

Answer only four questions.

1)- Calculate the projection of total magnetic moment vector $\vec{\mu}$ on the total angular momentum vector $\vec{J}$.

2)- a- Draw an energy level diagram representing the anomalous Zeeman Effect in a magnetic field for $[3^2P_{3/2,1/2} - 3^2S_{1/2}]$

b- Calculate the number of components in the Stark effect of the hydrogen line L_γ .

3)-a- Prove that the allowed rotational energies of linear molecule can be written as:-

$$\bar{E}_J = \bar{B}(J + 1) \quad \text{cm}^{-1} \quad , \bar{B} = h/8\pi^2 I c \quad \text{cm}^{-1}$$

b- Draw the energy – levels pattern for non – rigid rotating linear molecule.

4)- Considering the molecule HCl as a rigid rotating linear molecule, calculate the separation of the lines in the spectrum of the molecule.

$$[\text{Hint: } m_{Cl} = 35 m_H, \quad m_H = 1.68 \times 10^{-24} \text{ gm}, \quad r_o = 129 \text{ A}^\circ]$$

5)- a- Prove that the frequencies of the normal Zeeman transitions between two states are given by:-

$$\omega = \omega_o + (M_B H / \hbar)(m_{L2} - m_{L1}), \quad [\text{Hint: } U_H = g M_B M_J H]$$

b- The red line of cadmium splits into three components separated by 120 MHz when source is placed in magnetic field of flux density 8.6 mT. Calculate the ratio of charge to mass (e/m) of the electron.

$$[\text{Hint: } M_B = e\hbar/2m]$$

Good – Luck

Assiut University
Faculty of Science
Department of Physics

Undergraduate
Final Exam (50%)
Second semester 2016-2017

Course : Physical Measurements
using Computer
Code : P 462
Section : Physics
Time : 3 Hours
Date : 20/5/2017

Question (1): FORTRAN Language: Circle the correct choice: (5 Marks)

- 1) In which column does the code start in standard FORTRAN 77?
a) 2-5 column b) 6 column c) 7 column
- 2) What signals a comment in FORTRAN 90?
a) ! anywhere on the line b) C in column one c) * in column six
- 3) How can we continue source code from one line to the next in FORTRAN 90?
a) by * in column 6 b) by & at the end of a line c) by using brackets
- 4) What is the purpose of a number in column 2 to 5 in standard Fortran 77?
a) jump label or format label b) jump label c) format label
- 5) What is the difference between a function and a subroutine?
a) there is no difference
b) subroutine returns a value, but a function returns many values
c) subroutine returns many values, but a function returns a value
- 6) If we have a subroutine, how can we transfer a value calculated inside it out?
a) by using data block b) by having an argument which will retrieve the value
c) we cannot transfer values from a subroutine
- 7) The FORTRAN program begin with:
a) open statement b) declaration as real *var*, etc. c) program name
- 8) What meaning has the first * in the WRITE(*,*) statement?
a) tells the system to use default formatting
b) tells the system not to use the default new-line
c) tells the system to send the output to the screen
- 9) The common block is used to share _____ between subroutines.
a) large data b) large variables c) large declaration types
- 10) In the common block:
a) all variables don't have the same declaration type
b) all variables must have the same declaration type
c) all data must have the same declaration type

Question (2): FORTRAN Language: Circle the correct answer: (5 Marks)

1) One of the following expressions does not evaluate to 2. Which one ?

- a) SQRT(4.) b) $4^{**}0.5$ c) $4.0^{**}(1/2)$ d) $4^{**}(1./2.)$

2) What does the following program print on the screen ?

```
program test
i = 4
j = (i/2)**2
k = i/8
i = i - 2
write(*,*) i, j, k
stop
end
```

- a) 2 0 0 b) 2 4 0 c) 2 4 1 d) 4 1 1

3) If A = 2.0, B = 3.0, C = 4.0, what is the value of $A^{**}2*B-C/A$? (A, B, C are real variables)

- a) 0.2 b) 4.0 c) 10.0 d) non of them

4) What does the following program print on the screen ?

```
program loop
integer i, j
j=2
do 10 i = 2, 10, 2
j=2*j
10 continue
write (*,*) j
stop
end
```

- a) 2 b) 32 c) 64 d) 265

5) For the following segment of FORTRAN 77 code, what will be stored:

```
CHARACTER*8 SUBJ
SUBJ = 'P462programming'
```

- a) P426programming b) P462 c) P462prog d) Nothing will be stored

Question (3): FORTRAN Language: Solve the following problems: (10 Marks)

1) Write FORTRAN 77 program to read the value x and write an IF-THEN-ELSE structure to do the following:

$$y(x) = \begin{cases} -x & x < -1 \\ \frac{2x+1}{x^2} - 2x & -1 \leq x \leq 1 \\ x & x > 1 \end{cases}$$

Consider x and y are real in the program and write the value of $y(x)$ in each case. (4 points)

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where $\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$, R is the radius of the loop, I is the current, and x is the distance from the center of the loop.

Write FORTRAN 77 program "bfield" to calculate a table of values of B_x for r from 0 to 5 cm by step of 1 mm, for $I = 0.1$ A and $R = 1.4$ cm. Build the program as:

- in main program: μ_0 and π are REAL parameters.
- in main program: R and I are REAL and read from screen with free format.
- build a function to calculate B_x .
- in main program: save the results to file "bfield.out" with B_x in exponent notation with 10 field width and three decimal places. (6 points)

[illegible]

Question (4): Numerical Methods: Circle the correct choice:

(5 Marks)

- 1) Newton-Raphson's method of finding roots of nonlinear equations needs:
a) 1 initial guess b) 2 initial guesses c) 3 initial guesses d) 4 initial guesses
- 2) Newton-Raphson's method converges fast because it is a convergence from:
a) first order b) second order c) third order d) fourth order
- 3) If for a real continuous function $f(x)$, $f(a)f(b) < 0$, then in the range of $[a, b]$ for $f(x) = 0$, there is (are):
a) one root b) at least one root c) two roots d) many roots
- 4) The differential equation $2 \frac{d^2y}{dx^2} + x^2y = 2x + 3$ is called:
a) homogeneous first order second degree
b) homogeneous second order first degree
c) nonhomogeneous second order first degree
d) nonhomogeneous second order second degree
- 5) Solving differential equation gives:
a) one solution b) two solutions c) three solutions d) none of them
- 6) Extended Euler's method of solving ordinary differential equation has the form:
a) $y_{i+1} = [y_i - f(x_i, y_i)w]$ b) $y_{i+1} = \left[y_i + f(x_i, y_i)w + f'(x_i, y_i) \frac{w^2}{2} \right]$
c) $y_{i+1} = [y_i + f(x_i, y_i)w]$ d) $y_{i+1} = \left[y_i - f(x_i, y_i)w - f'(x_i, y_i) \frac{w^2}{2} \right]$
- 7) Assume you pass a function $f(x)$ through all data points $(x_0, y_0), (x_1, y_1), \dots, (x_n, y_n)$. If the value of the function $f(x)$ is required to be found outside the range of the given x -data, the procedure is called:
a) extrapolation b) interpolation c) guessing d) iteration
- 8) Given $n + 1$ data pairs, a polynomial of degree _____ passes through $n + 1$ data points.
a) $n + 1$ b) $n + 1$ or less c) n d) n or less
- 9) Polynomials are the most commonly used for interpolation because they are easy to:
a) evaluate b) differentiate c) integrate d) evaluate, differentiate and integrate
- 10) Given the two points $(a, f(a)), (b, f(b))$, the linear Lagrange polynomial $p_1(x)$ that passes through these two points is given by:
a) $p_1(x) = \frac{x-b}{a-b}f(a) + \frac{x-a}{a-b}f(b)$ b) $p_1(x) = \frac{x}{b-a}f(a) + \frac{x}{b-a}f(b)$
c) $p_1(x) = f(a) + \frac{f(b)-f(a)}{b-a}(b-a)$ d) $p_1(x) = \frac{x-b}{a-b}f(a) + \frac{x-a}{b-a}f(b)$

Question (5): Physical Measurements: Solve the following problems: (5 Marks)

1) The data of the velocity of a body as a function of time is given as follows:

Time (s)	0	15	18	22	24
Velocity (m/s)	22	24	37	25	123

Find the velocity in m/s at 16 s using linear interpolation.

(2 points)

Solution:

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

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

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

x	15	18	22
$f(x)$	24	37	25

(3 points)

Solution:

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

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Question (6): Physical Measurements: Solve two only of following: (20 Marks)

Van der Waals equation for gases takes into account deviation of real gases. The equation is: $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, with P is pressure, T is absolute temperature, V is volume and R is the universal gas constant. Parameters a and b are empirical constants depends on a particular gas. Given $R = 0.08$, $a = 3.598$, $b = 0.04267$, $P = 10$ and $T = 300$. Rearrange the equation to be cubic equation of V and write FORTRAN program to find the volume V for the above values using Newton-Raphson's method. (10 points)

Solution:

Rearrangement of the equation:

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The Program:

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- 2) Cup of coffee is initially 170 degrees Fahrenheit and is left in a room with room temperature 70 degrees Fahrenheit. Assuming Newton's law of cooling in the form:

$\frac{dT}{dt} = k(T - A)$, where T is temperature of object, t is time in minutes, A is room temperature and k is constant.

Write FORTRAN program using extended Euler's method to find what is the degree of the cup after 7 min.?

To find the constant k , suppose that when the coffee is first placed in the room, it is cooling at a rate of 20 degrees per minute. (Note, put k with any value if you don't be able to calculate it) (10 points)

Solution:

Write the initial conditions and find the k :

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The Program:

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g) The following data of the velocity of a body is given as a function of time.

Time (s)	10	15	18	22	24
Velocity (m/s)	22	24	37	25	123

Write FORTRAN program using Lagrange interpolating polynomial to find the velocity of the body at time equals 20 s.

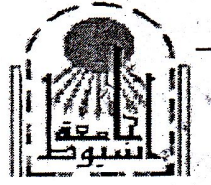
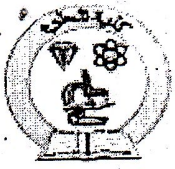
Solution:

Write Lagrange interpolating polynomial function and the law of L 's in this case:

The Program:

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Final Exam – Second Term: 2016/2017 - Course Title: Physics of Low Temperature P- 422- Time: 3h - Prof. Dr. Ahmed Sedky

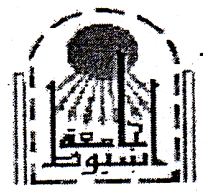
Answer the following questions:

Q1(10 marks):

(a) Explain with the required diagram the mechanism of BCS theory for electron pairs.

(b) Explain with drawing how you can measure the resistivity of superconductors.

(c) Write only London equation and explain the main difference between its physical meaning and Meissner effect.

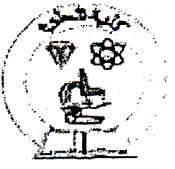


Q2 (10 marks):

(a) Write short account about Pippard non local modification.

(b) Prove that the lower critical field is mainly controlled by G-L parameter.

(c) If Ginsburg Landau parameter is 0.801 and density of carriers $12.16 \times 10^{21} / \text{cm}^3$, calculate the surface energy and critical fields H_c , H_{c1} , H_{c2} , and H_{c3} .



Q3(10 marks):

(a) Calculate size of BCS electron pairs in both conventional and high T_c superconductors, and then compare them with similar values of the normal state.

(b) Clarify in details how you can use a superconductor in only one of its applications.

(c) Calculate by nm the spacing of vortex lines for a superconductor if $K_{GI} = 0.955$, pinning radius = 1.2 nm and $\rho_f = 2\rho_n$.

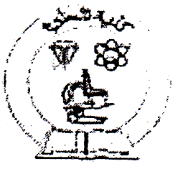


Q4-(10 marks):

(a) In terms of BCS theory, prove that $E_g(0) = 3.52K_B T_c$.

(b) Determine the flux flow resistance along a flat strip of type (II) in mixed state.

(c) Clarify in details how the flux creep occurs in a superconductor, and then explain how you can determine the activation energy of flux bundles.



Q5(10 marks):

(a) Prove that $E_g(0) = 3.52K_B T_c$ is applicable only for weakly coupled superconductor.

(b) Write the type of crystal structure, T_c , $J_c(0)$ and H_{c2} values for Ti: 2223 and Y:123 high T_c systems.

(c) Consider a cylindrical superconducting wire of $V = 3.14 \text{ cm}^3$, $\ell = 2 \text{ cm}$, $R = 10 \text{ m}\Omega$, $T_c = 30 \text{ K}$ and $H_{c2}(0) = 6 \text{ T}$. Calculate the thermodynamic critical field and the number density of electron pairs at 0 K . .

Physics of Nano materials and its applications
Cod :458 P

Answer the following questions:

1-Chose the correct answer in the following MSQ: (10 marks)

Nanomaterials may differ from micromaterials in the following aspects:-

- 1- Gravitational forces become (negligible, large, or intermediate) while electromagnetic forces dominate.
- 2- The(classical , quantum mechanical, or both)models; can be sufficient to describe motion and energy.
- 3-(Greater, smaller, intermediate) surface to volume ratios.
- 4- Random molecular motion becomes (more , less) important.
- 5- Gravitational forces are (negligible, weak, strong).
- 6- Electromagnetic force is (strong ,weak, moderate) for nanosized particles.
- 7- Surface atoms requires (less, high ,average) energy to move because they are in contact with fewer atoms of the substance.
- 8- Melting point (decreases ,increases, still as a constant) with particle size reduction.
- 9- The mechanical strength of the materials becomes much larger than that for the micro sized or bulk.
- 10- The density of states for quantum wires, nanorods and nano tubes proportional to (E^2 , $E^{1/2}$ or E^n).

2- (a) Given the following data for GaAs : $m_e = 0.067 m_0$, $m_h = 0.45 m_0$, $\epsilon = 12.4$. Calculate 1- The effective mass. 2- Exciton Bohr radius. (5 marks).

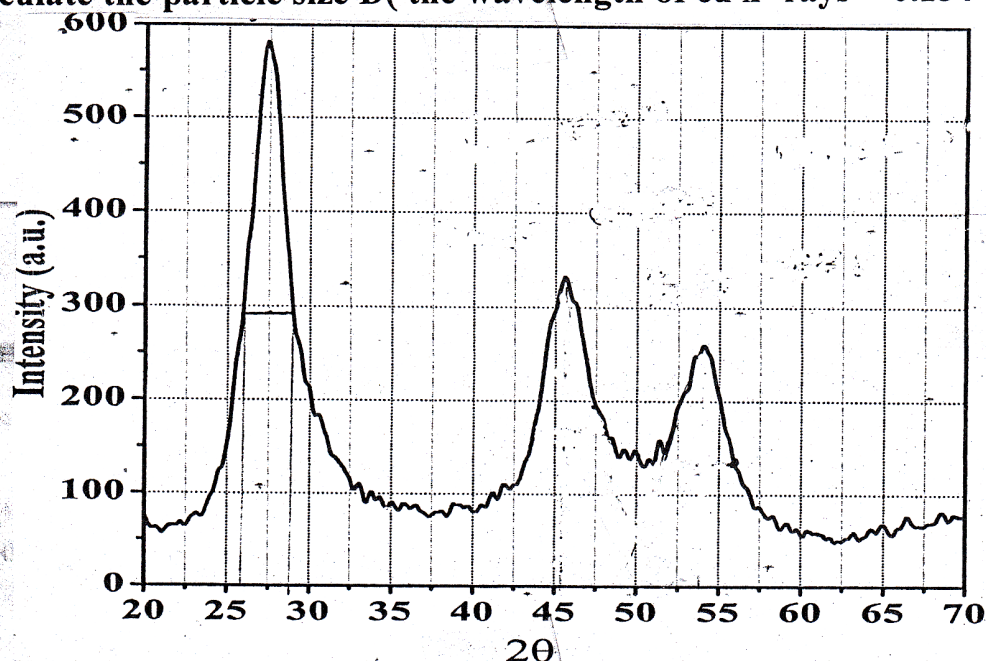
(b) Explain what the size of Exciton Bohr radius means for achieving strong and weak quantum confinement. (5 marks)

3-- Write True (T) or False (F) in the following: (10 marks)

- (a) (1) Tuning the size of the nanocrystal is a means to tune the optical band gap and therefore the wavelength absorbed or emitted by the nanocrystal. ()
- (2)- Quantum confinement effect causes the energy gap to increase, therefore more energy must be absorbed for electronic transitions to the conduction band gap of the material. ()
- (3)- High surface area to volume ratio provides strong driving force to speed up thermodynamic processes that minimize free energy.
- (4)- At the earth's surface, the gravitational force scales to L^2 (L is the dimention) .()

(5) Electrical resistivity increases by about 3 times compared to bulk value ().

(b) From the figure below which shows x-ray diffraction pattern for ZnS nanoparticles; calculate the particle size D (the wavelength of cu x- rays = 0.154 nm) (5 marks).



4- Write about only two of the following:

(10 marks)

- 1- Sol-Gel technique as a chemical bottom-up method.
- 2- Ultrasound method for nano-materials synthesis.
- 3- Electron beam lithography. (10 marks)

5- Explain the effects of nanoscale length on:

- 1- Melting point System total energy .
- 2- The mechanical strength. (10 marks)

Constants:

$$\text{Electronic charge} = 1.602 \times 10^{-19} \text{ Coul}, \quad \epsilon_0 = 8.85 \times 10^{-12} \text{ }^{-34},$$
$$h/2\pi = 1.054 \times 10^{-34}$$

my best wishes/ Prof .dr. Aly Othman



Final Exam of Radiation Physics – Course Code: P444 - (50 Marks)

Answer the following questions:

Q1: (A) Define the binding energy, then Calculate the binding energy of deuterium, ${}^2\text{H}$. Give a short comment on your result. Where the masses of ${}^2\text{H} = 2.01410178 \text{ u}$, proton = 1.00727647 u , neutron = 1.00866491 u , and electron = 0.00054858 u . [4 Marks]

(B) Discuss the unstable nuclei that contains: [in short]

i) Neutron-rich, ii) Proton-rich [3 Marks]

(C) Give a short description about neutron sources? [3 Marks]

Q2: (A) distinguish between secular equilibrium and transient equilibrium in short? [4 Marks]

(B) An amount of 10 mCi of ${}^{90}\text{Sr}$ ($T_{1/2} = 28.78 \text{ y}$) is separated from a fission product mixture and allowed to set for ${}^{90}\text{Y}$ ($T_{1/2} = 2.67 \text{ d}$) to grow in. What is the activity of ${}^{90}\text{Y}$ at (a) 20 h and (b) 600 h? [2.5 Marks]

(C) What is the maximum activity of ${}^{90}\text{Y}$ that will ever be present in the sample in previous problem and at approximately what time after separation does it occur? [2.5 Marks]

Q3: (A) Define: Exposure, absorbed dose, and Equivalent dose [3 Marks]

(B) What is the photon/particle flux produced by a 1 mCi point source of ${}^{137}\text{Cs}$ at 100 cm? where the transformation of γ -photons is 85% and β -particles is 5.6%. [3 Marks]

(C) If the ${}^{137}\text{Cs}$ source emits γ -photons with energy 0.662 MeV and β -particles with energy 1.1756 MeV, calculate the energy flux of ${}^{137}\text{Cs}$ source for both emissions? [2 Marks]

Q4: (A) Write short note about FOUR ONLY [for heavy charged particles]: [6 Marks]

- i. Stopping power
- ii. Energy straggling
- iii. Bragg curve
- iv. RANGE
- v. Stopping time
- vi. Bragg-Kleeman rule (Scaling Laws)

(B) What is main difference between negatron and positron Interactions? in short! [3 Marks]

(C) Differentiate between good geometry and bad geometry in the transmission experiment? [in short] [3 Marks]

Q5: (A) Write a short description about THREE ONLY from the following: [6 Marks]

- i. Proportional counter
- ii. Conductivity Detectors
- iii. Scintillation Detectors
- iv. Thermoluminescence Detectors
- v. Activation Effect

(B) What Follows Chromosome Damage by ionizing radiation? [3 Marks]

(C) What Follows DNA Damage by ionizing radiation? [2 Marks]

 Faculty of Science Department of Physics	Second semester 2016-2017 Final Exam (50%) Date: 31/5/2017 Time: 3 hours Course Title: Selected Topics in Physics (II) Course Code: P 492	 Assiut University
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Constants: Magnetic permeability of air $\mu_0 = 4\pi \times 10^{-7} \text{ T.m/A}$, Boltzmann Constant $k_B = 1.38 \times 10^{-16} \text{ erg/K}$, Avogadro's number $N_A = 6.023 \times 10^{23} \text{ molecule/mole}$, Proton Mass $= 1.67 \times 10^{-27} \text{ kg}$, Electron mass $= 9.1 \times 10^{-31} \text{ kg}$, Proton (electron) charge $= + (-) 1.6 \times 10^{-19} \text{ C}$ and the Bohr magneton $\mu_B = 0.927 \times 10^{20} \text{ erg/Oe}$.

Part I: Choose the correct one for the following statements: - (15 Marks)

1- A positively charged particle has a velocity in the negative z direction at point P. The magnetic force on the particle at this point is in the negative y direction. From this data the direction of magnetic field at point P is:

- a. - x direction. b. + x direction c. - z direction d. + z direction

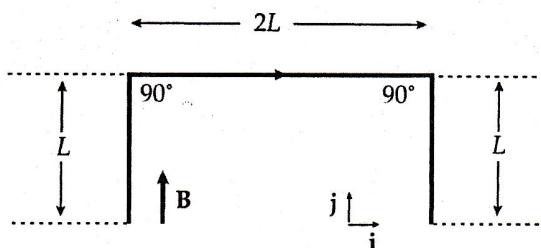
2- A charged particle (mass = M , charge = $Q > 0$) moves in a region of space where the magnetic field has a constant magnitude of B and a downward direction. What is the magnetic force on the particle at an instant when it is moving horizontally toward the north with speed V ?

- a. QVB toward the east. b. Zero c. QVB toward the west d. QVB toward the south.

3- The susceptibility of a ferromagnet in its paramagnetic state diverges with decreasing temperature at Weiss temperature, θ , which is :

- a. Higher than 0 K. b. Lower than 0 K. c. Exactly 0 K. d. Not identified.

4- A straight wire is bent into the shape shown. Determine the net magnetic force on the wire when the current I travels in the direction shown in the magnetic field B .



- a. $2IBL$ in $-z$ direction b. $2IBL$ in $+z$ direction c. $4IBL$ in $+z$ direction d. $4IBL$ in $-z$ direction

5- You stand near the earth's equator. If you know there are no electric fields in the vicinity, a positively charged particle that starts moving parallel to the surface of the earth in a straight line directed east is deflected:

- a. upward b. downward c. to the east d. to the west

6- On the average, the permanent atomic magnetic moments inside a ferromagnetic domain are aligned _____ to one another.

- a. antiparallel b. parallel c. perpendicular d. randomly relative

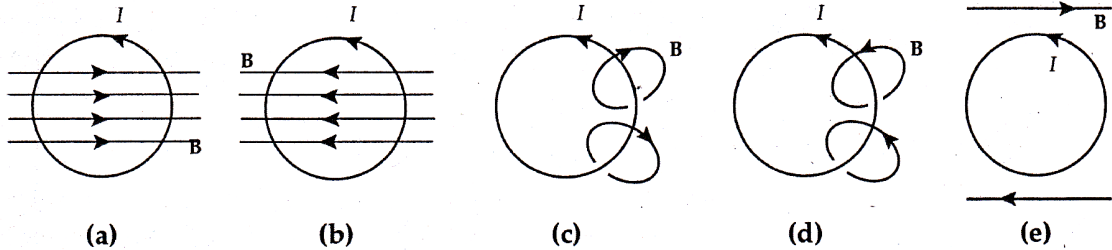
7- An equivalent expression of the cgs unit of the magnetic field strength, 1 Oe, is:

- a. 1 line of force/cm² b. 1 maxwell/cm² c. $10^5 \gamma$ d. any of a, b and c

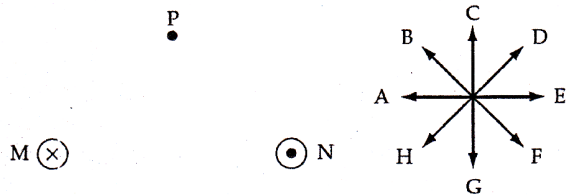
8- When applying a magnetic field H to a piece of paramagnetic material, the ratio of the measured magnetization M to the applied field, M/H , is:

- a. small and negative b. large and positive c. Zero d. small and positive

9- Which diagram correctly shows the magnetic field lines created by a circular current loop in which current flows in the direction shown?



10- Equal currents of magnitude I travel into the page in wire M and out of the page in wire N . Eight directions are indicated by letters A through H.



The direction of the magnetic field at point P is:

- a. C.
b. E.
c. F.
d. G.
e. H.

Part II: Solve the following problems then choose the correct answer:- (20 Marks)

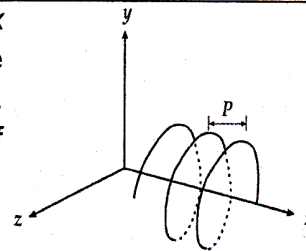
1- A particle (mass = 2.0 mg, charge = $-6.0 \mu\text{C}$) moves in the positive direction along the x axis with a velocity of 3.0 km/s. It enters a magnetic field of $(2.0\mathbf{i} + 3.0\mathbf{j} + 4.0\mathbf{k})$ T. What is the acceleration of the particle?

- A. $(36\mathbf{j} - 27\mathbf{k}) \text{ m/s}^2$ B. $(-36\mathbf{j} + 27\mathbf{k}) \text{ m/s}^2$ C. $(-24\mathbf{j} + 18\mathbf{k}) \text{ m/s}^2$ D. $(24\mathbf{j} - 18\mathbf{k}) \text{ m/s}^2$

2- A straight wire carries a current of 40 A in a uniform magnetic field (magnitude = 80 mT). If the force per unit length on this wire is 2.0 N/m, determine the angle between the wire and the magnetic field.

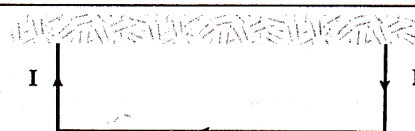
- A. either 39° or 141° B. either 25° or 155° C. either 70° or 110° D. either 42° or 138°

- 3- A uniform magnetic field of 0.50 T is directed along the positive x axis. A proton moving with a speed of 60 km/s enters this field. The helical path followed by the proton shown has a pitch of 5.0 mm. Determine the angle between the magnetic field and the velocity of the proton.



- A. 39° B. 51° C. 44° D. 34°

- 4- A wire (mass = 50 g, length = 40 cm) is suspended horizontally by two vertical wires which conduct a current $I = 8.0$ A, as shown in the figure. The magnetic field in the region is into the paper and has a magnitude of 60 mT. What is the tension in either wire?



- A. 0.15 N B. 0.68 N C. 0.10 N D. 0.34 N

- 5- Each of two parallel wires separated by 8.0 mm carries a 20-A current. These two currents are oppositely directed. Determine the magnitude of the magnetic field at a point that is 5.0 mm from each of the wires.

- A. 2.0 mT B. 1.6 mT C. 1.3 mT D. 1.8 mT

6- A solenoid 4.0 cm in radius and 4.0 m in length has 8000 uniformly spaced turns and carries a current of 5.0 A. Consider a plane circular surface (radius = 2.0 cm) located at the center of the solenoid with its axis coincident with the axis of the solenoid. What is the magnetic flux through this surface? ($1 \text{ Wb} = 1 \text{ T} \cdot \text{m}^2$)

A. $63 \mu\text{Wb}$

B. $16 \mu\text{Wb}$

C. 0.25 mWb

D. $10 \mu\text{Wb}$

7- A cylinder of paramagnetic material is 6.0 cm long and 1.25 cm in diameter, has a volume susceptibility χ_v of 2.0×10^{-6} (SI). What are its magnetization and magnetic moment in an applied field of 1.2 T?

A. $2.4 \mu\text{A/m}$ and $7.36 \mu\text{A m}^2$ B. 2.4 emu/Oe and 7.3 emu C. $2.4 \mu\text{A/m}$ and $0.33 \mu\text{A m}^2$ D. $1.5 \mu\text{A/m}$ and $6 \mu\text{A m}^2$

8- What is the magnetic susceptibility per gram of the diamagnetic carbon $^{12}\text{C}_{12.01}$ (atomic radius = $0.7 \text{ \AA}$, $e = 4.8 \times 10^{-10} \text{ esu}$, $m_e = 9.11 \times 10^{-28} \text{ g}$, $c = 3 \times 10^{10} \text{ cm/s}$, density = 2.22 g / cm^3).

A. $-1.53 \times 10^{-6} \text{ emu/g}$

B. $1.53 \times 10^{-6} \text{ emu/g}$

C. $-6.9 \times 10^{-7} \text{ emu/g}$

D. $6.9 \times 10^{-7} \text{ emu/g}$

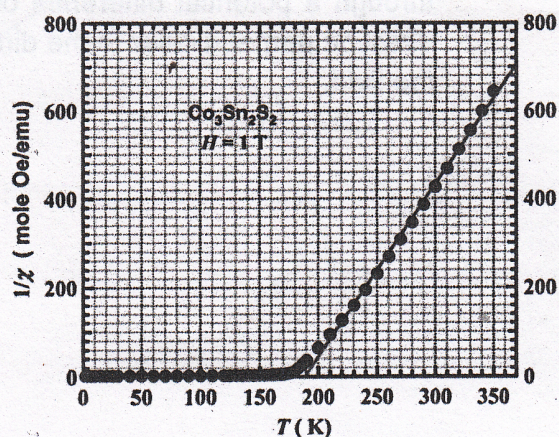
(15 Marks)

(15 Marks)

- Page 5

- 3- The figure below shows the experimental data of the inverse susceptibility versus temperature for a crystal of mass = 63 mg of $\text{Co}_3\text{Sn}_2\text{S}_2$ ($^{27}\text{Co}_{58.93}$, $^{50}\text{Sn}_{118.71}$ and $^{16}\text{S}_{32.07}$) which is ferromagnetic below 173 K. The solid line indicates a linear fit to data in the paramagnetic state of $\text{Co}_3\text{Sn}_2\text{S}_2$. Using Curie-Weiss law and the figure, determine:

- Weiss temperature, θ .
- The effective magnetic moment of $\text{Co}_3\text{Sn}_2\text{S}_2$ in Bohr magneton.



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

أجب عن خمسة أسئلة فقط مما يأتي:-

السؤال الأول

- ا- اشرح كيف يمكن حساب تردد الانتقالات الليزرية لذرة الهيدروجين باستخدام النظرية الكمية لبوهر (6 درجات)
- ب- احسب طول موجة وتردد الانتقال الليزري من مستوى الطاقة السادس الى مستوى الطاقة الاول لذرة الكربون C_4^{13} ثم احسب فرق الطاقة بين المستويين بالالكترون فولت (4 درجات)

السؤال الثاني

- ا- استنتج قيمة الشرط الحرج لانبعاث اشعة الليزر (4 درجات)
- ب- تجويف ليزري يتكون من مرآتين ذو انعكاسية $R_1=100\%$ و $R_2=50\%$ وطوله 5 cm استخدم لتوليد ليزر النيتروجين احسب قيمة الشرط الحرج لتوليد اشعة ليزر النيتروجين اذا علمت ان مساحة المقطع العرضي للانتقال $\sigma=8 \times 10^{-19} \text{ cm}^2$ (3 درجات)
- ج- شريحة زجاجية سمكها 0.02 mm استخدمت لمقياس ميكلسون فسمحت بمرور 150 هدبة احسب طول موجة شعاع الليزر المستخدم اذا علمت ان معامل انكسار مادة الشريحة 1.5 (3 درجات)

السؤال الثالث

- ا- اشرح بايجاز كل من :- ليزر المستويات الثلاثة - ليزر المستويات الاربعة (3 درجات)
- ب- استخدم مصدري ليزر في تجربة يونج ذو الشق المزدوج في نفس اللحظة احدهما ذات طول موجي معلوم $\lambda_1=632 \text{ nm}$ والآخر ذات طول موجي مجهول λ_2 فتكونت الهدبة الرابعة المضينة للطول الموجي المعلوم علي تفس بعد الهدبة الثالثة المظلمة للطول الموجي المجهول عن النقطة المركزية . احسب طول موجة شعاع الليزر المجهول (3 درجات)
- ج- اذكر خصائص اشعة الليزر ثم اشرح بالتفصيل خاصية الاتجاهية موضحاً كيفية حساب زاوية حيود الاشعة في حالي الترابط المكاني التام و الترابط المكاني الجزئي (4 درجات)

السؤال الرابع

- ا- اشرح بالتفصيل كيفية حساب معامل كسب الإشارة الصغيرة ومعامل تكبير شعاع الليزر (6 درجات)
- ب- سقط شعاع ليزري على مادة معامل امتصاصها 0.6 cm^{-1} احسب سمك المادة اذا علمت ان شدة الشعاع الساقط ضعف شدة الشعاع النافذ. (4 درجات)

السؤال الخامس

- ا- اذكر مميزات وعيوب استخدام الليزر في الصناعة (5 درجات)
- ب- احسب النسبة بين تعداد المستوى الاول الى تعداد المستوى الثاني عند درجة حرارة 57°C اذا كان طول موجة الانتقال بين المستويين 600 nm (درجتان)
- ج- استخدم ليزر النيترودجين ذات الطول الموجي $\lambda = 337.1 \text{ nm}$ لاضاءة فتحتين فتكونت الهدبة الرابعة المضينة على بعد 4 cm من الهدبة المركزية . احسب المسافة الفاصلة بين الفتحتين اذا علمت ان المسافة بين الشاشة والفتحتين $R = 1.2 \text{ m}$ وما هو الوضع الزاوي لهذه الهدبة. (3 درجات)

السؤال السادس

- ا- اذكر الشروط التي يجب توافرها في التجاويف الرنانة ثم اذكر انواع هذه التجاويف (3 درجات)
- ب- احسب عدد الانماط الليزرية المتكونة داخل تجويف فابري-بيرو لكل من اللون الاحمر $\lambda_R = 700 \text{ nm}$ واللون الازرق $\lambda_B = 400 \text{ nm}$ اذا علمت ان المسافة الفاصلة بين المرأتين لكل من اللون الاحمر $L_R = 3.5 \text{ mm}$ واللون الازرق $L_B = 4 \text{ mm}$ (4 درجات)
- ج- احسب قوة سطوع شعاع ليزري قدرته 3 mW وقطره 3 mm وزاوية انفرجه 0.2° (3 درجات)
- انتهت الأسئلة والله الموفق

ثابت بلانك $h = 6.625 \times 10^{-34} \text{ j.sec}$

ثابت بولتزمان $k = 1.38 \times 10^{-23} \text{ j/k}^\circ$

شحنة الالكترون $e = 1.6 \times 10^{-19} \text{ C}$

سرعة الضوء $C = 3 \times 10^8 \text{ m/sec}$

ثابت رايدبرج $R = 10.97 \times 10^6 \text{ m}^{-1}$