Faculty of Science **Date: 6 June, 2015**
Physics Department **Time: 3 hours**

Final Examination in (Crystal Growth 354 P)

==========

Answer 4 questions from the following:

1- (a): Why single crystal fibers were of the focus interest. Explain using graphs the method used for growing single crystal fibers.
(b): Show the difference between Czochralski technique and Bridgman method.
(c): Design an experiment to deposit CdS thin film on glass substrate via chemical bath deposition technique.

2- (a): Explain the method used for growing crystals under conditions where the solvent temperature is changing usually throughout the period of crystal growth.
(b): Write short notes on the effect of impurities on crystal growth kinetics.
(c): Explain the basic working principle of e-beam evaporation process.

3-(a): Write on four from the following:
i- Liquid encapsulation technique **ii- Protein crystallization**
iii- The form of heating in melt techniques **iv- space-based growth**
v- Crystallization by solute diffusion
(b): Differentiate between thin film technique and chemical transport method used for growing single crystals.
(c): Write short notes on:
i- Perfect crystal **ii-Unassisted nucleation** **iii-Crystal twins**
iv- Multipass technique and segregation coefficient

4- (a): *Write on brief :*
i- Crystallization by reactant diffusion
ii- Crystallization by sublimation
iii- Assisted nucleation growth
(b): i- Write the advantages and disadvantages of the non-melt techniques used for growing single crystals.
ii- Why the choice of crucible is of fundamental importance in melt techniques.
(c): Compare using examples between the two methods:
Fluxed melt technique and hydrothermal crystallization.

5- (a): The production of single crystals demands exacting techniques. Explain in brief the method used for growing single crystal from gel.
(b): One of the methods of growth from the melt without containing the melt in a crucible is the Verneuil method. Explain using graphs this method and the advantages and disadvantages of this method.
(c): Write short notes on:
i- Crystal perfection **ii- Seed crystal preparation** **iii- Crystal habit**

Best wishes
Prof. Dr. Abdulaziz Abualfadl

Assiut University	Final Exam	Term: Fall 2015
Faculty of Science	Grade (50)	Date: June 10th, 2015
Department of Physics		Time: 3 hours
Course: Diffraction of waves and its Applications - 352P		

Part I. Mark which of the following is true or false, and correct the false **(8 marks)**

1. Thermal neutrons can be used to study the crystal structure although they are uncharged. ( )

2. A unit cell that contains only one lattice point is called body center. ( )

3. If the atoms are arranged in such way that their positions are disordered, the solid is called polycrystalline. ( )

4. The electrical neutrality is an advantage of neutrons for crystal structure study. ( )

5. X-ray is an electromagnetic wave. ( )

Part II. Give reasons for: **(9 marks)**

R1. The possibility of using x-ray to study the crystal structure while visible light not.

R2. The possibility of using neutron for studying the crystal structure

---

R3. The possibility of using electron beam for observing the morphology and studying material crystallography

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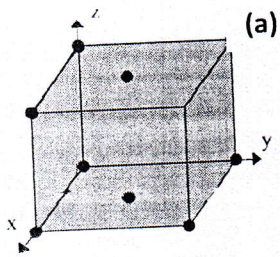
(33 marks)

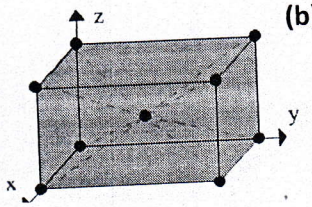
Part III. Answer the following:

P1. Define the shown lattice and calculate the number of lattice point per unit cell. (4 marks)

(a)

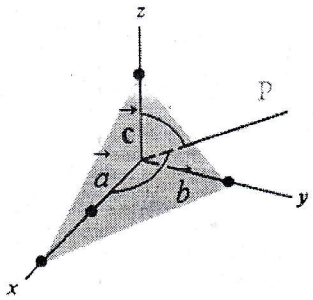


(b)



P2. Find the miller indices for the plane P shown in the figure, where $x = 2a$, $y = b$, $z = c$.

(3 marks)

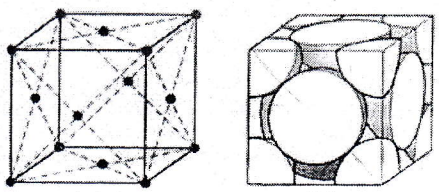


P3. Aluminum has face-centered cubic structure of lattice constant $a = 4.04$ Å, calculate

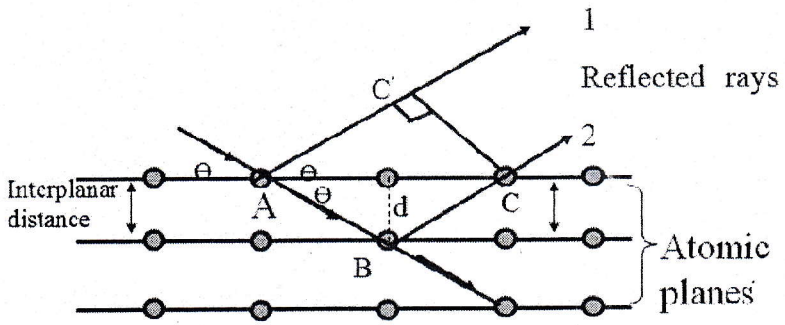
(3 marks)

(a) the number (N) of atom per unit cell

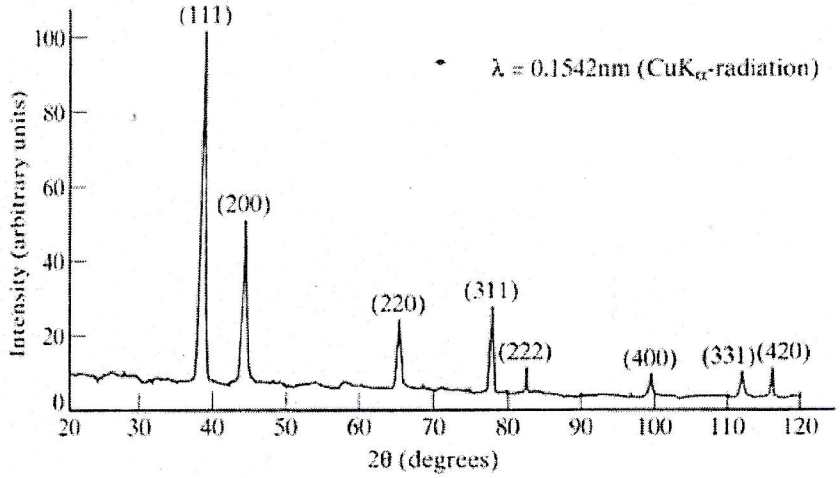
(b) the atomic radius (r)



P4. When a monochromatic x-ray beam is incident on the surface of a crystal, it is reflected only when the angle of incidence has a certain value. To explain this, the crystal is considered as a set of parallel planes corresponding to the atomic planes, which act as mirrors, see the shown Figure. Constructive interference will occur only when the path difference between two consecutive rays is an integral multiple of the wavelength. Demonstrate this concept with deriving the Bragg's Law. (8 marks)



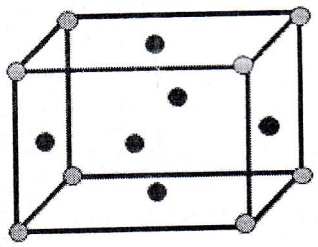
P5. Using the XRD patterns of unknown materials shown in the figure, (a) calculate the lattice parameter *a, b, and c* by given information that on the graph. (5 marks)



P6: Using Bragg's law, calculate the diffraction angles (2θ) for (111), (200) and (220) planes for Aluminum which is an fcc metal of lattice constant a = 4.04 Å. The wavelength of used X-ray λ = 1.542 Å. (4 marks)

(7)

P7: For face-centered cubic lattice, prove that the diffraction lines possess all even or odd value of (*h k l*) are allowed (111) and (222), while the lines possess an odd and even value of (*h k l*) are missed (100) and (221). Where *h, k,* and *l* are miller indices. (6 marks)



GOOD LUCK
Nagih Shaalan

Assiut University
Faculty of Science
Department of Physics

Term: Spring 2014- 2015
Date: 30 May, 2015
Time: 3 Hours

Course Title: Quantum Mechanics – Code P311 – Final Exam. (50%)

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

Question #1

a) ***Name four qualities*** that an acceptable quantum mechanics wave function must possess. Then in **one sentence or less** say ***why*** these qualities are required.

b) ***Determine*** whether the operator x and $\hat{L}_z = i\hbar\left(x\frac{\partial}{\partial y} - y\frac{\partial}{\partial x}\right)$ commute.

Question #2

a) The function $\Psi(x,0) = A\left(\frac{x}{L}\right)^2\left[1-\left(\frac{x}{L}\right)\right]$ is an acceptable wave function for the particle in a one-dimensional infinitely deep box of length L. ***Calculate*** the normalization constant A.

b) For a particle in a one-dimensional infinite depth box of length L, the first excited state wave function is:

$$\Psi_2(x) = \sqrt{\frac{2}{L}}\sin\left(\frac{2\pi}{L}x\right).$$

What is the probability that the particle will be found in the middle third of the box?

Question #3

a) Consider the one-dimensional time dependent Schrödinger equation,

$$i\hbar\frac{\partial\Psi}{\partial t} = -\frac{\hbar^2}{2m}\frac{\partial^2\Psi}{\partial x^2} + V(x)\Psi$$

Where Ψ is a function of both x and t. ***Use*** the separation of variables technique to recover the time independent Schrödinger equation. ***Show all work and justify your steps*** where appropriate.

b) ***Show that*** the function $e^{i p_z x/\hbar}$ is an eigenfunction of $\hat{p}_x$ with eigenvalue p_z.

Question #4

a) A particle of mass m is confined to a harmonic oscillator potential given by $V = mx^2\omega^2/2$ where $\omega^2 = k/m$ and k is the force constant. The particle in a state described by the wave function

$$\Psi(x,t) = A\, e^{\left(\frac{-m x^2 \omega}{2\hbar} - \frac{i\omega t}{2}\right)}$$

Verify that this is a solution of Schrödinger's equation.

Question #5

a) ***Work out*** the radial wave function R_{32} and normalize it.

b) ***Construct*** the wave function Ψ_{322}.

$$\left[Y_2^{\pm 2} = \left(\frac{15}{32\pi}\right)^{1/2}\sin^2\theta\, e^{\pm 2i\phi}\right]$$

***Good Luck ***

Dr. A. A. Ebrahim

Assiut University	Final Exam	Term: Fall 2015
Faculty of Science	Grade (50)	Date: June 10th, 2015
Department of Physics		Time: 2 hours

Course: Diffraction of waves and its Applications - 352P

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3. If the atoms are arranged in such way that their positions are disordered, the solid is called polycrystalline. ( )

4. The electrical neutrality is an advantage of neutrons for crystal structure study. ( )

5. X-ray is an electromagnetic wave. ( )

Part II. Give reasons for: (9 marks)

R1. The possibility of using x-ray to study the crystal structure while visible light not.

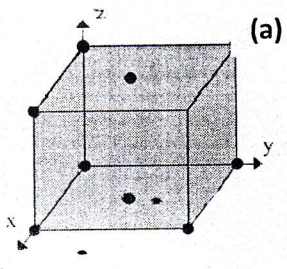
(C)

R2. The possibility of using neutron for studying the crystal structure.

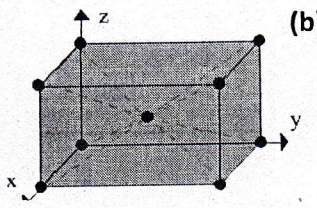
R3. The possibility of using electron beam for observing the morphology and studying material crystallography.

Part III. Answer the following: **(33 marks)**

P1. Define the shown lattice and calculate the number of lattice point per unit cell. (4 marks)



(a)

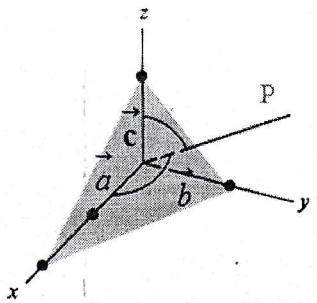


(b)

(٢)

P2. Find the miller indices for the plane P shown in the figure, where $x = 2a$, $y = b$, $z = c$.

(4 marks)

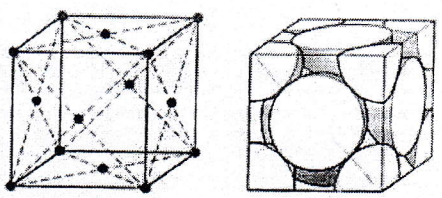


P3. Aluminum has face-centered cubic structure of lattice constant $a = 4.04$ Å, calculate

(4 marks)

(a) the number (N) of atom per unit cell

(b) the atomic radius (r)



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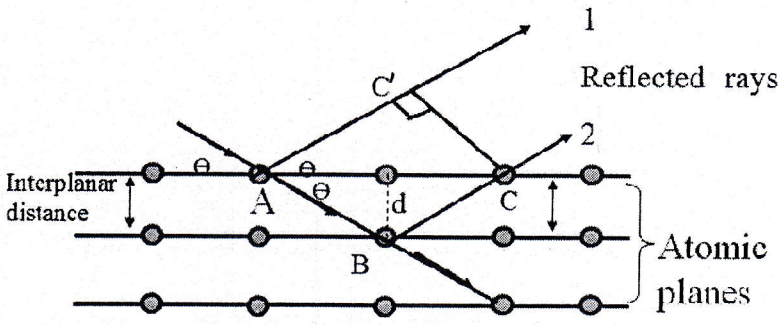

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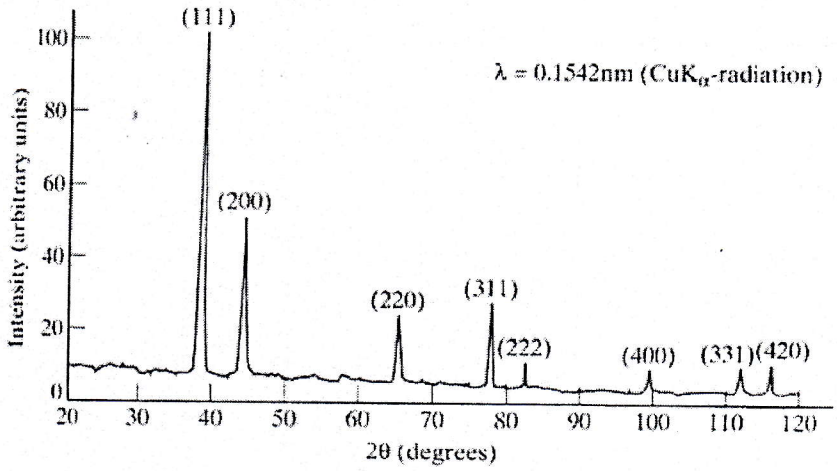

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GOODLUCK
Nagih Shaalan

Assiut University
Faculty of science
Physics Department

جامعة اسيوط
كلية العلوم
قسم الفيزياء

Final Exam. "In Solid state physics" (350 P)

May , 2015 — Time: 2 hours

Answer only three questions: (*all questions carry the same weight 20 points*)

1-a) A cylindrical conductor, containing n electrons per unit volume, under applied electric field E, prove that: (i) The current density: $J = ne\upsilon_d$, (ii) The drift velocity: $\upsilon_d = eE\tau / m$.

b) Compare between the Schottkey and Frenkel defects in crystalline structure.

2-a) If the dispersion relation satisfies the equation: $\omega^2 = B(\frac{1}{m}+\frac{1}{M}) \pm B[(\frac{1}{m}+\frac{1}{M})^2 - \frac{4\sin^2 Ka}{Mm}]^{1/2}$ determine the max. and min. values of ω, and mark its on the ω vs. K plots. Explain the physical meaning of the resulting optical and acoustical branches.

b) Using the average energy of the crystal oscillator: $U = h\nu[exp(h\nu / K_B T - 1]^{-1}$ to explain the agreement between the Einstein and classical theories of heat capacity at high temperature.

3-a) Consider a uniform cross section conductor with three similar parts separated by an equivalent distance λ, prove that the thermal conductivity dependence of the heat capacity given by: $\sigma_{th} = nu\lambda C_V / 3$, where u, and n are the velocity and no. of the electron, receptivity

b) Apply the principles of kinetic theory in thermodynamic to:

(i) Calculate the electron heat capacity contribution,

(ii) illustrate with the eqns. the electrical conductivity dependence of the temperature.

4-a) Apply the boundary conditions assumptions of the free electron model, to describe the wave accompanied with the electron in different energy levels. (Use the S. eqn. $\frac{d^2\Psi}{dx^2} + \frac{2mE}{\hbar^2}\Psi = 0$)

b)Compare between the continuous and linear X-ray spectra. Find the wave length corresponding to the totally X-ray-reflection condition.

c) Prove that the conductivity and mobility of the electron depends on the mean free path.

انتهت الأسئلة ..... مع أطيب لتمنيات بالتوفيق والتفوق .....

أ.د. عبد المنعم سلطان

بسم الله الرحمن الرحيم

جامعة أسيـــوط
كليـــة العلـــوم
قسم القيزيـــــاء

المقرر 332 ف
Plasma Physics
and its Applications

الفرقة: مستوى ثالثة علوم
13يونيو 2014م / 2015 م
الزمن : ثلاث ساعات

****

Answer Only Five Questions: **أجب عن خمسة اسئلة فقط مما يأتى:**

الأمتحان على صفحتين

1- Explain fully **Only Two** of the following: [10 Marks]

a- Geiger counter.

b- Arc furnaces.

c- Direct power generation by using an ionized gas.

2- Discuss **in details ONLY ONE** of the following: [10 Marks]

a- The Plasma magnetic mirror.

b- The Plasma Pinch effect.

3- Plasma Nuclear Fusion Reactors are promising devices for generating low cost and clean electrical energy. Discuss the physics of this statement, in term of a fully ionized Plasma. [10 Marks]

4- Write a short note on electron emission from metals, by positive-ion bombardment and by photoelectric emission .

5- Put (√) for the correct statements and (**X**) for the others. **Put your answer in a Vertical Table:** [10 Marks]

1- The glow discharge is non-self-sustaining discharge.

2- The rate of recombination, in a gas discharge , is inversely proportional to the concentration of both positive ions and electrons.

3- The necessary energy to raise one electron to the metal surface is (e m) which is known as the surface work function of the metal.

4- Ionized gas is usually called plasma when it is chemically quasi-neutral .

5- The equilibrium plasma is usually called non-thermal plasma.

6- Plasma angular frequency is giving by: $\omega p = \frac{eB}{m}$.

7- The linear pinch in a fully-ionized plasma is due to Force **F = e (JXB)**.

8- The magnetic moment in a fully-ionized plasma is constant.

9- Plasma is a diamagnetic material..

اقلب الصفحة من فضلك

10- Plasma temperature in thermonuclear applications, should be about $10^8\ ^0K$.

11- The ionic current density in a gas discharge is much greater than the electronic current density.

12- Electron may be drawn out of metal surfaces by any voltage. This process is known as Larmor effect.

13- Plasma as a whole will be quasi-neutral provided: $r_d << 5\ (T_e/n)^{1/2}$, where r_d is called Debye radius.

14- The magnetic moment in a fully-ionized plasma is not constant.

15- If the plasma is not neutral, the electric drift velocity does produce a current in a direction parallel to **E** or **B**.

16- For plasma in thermonuclear applications, $N \approx 10^{14}\ cm^{-3}$ giving $f_p \approx 10^{18}\ H_z$

17- Plasma angular frequency is giving by: $\omega p = \sqrt{\frac{N e^2}{\pi m}}$.

18- Plasma oscillations in a fully-ionized plasma is due to ions.

19- Plasma temperature in thermonuclear applications, should be about $10^8\ ^0K$.

20- In transmission of electromagnetic waves through plasma, the induced electric dipole moment per unit volume P is giving by:

$$P = N e x = - \frac{Ne^2}{m_e \omega^2} E_x$$

[6]- Solve ONLY ONE of The Following Problems: [10 Marks]

(6-1) Compute Larmor radius r_L for the following cases, if V_{11} is negligible:

(a) **A 10 K.e.V electron in the earth's magnetic field of $5x10^{-5}$ T.**

(b) **A solar wind proton with streaming velocity 300 km/sec, $B = 5x10^{-9}$ T.**

(c) **A 1 k.e.V He^+ ion in the solar atmosphere near a sunspot, where $B = 5x10^{-2}$ T.**

(d) **A 3.5 M.e.V H_e^{++} ion particle in an 8 T, DT fusion reactor.**

(6-2) A 20 k.e.V. deuteron in a large mirror fusion device has a pitch angle θ of 45° at the midplane, with B = 0.7 T. Compute its Larmor radius.

(6-3) Compute r_d and No. density n for the following cases:

(a) **A glow discharge, with $n = 10^{16}\ m^{-3}$, $KT_e = 2$ eV.**

(b) **The earth's ionosphere, with $n = 10^{12}\ m^{-3}$, $KT_e = 0.1$ e.V.**

(c) **A θ- pinch with $n = 10^{25}\ m^{-3}$, $KT_e = 800$ e.V.**

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

أستاذ المادة : أ.د. عادل عباس محمد

موبايل : 01001976345

Assiut University **Faculty of Science** **Department of Physics**		**Term: Spring 2014- 2015** **Date: 6 June, 2015** **Time: 3 Hours**
Course Title: Nuclear Physics 1 – Code P342 – Final Exam. (50%)		
Instructor ***Prof. Dr.*** **A. A. Ebrahim**		
Constants: $R_o = 1.3$ fm, $e^2 = 1.44$ MeV – fm, $m_e = 0.511$ MeV, $M_p = 938.28$ MeV, $M_n = 939.52$ MeV		

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

Question #1

a. In a scattering experiment it was found that ^{12}C has a nuclear radius of 2.7 fm. The experiment is then repeated with another, unknown element and it is found the nuclear radius is twice as big. ***What*** is the mass number of this unknown element?

b. The Q value for the reaction $^{9}Be + p \rightarrow {}^{8}Be + {}^{2}H$ is 559.5 KeV. Using the masses of ^{9}Be=9.01218u and ^{2}H=2.014u to ***find*** the mass of ^{8}Be in MeV.

c. ***Suggest*** a simple reason why the $^{12}_{6}C$ nucleus has a higher binding energy (more stable) than $^{12}_{7}N$, even though they are isobars?

d. ***Calculate*** the ratio of the surface energy term per nucleon for ^{42}Ca to that of ^{208}Pb.

e. ***Show*** that the nucleons are not elementary particles but have an internal structure.

Question #2

a. Use the Semi Empirical mass formula to estimate the kinetic energy of an α-particle emitted from the decay of $^{242}_{98}\mathrm{Cf}$ to $^{238}_{96}\mathrm{Cm}$, where B is given by:

$$B(Z,A) = a_v A - a_s A^{2/3} - a_c \frac{Z^2}{A^{1/3}} - a_a \frac{(N-Z)^2}{A} - \frac{a_p}{A^{1/2}}$$

and $a_v = 15.56\text{MeV}$, $a_s = 17.23\ \text{MeV}$, $a_c = 0.697\text{MeV}$, $a_a = 23.285\text{MeV}$, $a_p = \pm 12,0\ \text{MeV}$.

Calculate the masses of all three particles involved and the kinetic energy of α-particle.

b. The radioactive decay series begins with $^{238}_{92}U$ and ends with $^{206}_{82}Pb$.

1) ***How*** many α-decays are there in this chain?
2) ***How*** many beta-decays are there in this chain?
3) ***How*** many energy is released in this complete chain?

Question #3 (٢٠ /

a. Using the Semi-Empirical Mass Formula (SEMF) from the Liquid Drop Model of the nucleus to ***calculate*** the Q - value in MeV for the β^- decay for the reaction:

$$^{125}_{51}\mathrm{Sb} \rightarrow {}^{125}_{52}\mathrm{Te} + \beta^- + \bar{\nu}$$

b. What is meant by ***only two*** of:

Distance of closest approach – Nuclear photodisintegration – Radioactive capture.

Question #4

a. ***Find*** whether $^{39}_{19}K$ is stable or not. If not, find the decay mode.

Given:

$$M(^{39}_{19}K) = 39.098300u$$
$$M(^{39}_{18}Ar) = 39.097299u$$
$$M(^{39}_{20}Ca) = 39.098500u$$

- ***Draw*** a diagram for this decay.
- ***What*** is the most important characteristic of this decay?.

b. If the Q-value for the $^3H(p, n)^3He$ reaction is -0.7637 MeV and tritium (^3H) emits negative β-particles of end point energy 18.5 KeV, ***calculate*** the difference in mass between the neutron and the hydrogen atom.

Question #5

a. ***Show*** that the electric quadrupole moment of a nucleus vanishes for:

(i) Spherically symmetric charge distribution

(ii) Nuclear spin $I = 0$ or $I = 1/2$

b. ***Prove*** that the number of energy levels produced from two nucleons ($\ell_1 = 1,\ \ell_2 = 0$) does not depend on whether the type of bonding (L - S or J - J coupling).

***Good Luck ***