *R* are related through the relation:

$$a = \frac{4R}{\sqrt{3}}$$

2- (a)-What are the advantages and disadvantages of using neutron diffraction for structure determination?

(b)- Write the procedure for finding the Miller indices of a given plane. In a cubic unit cell, draw correctly a vector with indices [111], [100], [020]. And planes (110), (001).

3- (a)- Show the technique of X-ray structure determination in which a single crystal specimen is rotated in a beam of monochromatic X-rays.

(b)- A crystal has a cubic unit cell of 4.2 °A. Using a wavelength of 1.54 °A. What is the angle (2θ) for the (111) peak.

4- (a)- Find the atomic packing factor for face centered cubic (F.C.C) crystal.

(b)- The lattice constant of the simple cubic lattice is 5:63°A. Calculate the distance between the nearest (110) planes in simple cubic lattice.

5- (a)- Find the geometrical structure factor (F_{hkl}) for body centered cubic (B.C.C) by taking the cell contain one atom at the center.

(b)- Define what is meant by the terms: lattice, basis, conventional unit cell and primitive unit cell, crystal system, Bravais lattice and point groups.

Good Luck

Assiut University
Faculty of Science
Department of Physics

Term: Summer 2018
Date: 27 August, 2018
Time: 3 Hours

Course Title: Quantum Mechanics – Phy 311 – Final Exam (50%)

Answer the following question: (*all questions carry the same weight* 10 points)

Question #1

A region of space has a potential step such that particles have a wave function given by

$$\psi(x,t)=\begin{cases} \frac{7b}{\sqrt{3}}\, e^{i(kx-Et/\hbar)} + \frac{5b}{\sqrt{3}}\, e^{i(-kx-Et/\hbar)}, & x<0 \\ \frac{9b}{\sqrt{3}}\, e^{i(\alpha x-Et/\hbar)}, & x>0 \end{cases}$$

The incident particles are initially travelling in the positive x direction.

(a) What fraction of the incident particles will be reflected and transmitted?

(b) Give the value of α/k .

Question #2

In a region of space, a particle with mass m and with zero energy has a time-independent wave function

$$\psi(x)= A\, x\, e^{-x^2/L^2}$$

where A and L are constants.

Determine the potential energy V(x) of the particle.

Question #3

Consider a simple harmonic oscillator with mass m and force constant k, and a particle with the same mass in a one-dimensional box of length L.

(a) ***What*** is the relationship between k and L such that the zero-point (ground state) energies of these two systems will be the same?

(b) If m is equal to the mass of a 1H atom, ***what*** is the value of k (in N/m) corresponding to L=1.4 nm? (m=1.00783 amu=1.6736×10^{-24} gm).

Question #4

(a) ***prove that:*** $\left[\hat{L}_z\ ,\hat{L}_+\right]$ do not commute.

(b) ***Find:*** $\left[\hat{x},\hat{H}\right]$, $\left[\hat{x},\hat{p}_x\right]$.

Question #5

(a) *Work out the radial wave functions*: $R_{31}(r)$ and $R_{32}(r)$

(b) ***Normalize*** $R_{32}(r)$ and construct $\psi_{322}(r,\theta,\phi)$.

***** ***** ***** ***** ***** ***** **Good Luck** *** ***** ***** ***** ***** *****

Prof. Dr. A. A. Ebrahim

Faculty of Science
Physics Department

Date: 27 August, 2018
Time Allowed: 3 hours

Final Examination in (Crystal Growth 354P)-Summer Course

Teaching Staff: Prof. Dr. Abdulaziz Abualfadl

==========

Answer 5 questions from the following: [10 marks for each]

1- (a)- Write short notes on:
-Why the choice of crucible material is of fundamental importance in melt techniques
- Protein crystallization.
(b)- Explain the advantages and disadvantages of non-melt techniques and describe in details one method used in this technique.

2- (a)- In Laser- Heated pedestal growth technique (LHPG). Write in brief in four from the following:
i-The importance of single crystal fibers ii-Line shaped laser beam iii-Source rods preparation iv- Advantages of LHPG method v-Seeding process and formation of molten zone.
(b)- Discuss each of the following: i- Crystal Twins ii- Perfect crystal iii- Why crystals grow at different rates in different directions

3- (a)- Compare using examples between the two methods:
i- Slow crystallization from solution in water or organic solvent.
ii-Hydrothermal crystallization for substance insoluble in water.
(b) Describe shortly the method in which a molten zone is progressively passed along a single crystal rod.

4- (a)- Write on brief:
i-Crystallization by reactant diffusion ii- Crystallization by sublimation iii- Unassisted Nucleation growth.
(b)- Describe using diagram the basis of the method used for growth of epitaxial films.

5- (a)--Show the differences between Vernul method and Gel growth method.
(b)- Non melt techniques permit growth to occur at temperatures well below the normal melting point. From there techniques crystals can be grown from the vapor phase. Explain in details the procedure of this technique and the major problems facing this technique.

6- (a)- Both Kyropoulos and Czochraliski methods are used for crystal growth from the melt. Differentiate between the two methods.
(b)- Explain the fluxed–melt technique and electro crystallization methods used for growing single crystals.

Good Luck