Assiut University **Term: 2nd 2018**
Faculty of Science **Date: 13-5-2014**
Department of Physics **Time allowed: 3 hours**

Physics of Nano materials and its applications
Cod :458 P

Answer the following questions:

Q1: Chose the correct answer in th following. *(10 marks)*

1- Nano materials are: (a) Small volume materials
(b) Having grain size about 100 nm and down,(c) Having grain size of 1 nm.
2- Properties on nanoparticles differ from bulk materials:(a) due to the large surface area to volume ratio ,(b) less number surface atoms. (b) , (c) impurities.
3- When a metal particle having bulk properties, is reduced in size, the density of states :(a) increases. (b) decreases.(c) remains same.
4- Nanosized particles are chemically very active because:
(a) of their small size. (b) number of surface atomss is less.
(c) the number of surface atoms is more.
5- In the fabrication of nanoparticles, macro-crystalline structures are broken down to nanocrystalline structures in: (a) chemical vapour deposition. (b) ball milling. (c) electro deposition .
6- The surface area to vol ume ratio of a sphere with radius 1 cm is R1 and that of a sphere with radius 5 cm is R2. Then R_1=.....R_2 :
(a) 3 (b) 1/3 (c) 5 .
7- The mechanical strength of nano material becomes:
(a) Larger (b) smaller (c) does n't change.
8- Only (the classical models ,quantum mechanical models ,or both); can describe the motion and energy of the nanomaterials.
9- In nano-materials: with decrease of size, the inter-atomic spacing:
(a) increases (b) decreases (c) first increases and then decreases.
10 - The density of states for the two dimensional material is described by:
(a) parabolic function , (b) step function , (c) Delta function.

Q2- (a) Given the following data for GaAs : $m_e = 0.067\ m_0$, $m_h = 0.45\ m_0$, $\varepsilon = 12.4$: Calculate 1- The effective mass. 2-ExcitonBohr radius *(5marks)*.
(b) Write about quantum confinement effect in nano materials. *(5marks)*.

Q3-
a- Write True (T) or False (F) in the following: *(5 marks)*
(1) Tuning the size of semiconductor nanocrystal is a method for tunning the band gap ,hence the wavelengthof light absorbed or emitted by the crystal .
(2)- Quantum confinment effect causes the enrgy gap to increase, therefore more energy is needed in order to be absorbed by the material.

(3)- High surface area to volume ratio provides a strong driving force to speed up thermodynamic processes that minimize free energy.

(4)- As the size on nanocale reduced , the fraction of atoms on the surface of the nanocrystal grows larger and larger.

(5) When the frequency of Plasmon oscillation is the same as the frequency of light that it generates it (i. e., the incident light), the plasmon is said to be in resonance with the incident light.

(b) Explain how an atomic force microscope works and mention the modes of operation . *(5 marks)*.

Q4-

Write about the following: ***(10marks)***

1- Ball milling (mechanical attrition) method.

2- Sol-Gel technique for synthesis of nano materials .

3- Ultrasonication method for synthesis of nano materials.

Q5 write about :

1- Basic types of low-dimentional semiconductors, according to dimensionality.

2- Types of defects in solid nanomaterials.

2- The Scanning tunneling microscope. (10 marks)

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With my best wishes/ Prof .dr. Aly Othman

السؤال الخامس

ا- اذكر مميزات وعيوب استحدام الليزر في الصناعة (٤ درجات)

ب- اذ كانت النسبة بين تعداد المستوى الثاني الى تعداد المستوى الاول $N_2/N_1 = 1 / e^{1/4}$ عند درجة حرارة $57C^0$

احسب طول موجة وتردد الانتقال بين المستوين ثم احسب فرق الطاقة بالالكترون فولت (٣ درجات)

ج- استخدم ليزر ذات الطول الموجي $\lambda = 480$ nm لاضاءة فتحتين فتكونت الهدبة الثالثة المظلمة على بعد 3 cm من الهدبة المركزية . احسب المسافة الفاصلة بين الفتحتين اذا علمت ان المسافة بين الشاشة والفتحتين $R=1.1$ m وما هو الوضع الزاوي للهدبتين الرابعة و الخامسة وما نوعهما . (٣ درجات)

السؤال السادس

ا- اذكر فقط انواع التجاويف الرنانة ثم اشرح بالتفصيل تجويف فابيري-بيرو (٤ درجات)

ب- احسب عدد الانماط الليزرية المتكونة داخل تجويف كروي متحد المركز اذا علمت ان قطر كل من المراتين 1m وطول موجة شعاع الليزر المتكون بداخله 600 nm ثم احسب تردد التجويف (٣ درجات)

ج-احسب رتبة المدار النهائي في طيف ذرة الهيدروجين نتيجة للانتقال من مستوى الطاقة الخامس اذا كان تردد الانتقال $5.45x10^{14}$ Hz (٣ درجات)

انتهت الأسئلة والله الموفق

ثابت بولتزمان $k=1.38x10^{-23}$ j/k^0 ثابت بلانك $h=6.625x10^{-34}$ j.sec

سرعة الضوء $C=3x10^8$ m/sec شحنة الالكترون $e=1.6x10^{-19}$ C

ثابت رايدبرج $R=10.97x10^6$ m-1

جامعة أسيوط | امتحان الفصل الدراسي الثاني ٢٠١٧ – ٢٠١٨ | الفرقة: رابعة علوم

كلية العلوم | المقرر: فيزياء الليزر وتطبيقاتها (٤٧٢ ف) | الزمن: ثلاث ساعات

قسم الفيزياء | تاريخ الاختبار ٢٠١٨/٥/٢٠ م | الممتحن: د. محمد العسيلي

أجب عن خمسة أسئلة فقط مما يأتى:-

السؤال الأول

ا- استنتج العلاقة بين معاملات ايتشتين (٦ درجات)

ب- احسب النسبة بين معاملات اينشتين لليزر النيتروجين ذات الطول الموجي 337.1 nm عند درجة حرارة T=6000 K ثم احسب كثافة الاشعاع $\rho(\nu)$ (٤ درجات)

السؤال الثاني

ا- اذكر فقط خصائص اشعة الليزر ثم اشرح بالتفصيل كيفية حساب اتساع المنحنى الطيفي باستخدام ظاهرة دوبللر (٦ درجات)

ب- إذا كان طول موجة شعاع ليزر الكربون $10.6\ \mu m$ أحسب اتساع المنحنى الطيفى الناتج من ظاهرة دوبلر عند درجة حرارة $500K$ ثم احسب التغير فى الطول الموجى الناتج من تأثير دوبلر علماً بان كتلة ذرة الكربون 13 وحدة كتل ذرية (٤ درجات)

السؤال الثالث

ا-اذكر فقط انواع الليزرات ثم اشرح بالتفصيل ليزر الهليوم - نيون (٤ درجات)

ب- غشاء رقيق معامل انكساره 1.35 nm استخدم لمقياس ميكلسون فسمح بمرور 150 هدبة احسب سمك الغشاء اذا كان طول موجة شعاع الليزر المستخدم λ=550nm واذا استبدل الغشاء بشريحة زجاجية لها نفس السمك ومعامل انكسارها 1.5 فما هو عدد الهدب التي تسمح بمرورها الشريحة الزجاجية (٣ درجات)

ج- سقطت حزمة من ليزر الهليوم-نيون ذات الطول الموجي 632 nm على حاجز به فتحة قطرها 0.03 mm احسب زاوية انفراج الشعاع في حالتي الترابط المكاني التام والترابط المكاني الجزئي (٣ درجات)

السؤال الرابع

ا- اشرح بالتفصيل كيفية حساب معامل كسب الاشارة الصغيرة ومعامل تكبير شعاع الليزر (٦ درجات)

ب- سقط شعاع ليزري على مادة سمكها 0.5 cm احسب معامل امتصاصها اذا علمت ان شدة الشعاع الساقط ثلاثة اضعاف شدة الشعاع النافذ. (٤ درجات)

اقلب الصفحة

كلية العلوم - قسم الفيزياء

دور مايو 2018م
امتحان نهاية الفصل الدراسى الثانى
فى مادة أطياف ذرية وجزيئية (432 ف)
التاريخ: 29 / 5 / 2018م

المستوى: الرابع علوم
الشعبة:ف. ك
الزمن:3 ساعات

أجب عن خمسة أسئلة فقط ممايأتى:- **درجة كل سؤال (10 درجات)**

1- اشرح قاعدة هوند ومنها أحسب الحد الطيفى الأساسى لكل من الكروم والكوبلت والنحاس علماً بأن العدد الذرى لكل منهم هو 24، 27، 29 على الترتيب.

2- اشرح التركيب الدقيق للخط الطيفى الأول فى سلسلة بالمر فى ذرة الهيدروجين

3- وضح تأثير مجال مغناطيس قوى على خط طيفى فى الذرة مفسراً ذلك كلاسيكياً.

4- اشرح تركيب وطاقة وطيف الجزئ ثنائى الذرية كدوار تذبذبى.

5- اشرح تركيب وطاقة وطيف الجزئ ثنائى الذرية كمذبذب غير توافقى.

6- من الجدول التالى:-

	Wave numbers of line spectra in cm^{-1}	
J	R(J)	P(J)
0	21199.81	
1	21202.88	21193.25
2	21205.74	21189.97
3	21208.52	21186.41
4	21211.12	21182.66
5	21231.58	21178.88

أوجد كل من:-

أ- الثوابت الدورانية (B_υ'', B_υ') عند العدد الكمى J=3

ب- الفصل بين رأس الحزمة وأصل الحزمة

ج- موقع رأس الحزمة من الطيف

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انتهت الأسئلة مع اطيب الامنيات بالنجاح

د/ على محمود حافظ

جامعة أسيوط - كلية العلوم
جمهورية مصر العربية – أسيوط - ت : ٠٠٢٠٨٨٢٣٣٣٨٣٧ فاكس : ٠٠٢٠٨٨٢٣٤٢٧٠٨

Final Exam-Second Term: (2017/2018) - Course Title: Physics of Low Temperature P- 422- Time: 3h - Prof. Dr. Ahmed Sedky

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Answer the following questions:

Q1(10 marks):

(a) In terms of G-L theory, discuss only the main difference between type (I) and type (II).

(b) Calculate the T_c and $H_c(0)$ for type (I) if $H_c = 7616$ Oe at 12 K, and 4284 Oe at 16 K.

(c) Prove that BCS energy gap at 0 K is given by $3.52K_BT_c$.

Q2(10 marks):

(a) Calculate the T_c of type (II) superconductor if $H_{c2}(0) = H^2_c(0)$.

(b) Explain how you can determine the flux creep activation energy of flux bundles.

(c) Write the type of structure, T_c, $J_c(0)$ and $H_c(0)$ values for Y:123 and Hg: 1223 systems.

Q3(10 marks):

(a) Prove that type (I) superconductor can carry surface sheath.

(b) Explain how you can determine the flux flow resistance along a flat strip in mixed state of type II.

(c) Write only the physical meaning of London depth and then calculate London depth at 25 K for a superconductor if $\lambda(0) = 0.51\ \mu m$ and $T_c = 100$ K.

Q4(10 marks):

(a) Write short account about BCS electron-lattice interaction for Cooper pair.

(b) Clarify in details how you can determine the resistivity of superconductor.

(c) If $\lambda_L = 1.2$ nm and $K_{GI} = 0.955$, calculate by nm the space of vortex lines when ρ_f increased up to $2\rho_n$.

Q5(10 marks):

(a) Determine only the expected size of BCS Copper pair in superconductors.

(b) Calculate the surface energy, difference in free energies and H_{c3} of type (II) if $\lambda_L = 1.2$ nm, $\xi = 0.5$ nm.

(c) In terms of entropy, derive the relation between the specific heat and H_c in superconductors.

7) For the following program, what will be printed?

```
program test
x1 = 1.0
x2 = 2.0
call calc(x2,x3)
x1=2*x1
write(*,*)x1,x2,x3
stop
end
subroutine calc(y1,y2)
x1=y1**2
y2=x1+3
return
end
```

a) 2.0 2.0 7.0 b) 4.0 2.0 7.0 c) 1.0 2.0 4.0 d) 1.0 4.0 7.0

8) What will be printed for value of variable "ans" in the following FORTRAN?

```
x = 1.0
y = 2.0
ans=0.0
if(x.gt.0.0.and.y.lt.10.0.and.y.ne.2.)then
   ans=1.0
   x=-1.0
elseif (x.lt.0.0) then
   ans=2.0
else
   ans=3.0
end if
write(*,*) ans
end
```

a) 0.0 b) 1.0 c) 2.0 d) 3.0

9) A function subprogram differs from subroutine in which of the following:

a) function name's type must be declared, but no type declaration for subroutine name
b) many variables can enter function subprogram, but one variable can enter subroutine
c) one variable can enter function subprogram, but many variables can enter subroutine
c) function subprogram returns many values, but subroutine returns a value

10) The variable *y* is declared Logical. Which of the following is a valid statement?

a) `y = 'Yes'` b) `y = .Yes.` c) `y = .True.` d) `y = 'True'`

Question (3): Numerical Methods: Circle the correct choice: (6 Marks)

1) The Newton-Raphson method fails when:

a) $f'(x)$ is negative b) $f'(x)$ is too large c) $f'(x)$ is zero d) never fails

2) In false position method, in the range of $[a, b]$ for a real continuous function $f(x)$, if $f(a)f(b) > 0$, then there is (are):

a) no roots b) at least one root c) two roots d) none of them

3) In false position method, in the range of $[a, b]$ for a real continuous function $f(x)$, the first approximation is:

a) $x_1 = \frac{af(b)-bf(a)}{f(b)-f(a)}$ b) $x_1 = \frac{bf(b)-af(a)}{f(b)-f(a)}$ c) $x_1 = \frac{bf(a)-af(b)}{f(b)-f(a)}$ d) $x_1 = \frac{af(a)-bf(b)}{f(b)-f(a)}$

4) By applying Simpson's 3/8 rule the number of sub intervals (divisions) should be:

a) odd b) even c) odd or even d) multiple of 3

5) By applying Trapezoidal method the number of sub intervals (divisions) should be:

a) odd b) even c) odd or even d) multiple of 3

6) Linear interpolation is called:

a) first-degree interpolating polynomial b) second-degree interpolating polynomial
c) third-degree interpolating polynomial d) none of them

7) Using Euler's method, solve $\frac{dy}{dx} = \frac{2x}{y}$, $y(0) = 1.$, the value of $y(0.1)$ in two subintervals is:

Solution: Euler's method form is: $y_{i+1} =$ .....

$x_0 =$ ....., $y_0 =$ ....., $\bar{x} =$ ....., $n =$ ....., $w =$ .....

a) 1.0000 b) 1.0050 c) 1.0075 d)1.0099

8) Using Simpson's method, integrale $\int_0^{\pi} sin(x)\, dx$ in two subintervals is:

Solution: Simpson's method form is: $A_i =$ .....

$x_a =$ ....., $x_b =$ ....., $n =$ ....., $w =$ .....

a) 1.0000 b) 1.5704 c) 2.0000 d) 2.0946

Question (2): FORTRAN Simulation: Solve the following problems: (5 Marks)

In the experiment of determination the focal length of convex lens, you have the data:

object distance x (m)	30	32	34	36	38
image distance y (m)	15	14.54	14.17	13.85	13.57

If you know that the focal length f is given by the following relation: $\frac{1}{f} = \frac{1}{x} + \frac{1}{y}$

Write a Fortran program to simulate this experiment by building the main program as:

- **Values of x are declared as real array and varying by step 2 from 30 to 38 in do loop.**
- **Values of y are declared as real array and stored in data block.**
- **Focal lengths f are declared as real array and calculated at each given data in do loop.**
- **In the do loop, write on the screen the values of x, y and f .**
- **Calculate the average focal length and store it as real variable called average.**
- **Write on the screen the average focal length as: 'average f = ' the average.**

The calculated Lagrange coefficients are:

The length in cm at weight 70 gm using Lagrange polynomial is:

Question (4): Physical Measurements: Solve the following proplems: (9 Marks)

1) The experimental data between the expansion x of the length of a copper wire under the influence of different weights w is given by:

w (gm)	0	50	100	150	200
x (cm)	0	0.0130	0.0251	0.0387	0.0520

Find the length in cm at weight 70 gm using linear interpolation. (3 points)

Solution:

The linear interpolating function $p(x)$ is:

.....

By substituting the data points (.....,.....) and (.....,.....) into the equation $p(x)$, we get:

.....

.....

.....

.....

.....

.....

.....

2) Find and calculate Lagrange polynomial equation that passes through the 3 data points:

w (gm)	50	100	150
x (cm)	0.0130	0.0251	0.0387

(6 points)

Then calculate the length in cm at weight 70 gm using Lagrange polynomial

Solution:

The Lagrange interpolating polynomial function for the 3 data points has the form:

.....

where $x_0 =$ $, f(x_0) =$ $, x_1 =$ $, f(x_1) =$ $, x_2 =$ $, f(x_2) =$

The Lagrange coefficients in product general form are:

.....

.....

.....

Question (5): Physical Measurements: Solve two only of following: (20 Marks)

1) A simple circuit with resistance R, capacitance C in series with a battery of voltage V. The charge Q at any instant time t is given by:

$$Q = CV\left[1 - e^{-t/(RC)}\right]$$

Write a FORTRAN program with Newton-Raphson method to find the capacity C of the capacitor at $t = 0.004$ if you know that, $R = 2000$, $V = 10$ and $Q = 0.00001$. Consider the initial value is 10^{-7} and the tolerance is 10^{-9}. (10 points)

Solution:

Rearrangement of the equation to be in the form $f(x) = 0$:

.....

.....

The variable x refers to ..... into original equation.

The derivative $f'(x) =$ .....

.....

The Newton-Raphson form is: $x_{i+1} =$ .....

.....

The initial value $x_0 =$ .....

The Program:

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2) In blackbody experiment, the following data represent the emitted radiation energy $E(\lambda)$ as a function of emitted wavelength λ at a constant temperature T.

λ	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
$E(\lambda)$	3	7	9	10	8	6	5	4	3.5	3.4	3.3

Write FORTRAN program using Trapezoidal method to find the total emitted radiant energy. (10 points)

Solution:

The width of each trapezoid is given by:

The Trapezoidal method equation has the form:

Number of iteration is:

The Program:

3) For radioactive element, the rate of decay is given by: $\frac{dN}{dt} = -\lambda N$, where N is the number of radioactive nuclei of the element at any instant time t and λ is the decay constant. Consider the number of radioactive nuclei at the beginning of the experiment is 10^3 nuclei, and $\lambda = 0.5$.

Write FORTRAN program using extended Euler's method to:

- Calculate the number of radioactive nuclei N at time $t = 7$ s.
- If you know that the number of radioactive nuclei at any instant time t can be calculated by radioactive decay law: $N = N_0\, exp(-\lambda t)$, then:
  - In the program, write on screen the absolute error between calculated values of N by using both extended Euler's and radioactive decay law at time $t = 7$ s.

Solution: **(10 points)**

Write the ordinary differential equation in the form of $\frac{dy}{dx}$:

$\frac{dy}{dx} =$ ..... where $f(x, y) =$ .....

The variable x refers to ..... into original equation.

The variable y refers to ..... into original equation.

The derivative $f'(x, y) =$ .....

The extended Euler's method has the form: .....

.....

The initial condition $x_0 =$ ..... , $y_0 =$ .....

Find the solution at $\bar{x} =$ .....

The Program:

.....

.....

.....

.....

.....

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End of Exam ... BEST WISHES ... Instructor: Dr. Sherif Rashad MOKHTAR

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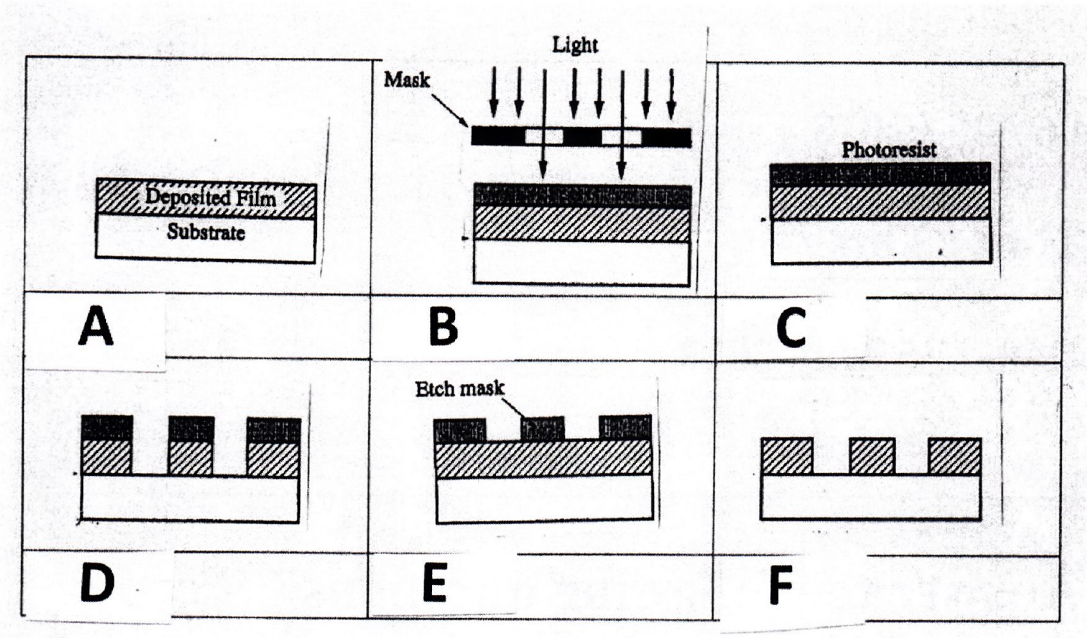
End of Exam ... BEST WISHES ... Instructor: Dr. Sherif Rashad MOKHTAR

Q 1

(1 a) Lithography fabrication

Steps Used in Photolithography : rearrange the steps to produce the pattern F , write the process



Assiut University
Faculty of Science
Physics Department

Final Exam

Thin Film Applications 492

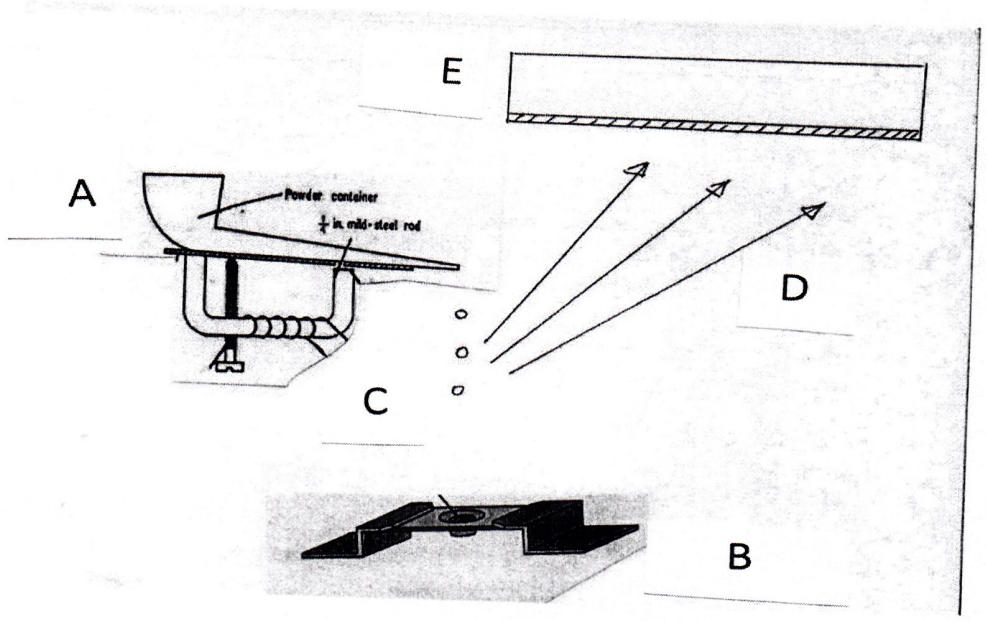
06 / 05 / 2018

Time : 3 hrs

Date : 25 May 2018

Answer the following questions (5) :
((each question 10 points))

Q 2



Flash Evaporation

1.1 Write the following components :

A

B

C

D

E

Steps	symploe	Name of process
1		
2		
3		
4		
5		
6		

(1 b) What is Lithography?

-

(1 c) What is the components of photolithography ?

1 –

2 –

3 -

Steps	symploe	Name of process
1		
2		
3		
4		
5		
6		

(1 b) What is Lithography?

-

(1 c) What is the components of photolithography ?

1 –

2 –

3 -

1.2 Write the steps to obtain thin film deposited on the substrate E ?

1

2

3

4

5

(4 c) In the electro-plating cell ,the weight of the deposited metal (W) and the average deposited metal thickness (X) are given by the following relations :

$$w = \frac{M.I.t}{z.F}$$

$$x = \frac{M.I.t}{\rho.A.z.F}$$

- t =
- Z =
- F =
- P =
- A =

Nickel is plated from a Watts bath at a current density of 4 A dm^{-2}.

The current efficiency is 96%.

The molar mass of nickel is 58.71 g mol^{-1}.

The density of nickel is 8.90 g cm^{-3}.

The Faraday constant is 96 485 C mol^{-1}.

What will be the averaged plating thickness in 3 hours ?

Q 4

(4 a) Sketch the electro-plating cell , and show how it work ?

(4 b) In the electro-plating cell , the average deposited metal thickness depends on :

1.
2.
3.
4.
5.
6.

Q5

(5 A) Identify the technique which is suitable for the preparation of the following thin films :

material	Melting point C	Method
Se	280	
Gold Au	1132	
Tungsten W	3380	
Carbon C	3799	
$Cd_2 Se_3$ alloy	1050	
NaCl	850	

(5 b) What distinguish Flash evaporation method ?

(5 c) Rates of evaporation and condensation can vary dependent upon :

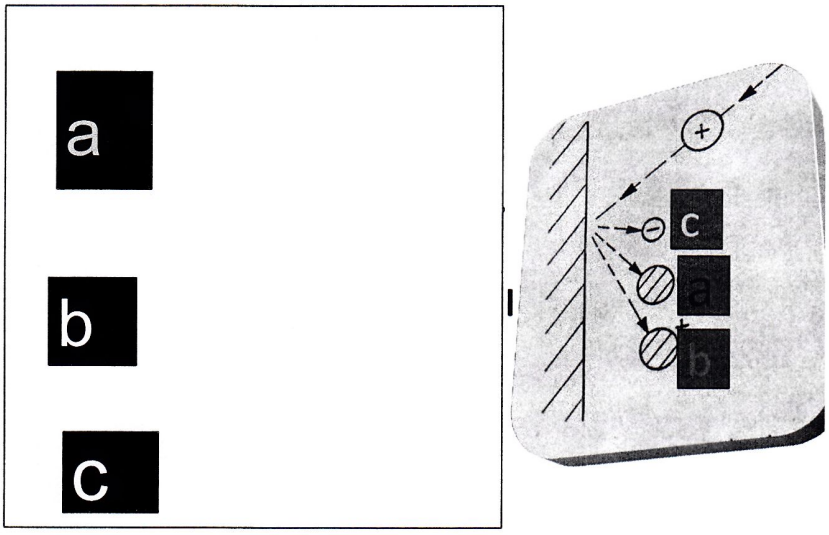
(4 d) Sketch the diagram for each of the following , then describe the function of each part :

a – Vacuum rotary pump

b – Cold cathode vacuum guage

c – Diffusion pump

- (5 d) Sputtering
- What is the sputtering process
-
- Define A , B and C



(5 E) Compare between sputtered and evaporated films ?

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–