

Third Question: [16 degrees]

Sodium (Na^{11}) metal crystallizes in the form of body centered cubic structure. The cube edge equals $4.3 \text{ \AA}$. The density of sodium metal equals 9.6 g/cm^3 , its atomic weight equals 23. Assume the Avogadro's number equals 6.02×10^{23} , fill the spaces below,

1-	Number of lattice points related to one unit cell is
2-	Number of the nearest neighbors (NN) in the above sodium crystalline lattice is
3-	The number of sodium atoms per one cm^3 equals
4-	The number of sodium atoms per one gram equals
5-	The number of unit cells per one cm^3 equals.....
6-	The international units of the atomic weight of an element is
7-	The international units of the Avogadro's number is
8-	The radius of one sodium atom is

Fourth Question: [8 degrees]

Choose The Correct Answer

1- In orthorhombic crystal structure, the primitive lattice vectors are

a)- $a = b = c$	b)- $a = b \neq c$	c)- $a + b = c$	d)- $a \neq b \neq c$
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2- For a face centered cubic, the number of lattice points in one unit cell is...

a)- 1 point	b)- 2 points	c)- 3 points	d)- 4 points
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3- For a face centered cubic structure, the nearest neighbors are equal to

a)- 8 points	b)- 10 points	c)- 12 points	d)- 6 points
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4- The volume of one atom in terms of its radius (R) is given by

a)- $(4/3)\pi R$	b)- $(3/4)\pi R^2$	c)- $(4/3)\pi R^3$	d)- $(4\pi R^2)$
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5- In terms of the atomic radius (R), the length of the *fcc* cube (a) equals....

a)- $a = 2R$	b)- $a = \sqrt{2} R$	c)- $a = 2\sqrt{2} R$	d)- $a = R/\sqrt{2}$
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6- In terms of the atomic radius (R), the length of the *bcc* cube is given by ...

a)- $a = 4R/\sqrt{2}$	b)- $a = 4R/\sqrt{3}$	c)- $a = 4R/\sqrt{4}$	d)- $a = 4R$
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7- "A system which is periodic in real space with a periodicity (a) will be periodic in reciprocal space with periodicity

a)- $2a/\pi$	b)- $2\pi/a$	c)- $\pi/2a$	d)- π/a
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8- When packing the atoms as hard spheres, the highest value of atomic packing in metals will be

a)- 0.68	b)- 0.74	c)- 0.84	d)- 0.98
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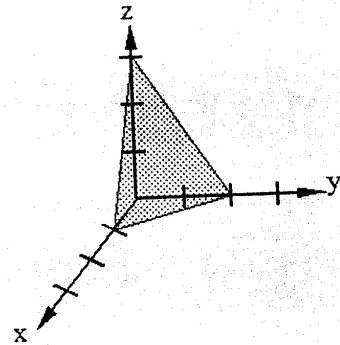
انتهت الأسئلة مع تمنياتي بالنجاح

	Assiut University- Faculty of Science Final Exam 2025 - 2026 Physics Department	Program : Physics Date : 24 / 5 / 2026 Sunday : (9-11)
Course Title : X-ray diffraction and its Applications		Code : P352
Instructor: Dr. Abdel-Rahim Hassan Moharram		Level : 3
Important: No. of Pages : 4	No. of Questions : 4	Total Mark: 50 degree

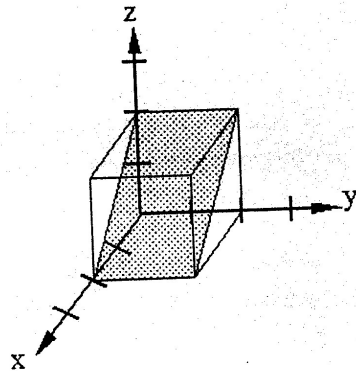
Answer All Questions

First Question: [8 degrees]

a)- Write down three steps to find the Millar indices for the dashed plane shown in the figure below,

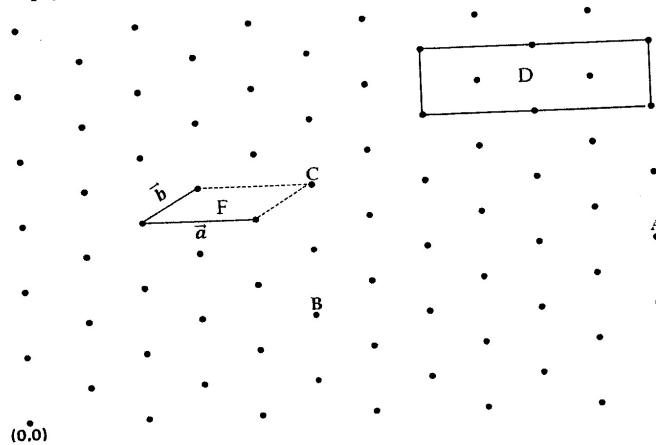


b)- Write down three steps to find the Millar indices for the dashed plane shown in the figure below,



Second Question: [18 degrees]

In real lattice shown below, and assuming that the primitive lattice vectors are $(\vec{a}, \vec{b})$, complete the empty spaces given in the following sentences:



- | | |
|------|--|
| (1)- | The number of lattice points related to the unit cell (D) equals |
| (2)- | In terms of the primitive lattice vectors $(\vec{a}, \vec{b})$, the location of point (A) in the lattice is |
| (3)- | In terms of the primitive lattice vectors $(\vec{a}, \vec{b})$, the location of point (B) in the lattice is |
| (4)- | Using the Millar indices, the direction of line coming from point (B) to point (A) is |
| (5)- | Using the Millar indices, the direction of line coming from point (C) to point (A) is |
| (6)- | The value of the ratio $\left(\frac{\text{Area of the unit cell } F}{\text{Area of the unit cell } D} \right)$ equals |

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7-	The international units of the Avogadro's number is
8-	The radius of one sodium atom is

Fourth Question: [8 degrees]

Choose The Correct Answer

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a)- $a = 4R/\sqrt{2}$	b)- $a = 4R/\sqrt{3}$	c)- $a = 4R/\sqrt{4}$	d)- $a = 4R$
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7- "A system which is periodic in real space with a periodicity (a) will be periodic in reciprocal space with periodicity

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انتهت الأسئلة مع تمنياتي بالنجاح



The final exam is in 4 pages (50 Marks)

First question: Choose the correct answer (18 Marks: 1 Mark each)

1) In absences of electric field, the direction of the gyration is always such that the magnetic field generated by the charged particle and is ____ to the externally imposed field. Plasma particles, therefore, tend to ____ the magnetic field.

- A. opposite- reduce B. parallel- reduce C. opposite-maximize D. parallel-maximize

2) In a finite electric field E , the first half-cycle of the ion's orbit, it ____ energy from the electric field and ____ in $v_{\perp}$ and, hence, in r_L .

- A. lose-increase B. lose-decrease C. gain-increase D. gain-decrease

3) A plasma is considered 'quasineutral' when which of the following is true?

- A. The magnetic field is zero.
B. The number of ions is exactly zero.
C. The density of ions and electrons is approximately equal on a large scale.
D. All particles are neutral atoms.

4) The guiding center drift caused by the force of gravity v_g is usually negligible but when the lines of force are curved, there is an effective gravitational force due to ____

- A. real gravity B. centrifugal force C. thermal pressure D. current density

5) The Larmor radius of a solar wind proton with streaming velocity 300 km/s , in field $B = 5 \times 10^{-9} \text{ T}$ is ____

- A. $6.26 \times 10^5 \text{ m}$ B. $1.6 \times 10^{-6} \text{ m}$ C. 0.183 m D. 1.63 m

6) A "guiding center" is defined as:

- A. The center of the plasma.
B. The fixed point (x_0, y_0) around which a particle gyrates.
C. The source of the electric field.
D. The point of highest density.

7) The electric field drift of the guiding center velocity v_E magnitude is calculated as:

- A. $E \times B$ B. E/B C. B/E D. E/B^2

8) The continuity equation for a plasma fluid is based on the conservation of:

- A. Energy B. Charge C. Matter D. Momentum

9) The equation of motion for a fluid element includes the force due to:

- A. Electromagnetic fields ($q(E + v \times B)$)
- B. Pressure gradients ($-\nabla p$)
- C. Collisions
- D. All of the mentioned

10) Adiabatic plasma behavior for 3D compression implies γ is ____

- A. 1
- B. 1/2
- C. 3/2
- D. 5/3

11) Plasma frequency, depending only on the ____

- A. plasma density
- B. temperature
- C. ions velocity
- D. magnetic field

12) In a plasma with no neutrals and few collisions, a phenomenon called ____ occurs.

- A. ion wave
- B. linearization
- C. source
- D. sink

13) The group velocity of a wave is defined as ____

- A. ω/k
- B. $d\omega/dk$
- C. k/ω
- D. $dk/d\omega$

14) Ion acoustic waves are essentially ____

- A. Light waves
- B. Stationary oscillations
- C. Sound waves in plasma
- D. Magnetic ripples

15) If $\omega^2 = \omega_p^2 + 3k^2 v_{th}^2$, the wave is ____

- A. sound wave
- B. electron wave
- C. ion wave
- D. light wave

16) The components of velocity perpendicular to B and parallel to B may then belong to different Maxwellian distributions with temperatures $T_\perp$ and $T_\parallel$. A. True | B. False

17) In the fluid equation, the tensor cannot be represented by a scalar p but must be given by shear stress P. A. True | B. False

18) In the equation of continuity, sink means that the incoming fluid is larger than the outflow. A. True | B. False

Put Q1 answers in table as the following table:

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Second question: Answer ONLY EIGHT of the following (32 Marks: 4 Marks for each)

1- From the Lorentz force equation in the absence of an electric field, find the radius of circular motion of a charged particle in the presence of a uniform magnetic field (Larmor radius).

2- Compute r_L for a solar wind proton with streaming velocity 300 km/s , $B = 5 \times 10^{-9} \text{ T}$, if $v_{\parallel}$ is negligible.

3- Prove that

$$\frac{\nabla T}{T} = (\gamma - 1) \frac{\nabla n}{n}$$

from the general thermodynamic equation of state $p = C\rho^{\gamma}$ for an adiabatic fluid.

4- For a steady-state ($\partial/\partial t = 0$), a slowly varying fluid element where the convective term $(\mathbf{v} \cdot \nabla)\mathbf{v} \approx 0$, show that the momentum equation yields a perpendicular fluid velocity composed of two distinct drifts:

$$\mathbf{v}_{\perp} = \frac{\mathbf{E} \times \mathbf{B}}{B^2} - \frac{\nabla p \times \mathbf{B}}{qnB^2}$$

5- Write 1D motion equation, continuity equation, and Poisson's relation. Linearize these equations about a static, uniform field-free background, then prove that the plasma frequency relationship is:

$$\omega_p = \left(\frac{e^2 n_0}{m \epsilon_0} \right)^{1/2}$$

6- A laboratory plasma has an equilibrium density of $n_0 = 10^{18} \text{ m}^{-3}$. Compute the electron plasma frequency in rad/sec and determine the corresponding linear frequency in Hz.

7- Two waves E_1 and E_2 differ in frequency by $2\Delta\omega$ and different wave numbers $2\Delta k$ in the propagation constant. Each wave has the phase velocity ω/k appropriate to the medium in which they propagate. What is the amplitude of the resultant wave, and draw it? (plot the wave shape)

8- Two closely spaced high-frequency signals create a modulated wave packet represented by $E = 2E_0 \cos(\Delta kx - \Delta\omega t) \cos(kx - \omega t)$. Let the center values be $\omega = 2 \times 10^{10}$ rad/s and $k = 80 \text{ m}^{-1}$, while the envelope modulation parameters are $\Delta\omega = 5 \times 10^7$ rad/s and $\Delta k = 0.4 \text{ m}^{-1}$.

Find the phase velocity of the rapid carrier wave and the group velocity of the modulating envelope.

9- Electron plasma waves are propagated in a uniform plasma with $KT_e = 100 \text{ eV}$, $n = 10^{16} \text{ m}^{-3}$, and $B = 0$. If the frequency f is 1.1 GHz , what is the wavelength in cm ?

10- Find the frequency of electron plasma waves and plot the dispersion relation. In the plot, show the plasma frequency, the group velocity, the phase velocity, and the thermal velocity (one-dimensional problem).

End of Questions

Good Luck

Dr. Hadeer El-Hawary

Important relations:

$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$$

$$(A \times B) \times C = (A.C)B - (B.C)A$$

$$e^{i\omega t} = \cos(\omega t) + i \sin(\omega t)$$

Electron charge (e)	$1.6 \times 10^{-19} \text{ C}$	Boltzmann's constant (k_B)	$1.38 \times 10^{-23} \text{ J/K}^{-1}$
Electron mass (m_e)	$9.1 \times 10^{-31} \text{ kg}$	Universal gas constant (R)	8.314 J/mol.K
Avogadro's number	6.022×10^{23}	Proton mass (m_p)	$1.67 \times 10^{-27} \text{ kg}$
Vacuum Permittivity ϵ_0	$8.85 \times 10^{-12} \text{ F/m}$		

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	Assiut University - Faculty of Science Physics Department Second Semester 2025-2026- Final Exam	Program: Physics Level: (3) Date: 3/6/2026 (9 - 12 Am) Time: 3 hours	
Course Title: Electromagnetic Theory and Electrodynamics		Course Code: 312 Phys.	
Instructors: Prof. Dr. Ashraf Yehia			
Important:	No. of pages: 8	No. Of questions: 2	Total Mark: 50 degrees

Answer the Following Questions

Q1: Choose the Correct Answer (30 Marks -One Mark for Every Point)

- What is the electric field strength produced by a ring of radius a carrying a charge Q uniformly distributed along the circumference at a point located on the axis of the ring and at a distance of x from the center?
 (A) $E_x = \frac{kQx}{(x^2 + a^2)^{1/2}}$ (B) $E_x = \frac{kQx}{(x^2 + a^2)^{2/3}}$ (C) $E_x = \frac{kQx}{(x^2 + a^2)^{3/2}}$
- A thin wire (2 m) long carries an electric charge of $(-2\mu\text{C})$. What is the electric field strength at a point around the wire at (5 cm)?
 (A) $3.6 \times 10^5 \text{ N/C}$ (B) $4.5 \times 10^5 \text{ N/C}$ (C) $3 \times 10^5 \text{ N/C}$
- A long cylindrical charge of radius R and density ρ . What is the electric field strength at a point inside the charge at a distance r from the axis, where $(r < R)$?
 (A) $E = \frac{\rho r}{\epsilon_0}$ (B) $E = \frac{\rho r}{2\epsilon_0}$ (C) $E = \frac{\rho r^2}{\epsilon_0 R}$
- A ring has radius R and a total charge Q uniformly distributed around its circumference. What is the potential difference between a point at the center of the ring and a point on the axis of the ring at a distance R from the center?
 (A) $\Delta V = \frac{kQ}{R}$ (B) $\Delta V = \frac{0.293kQ}{R}$ (C) $\Delta V = \frac{kQ}{2R}$
- The electric potential in volts in a certain region of space is $(V = 5x - 3x^2y + 2yz^2)$. What is the value of the electric field at a point in the space with coordinates $(x = 1, y = 0, z = -2) \text{ m}$?
 (A) 5 N/C (B) 3.16 N/C (C) 7.07 N/C
- What is the relationship between the magnetic flux density $\vec{B}$ and the magnetic field strength $\vec{H}$?
 (A) $\vec{B} = \mu_0 \vec{H}$ (B) $\vec{H} = \mu_0 \vec{B}$ (C) $\vec{B} = \epsilon_0 \vec{H}$
- A proton moves with a speed of $[\vec{v} = (2\vec{i} - 4\vec{j} + \vec{k}) \text{ m/s}]$ in a region where the magnetic field is $[\vec{B} = (\vec{i} + 2\vec{j} - 3\vec{k}) \text{ T}]$. What is the magnitude of the magnetic force acting on the proton?
 (A) $1.44 \times 10^{-18} \text{ N}$ (B) $1.89 \times 10^{-18} \text{ N}$ (C) $2.34 \times 10^{-18} \text{ N}$
- What is the radius of the circular path of a particle of mass m and charge q moving with a speed of v in a direction perpendicular to a uniform magnetic field of flux density B ?
 (A) $r = \frac{mv}{qB}$ (B) $r = \frac{qB}{m}$ (C) $r = \frac{2\pi m}{qB}$
- A positively charged particle moves with a speed of $(4 \times 10^{-3} \text{ m/s})$ in a direction perpendicular to a uniform magnetic field of magnitude (0.05 T). What is the magnitude of the uniform electric field that must be applied perpendicular to the magnetic field so that the particle moves in a straight horizontal line through both fields without deviation?
 (A) 80 kN/C (B) 200 N/C (C) $1.25 \times 10^{-5} \text{ N/C}$



Assiut University - Faculty of Science
Physics Department
Second Semester 2025-2026- Final Exam

Program: Physics
Level: (3)
Date: 3/6/2026 (9 - 12 Am)
Time: 3 hours



Course Title: Electromagnetic Theory and Electrodynamics

Course Code: 312 Phys.

Instructors: Prof. Dr. Ashraf Yefia

Important:

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 (A) 80 kN/C (B) 200 N/C (C) $1.25 \times 10^{-5} \text{ N/C}$

10. A straight wire of length (40 cm) carries an electric current of (2 A). What is the magnetic flux density at a point located (20 cm) from the midpoint of the wire?
 (A) 2×10^{-6} T (B) 1.7×10^{-6} T (C) 1.41×10^{-6} T
11. What is the maximum magnetic flux density produced by a circular loop of radius R carrying an electric current I ?
 (A) $B \approx \frac{\mu_o I R^2}{2x^3}$ (B) $B = \frac{\mu_o I}{2R}$ (C) $B = \frac{\mu_o I}{5.66R}$
12. Which of the following equations indicates that it is not possible to obtain a permanent magnet having only a north pole or having only a south pole?
 (A) $\nabla \cdot \vec{B} = 0$ (B) $\Phi_B = \vec{B} \cdot \vec{A}$ (C) $\nabla \times \vec{B} = \mu_o \vec{J}$
13. A solenoid of diameter (2.5 cm) and length (30 cm), consisting of 300 turns, and carries an electric current of (12 A). What is the magnetic flux through the cross-sectional area of the solenoid?
 (A) 2.96×10^{-5} Wb (B) 7.4×10^{-6} Wb (C) 8.9×10^{-6} Wb
14. What is the physical meaning of the equation $(\nabla \times \vec{B} = \mu_o \vec{J} + \epsilon_o \mu_o \frac{\partial \vec{E}}{\partial t})$?
 (A) The time-varying electric field generates a magnetic field.
 (B) The magnetic field is generated only by conduction currents.
 (C) The magnetic field is a conservative field.
15. An electric current of (0.2 A) is used to charge a capacitor consisting of two parallel circular plates with a radius of (10 cm). What is the rate of increase of the electric field between the plates?
 (A) 5.94×10^{11} V/m.s (B) 8.88×10^{11} V/m.s (C) 7.19×10^{11} V/m.s
16. An electric current of (0.2 A) is used to charge a capacitor consisting of two parallel circular plates, each with a radius of (10 cm). What is the magnitude of the magnetic field generated between the plates at a distance of (10 cm) from the center of the plates?
 (A) 2×10^{-7} T (B) 4×10^{-7} T (C) 3×10^{-7} T
17. A circular coil consisting of (15) turns and having a radius of (10 cm) surrounds a long solenoid of radius (2 cm) with (1000) turns per meter. The current in the solenoid varies with time according to $[I = (5 \text{ A}) \sin(120t)]$. What is the maximum value of electromotive force (EMF) generated in the circular coil.
 (A) 0.355 V (B) 0.185 V (C) 0.014 V
18. What is the physical meaning of the equation $(\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t})$?
 (A) A time-varying magnetic field creates an induced electric field.
 (B) The static electric field is not a conservative field.
 (C) The induced electric field is a conservative field.
19. A magnetic field changes with time according to the equation $[(B = 2t^3 - 4t^2 + 8) \text{ T}]$ in a direction perpendicular to a circular region of space with a radius of (5 cm). What is the magnitude of the induced electric field generated around the circumference of the circular region when $(t = 2 \text{ s})$?
 (A) 0.2 N/C (B) 1.8 N/C (C) 0.75 N/C
20. A magnetic field changes with time according to the equation $[(B = 2t^3 - 4t^2 + 8) \text{ T}]$ in a direction perpendicular to a circular region of space with a radius of (5 cm). At what time does the induced electric field generated through the circular region become zero?
 (A) $t = 1 \text{ s}$ (B) $t = 1.33 \text{ s}$ (C) $t = 1.66 \text{ s}$

21. An electron moves through a uniform electric field $[\vec{E} = (2.5 \hat{i} + 5 \hat{j}) \text{ V/m}]$ and a uniform magnetic field $[\vec{B} = (0.4 \hat{k}) \text{ T}]$. What is the force acting on the electron when its speed is $[\vec{v} = (10 \hat{i}) \text{ m/s}]$?
- (A) $\vec{F} = -(4 \times 10^{-19} \hat{i}) \text{ N}$ (B) $\vec{F} = -(1.6 \times 10^{-19} \hat{j}) \text{ N}$
 (C) $\vec{F} = -(4 \times 10^{-19} \hat{i} + 1.6 \times 10^{-19} \hat{j}) \text{ N}$
22. Which of the following equations applies to the free space?
- (A) $\nabla \times \vec{B} = \mu_0 \vec{J} + \epsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$ (B) $\nabla \times \vec{B} = \mu_0 \vec{J}$ (C) $\nabla \times \vec{B} = \epsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$
23. What does the equation $(\frac{\partial^2 B_y}{\partial z^2} = \epsilon_0 \mu_0 \frac{\partial^2 B_y}{\partial t^2})$ describe?
- (A) A magnetic field wave oscillates in direction of y-axis and propagates in free space with time in direction of z-axis.
 (B) A magnetic field wave oscillates in direction of x-axis and propagates in free space with time in the direction of z-axis.
 (C) A magnetic field wave that oscillates in direction of z-axis and propagates in free space with time in direction of x-axis.
24. What is the speed of electromagnetic waves in a vacuum?
- (A) $c = \sqrt{\epsilon_0 \mu_0}$ (B) $c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$ (C) $c = \frac{1}{(\epsilon_0 \mu_0)^2}$
25. What is the refractive index of an isotropic insulating medium for electromagnetic waves?
- (A) $n = \sqrt{\epsilon \mu}$ (B) $n = \sqrt{\epsilon_r \mu_r}$ (C) $n = 1/\sqrt{\epsilon_r \mu_r}$
26. An electric lamp with a resistance of (110Ω) is connected to an alternating voltage source $(120 \text{ V}_{\text{rms}})$. Only (1%) of the electrical energy consumed in the lamp is emitted into space as monochromatic electromagnetic radiation. What is the amplitude of the magnetic field component of the radiation at a distance of (1 m) from the lamp?
- (A) 317.1 nT (B) 342.5 nT (C) 295.4 nT
27. What does the equation $(\frac{\partial^2 E_x}{\partial z^2} = \epsilon \mu \frac{\partial^2 E_x}{\partial t^2} + \mu \sigma \frac{\partial E_x}{\partial t})$ describe?
- (A) An electric field wave oscillates in direction of x-axis and propagates in a vacuum over time in direction of z-axis.
 (B) An electric field wave oscillates in direction of x-axis and propagates in an isotropic insulating medium over time in direction of z-axis.
 (C) An electric field wave oscillates in direction of x-axis and propagates in a conductor over time in direction of z-axis.
28. What is the relationship between the magnetic field component and the electric field component of the electromagnetic waves propagating in the conductors?
- (A) $B_o = \left(\sqrt{\frac{\omega \mu \sigma}{2}} \right) E_o$ (B) $B_o = \left(\sqrt{\frac{\mu \sigma}{2 \omega}} \right) E_o$ (C) $B_o = \left(\sqrt{\frac{2 \omega}{\mu \sigma}} \right) E_o$
29. An electromagnetic radiation of frequency (10^{10} Hz) is incident perpendicularly on the surface of a piece of iron with a magnetic permeability of $(6.3 \times 10^{-3} \text{ Wb/A.m})$ and an electrical conductivity of $(1.04 \times 10^7 \text{ S/m})$. What is the attenuation distance of the incident radiation inside the piece of iron?
- (A) $0.022 \mu\text{m}$ (B) $0.055 \mu\text{m}$ (C) $0.039 \mu\text{m}$
30. An electromagnetic radiation of frequency (10^{10} Hz) is incident perpendicularly on the surface of a piece of iron with a magnetic permeability of $(6.3 \times 10^{-3} \text{ Wb/A.m})$ and an electrical conductivity of

$(1.04 \times 10^7 \text{ S/m})$. What is the ratio of the wavelength of the radiation reflected from the iron surface into air to the wavelength of the radiation transmitted through the iron?

(A) 2.174×10^5

(B) 0.867×10^5

(C) 1.224×10^5

Q2: Essay Question (20 Marks)

- (a) Write the general forms of the four Maxwell's integral and differential equations in the following table, indicating the source of each equation. (4 Marks)

The Answer

Source of the equation	Integral Forms	Differential Forms

- (b) Compare between the static electric field and the induced electric field in the following table. (4 Marks)

The Answer

The comparison	The static electric field	The induced electric field

(c) A plane electromagnetic wave propagates in a vacuum along the Z-axis. The equation for the electric field component of this wave is $E_x = 100 \cos[Kz - (6\pi \times 10^7) t]$, where the physical quantities in the equation are expressed in SI units. Calculate the following: - (4 marks)

- (1) The frequency of the wave.
- (2) The wavelength.
- (3) The equation for the magnetic field component of the wave.
- (4) The Pointing vector of the wave.

The Answer

(d) Prove that the electromagnetic waves propagate in the free space at the speed of light.
The Answer

(8 Marks)



Assiut University
Faculty of science – Physics department

Exam time	3 hours	Course	Nuclear Physics P342
degree	50	Exam	Final-term

1. Choose the correct answer (10 degrees)

1. The nuclear radius is given by:

- A. $R = R_0 A^{1/2}$
- B. $R = R_0 A$
- C. $R = R_0 A^{1/3}$
- D. $R = R_0 / A$

2. An alpha particle is

- A. An electron
- B. A proton
- C. A helium nucleus
- D. A neutron

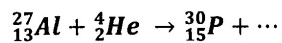
3. In β^- decay:

- A. A proton changes into a neutron
- B. A neutron changes into a proton
- C. An alpha particle is emitted
- D. The atomic number remains unchanged

4. The strong nuclear force is:

- A. Long-range
- B. Electromagnetic
- C. Short-range
- D. Repulsive only

5. What form of radioactive decay is shown in the following reaction?



- A. Beta negative.
- B. Beta positive.
- C. Neutron decay.
- D. Gamma decay

2. Explain Why (15 Marks)

1. The nucleus remains stable despite the electrostatic repulsion between protons.
2. The strong nuclear force is considered a short-range force.
3. Medium-mass nuclei are generally more stable than very light or very heavy nuclei.
4. Gravity cannot account for nuclear binding.

3. Write the complete nuclear reaction equation for: (10 degrees)

1. Alpha decay of Uranium-238.
2. Beta-minus decay of Carbon-14.

3. Beta-plus decay of Oxygen-15.
4. Gamma emission from an excited nucleus.
5. Neutron capture followed by gamma emission.

4. **Answer the following questions:** (15 degrees)

1. Discuss the properties of the strong nuclear force.
2. Explain the Liquid Drop Model, including its advantages and limitations.
3. Compare Alpha, Beta, and Gamma radiation in terms of:
 - Charge
 - Mass
 - Penetrating power
 - Ionizing ability

3. Beta-plus decay of Oxygen-15.

4. Gamma emission from an excited nucleus.

5. Neutron capture followed by gamma emission.

4. **Answer the following questions: (15 degrees)**

1. Discuss the properties of the strong nuclear force.

2. Explain the Liquid Drop Model, including its advantages and limitations.

3. Compare Alpha, Beta, and Gamma radiation in terms of:

- Charge
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3. Compare Alpha, Beta, and Gamma radiation in terms of:
 - Charge
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4. Describe Rutherford's scattering experiment and explain its significance in the discovery of the atomic nucleus.

5. What are the main components of a nuclear reactor? Explain the function of each part.

	Assiut University- Faculty of Science Second Semester- Final Exam 2025-2026 Physics Department	Program: Physics Level: (3) Date: 10/6/2026 Time: 3 h	
Course Title: Crystal Growth and Physical Properties of Crystals		Code: 354 Phy	
Instructors: Prof. Dr. Abdelaziz Abulfadi Abdelaziz			
Important:	No. of pages 4	No. Of Question Parts: 4	Total Mark: 50 degree

Part 1: Answer the following questions (2 Marks for each question):

- 1- Why go after proteins in the microgravity environment aboard using the space shuttle?
- 2- Why go after structure of proteins through X-ray crystallography?
- 3- Mention the main features for the scientific potential of crystal growth in space?
- 4- What are the basic requirements for the growth of crystals from solutions? Then explain the slow cooling method of growing single crystals with an example.
- 5- List the advantages of gel growth technique. Discuss the methods of growing single crystals by gel growth technique with suitable examples.
- 6- Explain in detail the Bridgeman method of growing single crystals with necessary diagrams. List its merits and demerits.

Part 2- Define each of the following: (2 Marks for each definition)

- (1)- Why different crystals have different shapes and sizes?
- (2)- liquid encapsulation technique for compounds that dissociate on melting?
- (3)- Although in the Verneuil method the disadvantages of the presence of a crucible are eliminated there. What are two serious disadvantages of this technique.
- (4)- How Light Affect the Color of a Crystal?
- (5)- Epitaxial Growth:

(6)- The choice of crucible material is of fundamental importance in melt techniques?

(7)- Crystal twins and crystal habit.

Part 3: Choose the correct answer from a, b, c and d (one Mark for each)

1. Which phenomenon, common in Earth-based crystallization, is eliminated in space, leading to better crystals?

- a) Diffusion
- b) Nucleation
- c) Gravity-driven convection
- d) Salting in

2. Protein crystals grown in space are superior for which analytical technique?

- a) Mass Spectrometry
- b) X-ray Crystallography
- c) Electron Microscopy
- d) NMR Spectroscopy

3. What is the disadvantage of using a solution growth method for the growth of the crystals?

- a) Rapid growth rates
- b) Simple apparatus
- c) Slow growth rates
- d) Isothermal conditions

4. What is a primary advantage of creating higher-quality protein crystals?

- a) They can be used for fuel.
- b) They are easier to dissolve.
- c) They provide better resolution for structural modeling.
- d) They grow faster.

5. Which factor in space helps to reduce the incorporation of impurities and aggregates during crystal growth?

- a) High radiation levels.
- b) The absence of a vacuum.
- c) Reduced convection.
- d) Increased temperature.

6. Why is the study of protein crystals important for drug development?

- a) Crystals help determine the proteins, and thus, its binding site for new drugs.
- b) Crystals are used as a drug themselves.
- c) Crystals increase the weight of the drug.
- d) Crystals allow drugs to be absorbed faster.

7. What is the purpose of seed crystal in crystal growth?

- a) Nucleation center
- b) Catalyst
- c) Solvent
- d) Solution

(6)- The choice of crucible material is of fundamental importance in melt techniques?

(7)- Crystal twins and crystal habit.

Part 3: Choose the correct answer from a, b, c and d (one Mark for each)

1. Which phenomenon, common in Earth-based crystallization, is eliminated in space, leading to better crystals?

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- a) Nucleation center
- b) Catalyst
- c) Solvent
- d) Solution

8. Polymorphism" refers to:

- a) The ability of a crystal to change color.
- b) The ability of a solid chemical substance to exist in more than one crystalline form (lattice structure)
- c) The formation of amorphous solids.
- d) The variation in particle size distribution.

9. "Agglomeration" is defined as:

- a) The breakage of crystals due to impact.
- b) The cementing together of two or more particles by crystal growth to form a larger, often irregular, multiparticle entity.
- c) The redissolution of fines.
- d) The formation of a solvate

10. Czochralski (CZ) and Bridgman methods both fall under which category of crystal growth?

- a) Solution growth methods.
- b) Vapor phase growth methods.
- c) Melt growth methods.
- d) Hydrothermal methods.

11- The single crystal growth method of physically moving a melt through a temperature gradient is known as:

- a) Vernell
- b) Czochralski
- c) Bridgman
- d) Stockbarger

Part 4: Write True (✓) or False (X) for each of the following statements:
(one Mark for each)

1. True or False: During the Czochralski process, the seed crystal is slowly pulled upward and rotated. ()

2. True or False: The crucible used in the Czochralski method is typically made of graphite or quartz. ()

3. True/False: A seed crystal is required for any crystal to begin forming in a solution. ()

4. True or False: In the Bridgman technique, the crystal growth starts at the interface between the seed crystal and the melt. ()

5. True or False: The primary disadvantage of the Bridgman method compared to the Czochralski method is the contact with crucible walls can lead to stress or contamination. ()

6. True or False: From the limitation or characteristic of Verneuil-grown crystals is they always have perfect crystalline structures. ()

7. **True or False:** The best solvent for all crystals is water. ()
8. **True or False:** Impurities concentrate in the liquid phase than in the solid phase has been used in the zone melting method. ()
9. **True or False:** The solution which is obtained after filtration is a clear solution. The solution is filtered to remove insoluble impurities. ()
10. **True or False:** Rapid growth rate is the advantage of using Czochralski, Bridgman- Stockbarger and Verneuil methods. ()
11. **True or False:** Czochralski and Bridgman methods both fall under the category of solution growth methods. ()
12. **True or False:** Crystals don't grow in cold temperature. ()
13. **True or False:** A crystal is homogenous solid exhibiting a high degree of internal order. ()

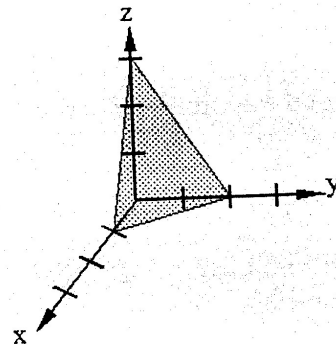
انتهت الأسئلة مع التمنيات بالتوفيق

	Assiut University- Faculty of Science Final Exam 2025 - 2026 Physics Department	Program : Physics Date : 24 / 5 / 2026 Sunday : (9-11)
Course Title : X-ray diffraction and its Applications		Code : P352
Instructor: Dr. Abdel-Rahim Hassan Moharram		Level : 3
Important: No. of Pages : 4	No. of Questions : 4	Total Mark: 50 degree

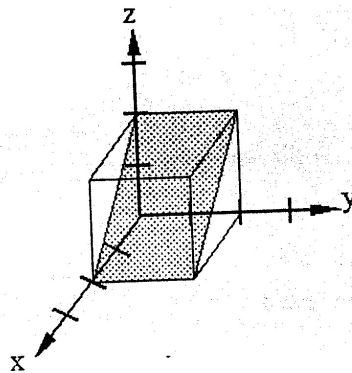
Answer All Questions

First Question: [8 degrees]

a)- Write down three steps to find the Millar indices for the dashed plane shown in the figure below,

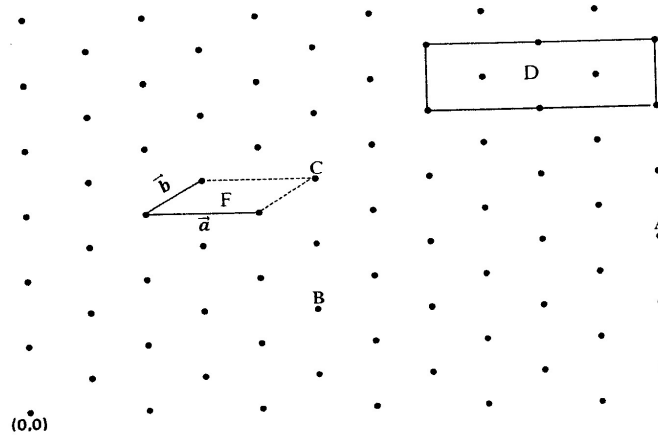


b)- Write down three steps to find the Millar indices for the dashed plane shown in the figure below,



Second Question: [18 degrees]

In real lattice shown below, and assuming that the primitive lattice vectors are $(\vec{a}, \vec{b})$, complete the empty spaces given in the following sentences:



(1)-	The number of lattice points related to the unit cell (D) equals
(2)-	In terms of the primitive lattice vectors $(\vec{a}, \vec{b})$, the location of point (A) in the lattice is
(3)-	In terms of the primitive lattice vectors $(\vec{a}, \vec{b})$, the location of point (B) in the lattice is
(4)-	Using the Millar indices, the direction of line coming from point (B) to point (A) is
(5)-	Using the Millar indices, the direction of line coming from point (C) to point (A) is
(6)-	The value of the ratio $\left(\frac{\text{Area of the unit cell } F}{\text{Area of the unit cell } D} \right)$ equals