University of Baghdad
College of Science
Department of Physics
Date: 22 /6/ 2017

Qualifying Examination
for Ph.D Students
Year : 2017 -2018
Time : 3 Hours

الامتحان التنافسي للمتقدمين للدراسات العليا (الدكتوراه) لقسم الفيزياء / كلية العلوم/جامعة بغداد

للعام الدراسي 2017- 2018

الاختصاص : فيزياءالليزر والجزيئية (الورقة العامة)

1-Multiple Choice Questions (MCQ)

Q.1) If a generalized coordinate has the dimensions of velocity, generalized Velocity has the dimensions of
 (a) Displacement
 (b) Velocity
 (c) Acceleration
 (d) Force

Q.2) Choose the correct statements:
 (a) The angular momentum is conserved for system possessing rotational symmetry.
 (b) If the Lagrangian of a system is invariant under translation along a direction, the corresponding linear momentum is conserved.
 (c) If the lagrangian of a system is invariant under translation a long a direction, we cannot say anything about the corresponding linear momentum.
 (d) For a conservation system, the Hamiltonian is equal to the sum of kinetic and potential energies.

Q.3) A particle is moving on elliptical path under inverse square law force of the   form
   $F(r)= (-K/r^2)$, the eccentricity of the orbit is
 (a) A function of total energy.
 (b) Independent of total energy.
 (c) A function of angular momentum.
 (d) Independent of angular momentum.

Q.4) The binding energy of alkali metal is -------- than of alkali halide crystal

 a- equal
 b- Higher
 c- More higher
 d- Less

Q.5) The space lattice in diamond structure is ------

 a- Bcc
 b- Hexagonal
 c- Cubic
 d- Fcc

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Q.6) Bragg law satisfied only for wavelength ---------

   a- $\lambda \geq 2d$
   b- $\lambda = 2d$
   c- $2\lambda \geq 2d$
   d- $\lambda \leq 2d$

Q.7) The absolute value of the real number x is defined by:

(a) $|x| = \begin{cases} x, & if \ x < 0 \\ -x, & if \ x \geq 0 \end{cases}$ (b) $|x| = \begin{cases} x, & if \ x \geq 0 \\ -x, & if \ x < 0 \end{cases}$

(c) $|x| = x$ for $-\infty < x < \infty$ (d) $|x| = -x$ for $-\infty < x < \infty$.

Q.8) The result of $\left(e^{x_1}\right)^{x_2}$ is given by:

(a) $e^{x_1 + x_2}$,

(b) e^{x_1 / x_2},

(c) $e^{x_1 - x_2}$,

(d) $e^{x_1 x_2}$.

Q.9) The Domain (D_0) and Range (R_g) of the function $y = \sqrt{x+4}$ are given by:

(a) $D_0 : x \geq -4, \ R_g : y \geq 0$ (b) $D_0 : -\infty < x < \infty, \ R_g : y = 0$

(c) $D_0 : x = 0, \ R_g : y = -4$.   (d) $D_0 : x \geq -4, \ R_g : y = 0$.

Q.10) The expectation value of the kinetic energy of the one dimensional harmonic oscillator in the ground state is

A: $0 \ \hbar\omega$ B: $1 \ \hbar\omega$ C: $1/2 \ \hbar\omega$

Q.11) In Angular momentum By Ladder Operators, $[L_x, L_y] =$

   A: $i\hbar L_z$ B: 0   C: 1

Q.12) In one dimensional harmonic oscillator , $a\psi_1 =$

   A: ψ_0 B: ψ_1 C: ψ_2

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2-Short Note Questions (MCQ)

Q.1) If **F=(2xy+z²) ĭ + x² ĵ + 2xz Ḱ** newton ,then show that it is conservation. Calculate the amount of work done by this force in moving a particle from **(0,1,2)** to**(5,2,7) m** .

Q.2) A particle of mass (m) move on plane in the field of force given by polar Coordinate (**F= -KcosΘ ř)** , where **(K)** is constant and**(ř)** is the radial unit vector

(a) Will the angular momentum of the particle about the origin be conserved? Justify your statement.
(b) Obtain the differential equation of the orbit of the particle.

Q.3) Explain the structure factor of Fcc lattice

Q.4) What is Brilloiun zone

Q.5) Evaluate $\int \frac{\cos x \, dx}{\sin x}$.

Q6.) Find $\frac{dy}{dx}$ for $y = \cosh^2 5x - \sinh^2 5x$.

Q.7) In Angular momentum By Ladder Operators Prove that $[L^2, L] = 0$

Q.8) Represent L^2 it in a matrix form if you given that

$$\langle \ell'm' | L^2 | \ell m \rangle = \hbar^2 \ell(\ell+1)) \delta_{\ell'\ell} \delta_{m'm}$$

الاختصاص : فيزياء الليزر والجزيئية (الورقة الخاصة)

1-Multiple Choice Questions (MCQ)

Q.1) Intense light in laser action is :

 (a) Reduced gain.

 (b) Reduces the population inversion.

 (c) Increase the population inversion.

 (d) Increase gain.

 Q.2) Which laser is considered "eye safe"?

(a) Laser bar-code scanners   (b) The eximer laser   (c) Communications lasers

Q.3) Why are lasers used in fiber optic communications systems
(a) The government has mandated it   (b) They can be pulsed with high speed data
(c) They are very inexpensive

Q.4) When the green one is dead, I have a red laser pointer that emits light with a
wavelength of 670 nm. What is the energy of this light?
(a) 2.97 J mol^{-1} (b)179 kJ   (c) 1.79 kJ mol^{-1} (d) 3.8 kJ mol^{-1} (e) 17.9 J
(f)17.9 kJ mol^{-1} (g) 2.97 kJ mo   (h) 179 J mol^{-1} (i) 179 kJ mol^{-1} (j) 297 J mol^{-1}

Q.5) The Excimer laser produces light with what wavelength
(a) Visible   (b) Ultraviolet   (c) Infrared

Q.6) What type of laser could cause skin cancer if not used properly?
  (a) Red semiconductor laser
  (b) Blue semiconductor
  (c) Excimer laser
  (d) YAG laser

Q.7) Metals can _____ the light beams.
  (a) Reflect   (b) Refract   (c) Transmit   (d) Any

Q.8) Fluorescence occurs within _____.
  (a) 10^{-5} s   . (b) 10^{-5}ms.   (c) 10^{-5}μs.   (d) 10^{-5}ns.

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Q.9) What is the correct way to display spectra?

(a) In absorbance.   (b) In transmission.   (c) Either absorbance or transmission (d) As raw data.

Q.10) If you shine green laser ($\lambda = 520$ nm) on a material, what is the most likely response of the molecules in that material to this wavelength of light?
  (a) Electronic transition   (b) Nuclear spin flip   (c) Bond stretch
  (d) Bending vibration   (e) Bond rotation   (f) Bond dissociation
  (g) Ionization   (h) Photon emission

Q.11) What occurs when a molecule absorbs infrared radiation?

(a) It warms up   (b) It flies around   (c) It spins faster   (d) It vibrates faster

**Q.12)** Which of the following is NOT a correct aspect of the Born-Oppenheimer approximation
(a) The electrons in a molecule move much faster than the nuclei.
(b) Excited electronic states have the same equilibrium inter nuclear distance as the ground electronic state
 (c) The electronic and vibration motions of a molecule are approximately separable.
 (d) Electronic energy curves serve as potential energy functions for nuclear vibration motion
 (e) The typical amplitude of nuclear vibration is much smaller than that characterizing the motion of electrons.
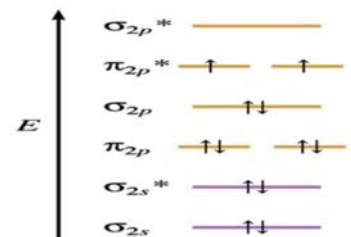
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2-Short Note Questions (MCQ)

Q.1) What portion of the electromagnetic spectrum induces the nuclear spin flip that occurs to generate an NMR spectrum?

Q.2) How many sigma (σ) and pi (π) bonds are present in the entire molecule C2H4?: …......sigma bonds……………. pi bonds.. between nuclei highest?

Q.3) Answer each of the following:

 (a) Spectral Region for Molecular Electronic Transitions …………………

 (b) Spectral Region for Molecular Vibrational Transitions ……………….

 (c) Spectral Region for Molecular Rotational Transitions …………………

Q.4) Line broadening reduces the effective gain because all ……………atoms are capable of interacting with the radiation field.

Q.5) In the fig. below describe the parameters in the lasing cycle of the 4-Level System:
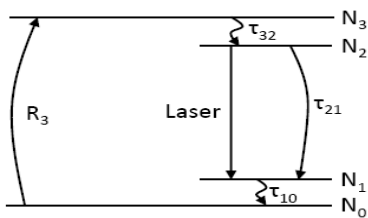
Q.6) There are many efficiencies in common use in   laser physics write it and explain.
Q.7) What is the essential components of a laser system. Explain it

Q.8) The fig. in the right describes one molecule:
What is the molecule with this molecular orbital diagram?
What is the bond order?
Is it paramagnetic or diamagnetic?

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