

الفرقة الرابعة

Question 1(10 degrees): Put (✓) in front of the correct sentence and (x) in front of the wrong sentences.

1) Frenkel exciton has higher binding energy than Wannier-Mott exciton	
2) A free exciton is always observed in the optical absorption of semiconductor materials at high temperatures.	
3) The hole's mobility and concentration have a strong effect on the metallic electrical conductivity	
4) The increase of radiative lifetime (τ_R) results in an overall decrease in luminescence emission efficiency (η)	
5) The direct interband transition from the initial state at wavenumber (k_i) through photon excitation with wavevector (q) to the final state at wavenumber (k_f) must satisfy the momentum conservation law according to the following relation: $k_f = k_i \pm q$	
6) The conduction band occupancy of semiconductors with low carrier concentration follows the Boltzman distribution.	
7) The interband luminescence peak width ($\Delta\omega$) is directly proportional to thermal energy ($k_B T$)	
8) In n-type semiconductors the Fermi-energy level follows these criteria: $(E_c - E_f) > (E_f - E_v)$.	
9) The optical absorption coefficient (α) in the point of view of quantum mechanics depends on two main factors the matrix element (M) and the density of states $g(h\nu)$	
10) The interband luminescence could result from the recombination of excited electrons at an energy higher than the optical band gap with holes at the top of the valence band.	

Question 2(15 degrees): Select the correct answer.

1. The intrinsic carrier concentration (n_i) of the semiconductor is given by:		
a) $n_i = 2 \left[\frac{2\pi m k_B T}{h^2} \right]^{3/2} \exp(E_g/k_B T)$	b) $n_i = 2 \left[\frac{2\pi m k_B T}{h^2} \right]^{3/2} \exp(E_g/2k_B T)$	c) $n_i = 2 \left[\frac{\pi m k_B T}{h^2} \right]^{1/2} \exp(E_g/2k_B T)$
2. The position of the Fermi-energy level of a semiconductor is estimated from the following relation:		
a) $E_f = \frac{E_c + E_v}{2} + \left[\frac{3k_B T}{4} \right] \ln \left[\frac{m_p^*}{m_e^*} \right]$	b) $E_f = \frac{E_c + E_v}{2} + \left[\frac{3k_B T}{4} \right] \ln \left[\frac{m_e^*}{m_p^*} \right]$	c) $E_f = \frac{E_c - E_v}{2} + \left[\frac{3k_B T}{4} \right] \ln \left[\frac{m_e^*}{m_p^*} \right]$
3. The distribution of optically excited electrons at high carrier concentration can be statistically represented by:		
a) Boltzmann statistics	b) Fermi-Dirac statistics	c) Poisson statistics

4. If an electron is excited to energy levels higher than the bottom of the conduction band in a direct band semiconductor. Then, the interband luminescence will result from:		
a) Recombination of electrons at energy levels higher than the bottom of the conduction band to holes on the top of the valence band.	b) Recombination of electrons at the bottom of the conduction band to holes on the top of the valence band.	
5. Semiconductors with high carrier concentration will be in the quasi-equilibrium state, which means that the position of Fermi levels of electrons and holes are different. The position of the Fermi level is strongly dependent on the free carrier concentration that can be represented by:		
a) $E_F^{c,v} = \frac{\hbar^2}{2m_{e,h}^*} (3\pi^2 N_{e,h})^{2/3}$	b) $E_F^{c,v} = \frac{\hbar^2}{2m_{e,h}^*} (3\pi^2 N_{e,h})^{3/2}$	c) $E_F^{c,v} = \frac{\hbar}{2m_{e,h}^*} (3\pi^2 N_{e,h})^{2/3}$
6. In the light emitting diode construction by epitaxial layer technique, the p-type layer will be		
a) Below n-type layer	b) Above n-type layer	
7. GaAs with a direct band gap of 1.98 eV will emit an interband luminescence band with an emission center of		
a) 6260 Å	b) 6620 Å	c) 5260 Å
8. If an electric field is applied to the semiconductor material. Hence, the exciton absorption will be shifted to		
a) Higher energy side	b) Lower energy side	c) Not affected
9. The conduction band in semiconductor materials has a bonding nature of		
a) p-bonding	b) p-antibonding	c) s-antibonding
10. The split-off sub-band in the valence band has an energy level		
a) Below light hole level	b) Above the heavy hole level	c) In the middle between the light hole level and heavy hole level

Question 3: (5 degrees): The band gap of semiconductor alloy $\text{Al}_x\text{Ga}_{1-x}\text{As}$ at $k=0$ is changed with composition (x) according to the following equation: $E_g(x) = 1.42 + 1.087x + 0.438x^2$, the material is a direct band gap at $x \leq 0.43$ and an indirect at a higher value of x. The emission wavelength (λ) of the LED can be tuned by changing the compositions. Calculate the following:

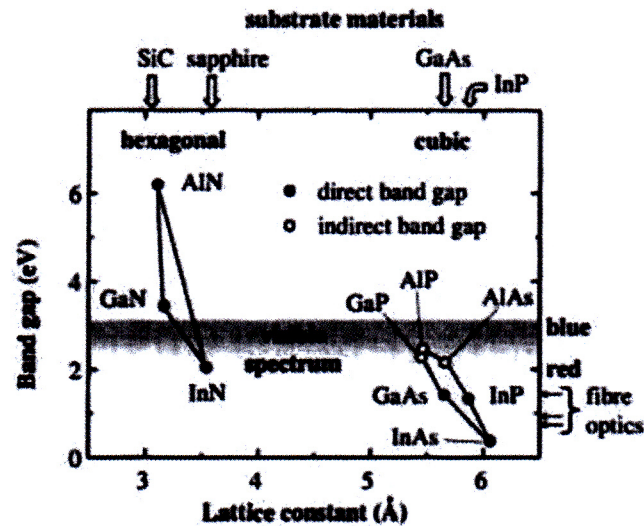
- The composition of the alloy could emit light at 800 nm.
- The range of wavelengths that can be obtained from AlGaAs as LED.

Question 4: (5 degrees): Draw a schematic diagram representing the allowed optical transitions in direct and indirect transition. Then, briefly explain which is better for luminescence emission.

Question 5: (5 degrees): Calculate the electrical conductivity of intrinsic germanium semiconductor with intrinsic carrier concentration ($n_i = 24 \times 10^{18} \text{ m}^{-3}$), $\mu_e = 0.39 \text{ m}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$, and $\mu_h = 0.19 \text{ m}^2 \cdot \text{V}^{-1} \cdot \text{s}^{-1}$ at a temperature of 300 K

Question 6: (5 degrees): Semiconductor material with an active absorption in the infrared region has the complex dielectric constant defined by $\epsilon_r = -16.8 + i91.4$. Hence, calculate the optical absorption coefficient (α), Reflectivity (R) of the given material at ($\lambda = 60 \mu\text{m}$).

Question 7: (5 degrees): Based on the following diagram discuss the main factors to determine the choice of material and substrate that can be used for LED fabrication.



Best Regards

Dr Ahmed Galal



**Important
remarks**

- No. of Pages: 2
- No of Questions : 5
- Answer All the Questions

QUESTION 1: [10 POINTS] – [1 POINT EACH]

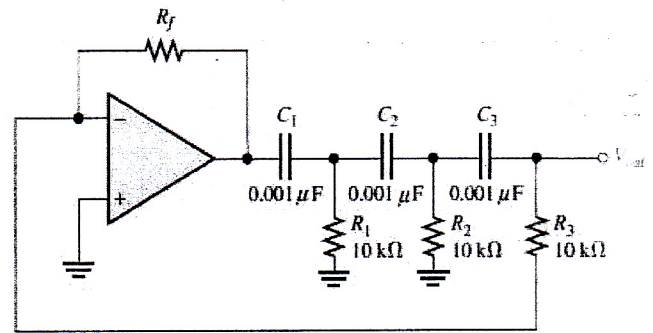
Choose the correct answer:

1. For an operational amplifier, the purpose of offset nulling is to
(a) reduce the gain (b) equalize the input signals
(c) zero the output error voltage (d) answers (b) and (c)
2. A voltage-follower
(a) has a gain of 1 (b) is non-inverting
(c) has no feedback resistor (d) has all of these
3. In a zero-level detector, the output changes state when the input
(a) is positive (b) is negative
(c) crosses zero (d) has a zero rate of change
4. The low-frequency response of an amplifier is determined in part by
(a) the voltage gain (b) the type of transistor
(c) the supply voltage (d) the coupling capacitors
5. The high-frequency response of an amplifier is determined in part by
(a) the gain-bandwidth product (b) the bypass capacitor
(c) the internal transistor capacitances (d) the roll-off
6. An oscillator differs from an amplifier because the oscillator
(a) has more gain (b) requires no input signal
(c) requires no dc supply (d) always has the same output
7. One condition for oscillation is
(a) a gain around the feedback loop of one-third (b) a phase shift around the feedback loop of 180°
(c) a gain around the feedback loop of less than (d) a phase shift around the feedback loop of 0°
8. In a certain oscillator, $A_v = 50$, The attenuation of the feedback circuit must be
(a) 1 (b) 0.01 (c) 10 (d) 0.02
9. The Wien-bridge oscillator's positive feedback circuit is
(a) an RL circuit (b) an LC circuit (c) a voltage divider (d) a lead-lag circuit
10. In a Wien-bridge oscillator, if the resistances in the positive feedback circuit are decreased, the frequency
(a) remains the same (b) increases (c) decreases

QUESTION 2: [10 POINTS]

For the oscillator circuit shown in Figure (1):

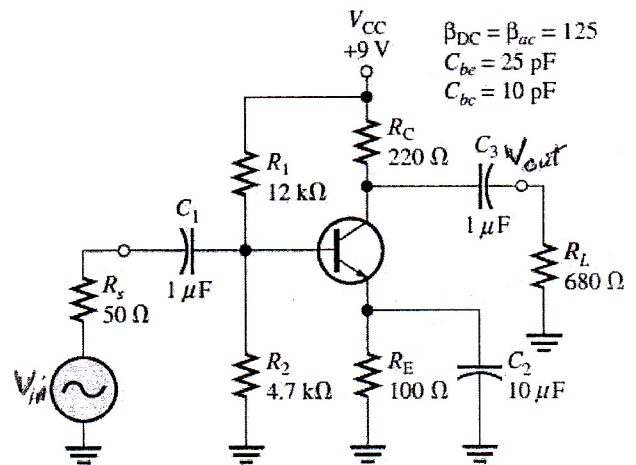
- State type of the oscillator **[2 points]**
- Determine the value necessary for the circuit to operate as an oscillator **[4 points]**.
- Determine the frequency of oscillation **[4 points]**.



QUESTION 3: [15 POINTS]

For the amplifier circuit shown in Figure (2), determine

- Critical frequencies associated with the low-frequency response **[3 Points]**
- Dominant critical low frequency **[3 Points]**.
- Critical frequencies associated with the high-frequency response **[3 Points]**.
- Dominant critical high frequency **[3 Points]**.
- The bandwidth of the amplifier **[3 Points]**.



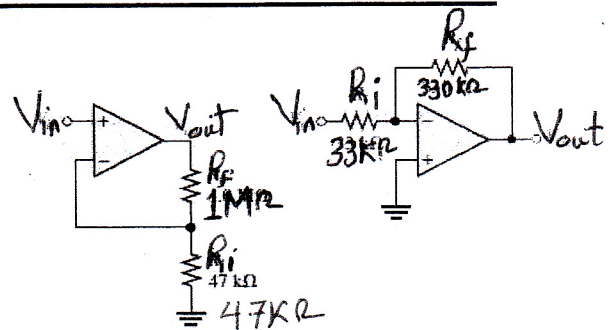
QUESTION 4: [10 POINTS]

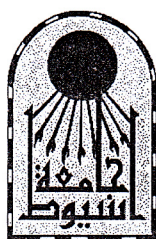
Using operational amplifier(s) and resistor(s), design and draw your design connections of an electronic circuit that takes an input V_1, V_2 and produces an output V_o given by the following equation.

$$V_o = -5V_1 - 2V_2$$

QUESTION 5: [5 POINTS]

If a sinusoidal signal voltage of 10 mV rms is applied to each of the following amplifiers, what are the output voltages and what is their phase relationship (In phase or Out of phase) with inputs?





Physics 432P – Atomic and Molecular Spectroscopy

FINAL EXAM

DURATION OF TEST: THREE HOURS

Date: 03rd June 2023

Examiner: Dr. Ahmed Mostafa Amry

Quantity	Symbol	Value and units ^a
Speed of light (in vacuo)	c	$2.997\,924\,58 \times 10^8 \text{ m s}^{-1}$ (exactly)
Vacuum permittivity	ϵ_0	$8.854\,187\,816 \times 10^{-12} \text{ F m}^{-1}$ (exactly)
Charge on proton	e	$1.602\,176\,462(63) \times 10^{-19} \text{ C}$
Planck constant	h	$6.626\,068\,76(52) \times 10^{-34} \text{ J s}$
Molar gas constant	R	$8.314\,472(15) \text{ J mol}^{-1} \text{ K}^{-1}$
Avogadro constant	N_A or L	$6.022\,141\,99(47) \times 10^{23} \text{ mol}^{-1}$
Boltzmann constant	$k (= R N_A^{-1})$	$1.380\,650\,3(24) \times 10^{-23} \text{ J K}^{-1}$
Atomic mass unit	$u (= 10^{-3} \text{ kg mol}^{-1} N_A^{-1})$	$1.660\,538\,73(13) \times 10^{-27} \text{ kg}$
Rest mass of electron	m_e	$9.109\,381\,88(72) \times 10^{-31} \text{ kg}$
Rest mass of proton	m_p	$1.672\,621\,58(13) \times 10^{-27} \text{ kg}$
Rydberg constant	R_∞	$1.097\,373\,156\,854\,8(83) \times 10^7 \text{ m}^{-1}$

Answer ALL questions in section A and B.

A. MC Questions: Answer 50 Questions Only.

(25 Marks)

Select the best answer.

- A subshell of an atom contains a maximum of _____ electrons.
a) $4l - 2$ b) $4l + 2$ c) $2l + 1$ d) $2n^2$
- When electrons move from the higher energy level to a lower energy level, energy is
a) absorbed b) emitted c) both a) & b) d) none of these
- The radius of the Bohr orbit depends on which of the following?
a) $1/n$ b) n c) $1/n^2$ d) n^2
- Photoelectric emission occurs only when the incident light has more than a certain minimum
a) power b) wavelength c) intensity d) frequency

5. The work-function of a metal is
- The minimum current required to take out electron from the metal surface.
 - The maximum frequency required to take out electron from the metal surface.
 - The minimum amount of energy required to take out the electron from the metal surface.
 - None of these.
6. What will be the longest wavelength in the Balmer series of hydrogen spectrum?
- $6557 \times 10^{-10} \text{ m}$
 - $5557 \times 10^{-10} \text{ m}$
 - $9557 \times 10^{-10} \text{ m}$
 - $1557 \times 10^{-10} \text{ m}$
7. A hydrogen atom in its ground state absorbs 10.2 eV of energy. What is the orbital angular momentum is increased by?
- $4.22 \times 10^{-3} \text{ Js}$
 - $2.11 \times 10^{-34} \text{ Js}$
 - $3.16 \times 10^{-34} \text{ Js}$
 - $1.05 \times 10^{-34} \text{ Js}$
8. Which of the following is true regarding the Bohr model of atoms?
- Assumes that the angular momentum of electrons is quantized.
 - Uses Faraday's laws.
 - Predicts continuous emission spectra for atoms.
 - Predicts the same emission spectra for all types of atoms.
9. Hydrogen atoms are excited from ground state to the state of principal quantum number 4. Then, what will be the number of spectral lines observed?
- 3
 - 6
 - 5
 - 2
10. When a hydrogen atom is in its first excited level, what is the relation of radius and Bohr radius?
- Twice
 - 4 times
 - Same
 - Half
11. What is the wavelength of electromagnetic radiation which has a frequency of $4.464 \times 10^{14} \text{ s}^{-1}$?
- $1.338 \times 10^{23} \text{ m}$
 - 1.489 nm
 - $1.489 \times 10^{-6} \text{ m}$
 - $6.716 \times 10^{-7} \text{ m}$
12. What is the wavelength of electromagnetic radiation which has a frequency of $5.732 \times 10^{14} \text{ s}^{-1}$?
- $1.718 \times 10^{23} \text{ m}$
 - $1.912 \times 10^6 \text{ m}$
 - $5.230 \times 10^{-7} \text{ m}$
 - 523.0 m
13. What is the electronic spectra in the visible range span?
- 12500-25000 cm^{-1}
 - 25000-50000 cm^{-1}
 - 25000-72000 cm^{-1}
 - 15000-30000 cm^{-1}
14. According to the uncertainty principle for an electron, time measurement will become uncertain if which of the following is measured with high certainty?
- Energy
 - Momentum
 - Location
 - Velocity

15. Which atomic orbital is spherical in shape?

- a) 2s b) 3p c) 3d d) 4f

16. A neutral atom of an element has 2 electrons in the first energy level, 8 in the second energy level and 8 in the 3rd energy level. This information does not necessarily tell us:

- a) The atomic number of the element.
b) The total number of electrons in s orbitals.
c) The total number of electrons in p orbitals.
d) The number of neutrons in the nucleus of an atom of the element.

17. Which statement about the four quantum numbers which describe electrons in atoms is incorrect?

- a) n = principal quantum number, $n = 1, 2, 3, \dots$
b) l = subsidiary (or azimuthal) quantum number, $l = 1, 2, 3, \dots, (n-1)$
c) m_l = magnetic quantum number, $m_l = (-l), \dots, 0, \dots, (+l)$
d) m_s = spin quantum number, $m_s = +1/2$ or $-1/2$.

18. The maximum number of electrons with $l = 3$ is

- a) 14 b) 2 c) 10 d) 6

19. If 5eV of energy is supplied to an electron with a binding energy of 2.3eV, with what kinetic energy will the electron be launched?

- a) 4.2.3eV b) 4.7.3eV c) 4.11.5eV d) 2.7eV

20. A 500 nm photon of light strikes a semi-conductive surface with a binding energy of 2eV. With what velocity will an electron be emitted from the semi-conductive surface?

- a) 8.38×10^5 m/s b) 9.33×10^5 m/s c) 3×10^8 m/s d) 4.11×10^5 m/s

21. The quantum mechanical model describes electrons as:

- a) Particles b) Waves
c) Particles with wave-like properties d) Small, hard spheres

22. Heisenberg's Uncertainty Principle states that the ___ and ___ of an electron cannot be known simultaneously.

- a) Position, mass b) Position, charge
c) Momentum, speed d) Position, momentum

23. There are ___ types of quantum numbers.

- a) 2 b) 7 c) 4 d) 5

24. The principle quantum number is related to:
- The shape of the orbital.
 - The spatial orientation of the orbital.
 - The average distance of the most electron-dense regions from the nucleus.
 - The number of electrons.
25. The spin quantum number (m_s) can have a value of:
- $-1/2, +1/2$
 - $1/2, -3/2$
 - $+1, -1$
 - $0, +1$
26. According to Heisenberg's uncertainty principle, the more accurately we know about a subatomic particle's momentum, the less we know about its precise:
- mass
 - speed
 - location
 - energy
27. A sodium surface is illuminated with light of wavelength 300 nm. The work function for sodium metal is 2.46 eV. Find the maximum kinetic energy of the ejected photoelectrons.
- 4.13 eV.
 - 2.46 eV.
 - 1.67 eV.
 - 6.59 eV.
28. What is the Pauli Exclusion Principle?
- An atomic orbital can only hold a maximum of 2 electrons, each with opposite spins.
 - An atomic orbital can hold a minimum of 6 electrons, each with opposite spins.
 - An atomic orbital can hold a maximum of 6 electrons, each with the same spin.
 - An atomic orbital can hold a minimum of 2 electrons, each with opposite spins.
29. Which of the following set of quantum numbers is not valid?
- $n = 5, l = 2, m = 0, s = 1/2$
 - $n = 1, l = 2, m = 0, s = 1/2$
 - $n = 5, l = 3, m = 2, s = 1/2$
 - $n = 5, l = 2, m = 0, s = -1/2$
30. What is the ratio of minimum to maximum wavelength in the Balmer series?
- 5:9
 - 5:36
 - 1:4
 - 3:47
31. Find out the minimum energy required to take out the only one electron from the ground state of Li^+ ?
- 13.6 eV
 - 122.4 eV
 - 25.3 eV
 - 67.9 eV
32. What is the energy required to ionize an H-atom from the third excited state, if ground state ionization energy of H-atom is 13.6 eV?
- 1.5 eV
 - 3.4 eV
 - 13.6 eV
 - 12.1 eV
33. The work function of lithium is 2.5 eV. The maximum wavelength of light that can cause the photoelectric effect in lithium is
- 3980 Å
 - 4980 Å
 - 5980 Å
 - 6980 Å

34. The Kinetic energy of a photoelectron emitted on shining a light of wavelength $6.2 \times 10^{-6} \text{ m}$ on a metal surface of work function 0.1 eV is:
 a) 0.01 eV b) 0.02 eV c) 0.1 eV d) 1 eV
35. The different types of energies associated with a molecule are _____
 a) Electronic energy b) Vibrational energy
 c) Rotational energy d) All of the mentioned
36. Spectrum applies specifically to a
 a) range of energy. b) range of speed
 c) range of d) range of wavelengths or frequencies.
37. The correct order of different types of energies is _____
 a) $E_{\text{el}} \gg E_{\text{vib}} \gg E_{\text{rot}} \gg E_{\text{tr}}$ b) $E_{\text{el}} \gg E_{\text{rot}} \gg E_{\text{vib}} \gg E_{\text{tr}}$
 c) $E_{\text{el}} \gg E_{\text{vib}} \gg E_{\text{tr}} \gg E_{\text{rot}}$ d) $E_{\text{tr}} \gg E_{\text{vib}} \gg E_{\text{rot}} \gg E_{\text{el}}$
38. Light of wavelength $4000 \text{ \AA}$ is incident on a sodium surface for which the threshold wavelength of photo-electrons is $5420 \text{ \AA}$. The work function of sodium is
 a) 5 eV b) 5.29 eV c) 2.29 eV d) 2 eV
39. Photoelectrons stopping potential depends on Photoelectrons stopping potential depends on
 a) Frequency of incident light and nature of the cathode material.
 b) The intensity of the incident light.
 c) The frequency of the incident light.
 d) Nature of cathode material.
40. A proton has four times the momentum of an electron. If the electron has a de Broglie wavelength λ_e , what is the de Broglie wavelength of the proton?
 a) λ_e b) $\lambda_e/4$ c) $4\lambda_e$ d) $16\lambda_e$
41. What is the wave number of an radiation moving with the speed of light, with a frequency of $6 \times 10^{14} \text{ Hz}$?
 a) $1.2 \times 10^6 \text{ m}^{-1}$ b) $2.0 \times 10^6 \text{ m}^{-1}$ c) $0.5 \times 10^6 \text{ m}^{-1}$ d) $4.6 \times 10^6 \text{ m}^{-1}$
42. The region of electromagnetic spectrum for nuclear magnetic resonance is
 a) Microwave b) UV-rays c) Infrared d) RF
43. The minimum energy required to remove an electron is called
 a) Stopping potential b) Kinetic energy
 c) Work function d) None of these
44. Zeeman effect is the splitting of spectral line in the presence of
 a) Electric Field b) Magnetic Field
 c) Inert Environmen d) Vacuum

45. The splitting of spectral lines because of electric effect is known as
 - a) Zeeman effect
 - b) electromagnetic effect
 - c) Stark effect
 - d) None of these
46. As per Bohr model, the minimum energy (in eV) required to remove an electron from the ground state of doubly ionized Li atom ($Z = 3$) is:
 - a) 122.4 eV
 - b) 40.8 eV
 - c) 1.52 eV
 - d) 13.6 eV
47. Raman effect is scattering of _____
 - a) Atoms
 - b) Molecules
 - c) Protons
 - d) Photons
48. The elastic scattering of photons is called as _____
 - a) Atmospheric scattering
 - b) Rayleigh Scattering
 - c) Conserved Scattering
 - d) Raman Scattering
49. In Raman spectroscopy, the radiation lies in the _____
 - a) Microwave Region
 - b) Visible Region
 - c) UV Region
 - d) X-ray Region
50. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is
 - a) 0.5
 - b) 2
 - c) 3
 - d) 4
51. According to Bohr model, the orbital angular momentum of electron in the orbit $n=2$ is
 - a) h
 - b) $h/2\pi$
 - c) h/π
 - d) $h/4\pi$
52. If J be the angular momentum of an electron in an Bohr orbit then orbit radius is equal to :
 - a) Jmv
 - b) $J/2mv$
 - c) $J/2\pi m$
 - d) $mJ/2\pi v$
53. The angular momentum of electron in n^{th} orbit is given by
 - a) nh
 - b) $h/2\pi n$
 - c) $nh/2\pi$
 - d) $n^2h/2\pi$
54. Bohr's atom model assumes _____
 - a) The nucleus is of infinite mass and is at rest.
 - b) Electrons in a quantised orbit will not radiate energy.
 - c) mass of the electron remains constant.
 - d) All the above conditions
55. The electron in a hydrogen atom first jumps from the third excited state to the second excited state and subsequently to the first excited state. The ratio of the respective wavelengths, λ_1/λ_2 , of the photons emitted in this process is:
 - a) 20/7
 - b) 27/5
 - c) 7/5
 - d) 9/7

B. Problems. Answer the following questions.

(25 Marks)

1. An electron, a proton, and a photon each have a wavelength of 0.24 nm. For each one, find the momentum, the energy, and, where relevant, the accelerating voltage needed to achieve that wavelength.

Solution.

2. What is the de Broglie wavelength of an electron that has 2.0 k eV of kinetic energy? What about an electron with 200 k eV of kinetic energy? The second one requires relativity—why?

Solution.

3. Given that the force constant for the $^1\text{H}^{35}\text{Cl}$ molecule is 515.7 N m^{-1} , and that $m(^1\text{H}) = 1.0078 \text{ u}$ and $m(^{35}\text{Cl}) = 34.969 \text{ u}$, calculate, in the harmonic oscillator approximation, the vibration wavenumber of this molecule.

Solution.

4. The Bohr model of the hydrogen atom proposed that the electron orbits around the proton in a circle of radius 5.3×10^{-11} m. The electric force is responsible for the radial acceleration of the electron. What is the speed of the electron in this model?

Solution.

5. A piece of metal has a cutoff wavelength of $\lambda_{\text{cutoff}} = 450 \text{ nm}$. Consider illuminating this piece of metal with two different wavelengths of light: a $\lambda_1 = 500 \text{ nm}$ beam and a $\lambda_2 = 400 \text{ nm}$ beam. For each of the two beams, find.
- a) The maximum kinetic energy of ejected electrons.
 - b) What is their speed?
 - c) What is their de Broglie wavelength?

Solution.

END OF EXAM....GOOD LUCK

اجب عن الأسئلة الآتية

السؤال الاول ضع علامة (✓) امام العبارات الصحيحة وعلامة (X) امام العبارات الخاطئة

(10 درجات - نصف درجة لكل جزئية)

- 1- تحتاج الليزرات الكيميائية الى طرق ضخ خارجية ()
- 2- في ليزر اشباه الموصلات يتم تحضير المادة الفعالة على شكل دايود ذات تركيز عالي ()
- 3- يجب تحديد طول موجة شعاع الليزر قبل استخدامه في معالجة الانسجة ()
- 4- تعتمد قوة سطوع شعاع الليزر على الزاوية المجسمة حيث تزداد قوة السطوع بزيادة الزاوية المجسمة ()
- 5- من عيوب استخدامات الليزر الطبية طول فترة نقاهه بعد اجراء العملية ()
- 6- عند استخدام الليزر في الصناعة يفضل ان تكون انفراجية شعاع الليزر اكبر ما يمكن ()
- 7- يعد ليزر اشباه الموصلات من اقوى الليزرات كفاءة ()
- 8- في مقياس ميكلسون يحدث التداخل بين الاشعة المنعكسة بين المرآتين ()
- 9- في ليزر الياقوت يكون تركيز ايونات الكروم اكبر من تركيز بلورة أكسيد الالمنيوم ()
- 10- وحدة قياس كثافة الاشعاع هي $J.Sec/m^3$ ()
- 11- عند الاتزان الحراري يكون معدل الامتصاص مساوياً للفرق بين معدل الانبعاث المستحث ومعدل الانبعاث التلقائي ()
- 12- يعتمد التغير في الطول الموجي المحسوب بطريقة دوبلر على درجة الحرارة المطلقة ()
- 13- يعد ليزر النيترودجين ذات الطول الموجي $\lambda = 337.1 \text{ nm}$ من ليزرات الاشعة فوق بنفسجية ()
- 14- في التجاويف الرنانة تكون النسبة بين شدة الاشعة الساقطة الى شدة الاشعة النافذة تتناسب طردياً مع حاصل ضرب انعكاسية المرآتين ()
- 15- قيمة الشرط الحرج لانبعاث اشعة الليزر تتناسب عكسياً مع سمك المادة الفعالة ()
- 16- تحتاج ليزرات المستويات الثلاثة لوقت اكبر لحدوث انقلاب التعداد بين مستويات الطاقة عن ماهو عليه في ليزر المستويات الاربعة ()

17- التردد الرنيني لتجويف فابيري-بيرو يتناسب طردياً مع عدد الانمط المتكونة بداخله

()

وعكسياً مع المسافة الفاصلة بين المرأتين

18- زاوية حيود شعاع الليزر ذو الترابط المكاني الجزئي اقل بكثير من زاوية حيود باقي

()

الاشعة الكهرومغناطيسية

19- في الجهاز المستخدم للحصول على ليزر الياقوت يحاط قضيب الياقوت بانبوبة

()

حلزونية مملوءة بغاز النيون

20- في ليزر اشباه الموصلات لا يمكن دراسة مستويات الطاقة لذرة او جزئ منفرد بل

()

يجب دراسة مستويات الطاقة للبلورة ككل.

السؤال الثاني اختار الإجابة الصحيحة من بين العبارات الآتية . (20 درجة -درجة لكل جزئية)

- 1- في الليزر الغازي المثار بواسطة المجال الكهربائي الموازي تكون
- ممانعة الدائرة كبيرة وبالتالي يكون الجهد المطبق صغير
 - ممانعة الدائرة صغيرة وبالتالي التيار المار وقدرة الخرج عالية
 - ممانعة الدائرة كبيرة وبالتالي يلزم وجود الغاز تحت ضغط مرتفع
 - لا شئ مما ذكر
- 2- إذا كان معامل الامتصاص لمادة 2.5 cm^{-1} فكم يكون سمكها إذا كانت النسبة بين الشعاع النافذ و الشعاع الساقط 40%
- 3- كم يكون عدد الأنماط الليزرية المتكونة في تجويف كروي متحد المركز لشعاع ليزري طوله الموجي $\lambda = 400 \text{ nm}$ إذا علمت أن قطر أي من المرآتين $R = 25 \text{ cm}$
- 4- استخدم شعاع ليزري طوله الموجي $\lambda = 700 \text{ nm}$ لإضاءة فتحتين المسافة الفاصلة بينهما 0.3 mm فكم يكون رقم الهدبة المظلمة التي تتكون على بعد 5 cm عن الهدبة المركزية إذا علمت أن المسافة الفاصلة بين الشاشة والفتحتين 1.4 m
- 5- اتساع المنحني الطيفي المحسوب بطريقة دوبلر
- يتناسب طردياً مع درجة الحرارة
 - يتناسب عكسياً مع كتلة الذرة
 - يتناسب طردياً مع التردد الرئيسي
 - كل مما ذكر
- 6- المقدار (A_{21}/B_{21}) له وحدات
- J.S/m^2
 - J/m^3
 - J.S/m^3
 - بدون وحدات
- 7- كم يكون معامل التكبير لشعاع الليزر إذا كان طول التجويف $L = 30 \text{ cm}$, $\gamma = 70 \text{ m}^{-1}$
- $G = 1.32 \times 10^8$
 - $G = 3.04 \times 10^8$
 - $G = 3.4 \times 10^9$
 - $G = 1.32 \times 10^9$

8- اذا كان طول موجة شعاع ليزر الهيدروجين نتيجة لانحلال الذرات من مستوي الطاقة

السادس الى مستويات طاقة اقل هو $\lambda=440\text{nm}$ احسب رتبة المدار النهائي

ا- المدار الثاني ب- المدار الثالث ج- المدار الرابع د-المدار الخامس

9- باستخدام السؤال السابق احسب فرق الطاقة بين المستويين بالالكترون فولت

ا- $4.517 \times 10^{-19} \text{ eV}$ ب- 4.517 eV

ج- $2.823 \times 10^{-19} \text{ eV}$ د- 2.823 eV

10- من مميزات الليزر الغازي المثار بواسطة المجال الكهربى العمودي

ا- نقاء الخط الطيفي ب- ضغط الغاز يكون صغير

ج- طاقة اشعة الخرج تكون عالية د- ممانعة الدائرة تكون كبيرة

11- تجويف ليزرى يتكون من مرآتين انعكاسية المرآة الاولى $R_1=100\%$ ، انعكاسية المرآة الثانية

$R_2=60\%$. احسب سمك المادة الفعالة اذا كان الشرط الحرج لانبعاث اشعة الليزر

$(N_2-N_1)_c = 3 \times 10^{14} \text{ atoms/cm}^3$ و مساحة المقطع العرضى للانتقال $\sigma=2.5 \times 10^{-16} \text{ m}^2$

ا- $t=8.4 \mu\text{m}$ ب- $t=3.4 \text{ mm}$

ج- $t=3.4 \mu\text{m}$ د- $t=8.4 \text{ mm}$

12- أستخدم ليزر (He-Ne) ذات الطول الموجى $\lambda=632 \text{ nm}$ لإضاءة فتحتين احسب المسافة

الفاصلة بينهما اذا علمت ان بعد الهدبة المظلمة الثانية عن النقطة المركزية 6 mm والمسافة بين

الشاشة والفتحتين 90 cm

ا- $d=2.37 \text{ cm}$ ب- $d=0.237 \text{ mm}$

ج- $d=0.348 \text{ mm}$ د- $d=3.16 \text{ cm}$

13- باستخدام السؤال السابق احسب الوضع الزاوى للهدبة لسادسة المضينة

ا- $\theta=0.917^\circ$ ب- $\theta=0.016^\circ$ ج- $\theta=0.67^\circ$ د- $\theta=0.0173^\circ$

14- احسب طول موجة الانتقال من المستوى الخامس الى المستوى الأول لذرة الليثيوم Li_3^7

ا- 10.55 nm ب- 1.055 nm ج- 31.65 nm د- 3.165 nm

15- تردد التجويف الكروي المتحد البؤرة يعطي بالعلاقة

ا- $v=NC/R$ ب- $v=2NC/R$ ج- $v=NC/2R$ د- $v=NC/4R$

16- غشاء رقيق من الزجاج سمكه 0.06mm استخدم لمقياس ميكلسون فسمح بمرور 150 هدبة .

معامل انكسار مادة الغشاء علماً بان طول موجة شعاع الليزر المستخدم $\lambda=480\text{ nm}$

ا- $\mu=1.3$ ب- $\mu=1.4$

ج- $\mu=1.5$ د- $\mu=1.6$

17 - اي من الكميات الفيزيائية الاتية لا تعتمد على شدة الموجة الكهرومغناطيسية الساقطة

ا-الامتصاص والانبعث التلقائي

ب- الامتصاص وانقلاب التعداد

ج-الامتصاص والانبعث الاجباري

د- الانبعث التلقائي فقط

18 - سقطت حزمة ليزرية ذات طول موجي $\lambda=600\text{nm}$ على حاجز به فتحة نصف قطرها 0.01 mm

فكم تكون زاوية حيود الشعاع ذو الترابط المكاني التام.

ا- $\theta=0.06^\circ$ ب- $\theta=0.03^\circ$ ج- $\theta=0.034^\circ$ د- $\theta=0.017^\circ$

19- يعتبر ليزر النيترودجين من ليزرات الغاز

ا- ذو الذرة المتعادلة

ب- ليزر الغاز الايوني

ج- ليزر ابخرة المعادن

د- ليزر الغاز الجزيئي

20- اي من الطرق الاتية تصلح للحصول علي ليزر اشباه الموصلات

ا-الضخ الضوئي

ب- الضخ الحراري

ج- الضخ الالكتروني

د- لا شئ مما ذكر

السؤال الثالث

(4 درجات)

ا- استنتج العلاقة بين معاملات اينشتين

(3 درجات)

ب- في ليزر He-Ne ذات الطول الموجي $\lambda = 632.8 \text{ nm}$

1- احسب النسبة بين معاملات اينشتين.

2- احسب كثافة الاشعاع عند درجة حرارة $T = 4000 \text{ K}$

السؤال الرابع

- ا- استنتج قيمة كل من معامل كسب الاشارة الصغيرة ومعامل التكبير لشعاع الليزر (4 درجات)
- ب- اذكر مميزات وعيوب استخدامات الليزر في الصناعة. (4 درجات)

التهنئة الأستاذة والله الموفق

ثابت بلانك $h = 6.625 \times 10^{-34} \text{ J.s}$ ثابت بولتزمان $k = 1.38 \times 10^{-23} \text{ J/K}$
ثابت رابنجر $R = 10.97 \times 10^6 \text{ m}^{-1}$ شحنة الالكترون $e = 1.6 \times 10^{-19} \text{ C}$ سرعة الضوء $C = 3 \times 10^8 \text{ m/sec}$

السؤال الخامس

ا- اشرح بالتفصيل كيفية الحصول على ليزر الهليوم-نيون موضعاً الانتقالات التي تحدث بين مستويات الطاقة .
(5 درجات)

انتهت الأسئلة والله موفق.

ثابت بلانك $h=6.625 \times 10^{-34} \text{ j.sec}$ ثابت بولتزمان $k=1.38 \times 10^{-23} \text{ j/k}^0$ **Constants:**
ثابت رايدبرج $R=10.97 \times 10^6 \text{ m}^{-1}$ شحنة الالكترون $e=1.6 \times 10^{-19} \text{ C}$ سرعة الضوء $C=3 \times 10^8 \text{ m/sec}$



Assiut University

Physics Department
Final Exam: Physical Measurements
Code: 462P

Teaching Staff: Dr. M. A. Sabet

Date: 8/6/2023

Time: 3 hours

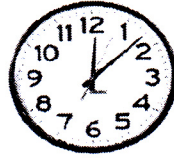


Faculty of Science

- في حالة اختيار أكثر من إجابة للنقطة الواحدة سيتم احتساب الإجابة خاطئة
- من حق الطالب/ة ورقة إجابة واحدة فقط
- لن يلتفت إلى أي إجابات مدونة خارج الجدول الموجود في صفحة الإجابة في آخر الورقة الامتحانية

First Question: True or False (37 Marks, Each 1 Mark)

1. As an example of the analogue readings, the values given by the shown clock.



2. The readings given by the clock shown in next figure is a digital value.



3. The expression "Hot or cold water" is a digital expression.
4. Numbering of weekdays (Sat. Sun. Mon ... etc.) is an octal system.
5. For the decomposition of the decimal number 315 we need at least 4 powers of 10.
6. The radix of the decimal number is 10, while the radices of the octal and hexadecimal are 8 and 15, respectively.
7. In the binary system we can represent any decimal number by a combination of 0 and 1 symbols.
8. One bit in the octal numbering system is replaced by three bits while conversion to a binary number and vice versa.
9. One bit in the hexadecimal system is represented by four bits in the binary system.
10. $122_3 = 101_4 = 32_5$
11. $111_2 + 100_2 = C_{16}$
12. The fractional part of a number is represented as the sum of the positive powers of the radix of the numeration system.
13. In the Sign-magnitude representation the sign bit is the number at the left and is set to 0 if the number is negative.
14. $101_{SM} = -1_{10}$ while $101_2 = -5_{10}$.
15. When the binary representation corresponds to an infinite sequence and if the absolute error (in decimal) is $\pm 5 \times 10^{-3}$, the expansion in powers of 2^{-n} will then stop at the $(n + 1)^{th}$ term according to $2^{-n} \leq 5 \times 10^{-3}$.
16. For any bivalent variable A, $(NOT NOT A = A)$, i. e. $(\bar{\bar{A}} = A)$.
17. For any bivalent variable A, $(A \cdot 1 = A)$
18. For any bivalent variable A, $(A + 0 = A)$

19. For any bivalent variable A, $(A + \bar{A} = 1)$

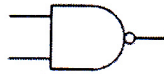
20. For any bivalent variable A, $(A \cdot \bar{A} = 0)$

21. For the **AND** logic function, the output variable takes the high logic level (or the value 1) if and only if the input variables are at the high logic level (or the value 1).

22. For the **OR** logic function, the output takes the logic level 1 if at least one of the inputs is at the logic level 1.

23. The **XOR** logic function is represented by a plus within a circle ($\oplus$) and the output takes logic level 1, when only inputs are at different values

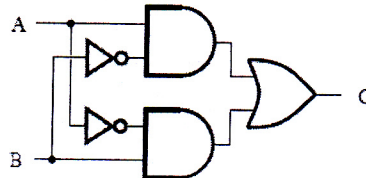
24. The shown figure represents the **NAND** function.



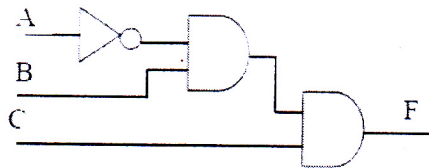
25. The shown figure represents the **XOR** function.



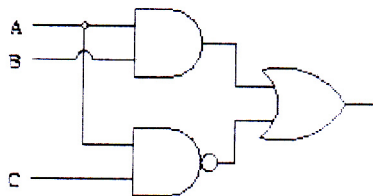
26. The shown figure represents the **XNOR** function.



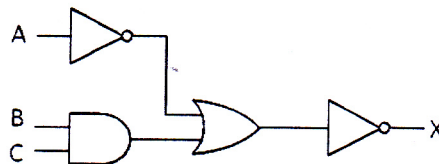
27. The next logic gate represents $F = \bar{A} \cdot B + C$



28. The next logic gate represents $(A \cdot B) + (\bar{A} \cdot \bar{C})$



29. The next logic gate represents $X = \bar{A} + B \cdot C$



30. For any bivalent variables A and B, $A + (B \cdot C) = (A \cdot B) + (A \cdot C)$.

31. De Morgan's theorem informs that for any bivalent variables A and B, $\overline{A + B} = \bar{A} \cdot \bar{B}$ and this results in $(A \cdot B) + (A \cdot \bar{B}) = A$

32. For the following truth table, the function F can be assumed to be given by

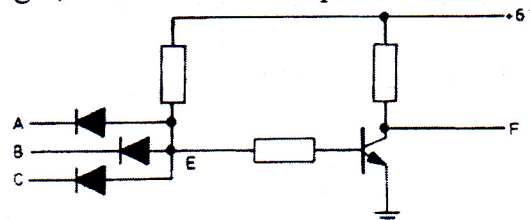
$$\bar{F} = \bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C}$$

A	B	C	Output
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

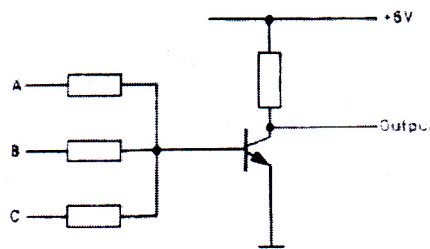
33. Assuming the negative logic, the next voltage table represents the **AND** function

A	B	F (output)
0V	0V	0V
0V	+6V	0V
+6V	0V	0V
+6V	+6V	+6V

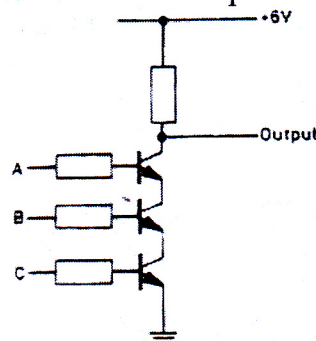
34. Assuming the positive logic, the next circuit represents the **NAND** function



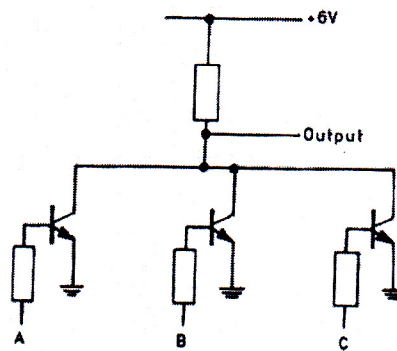
35. Assuming the positive logic, the next circuit represents the **NAND** function



36. Assuming the positive logic, the next circuit represents the **NOR** function



37. Assuming the positive logic, the next circuit represents the **NAND** function



Second Question: Choose the most accurate answer (13 Marks, Each 1 Mark)

38. The number 86_{10} can be written as
- 1010110_2
 - 1110110_2
 - 0110001_2
 - 0110111_2
39. The number 247_8 is represented in the binary system as
- 010100111_2
 - 111001010_2
 - 001100110_2
 - 010100100_2
40. The number $10FE_{16}$ is equivalent to
- 4350
 - 3251
 - 4341
 - 10155
41. $ABC_{16} = \dots$
- 101010111100_2
 - 100110111100_2
 - 000100110111_2
 - 111011001000_2
42. The number of bits needed to represent 623_{10} in the binary system is
- 8
 - 9
 - 10
 - 11
43. In the binary system, the arithmetic operation $1100101 + 101101 = \dots$
- 01001011
 - 10010111
 - 010010010
 - 101010010
44. In the binary system, the arithmetic operation $1100101 - 0000101 = \dots$
- 1010000
 - 1101100

- c) 1100000
- d) 1000000

45. The digit 11011.1101_2 equals to the decimal...

- a) 27.8125
- b) 27.13
- c) 13.27
- d) 445

46. The decimal 171144 represents the digit ...

- a) 5748_{32}
- b) $AF88_{32}$
- c) $B125_{32}$
- d) $F148_{32}$

47. Karnaugh map for 3 variables consists of ... cells.

- a) 3
- b) 6
- c) 8
- d) 9

48. The next Karnaugh map can be minimized in the form of

AB \ CD	CD			
	00	01	11	10
00	1	1	1	1
01				
11				
10	1	1	1	1

- a) AB
- b) $AB + CD$
- c) $\bar{B}$
- d) $\bar{A}$

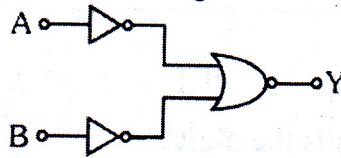
49. The adjacent cells of cell no. 16 are

AB \ CD	CD			
	00	01	11	10
00	1	2	3	4
01	5	6	7	8
11	9	10	11	12
10	13	14	15	16

- a) 4, 12, 13, 15

- b) 11,12,15
- c) 12,15
- d) 1,15

50. Which logic is represented by the following combination of logic gates?



- a) AND
- b) OR
- c) NAND
- d) NOR

END OF QUESTIONS

Answer Sheet

	1	2	3	4	5	6	7	8	9	10
True	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
False	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	11	12	13	14	15	16	17	18	19	20
True	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
False	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	21	22	23	24	25	26	27	28	29	30
True	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
False	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

	31	32	33	34	35	36	37
True	☐	☐	☐	☐	☐	☐	☐
False	☐	☐	☐	☐	☐	☐	☐

	38	39	40	41	42	43	44	45	46	47	48	49	50
a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
b	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
c	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
d	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

With my Best Wishes

Q1(35 marks): Choose the correct answer (MCQ):

- 1- Onset of diamagnetism of a superconductor occurs when;
(a) χ'' is maximum (b) χ' is zero (c) χ' is maximum
- 2- If $H_{c2}(0) = 20$ T , $\rho_n = 5 \times 10^{-5}$ ($\Omega.m$), then γ for Hg:1223 under pressure equals;
(a) 0.088 (J/Kg.K) (b) 0.079 (J/Kg.K) (c) 0.069 (J/Kg.K)
- 3- When $\delta = 0$ for R:123 system, the Cu of CuO-chains are formed in;
(a) 5-fold (b) 4-fold (c) 6-fold
- 4- If $E_c = 0.112$ J and $f_s(T) = 0.958$ J , then $f_n(T)$ equals;
(a) 1.061 J (b) 1.07 J (c) 1.081 J
- 5- If $T_c = 150$ K, $\lambda(0) = 0.51$ μm , then $\lambda(100$ K) equals;
(a) 0.549 μm (b) 0.569 μm (c) 0.579 μm
- 6- If $n(0) = 12.16 \times 10^{21}/cm^3$, $T_c = 150$ K , then $n(100$ K) equals;
(a) $9.758 \times 10^{21}/cm^3$ (b) $9.558 \times 10^{21}/cm^3$ (c) $9.798 \times 10^{21}/cm^3$
- 7- When $\delta = 0$ for R:123 system, the fold of Cu in CuO₂ planes are formed in;
(a) 5-fold (b) 8-fold (c) 4-fold
- 8- In R:123 system, the O(1) and O(5) are formed in
(a) CuO chains (b) CuO₂ planes (c) Ba-O layer
- 9- The crystal structure of Bi:2223 system is;
(a) tetragonal (b) hexagonal (c) monoclinic
- 10- Between Bi-O of Bi:2212 system, there are
(a) two CuO₂ planes (b) two CuO chains (c) one plane and one chain
- 11- If $\xi(0) = 2.1$ μm , then H_{c2} equals;
(a) 7.407×10^{-5} T (b) 7.474×10^{-5} T (c) 7.496×10^{-5} T
- 12- If $\xi = 0.81$ μm and $\lambda = 0.6$ μm , then δ_{ns} equals;
(a) 8.06×10^{-9} H_c (b) 8.36×10^{-9} H_c (c) 8.96×10^{-9} H_c
- 13- If G-L parameter $\kappa_{GL} = 0.511$ and $H_c = 0.21$ T, then H_{c2} equals;
(a) 0.149 T (b) 0.152 T (c) 0.137 T
- 14- One of superconducting applications is;
(a) solar cell (b) power cable (c) gas sensor
- 15- If $r = 0.45$ μm and $H_c = 0.125$ T, then I_c equal;
(a) 2.5×10^{-8} (A) (b) 2.81×10^{-8} (A) (c) 3.01×10^{-8} (A)
- 16- Electron pairs occurs as a result of interaction between;
(a) electron-lattice (b) electron- phonon (c) electron-electron
- 17- A rapid change of C_{en} at T_c is ascribed to;
(a) energy gap (b) electron pairs (c) both of them

- 18- The activation energy E_a of flux bundles can be obtained from the relation between;
 (a) $\ln f$ and T_p (b) f and $1/T_p$ (c) $\ln f$ and $1/T_p$
- 19- If $T_c = 110$ K for a superconductor, $\gamma = 0.0125$ (J/Kg.K), then $H_c(0)$ of BCS equals;
 (a) 14.569 T (b) 14.780 T (c) 14.699 T
- 20- The T_c of $HgBa_2Ca_{n-1}Cu_nO_{2n+2}$ is 134 K when
 (a) $n=2$ (b) $n=1$ (c) $n=3$
- 21- The energy gap at 0 K for a superconductor of 40 K T_c equals;
 (a) 1.916×10^{-23} J (b) 1.943×10^{-21} J (c) 1.966×10^{-20} J
- 22- The surface sheath of type (I) superconductor occurs when;
 (a) $\kappa_{GL} < 0.419$ (b) $\kappa_{GL} \geq 0.419$ (c) $\kappa_{GL} > 0.319$
- 23- The G-L parameter of type (II) superconductors is
 (a) $\kappa_{GL} < 0.707$ (b) $\kappa_{GL} \geq 0.707$ (c) $\kappa_{GL} = 0.607$
- 24- The G-L parameter of type (I) superconductors is
 (a) $\kappa_{GL} > 0.707$ (b) $\kappa_{GL} \leq 0.707$ (c) $\kappa_{GL} = 0.757$
- 25- If $H_{c2} = 4.1$ T, then H_{c3} equals;
 (a) 6.937 T (b) 6.949 T (c) 6.967 T
- 26- The specific heat of a superconductor at T_c equals ;
 (a) $\approx 3C_{en}$ (b) Zero (c) $\ll 3C_{en}$
- 27- The condensation energy at $H_c = 12$ T equals;
 (a) 5.732 J (b) 5.742 J (c) 5.712 J
- 28- If $H_c(0) = 5$ T, $T_c = 150$ K, then $H_c(100$ K) equals;
 (a) 2.778 T (b) 2.877 T (c) 2.768 T
- 29- According to London equation, the field at London depth equals;
 (a) $(1/e)B(a)$ (b) $B(a)$ (c) Zero
- 30- If $\lambda(0) = 5.1$ nm, then H_{c1} equals;
 (a) 12.67 T (b) 11.65 T (c) 13.67 T
- 31- The folds of La and Cu in La:214 are respectively;
 (a) 6 and 8 (b) 10 and 8 (c) 8 and 10
- 32- The critical field H_{c2} of Bi:2212 is about;
 (a) 7 T (b) 10 T (c) 9 T
- 33- The $H_c(0)$ of a superconductor when $E_g = 14.56 \times 10^{-22}$ J and $n_s(0) = 10^{20}/m^3$ equals;
 (a) 5.56 T (b) 3.65 T (c) 1.91 T
- 34- The T_c of a superconductor is obtained when
 (a) $I = 0$ (b) $T = 0$ (c) $V = 0$
- 35- The crystal structure of FeSeTe system is;
 (a) orthorhombic (b) hexagonal (c) tetragonal

Q2 - Choose True (T) or False (F) (15 marks):

- 36- The transport vehicles of super-train float on strong superconducting to increase friction.
(a) F (b) T
- 37- The structure of $\text{FeSe}_{0.5}\text{Te}_{0.5}$ consists of tetrahedral Fe-ions
(a) F (b) T
- 38- The sign of thermoelectric power of a superconductor is usually negative.
(a) F (b) T
- 39- The Cooper pairs move as a supercurrent with highly dissipation.
(a) F (b) T
- 40- The electron pairs require energy less than their binding energy for their breaking.
(a) F (b) T
- 41- The jump of specific heat at T_c is due enhancing the order parameter.
(a) F (b) T
- 42- When $I > I_c$, the voltage across superconductor appears and increases linearly with I .
(a) F (b) T
- 43- The slope (dV/dI) defines the flux flow resistance R_f of a superconductor.
(a) F (b) T
- 44- The entropy of the electrons in the normal state is higher than SS.
(a) F (b) T
- 45- In R:123 system, O(1) is occupied whereas O(5) is empty
(a) F (b) T
- 46- The T_c of Bi: 2223 is about 89 K
(a) F (b) T
- 47- When $F_L = F_p$, the vortex lines will move as well as flux flow.
(a) F (b) T
- 48- When $F_L > F_p$, the vortex will localized at the top of the well.
(a) F (b) T
- 49- Superconductivity is quenched when the flux creep occurs.
(a) F (b) T
- 50- The T_c of Ti: 2223 is about 117 K
(a) F (b) T

Assuit University

Grade: Four

Faculty of Science

Course: 492 F

Physics Department

Time: 3 hours

Second Term Exam 2023

Answer the following questions:

Question 1:

Write a short account on:

- a) The Specific heat of solids.
- b) The lattice thermal conductivity.

Question 2:

Discuss the following:

- a) Heat Capacity of electrons in Metal.
- b) The thermoelectric effects in Semiconductors.

Question 3:

Write a short account of the plane- Temperature wave technique and discuss how to measure the thermal properties of solids.

Question 4:

Discuss how to measure and calculate the thermophysical properties of insulators as syndiotactic polypropylene (SPP).

Question 5:

Explain the thermal analysis by figures for each:

- a) Thermo Gravimetric Analysis (TGA).
- b) Differential Thermal Analysis (DTA).
- c) Differential Scanning Calorimetry (DSC).

Good Luck

Examiner: Prof. Dr. Mostafa Saad Mostafa



Undergraduate
Final Exam
2nd semester 2022-2023
Course: Radiation Physics
Code:P444



Faculty of Science
Department of Physics

Section: Phys. and Phys./Chem
Time:3 hours
Date:12-6-2023

Assiut University

Answer the following question

Question (1):

(30 Mark)

1. Put [✓] or [x] for each of the statement. (15 Mark, 1.5 each question)

1) Compton scattering refers to the inelastic scattering of photons for bound electrons.	()
2) The radioactive equilibrium occurs when the half-life of the parent nucleus is more short-lived than the daughter nucleus.	()
3) The condition for β^+ decay to be possible is $M(A,Z)-M(A,Z+1) > 0$, where $M(A,Z)$ and $M(A,Z+1)$ are the atomic masses of parent and product nuclei.	()
4) The annihilation radiation is defined the original positron and electron disappear and are replaced by two oppositely directed 0.511 Mev electromagnetic photons.	()
5) Condition for α -decay to be possible is: $M(A, Z) > M(A-4,Z-2) - M(4,2)$.	()
6) Bremsstrahlung is defined when electron is decelerated by attractive Coulomb field when electron pass near nuclei of target.	()
7) β^+ decay is radioactive parent nucleus transforms a neutron into a proton.	()
8) Radiation damage means the bonds between atoms get weakened and as a result new chemicals are formed	()
9) Recombination occurs at high voltages.	()
10) Binding energy for a particle is defined as the energy required to separate one particle from the nucleus.	()

2. Choose the correct answer a, b or c

(15 Marks, 1.5 Mark each)

1) Nucleus capture orbital electron (usually K shell) and neutrino is emitted. a) Electron Capture decay b) Internal conversion c) Proton Emission
2) When $\tau_1 > \tau_2$, both number of atoms of parent N_1 and daughter N_2 decrease exponentially with time with the half-life of parent and the ratio N_2 / N_1 remains constant. a) Secular equilibrium b) Transient equilibrium c) No equilibrium
3) 1Ci =Bq. a) 3.70×10^{10} b) 3.07×10^{10} c) 3.70×10^9
4)decay is radioactive parent nucleus transforms a neutron into a proton. a) β^- b) β^+ c) α
5) The original positron and electron disappear and are replaced by two oppositely directed 0.511 MeV electromagnetic photons known as. a) Annihilation b) Proton Emission c) Internal conversion
6) The energy required to completely break up the nucleus into well separated Z protons and N neutrons. a) Binding energy b) Excitation c) Ionization
7)is a neutral particle with zero rest mass. a) Neutrino b) Proton c) Electron
8) Average energy of positrons from β^+ decay, is taken to be equal... a) $T_{\beta^+} = T_{max}/4$ b) $T_{\beta^+} = T_{max}/3$ c) $T_{\beta^+} = T_{max}/5$

