

الفرد

Answer Four questions only

Question . 1 Choose the correct answer:

(12.5 grads)

a- the current density J relates to the electrical field (E) and electrical conductivity σ as

- 1) $J = E/\sigma$ 2) $J = \sigma E^2$ 3) $J = \sigma/E$ 4) $J = \sigma E$

b-The relation of wiedeman- franz law given by

- 1) $k/\sigma = LT$ 2) $\sigma/k = LT$ 3) $k/\sigma = L/T$ 4) $\sigma/k = T/L$

C-If r is radius of the atom in a crystal in the simple cubic then the nearest neighbor distance is

- 1) $r/2$ 2) $4r$ 3) $2r$ 4) none of these

d-The packing Factor of fcc structure is

- 1) 52 % 2) 68% 3) 92% 4) none of these

e-x-ray consist of

- 1) negatively charged particles 2) a stream of neutrons
3) electromagnetic radiation 4) positively charged particles

Question . 2

(12.5 grads)

a- Derive Bragg's law of x-ray diffraction in crystals.

b- Copper crystallizes as face centered cubic (fcc) and the unit cell constant $a = 2.68 \text{ \AA}$ calculate

1- The inter- planar distance for (110) plan.

2- Wavelength of x-ray that diffract from (110) plane at Bragg's angle equal 55°

3- Packing factor for the fcc unit cell for copper.

Question -3

(12.5 grads)

Prove that the wave equation in one dimension for elastic wave is given by

$$\frac{\partial^2 u}{\partial x^2} - \frac{\rho}{y} \frac{\partial^2 u}{\partial t^2} = 0$$

Where ρ is the density and y is the young's modules.

Question -4

(12.5 grads)

a- Derive an expression for the inter-planer spacing for planes of the (hkl) in the cubic structure.

b- Find the miller indices (hkl) for the crystal plane that makes an intercept for x, y, z are 3a, 3b, 4c respectively

Question -5

(12.5 grads)

a- Prove that the electrical conductivity (σ) of a metal is given by $\sigma = \frac{Ne^2\tau}{m^*}$

Where N is the concentration of electrons e is the electron charge τ is the relaxation time and m^* is the electron mass

b- Prove that phonons number for elastic waves depend on the temperature.

=====Good Luck=====



Answer all the following questions

Question (I): Put (✓) or (×) for all the following sentences in the Table: (15 Marks)

1. Crystal structure = base + lattice.
2. A crystalline material is one in which the atoms are randomly distributed relative to each other.
3. The unit cell is the basic structural unit or building block of the crystal structure and defines the crystal structure by virtue of its geometry and the atom positions within.
4. The primitive unit cell contains the same kind of atoms, while the Bravais lattice contains only one lattice point.
5. Non-crystalline or amorphous materials are not crystallized, or the atoms are randomly arranged.
6. The primitive cell is a larger cell and contains more than one lattice point.
7. In Bravais lattice, all lattice points are equivalent and all atoms in the crystal are of the same kind.
8. In a simple cubic (SC) crystal structure, the number of atoms per unit cell is 2.
9. The cubic system has the greatest degree of symmetry, but the orthorhombic system has the least symmetry.
10. In a simple cubic (SC) crystal structure, the atomic packing factor (APF) for this structure is 0.57.
11. The coordination number is the number of nearest-neighbor or touching atoms.
12. In a simple cubic (SC) crystal structure, the coordination number for this structure is 6.
13. The unit cell geometry is completely defined in terms of six parameters (lattice parameters of a crystal structure): the three edge lengths a , b , and c , and the three inter-axial angles α , β , and γ .
14. In face-centered cubic (FCC) crystal structure, the relation between atomic radius, R , and unit cell length, a , given by $a=2\sqrt{2}R$.
15. In the cubic system $a = b = c$ and $\alpha = \beta = \gamma = 120^\circ$.
16. In the triclinic system $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma$.
17. In a simple cubic (SC) crystal structure, the relation between atomic radius, R , and unit cell length, a , is given by $R=2a$.
18. In face-centered cubic (FCC) crystal structure, the number of atoms per unit cell is 6.
19. In the hexagonal close-packed (HCP) crystal structure, the coordination number for this structure is 8.
20. In face-centered cubic (FCC) crystal structure, the atomic packing factor (APF) for this structure is 0.74.
21. In hexagonal close-packed (HCP) crystal structure, the ratio between c and a is $\frac{\sqrt{8}}{3}$.
22. In body-centered cubic (BCC) crystal structure, the number of atoms per unit cell is 4.
23. In face-centered cubic (FCC) crystal structure, the coordination number for this structure is 10.

24. In body-centered cubic (BCC) crystal structure, the atomic packing factor (APF) for this structure is 0.54.
25. In the hexagonal close-packed (HCP) crystal structure, the atomic packing factor (APF) for this structure is 0.74.
26. In body-centered cubic (BCC) crystal structure, the relation between atomic radius, R , and unit cell length, a , given by $a = \frac{4\sqrt{3}R}{3}$.
27. In the hexagonal close-packed (HCP) crystal structure, the number of atoms per unit cell is 4.
28. In hexagonal close-packed (HCP) crystal structure, the relation between atomic radius, R , and unit cell length, a , is given by $a = 2R$.
29. The atomic radius (R) is defined as the distance between the atom's center and the atom's surface.
30. The most efficient packing is present in BCC and SC cells.

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Sign															
Question	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Sign															

Question (II):

(11 Marks)

Part I: In the following multiple-choice questions, circle the correct answer(s). You must write down the steps to get the correct answer.

(8 Marks)

1. Iridium has an FCC crystal structure, a density of 22.4 g/cm^3 , and an atomic weight of 192.2 g/mol , then the radius of an iridium atom equal?
 a) 0.553 nm b) 0.439 nm c) 0.363 nm d) 0.211 nm e) 0.136 nm

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2. Miller indices for the indicated plane, below figure, is:

a) (001)

b) (110)

c) (101)

d) $(\bar{1}01)$

e) $(0\bar{1}1)$

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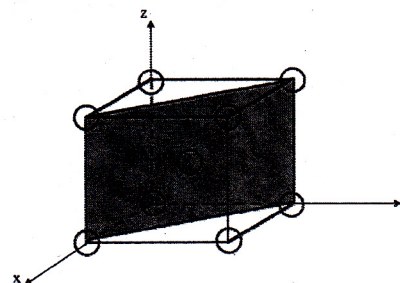
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3. Iron has a BCC crystal structure, an atomic radius of 0.124 nm, and an atomic weight of 55.85 g/mol; its theoretical density is closest to [Hint: $N_A = 6.025 \times 10^{23}$ atoms/mol]:

- a) 9.92 g/cm³ b) 8.40 g/cm³ c) 7.90 g/cm³ d) 6.35 g/cm³ e) 15.25 g/cm³

4. The linear density expression for FCC [100] direction in terms of the atomic radius R is:

- a) $\frac{1}{2\sqrt{2}R}$ b) $\frac{1}{\sqrt{2}R}$ c) $\frac{1}{2\sqrt{6}R}$ d) $\frac{1}{6R}$ e) $\frac{1}{2\sqrt{3}R}$

Part II: Give reasons for the following

(3 Marks)

(a) X-rays can be used to detect the crystallinity of materials.

(b) The atomic packing factor is always less than 1.

(c) The physical properties of single crystals of some substances depend on the crystallographic direction in which measurements are taken.

Question (III): Answer the following questions:

(14 Marks)

1. For which set of crystallographic planes will a first-order diffraction peak occur at a diffraction angle of 46.21° for BCC iron when monochromatic radiation having a wavelength of 0.0711 nm is used? **(5 Marks)**

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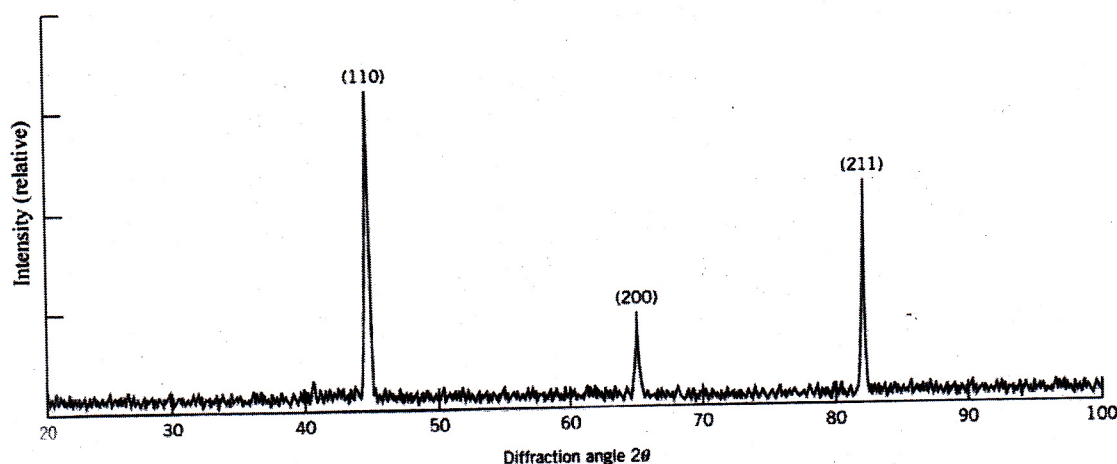
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2. The figure below shows an X-ray diffraction pattern for α -iron taken using a diffractometer and monochromatic X-radiation having a wavelength of 0.1542 nm ; each diffraction peak on the pattern has been indexed. Compute the interplanar spacing for each set of planes indexed; also determine the lattice parameter of Fe for each of the peaks. **(5 Marks)**



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3. The metal rubidium has a BCC crystal structure. If the angle of diffraction for the (321) set of planes occurs at $2\theta=27^\circ$ (first-order reflection) when monochromatic X-radiation having a wavelength of $0.711 \text{ \AA}$ is used, compute: **(4 Marks)**
- (a) The inter-planar spacing for this set of planes.
- (b) The atomic radius for the rubidium atom.

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Question (IV): Write in detail about TWO of the following **(10 Marks)**

The principles, generation, properties, and interaction with matter of (1) X-ray, (2) electron, and (3) neutron diffraction in the crystal.

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Constants: $N_A = 6.022 \times 10^{23} \text{ atoms/mol}$; $k_B = 1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$

BEST WISHES,

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ASSIUT UNIVERSITY
Department of Physics
Final Exam 50%
Quantum Mechanics



Sunday 01/6/2023

Code P311

3 Hours

Part I: Circle the correct answer for the following questions: (20 Marks)

- 1- What is the momentum p of a particle with a wavenumber $k = 2\pi / \lambda$?
- (i) $p = \hbar k / m_0$ (ii) $p = \hbar k / 2m_0$ (iii) $p = \hbar k$
- 2- What is the energy E of a particle with a frequency ν ?
- (i) $E = h\nu$ (ii) $E = \hbar\nu$ (iii) $E = \hbar\lambda$
- 3- What is the wavelength of electromagnetic radiation which has a frequency of $4.464 \times 10^{14} \text{ s}^{-1}$?
- (i) $1.489 \times 10^{-6} \text{ m}$ (ii) $1.338 \times 10^{23} \text{ m}$ (iii) $671.6 \times 10^{-9} \text{ m}$
- 4- What is the significance of (-13.6 eV) ?
- (i) It is the work function of hydrogen
(ii) It is the lowest energy state in a hydrogen atom
(iii) It is the highest energy state in a hydrogen atom
- 5- An electron in a 4p state has which of the two values?
- (i) $\ell = 4, n = 1$ (ii) $n = 4, \ell = 1$ (iii) $n = 4, \ell = 2$
- 6- Which of the following is not a characteristic of wave function?
- (i) Continuous (ii) Single valued (iii) Physically Significant
- 7- The square of the Schrodinger wave function is:
- (i) Equal to one (ii) Not integrable (iii) A probability density
- 8- The kinetic energy of a particle of mass m moving in the y -direction with momentum p_y is $\frac{p_y^2}{2m}$. The kinetic energy operator for this model is:
- (i) $-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial y^2}$ (ii) $\frac{\hbar^2}{2m} \frac{\partial^2}{\partial y^2}$ (iii) $-\frac{\partial^2}{\partial y^2}$
- 9- A free electron has a wavefunction $\psi(x)$ where x is measured in meters:
- $\psi(x) = A \sin(5 \times 10^{10} x)$
- (a) The electron's de Broglie wavelength, λ equals (where $\pi = 3.15$):
- (i) $0.79 \times 10^{10} \text{ m}$ (ii) $0.63 \times 10^{-10} \text{ m}$ (iii) $1.26 \times 10^{-10} \text{ m}$
- (b) The electron's momentum p equals (where $h = 6.626 \times 10^{-34} \text{ Js}$):

(i) $5.26 \times 10^{-24} \text{ kg m/s}$

(ii) $5.29 \times 10^{24} \text{ kg m/s}$

(iii) $8.35 \times 10^{-35} \text{ Js} \cdot \text{m}$

10- Which of the following is the correct expression for the Schrödinger wave function?

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

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

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

11- If $\Psi(x)$ is a solution to the time-independent Schrodinger equation in one dimension with energy E , what would be the corresponding solution to the time-dependent equation?

(i) $\Psi(x) e^{iEt/\hbar}$

(ii) $\Psi(x) e^{-iEt/\hbar}$

(iii) $\Psi(x) \sqrt{E}$

12- For a particle in a one-dimensional box, the wave function is given by:

$$\psi(x) = N \sin \frac{3\pi x}{L} \quad \text{for } 0 < x < L$$

The normalization constant N is given by:

(i) $2/\sqrt{L}$

(ii) $\sqrt{2/L}$

(iii) $1/\sqrt{L}$

13- Given a particle of mass m in a box of length L having the wave function:

$$\psi(x) = N \sin \frac{n\pi x}{L}$$

What is the energy of the level corresponding to $n = 4$?

(i) $\frac{8\pi^2 \hbar^2}{mL^2}$

(ii) $\frac{8 \hbar^2}{mL^2}$

(iii) None of the above

14- Suppose a particle is confined to the x -axis from $x = 0$ to $x = 3$, and that its wave function is given as $\psi(x) = Ax$. What is A ?

(i) 9

(ii) $1/3$

(iii) 3

15- Using the function from the previous part, and the probability of finding the particle between $x = 1$ and $x = 2$.

(i) 3.86

(ii) 0.26

(iii) $4/9$

16- A proton is confined to moving in a one-dimensional box of width $2 \times 10^{-10} \text{ m}$.

(a) The lowest possible energy of the proton (where $m_p = 1.67 \times 10^{-27} \text{ kg}$) equals:

(i) $8.22 \times 10^{-22} \text{ J}$

(ii) $2.11 \times 10^{-22} \text{ J}$

(iii) $5.13 \times 10^{-3} \text{ J}$

(b) The lowest possible energy of an electron confined to the same box?

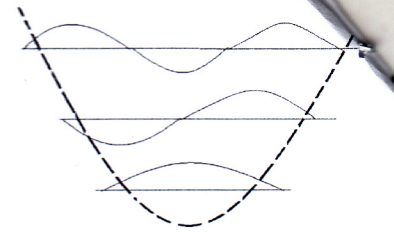
(i) 9.40 J

(ii) $1.5 \times 10^{-18} \text{ J}$

(iii) $3.15 \times 10^{-18} \text{ J}$

17- Which device is shown in the following figure?

- (i) Particle in a Box
- (ii) Harmonic Oscillator
- (iii) Atomic spectroscopy



18- The momentum operator in one-dimension is:

(i) $\hbar \frac{\partial}{\partial x}$

(ii) $\frac{\hbar}{i} \frac{\partial}{\partial x}$

(iii) $\frac{i}{\hbar} \frac{\partial}{\partial x}$

Part II: Answer the following questions:

(30 Marks)

Question #1

At time $t=0$ a particle is represented by the wave function:

$$\psi(x,0) = \begin{cases} Ax/a, & 0 \leq x \leq a \\ A(b-x)/(b-a) & a \leq x \leq b \\ 0 & \text{otherwise} \end{cases}$$

Where A , a and b are constants.

- a. **Normalize** ψ (that is, find A in terms of a and b).
- b. **Sketch** $\psi(x,0)$ as a function of x .

Question #2

An electron is in an equal superposition of the two eigenstates of the simple harmonic oscillator potential. We can therefore write the initial wavefunction as $\psi(x,0) = A[\psi_1(x) + \psi_3(x)]$, where $\psi(x)$ is normalized.

- a. **Determine** the value of A .
- b. **Write down** the wavefunction $\psi(x,t)$ for all $t > 0$.
- c. **What** is the probability density for this wavefunction for all $t > 0$?
- d. **Write down** the potential energy of that particle.

Question #3

Prove that the radial wave function $R_{30}(r)$ is given by:

$$R_{30}(r) = \frac{a_0}{3a} \left(1 - \frac{2}{3}(r/a) + \frac{2}{27}(r/a)^2 \right) e^{-r/3a}$$

- a. Construct $R_{30}(r)$
- b. Construct $\psi_{300}(r, \theta, \phi)$.

$$\left(Y_0^0(\theta, \phi) = \frac{1}{\sqrt{4\pi}} \right)$$

**** Good Luck ****

Prof. Dr. A. A. Ebrahim



Assiut University

Physics Department
Final Exam: Biophysics
Code: 323P

Teaching Staff: Dr. M. A. Sabet

Date: 15/6/2023

Time: 3 hours



Faculty of Science

Answer all the following questions in the answer tables

Choosing more than one answer is not allowed

• **General constants you may need:**

($c = 3 \times 10^8 \text{ m/s}$ is the speed of light in a vacuum)

($P_0 = 1.013 \times 10^5 \text{ Pa}$ is the atmospheric pressure)

($\rho_{\text{water}} = 1000 \text{ kg/m}^3$ is the average density of water)

($g = 10 \text{ m/s}^2$ is the acceleration of gravity)

($e = 1.6 \times 10^{-19} \text{ C}$ is the magnitude of the electronic charge)

($k_e = 8.99 \times 10^9 \text{ N.m}^2/\text{C}^2$ is Coulomb's constant)

($\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2/\text{N.m}^2$ is the permittivity of air)

First Question: True or False (25 Marks, Each 1 Mark)

1. The direction of the torque can be obtained by the left-hand rule.
2. A body is said to be static if only its linear velocity is zero.
3. The muscles producing skeletal movements consist of thousands of parallel fibers. The thousands of fibers in each muscle result in low variability of the muscle force.
4. The refractive index of a medium is the ratio of the speed of light in the medium to the speed of light in the vacuum.
5. Light velocity in any medium is larger than in a vacuum.
6. The ratio of the sine of the incident angle in the 1st medium to the sine of the refracted angle in the 2nd medium equals the ratio of the light speed in the 2nd medium to the light speed in the 1st medium.
7. The higher the refractive index of a material, the lower its optical density.
8. Total internal reflection occurs only when light attempts to pass from a less optically dense medium to a more optically dense medium with an angle greater than the critical angle.
9. The principal axis of the lens is the line passing through the upper and lower edges of the lens.
10. The focal point of the lens is the center of the lens in which light passes without undergoing any deviation (a ray of light passing through the focal point will not change its direction).
11. If a real object is placed, from a converging lens, at a distance equals to twice the focal length, the image is real, inverted, and has the same size as the object.
12. If a 3 cm height object is placed in front of a converging lens, and a real inverted image is formed with a height of -12 cm, then the magnification is -4.
13. The hypermetropia is treated with a converging lens.

14. Accommodation is the process by which the vertebrate eye changes optical power to maintain a clear image or focus on an object as its distance varies by varying the power of the eye lens.
15. The specific gravity (relative density) of any material is defined as the ratio of its density to the density of water.

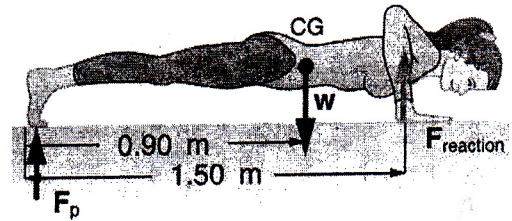
Compound	Density, kg/m ³
Drilling mud	1500 – 2000
Water	1000
Diesel	860
Gasoline	725
Liquid Petroleum Gas (LPG)	550
Liquefied Natural Gas (LNG)	460

16. Knowing that diesel is not soluble in water and using the data in the upper table, the diesel floats above water if mixed.
17. Laminar flow is characterized by the smooth flow of the fluid in layers that do not mix.
18. The diastolic pressure is the resistance to the blood flow in the blood vessels when the heart is relaxed. This is the lower number and is often considered the most important.
19. While monitoring the blood pressure, there is a noticeable effect of varying the arm position on the recorded blood pressure from the branchial artery.
20. DC (Direct Current) is a unidirectional flow of electric charge with invariable magnitude.
21. For two inductors L_1 and L_2 connected in series, the equivalent inductance L is given by $\frac{1}{L} = \frac{1}{L_1} + \frac{1}{L_2}$.
22. Due to the differences in the positive and negative ion concentrations inside and outside the cell, a potential difference is created across the cell membrane. The cell membrane potential difference is about -20mV.
23. The nervous system transmits messages in the form of mechanical pulses.
24. In the vertebrates' nervous system, the nerve endings are not in contact with the cells. The gap between the nerve ending and the next cell is called the synapse. Conduction in synapse takes place in a bidirectional manner.
25. The sinoatrial node (SA) acts as the heart's natural pacemaker and is a bundle of neurons in the upper part of the right atrium. If the SA node fails to initiate the stimulus, the heart stops.

Second Question: Choose the most accurate answer (25 Marks, Each 1 Mark)

26. If F is the force and τ is the torque, a body is said to be in mechanical equilibrium if ...
- $\sum \vec{F} = \sum \vec{\tau} = 0$
 - $\sum \vec{F} = \sum \vec{\tau}$
 - $\sum \vec{F} \neq \sum \vec{\tau}$
 - Only $\sum \vec{F} = 0$
27. The height of a person whose center of gravity is at 95 cm, measured from the soles of his feet is around ...
- 170 cm
 - 56 cm
 - 150 cm
 - 200 cm

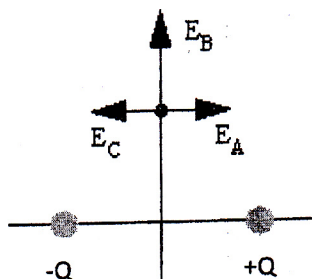
28. What force should the woman in the figure exert on the floor with each hand to do a push-up if her mass is 60 kg? (Assume that she moves up at a constant speed).



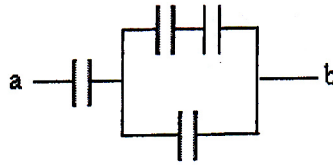
- a) 180 N
 - b) 294 N
 - c) 147 N
 - d) 360 N
29. The fulcrum is located between the load and the applied force in ...
- a) Class 1 lever
 - b) Class 2 lever
 - c) Class 3 lever
 - d) Class 4 lever
30. If the elbow contraction is assumed to be a lever, its mechanical advantage M is ...
- a) Less than 1
 - b) 1
 - c) Larger than 1
 - d) -1
31. Light passes from a material with an index of refraction of 1.3 into one with an index of refraction of 1.5. Compared to the incident ray, the refracted ray....
- a) is un-deflected.
 - b) bends away from the normal
 - c) skimmed boundary of refraction
 - d) bends toward the normal
32. A whiteboard has an area of about 1500 cm^2 . What is the force on one side of this sheet of paper due to the atmospheric pressure?
- a) $6.75 \times 10^5 \text{ N}$
 - b) $1.48 \times 10^{-6} \text{ N}$
 - c) $6.58 \times 10^{-5} \text{ N}$
 - d) $1.52 \times 10^4 \text{ N}$
33. Bernoulli's equation is a typical example of the energy conservation principle, the term that represents the potential energy of the fluid in this equation is ...
- a) P
 - b) A
 - c) $\frac{1}{2}\rho v^2$
 - d) ρgh
34. What is the difference between the pressure at the bottom of a water pool with a depth of 5 m and the atmospheric pressure?
- a) $5 \times 10^5 \text{ Pa}$
 - b) $15 \times 10^4 \text{ Pa}$
 - c) $15 \times 10^5 \text{ Pa}$
 - d) $5 \times 10^4 \text{ Pa}$

35. Ideal fluid is characteristic with all the following properties, except ...
- Incompressible
 - No smoke rings
 - The flow is steady; the fluid velocity is independent of time.
 - High viscosity
36. If water flows through a pipe at the rate of $20 \text{ cm}^3/\text{s}$, and the pipe radius is 2.5 cm , the velocity of the water is around ...
- 392.5 cm/s
 - 1 cm/s
 - 3.2 cm/s
 - 8 cm/s
37. According to Poiseuille's law, if pressure drop per length is kept constant, and the radius of the pipe is r , the viscosity of the liquid is η , the flow rate Q is directly proportional to ... and inversely proportional to ...
- η, r^4
 - r^4, η
 - r^2, η
 - η, r^2
38. If the measured blood pressure for a patient is $70/40 \text{ mmHg}$, the patient is advised to ...
- Use less salt
 - Lay down flat with raised legs
 - Drink less water
 - Stand straight
39. Pressure applied to an enclosed fluid is transmitted undiminished to every portion of the fluid and the walls of the containing vessel, this is known as ...
- Bernoulli's principle
 - Pascal's law
 - Flow rate
 - Archimedes's principle
40. An attraction electrostatic force must occur between two charged objects under which conditions?
- Charges are like signs.
 - Charges are unlike signs.
 - Charges are of equal magnitude.
 - Charges are of unequal magnitude.
41. A metallic object holds a charge of $-1.2 \times 10^{-9} \text{ C}$. What total number of electrons does this represent?
- 1.92×10^{28}
 - 1.92×10^{-28}
 - 7.5×10^9
 - 2.13×10^{-29}

42. Two point-charges are 2 cm apart. They are moved to a new separation of 4 cm. By what factor does the resulting mutual force between them change?
- 4
 - $1/2$
 - $1/4$
 - 2
43. Two charges, $-Q$ and $+Q$, are located two meters apart and there is a point along the line that is equidistant from the two charges as indicated. Which vector best represents the direction of the electric field at that point?



- Vector E_A
 - Vector E_B
 - Vector E_C
 - The electric field at that point is zero.
44. The unit of electrical potential is the volt and is dimensionally equivalent to:
- N.m.C.
 - C/N.m.
 - N.m/C.
 - N/m.C.
45. The unit of capacitance, the farad, is dimensionally equivalent to which of the following?
- V/C
 - V.C
 - C/V
 - J/V
46. Assuming σ is the conductivity, E is the electric field, ΔQ is the total charges flowing in a time Δt , A is the conductor cross-sectional area, n is the number of charges per unit volume, v is the charge drift velocity, e is the electron charge, and I is the current. Then the current density can be obtained by any of the following equations, except ...
- $\frac{E}{\sigma}$
 - $\frac{\Delta Q}{A\Delta t}$
 - nev
 - $\frac{I}{A}$
47. If each of the shown capacitors in the figure has a capacitance of 0.2 F, what is the equivalent capacitance between points a and b?



- a) 0.12 F
 - b) 0.33 F
 - c) 0.8 F
 - d) 0.05 F
48. The capacitance of an air-filled parallel plate capacitor with separation between the plates of 0.1 mm and a plate area of 50 cm² is ...
- a) 4.4×10^{-11} F
 - b) 1.7×10^{-11} F
 - c) 4.4×10^{-10} F
 - d) 1.7×10^{-10} F
49. Each Na⁺/K⁺ pump mechanism results in the ejection of ... [Na⁺] ions from the intracellular fluid to the extracellular fluid and the withdrawal of ... [K⁺] ions from the extracellular fluid to the intracellular fluid.
- a) 3,2
 - b) 2,3
 - c) 2,2
 - d) 3,3
50. ... is the record of electrical changes in the heart, ... is the measure of electrical signals from the muscles, and finally ... is the elicitation of muscle contraction using electric impulses.
- a) ECG, EMG, EMS
 - b) ECG, EMS, EMG
 - c) EMG, EMS, ECG
 - d) EMS, EMG, ECG

END OF QUESTIONS

With my Best Wishes

Answer the flowing questions

I-a-i Prove that the particle mean free path depends on the gas pressure P and temperature T.

ii- Derive an expression for the total particle current and the diffusion coefficient in the case of particles free diffraction in plasma. Write an expression for this current on the presence of a magnetic field and compare between these two expressions

b- Study with draw the motion of charged particles in

- i- a nonuniform magnetic field
- ii- a constant crossed electric and magnetic fields

II- a- Draw an illustrated figure for the magnetic mirror, Explain what does mean these two following equations in the magnetic mirror

$$\sin \theta(0) < \sqrt{\frac{B_{min.}}{B_{max.}}} \text{ and } \sin \theta(0) > \sqrt{\frac{B_{min.}}{B_{max.}}}$$

b- Assume that the absolute value of the magnetic flux θ is equal (16×10^{-4} wb.) through an area A of ($2 \times 10^{-4} \text{ m}^2$) at each end of the magnetic mirror while this flux is (10×10^{-4}) through an area of (5×10^{-4} wb.) in the middle of this magnetic marrior. Calculate the angle (θ) which the particle orbit makes with the z-axis of the central plane of magnetic mirror

III-a- Deduce an expiration for the plasma dielectric constant " ζ " and the store energy "E" in the plasma medium

b- For a plasma of density ($N=5 \times 10^{15} \text{ cm}^{-3}$) in a container area ($A=1000 \text{ cm}^2$), if the temperature required to reach (100 eV). Calculate the required current in Amp in this case where ($1 \text{ eV}=1.6 \times 10^{-19} \text{ joule}$) and KT in joule.

IV-a-i- Write a short account on the types of oscillations in a fully ionized plasma. Put an expression for the plasma angular and natural frequencies.

ii - Use the ion wave dispersion relation to get an expression for the propagation constant (K_x). Show when this K_x is real value, large and small values.

b-i- From the following equation

$$\left(\frac{\partial^2 E}{\partial x^2} = \frac{1}{C^2} \frac{\partial^2 \epsilon E}{\partial t^2} \right)$$

Deduce an expression for the Alfven waves phase velocity V_p

ii- Calculate the approximate speed of Alfven waves in plasma of mass density $\rho = 10^{-6} \text{ kg m}^{-3}$ and magnetic flux density $B=10^{-6} \text{ Tesla}$

=====Good Luck=====

Prof. Dr. Abdel-Haleem Turkey

Assiut University

Faculty of Science

Third Year (Physics), 2nd Semester/May2023

Time : 3 Hours

Electromagnetic Theory 342ph

Exm.Date 10/6/2023

Part (I) Choose the correct answer (each of 1 grade)

1-) According to Lenz's law of electromagnetic induction

1. The induced emf is not opposing the change in magnetic flux
2. relative motion between coil and magnet changes magnetic flux
3. Only the magnet should be moved towards the coil
4. Only the coil should be moved towards the magnet

2-) Paramagnetic materials have relative permeability :

- 1-Slightly less than unity
- 2-Equal to unity
- 3-Slightly more than unity
- 4-Equal to that ferromagnetic materials

3-) Which of the following materials not important in engineering applications : 1)Diamagnetic 2)Paramagnetic

- 3)Ferromagnetic
- 4) None of them

4-)What will be the current passing through a ring-shaped air-cored coil when the number of turns is 800 and ampere-turns are 6400

- 1)2
- 2)4
- 3)6
- 4) 8

5-) In the left-hand rule, the forefinger always represents :

- 1)Magnetic field
- 2) Current
- 3) Voltage
- 4)The direction of the force on the conductor

6-)The Biotsavart's law is a general modification of : 1)Kirchhoff's law

- 2)Lenz's law
- 3)Ampere's law
- 4) Faraday's laws

7-) Materials subjected to rapid reversal of magnetism should have

- 1)Large area of B-H loop
- 2) High permeability- low hysteresis loss

3) High coercivity- high retentivity 4) High coercivity - low density

8-) permeable substance is one a :

- 1) good conductor 2) bad conductor 3) strong magnet
4) Through which the magnetic lines of force can pass very easily

9-) Hysteresis loop in the case of magnetically hard materials is more in shape as compared to magnetically soft materials : 1) Triangular
2) Rectangular 3) Circular 4) None of the above

10-) The relative permeability of materials is not constant for :

- 1) Diamagnetic 2) Paramagnetic 3) Ferromagnetic 4) Insulating

11-) A magnet moving relative to a coil, induced emf does not depend on

- 1) Number of turns of the coil 2) Motion of the magnet
3) Pole strength of the magnet 4) Resistance of the coil

12-) When two ends of a circular uniform wire are joined to the terminals of a battery, the field at the center of the circle will :

- 1) depend on radius of circle 2) depend on the value of e.m.f. applied
3) be infinite 4) be zero

13-) Two long parallel conductors carry 100 A. The conductors are separated by 20 mm, force per meter of length of each conductor will be

- 1) 100 N 2) 0.1 N 3) 1 N 4) 10 N

14-) The magnetic reluctance of a material

1. Decreases with an increasing cross-sectional area of material
2. Increases with an increasing cross-sectional area of material
3. Does not vary with an increasing cross-sectional area of material
4. Any of the above

15-) Gilbert is a unit of :

- 1) Magnetomotive force 2) Conductance
3) Electromotive force 4) Permittivity

16-) The magnetic materials exhibit the property of magnetization because of :

- 1) Orbital motion of electrons
- 2) Spin of electrons
- 3) Spin of nucleus
- 4) None of the above

17-) Most effective and quickest way to make a magnet of soft iron is by

- 1) Placing it inside a coil carrying current
- 2) Induction
- 3) The use of a permanent magnet
- 4) Rubbing with another magnet

18-) The magnetic field inside a long current carrying straight solenoid is

- 1) More at the ends than at the center
- 2) Minimum in the middle
- 3) Same at all points
- 4) Found to increase from one end to other

19-) The electromagnet has 50 turns and a current of 1A flows through the coil. If the length of the magnetic circuit is 200 mm, what is the magnetic field strength?

- 1) 2500 AT/m
- 2) 250 AT/m
- 3) 25 AT/m
- 4) 2.5 AT/m

20-) A conductor of length L has current I through it, is placed parallel to a magnetic field. The force experienced by the conductor will be :

- 1) Zero
- 2) BLI
- 3) B^2LI
- 4) BLI^2

21-) Indicate which of the following material does not retain magnetism permanently :

- 1) Soft iron
- 2) Stainless steel
- 3) Hardened steel
- 4) None of the above

22-) One of the following laws of electromagnetism does not give the direction of magnetic field :

- 1) Right-hand thumb rule
- 2) Fleming's left-hand rule
- 3) Fleming's right-hand
- 4) Faraday's law

23-) One of the following is an electric conductor:

- 1) plastic sheet
- 2) Distilled water
- 3) Human body
- 4) wooden thin sheet

24-) Given three copper wires of different lengths and cross-section areas, one of them would have highest resistivity :

- 1) wire of 50 cm length and 1 mm diameter

($\frac{4}{5}$)

- 2) wire of 25 cm length and 0.5 mm diameter
3) wire 10 cm length, 2.0 mm diameter
4) All wires have same resistivity
- 25-) The magnet is strongest near the : 1) Poles
2) Ends 3) Centre 4) equator point from the poles
- 26-) The device producing electric current is called : 1) Generator
2) Galvanometer 3) Ammeter 4) Motor
- 27-) Sum of emf's and potential differences around a closed loop equals zero is a consequence of : 1) Ohm's law 2) Conservation of charge
3) Conservation of momentum 4) Conservation of energy
- 28-) Increasing speed of a moving magnet inside a coil, the current in the coil: 1) increases 2) decreases 3) reverses 4) remains same
- 29-) A 100 W electric bulb is used for 10 hours a day. How many units of energy are consumed in 30 days? 1) 1 2) 10
3) 30 4) 300
- 30-) Which one of the following material is most suitable for making core of an electromagnet? A) Air B) Steel
C) Cu-Ni alloy D) Soft iron

*** End of the first part *** Regards *** Prof. G. S. Hassan ****



Physics Department
Faculty of Science
Assiut University
2nd Semester - 2022/2023

3rd Year

Final-term Exam

Physics and Electronics Program
Course Code: EC 325
Microprocessors
(معالجات دقيقة)

Date: June 10th, 2023

Time: 9:00 am - 12:00 pm (3 hours)



Important Notes: Marks: 50, Number of Pages: 2, Number of Questions: 4

Answer All the Following Questions:

Question 1 10 Marks

Choose the correct answer to each of the following statements:

(1 Mark for Each Point)

(Note: multiple choices are not allowed)

1. Babbage designed an analytical engine in 1830, which its input operation can be done using

☐ A gears and wheels	☐ B strings of beads
☐ C motor-driven adding machines	☐ D non of the previous
2. The maximum size of memory that can be accessed in the real mode operation is

☐ A 1 MB	☐ B 64 KB	☐ C 4 MB	☐ D 256 KB
---------------------------------	----------------------------------	---------------------------------	-----------------------------------
3. is the computing machine which can be considered the first electromechanical computer.

☐ A Colossus	☐ B Z3	☐ C ENIAC	☐ D Abacus
-------------------------------------	-------------------------------	----------------------------------	-----------------------------------
4. The first microprocessor in Intel which has 32-bit address bus and 64-bit data bus is

☐ A Intel 80286	☐ B Intel 80386	☐ C Intel 80486	☐ D Intel Pentium
--	--	--	--
5. The main processing unit in Intel 8086 which is responsible for updating control flags is

☐ A EU	☐ B BIU	☐ C ALU	☐ D non of the previous
-------------------------------	--------------------------------	--------------------------------	--
6. Consider $SS = 25E7H$, the ending address of the stack segment in $SS:153AH$ is

☐ A 273AA H	☐ B 25E70 H	☐ C 35E6F H	☐ D 2539F H
------------------------------------	------------------------------------	------------------------------------	------------------------------------
7. can be considered as a suitable combination of segment:offset registers.

☐ A CS:SI	☐ B SS:BX	☐ C ES:BP	☐ D non of the previous
----------------------------------	----------------------------------	----------------------------------	--
8. IF $SP = 582CH$, the offset address of the first location in the stack to pop data from is after the execution of the following assembly line: `PUSH AX`

☐ A 582E H	☐ B 582C H	☐ C 582A H	☐ D 5828 H
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------
9. Consider $CF = 1$ and $AL = 10100011B$. After the execution of `RCL AL, 2`

☐ A $AL = 01000111B$	☐ B $AL = 10001111B$	☐ C $AL = 10001110B$	☐ D $AL = 11101000B$
---	---	---	---
10. Assume that the machine code of `MOV AL, 06H` is $B406H$. The value $B406H$ is stored in the

☐ A data segment	☐ B extra segment	☐ C code segment	☐ D stack segment
---	--	---	--

Question 2 14 Marks

- i) Check if the jump will occur or not in the following cases: (6 Marks)
(Note: answer with occur or not occur, and also write the reason)

a) MOV AX,32B7H CMP AX,9A2DH JG NEXT	b) MOV AL,0F5H ADD AL,41H JC NEXT	c) MOV CX,5 DEC CX JCXZ NEXT
--	---	------------------------------------

- ii) Show the contents of BX and the flag bits (CF, ZF, SF, OF, PF and AF) after the execution of the following assembly lines: (8 Marks)

```
MOV BH,23H
ADD BH,89H
CMC
MOV BL,0C8H
SBB BL,43H
```

Question 3 16 Marks

- i) Suppose that AL = 00011000 B. Using only the logical instructions, write the assembly lines to perform the following operations, and then show the contents of AL: (8 Marks)

a) Multiply AL by 4	b) Divide AL by 8
c) Set the bits No. 0, 3 and 5 in AL	d) Toggle the bits No. 2, 4 and 7 in AL

- ii) Consider the following assembly lines, the shown part of memory and the values of some registers:

	3A659 H	
MOV AX,295AH	3A658 H	
MOV CX,AX	3A657 H	69 H
MOV [BX+SI-12H],CX	3A656 H	3C H
MOV [DI],DX	3A655 H	
	3A654 H	

BX = 2E46 H, DX = F3B4 H, SI = 5820 H, DI = 8658 H, and DS = 3200 H.

- a) What is the addressing mode used in each line of the above assembly lines? (4 Marks)
b) Show the contents of the missing locations in the shown part of memory after the execution of the above assembly lines. (4 Marks)

Question 4 10 Marks

Write the assembly code that:

- adds and counts the even and odd numbers in the following series of byte size data: 37, 62, 28, 51, 46, 14, 72, 111 and 0
- stores the sum and count of the even numbers in CL and CH, respectively
- stores the sum and count of the odd numbers in DL and DH, respectively
- stops when the number 0 is read

then show the contents of CX and DX after the execution of the assembly code.



Assiut University
Faculty of Science
Physics Department



Final Exam of Solid-State Physics (353) Course code: P353 2nd semester
Year: 2022/2023 Date: 29/05/2023 Time Exam: 3 h Total Mark: 50 Marks

الاختبار مكون من اربعة اسئلة موزعة على 12 صفحة تتم الاجابة داخل كراسة الاسئلة ويجب اجابة السؤال

الأول الاختياري في الجدول التالي :

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ans.														
No.	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Ans.														

Question1: Choose the correct answer A, B, or C: 14 Marks (0.5 Mark for each)

- The strength and ductility of metals are controlled by
A. Surface
B. Dislocations
C. Defects
- Generally, rapid cooling produces whereas slow cooling result in larger grains
A. Smaller grains
B. Larger grains
C. Medium grains
- In all the atoms are of the same kind, all lattice points are equivalent.
A. Crystal lattice
B. Bravais lattice
C. Space lattice
- A change in the stacking sequence over a few atomic spacing's produces a stacking faults whereas a change over many atomic spacing produces a
A. Crystal
B. Twin region
C. Grain boundaries
- The term 'phase' refers to that region of space occupied by a physically homogeneous material. These regions are often called
A. Dislocations
B. Precipitates
C. Faults
- When a void occurs due to the shrinkage of a material as it solidifies, it is called
A. Porosity
B. Cavitation
C. Velocity
- Grain boundaries are a kind of defects.
A. Point
B. Volume
C. Surface
- The combination of anion cation vacancies (in pairs) is called..... imperfections.
A. Columb

- B. Schottkey
C. Frankel
9. The combination of a vacancy and interstitial is called a imperfections.
A. Columb
B. Schottkey
C. Frankel
10. Neutron does not interact with electrons in the crystal. Thus, unlike the x-ray, which is scattered entirely by, the neutron is scattered entirely by nuclei.
A. Electrons
B. Nuclei
C. Protons
11. Neutron diffraction is an important tool in the investigation ofordering that occur in some materials.
A. Electrical
B. Optical
C. Magnetic
12. Electron diffraction is a useful technique forstructure studies.
A. Surface
B. Body
C. Internal
13. Electrons are scattered strongly in air, so diffraction experiment must be carried out in avacuum.
A. Low
B. High
C. Medium
14. In crystals the typical interatomic spacing aboutso the suitable radiation is X-rays.
A. 1-2 Å
B. 2-3 Å
C. 2-3 nm
15. Neutrons are more useful than X-rays for determining the crystal structures of solids containing elements.
A. Heavy
B. Light
C. Small
16. The physical basis for the diffraction of electron andbeams is the same as that for X- rays diffraction.
A. Proton
B. Dutron
C. Neutron
17. Neutron radiations have an energy equal to 0.08 ev but the X-rays have an energy equal to 10 Kev but they have the same wavelength about
A. 1 Å
B. 2 Å
C. 3 Å
18. X-rays can be created by bombarding a metal target with high energy electrons.
A. $< 10^4$
B. $> 10^4$

C. $\approx 10^4$

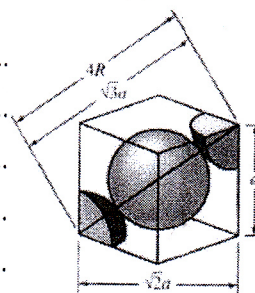
19. are a group of atoms which describe crystal structure.
- A. Unit cell
 - B. Space lattice
 - C. Basis
20. Neutron energy magnitude as the thermal energy KT for this reason we speak of
- A. Thermal electrons
 - B. Thermal neutrons
 - C. Thermal protons
21. The three general types of solids are.....,,
- A. Crystal, Lattice, Polycrystal
 - B. Polycrystal, Single Crystal, Precipitates
 - C. Single Crystal, Polycrystalline, Amorphous
22. The branch of science that deals with the geometric description of crystals and their internal arrangement is
- A. The polymorphism
 - B. The crystallography
 - C. The condensed matter
23. An imaginary network of lines, with atoms at intersection of lines, representing the arrangement of atoms is called
- A. Space lattice.
 - B. Space group
 - C. Twin regions
24. is an extra atom that has crowded its way into an interstitial void in the crystal structure.
- A. Substitutional impurity
 - B. Interstitial impurity
 - C. Self interstitial
25. is an atom of a different type than the bulk atoms, which has replaced one of the bulk atoms in the lattice.
- A. Substitutional impurity
 - B. Interstitial impurity
 - C. Self-interstitial
26. are regions where there are a large number of atoms missing from the lattice.
- A. Vacancies
 - B. Voids
 - C. Grains
27. Graphite is a metal, diamond is an insulator and buckminsterfullerene is a they are all just carbon.
- A. Semiconductor
 - B. Superconductor
 - C. Conductor
28. have mobile molecules, but a type of long range order can exist.
- A. Amorphous
 - B. Polycrystals
 - C. Liquid crystals

Question2:(12 Marks, 3 Marks for each question)

A. Copper has an FCC crystal structure and a unit cell with a lattice constant of 0.361 nm. What is its interplanar spacing d_{220} ?

This image shows a full page of a handwriting practice worksheet. It consists of approximately 28 horizontal rows. Each row is defined by two parallel dotted lines, creating a series of uniform gaps for letter height. The lines are evenly spaced across the entire page, providing a guide for consistent letter formation. There is no text or other markings on the page.

B. Iron at 20 °C is BCC with atoms of atomic radius 0.124 nm. Calculate the lattice constant (a) for the cube edge of the iron unit cell.



C. The d-spacing's for the same planes in a crystal with unit cell $a = b = 7 \text{ \AA}$, $c = 9 \text{ \AA}$. Is

[illegible]

This image shows a full page of a handwriting practice worksheet. It consists of numerous horizontal rows, each defined by two parallel dotted lines. The rows are evenly spaced and extend across the entire width of the page, providing a guide for letter height and placement. There is no text or other markings on the page.

Question3: (12 Marks 1 Mark for each point)

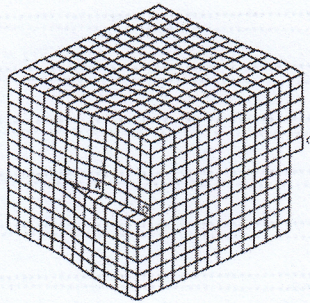
Write the correct scientific name of the numbers in this figures.

1:.....

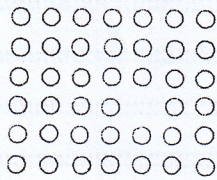
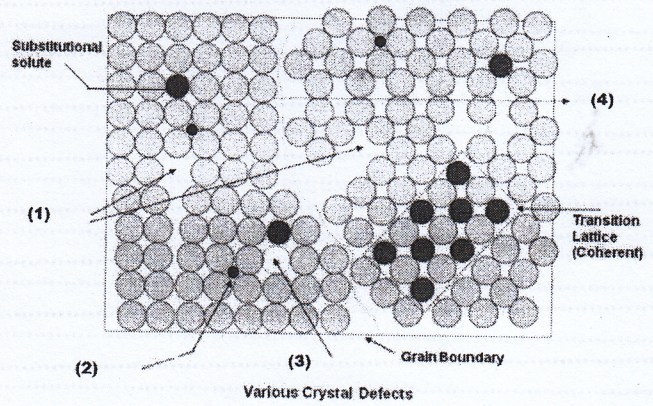
2:.....

3:.....

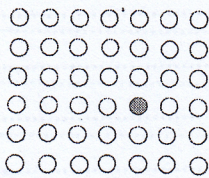
4:



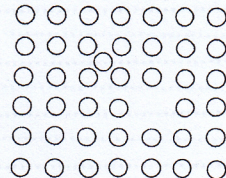
5:.....



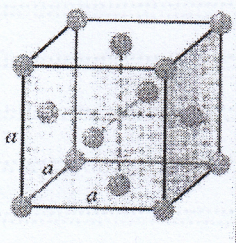
6:.....



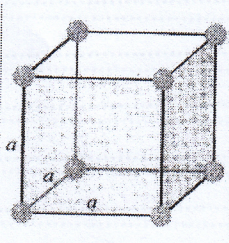
7:.....



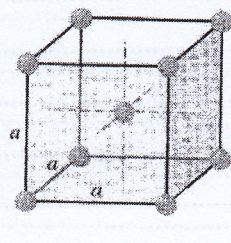
8:.....



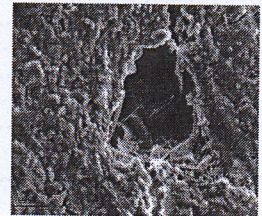
9:.....



10:.....



11:.....



12:.....

Question4: (12 Marks)

(A) Prove that the Atomic Packing Factor of FCC Structure is equal 0.74, and discuss what does it mean?

(2 Marks)

[illegible]

(B) Discuss why we use the X-ray to study the crystal structure of the materials and write on the X-ray applications and its advantages and disadvantages?

(3 Marks)

[illegible]

(C) Enumerate the reasons for the departure from perfect crystal structure?

(3 Marks)

[illegible]

[illegible]

With all my best wishes

Dr. Essam F. Abo Zeid