niversity of Baghdad
'ollege of Science
)epartment of Physics
)ate: 2 / 9 / 2015

Qualifying Examination
for M.Sc Students
Year:2015-2016
Time: 3 Hours

الامتحان التنافسي للمتقدمين للدراسات العليا (الماجستير) المحاولة الثانية لقسم الفيزياء-كلية العلوم/ جامعة بغداد للعام الدراسي ٢٠١٥-٢٠١٦

1-Multiple Choice Questions:

).1) The energy operator in quantum mechanics, $\hat{H} = -\frac{\hbar^2}{2m}\frac{\partial^2 x}{\partial x^2} + V$ (here given for one particle in one imension) is called the

(a) Lagrangian (b) Hamiltonian (c) Hermitian (d) Angular momentum

).2) The commutator $[L^2, L_y] =$:

(a)0 (b) $i\hbar L_x$ (c) $-i\hbar L_z$

).3) The probability of finding a particle in differential region dx is:

(a) $\psi(x,t)\,dx$ (b) $\psi(x,t)/\psi^*(x,t)\,dx$ (c) $\psi^*(x,t)\psi(x,t)\,dx$

).4) Radioactivity is the process of:

(a) an unstable nucleus becoming stable (b) an electron moving to a higher energy shell
(c) an electron moving to a lower energy shell (d) a stable nucleus becoming unstable

).5) The isotope ^{234}U92 undergoes five successive alpha decays. Identify the daughter nucleus at each step.

a) ^{230}Th90 --> ^{226}Ra88 --> ^{222}Rn86 --> ^{218}Po84 --> ^{214}Pb82
b) ^{232}Th90 --> ^{228}Ra88 --> ^{224}Rn86 --> ^{220}Po84 --> ^{216}Pb82
c) ^{228}Th90 --> ^{224}Ra88 --> ^{220}Rn86 --> ^{216}Po84 --> ^{212}Pb82
d) ^{233}Th90 --> ^{229}Ra88 --> ^{225}Rn86 ---> ^{218}Po84 --> ^{217}Pb82

).6)Identify the nucleus designated by X in each of the following a) ^{226}Ra88 -----> X + alpha b) ^{233}Pa91 -----> X + beta(-) c) ^{59}Fe26 -------> X + gamma

a) a) ^{212}Rn86 b) ^{239}U92 c) ^{57}Fe26
b) a) ^{232}Rn86 b) ^{231}U92 c) ^{58}Fe26
c) a) ^{230}Rn86 b) ^{234}U92 c) ^{60}Fe26
d) a) ^{222}Rn86 b) ^{233}U92 c) ^{59}Fe26

).7)Tesla is a unit of

a) field strength (b) inductance (c) flux density (d) flux.

).8) A magnetic field exists around

a) iron (b) copper (c) aluminum (d) moving charges.

).9) The Biot-Savart's law is a general modification of ---------- law.

a) Kirchhoff's (b) Lenz's (c) Ampere's (d) Faraday's.

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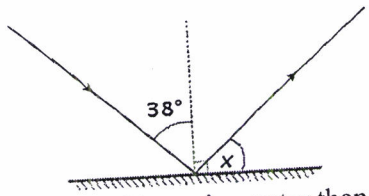
Q10.) Helium-neon laser light ($\lambda = 6.33 \times 10^{-7}$ m) is sent through a 0.30 mm-wide single slit. What is the width of the central maximum on a screen 1.0 m from the slit?
(a) 2.0 cm (b) 4.2 mm (c) 1.1 cm (d) 2.0 mm (e) 0.70 mm

Q11.) You are holding a flashlight so the beam strikes a plane mirror at an incident angle of 38. What is the measure of angle x between the reflected light ray and the mirror?
(a)38 (b)52 (c) 90 (d) 155



Q12.) What happens to the refracted ray if the angle of incidence is greater than the critical angle of the medium?
(a)It is bent toward the normal. (b) It is bent along the normal. (c)It exits the medium. (d)It does not exit the medium

Q13.) 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 $-\infty < x < \infty$.

Q14.) 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.15.) 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) $D_0: x \geq -4$, $R_g: y = 0$.

Q16.) Why was Towne's early work with stimulated emission done with microwaves?
(a) He was not concerned with light amplification. (b) It was easier to work with longer wavelengths.
(c) His partner Schawlow had already begun work on the las (d)The laser had already been developed
Q.17) For a constructive interference in a Laser cavity, the distance L between the two mirrors should
(a) $n\lambda$ (b) $(n+1)\lambda$ (c) $(n-1)\lambda$ (d) $n\lambda/2$

Q18.) In a semiconductor Laser, the population inversion followed by a stimulated emission is controlled by
(a) Resistance (b) Temperature (c) Current (d) Impedance

Q.19.) the particles are called "fermions" have spin quantum number equal:
(a)S = 1/2, 3/2, 5/2 (b)S = 0 ,1 ,2 ,3 (c)S = -2 , -1 , 0 , 1 , 2 (d)None of them

Q20.) The equation of the Fermi – Dirac statistics

(a) $N_i = \dfrac{g_i}{e^{(E_i-E_F)/kT}+1}$ (b) $N_i = \dfrac{g_i}{e^{(-E_F)/kT}+1}$ (c) $N_i = \dfrac{g_i}{e^{(E_i-E_F)/kT}}$ (d) $N_i = \dfrac{g_i}{e^{(E_i-E_F)/kT}-1}$

Q21.) Debye eqn of molal specific heat, C_v, for non-metallic crystals at high temperature equal to
(a) $C_v = 3R$ (b) $C_v \sim R$ (c) $C_v \gg R$ (d) $C_v = R$

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Q.22) The space lattice for NaCl crystal is :
(a)simple cubic . (b)face centered cubic. (c)body centered cubic.

Q.23) Electronic heat capacity for metals at very low temperature is proportional to
(a)temperature (b)pressure (c) crystal structure

Q.24) Debye Temperature is proportional to
a- Debye mode. b-Debye frequency. c-. Debye velocity.

Q.25) A 50 kg object starts from rest and its subject to a constant force of 5 N. what is the acceleration of the object:
(a)1 m/s^2 , **(b)** 0.1 m/s^2 **(c)** 0.01 m/s^2

Q.26)A pendulum of length L supporting mass M swings back and forth with period T. If the mass is doubled, what is the new period?
(a) T **(b)** T/2 **(c)** 2T

Q.27)A ball is thrown straight downward with an initial speed of 25 m/s. It strikes the ground after 2.0 seconds. How high is the building?
(a) 30m **(b)** 50m **(c)** 70m

Q.28) At low temperature a body emits radiation of
(a) Shorter wavelength (b) High frequencies (c) Longer wavelength (d) Low frequencies

Q.29) Compton effect is observed for
(a)visible light (b) UV rays (c) X rays (d) γ rays

Q.30) The maximum kinetic energy of photo electrons depend upon light's
(a)Intensity (b)Frequency (c)Wavelength (d)Energy

Q.31) Hysteresis refers to the _____ between flux density of the material and the magnetizing force applied.
(a) Leading effect (b) Ratio (c) Equality (d) Lagging effect

Q.32) The energy stored in an electrostatic field or electromagnetic field is called
(a)Electromagnetic energy (b) Kinetic energy
(c) Potential energy (d) Rest energy

Q.33) When the ferromagnetic substance is inserted in a current- carrying solenoid, the magnetic field is
(a) Greatly decreased (b) Greatly increased
(c) Slightly decreased (d) Slightly increased

Q.34) If the vector $a\mathbf{i}+\mathbf{j}-\mathbf{k}$ is perpendicular to the vector $\mathbf{i}+2\mathbf{j}-3\mathbf{k}$, the value of a is:
(a)-3 (b) 5 (c) -5

Q.35) The Hamilton's function (H) of any system is equal to:
(a)H= T- V (b) H= T+V (c) H= L- T

Q.36) If the force field F=i xy+j xz+k yz Is not conservative, the curl of F is:
(a)i(y-z)+ j+ k(z-x) (b) zero (c) i (z-x)+k (z-x)

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2- Short Note Questions

Q.1) Prove that : $H = \hbar w\left({}^{+}a\,a + \frac{1}{2}\right)$, where H is the Hamiltonian of the one dimensional harmonic oscillator, ${}^{+}a$ is the rising operator and a is the lowering operator.

Q.2) Hydrogen atom in the state $\psi(\vec{r},t) = \sqrt{\frac{3}{4}}\psi_{100}(\vec{r})\, e^{-iE_1 t/\hbar} + \sqrt{\frac{1}{4}}\psi_{211}(\vec{r})\, e^{-iE_2/\hbar}$

What is the probability of measurements which give $E = E_2$?

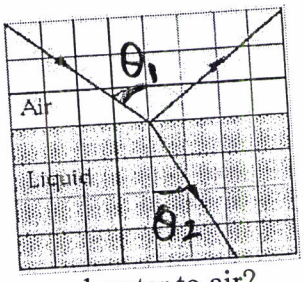
Q.3) Why must Geiger Muller tube for detecting α -particles have a very thin end window? Why does a Geiger Muller tube for detecting γ-rays not need a window at all?

Q.4) Discuss the advantages and disadvantages of fusion power from the point of safety, pollution and resources.

Q.5) What are the differences between Laplace's and Poison's equations?

Q.6) What will be the magnetic potential difference across the air gap of 2 cm length in magnetic field of 200 AT/m?

Q.7) A ray of light is shown reflected and refracted at the surface of a liquid. From the diagram determine the speed of light in this liquid.



Q.8) Find the critical angles for glass to water and water to air?

Q.9) Evaluate $\int \frac{\cos x\, dx}{\sin x}$.

Q.10) Find $\frac{dy}{dx}$ for $y = \cosh^2 5x - \sinh^2 5x$.

Q.11) State the type of losses inside the laser cavity?

Q.12) A He-Ne laser tube 50 cm long has a gain of 1.08; find the gain coefficient?

Q.13) In the classical perfect gas the number of molecules in the range p to p+dp is:

$n_p(p)\,dp = \frac{4\pi N}{(2\pi mkT)^{3/2}} e^{1\frac{p^2}{2mkT}} p^2 dp$, Find the number of molecules in the range of v to v+dv .

Q.14) From Fermi-Dirac distribution we have $N_i = g_i / (e^{(E-E_F)/kT} + 1)$, find the Fermi energy at zero Kelvin and draw the diagram for Fermi function.

Q.15) Plot and discuss the dispersion relation for linear diatomic lattice.

Q.16) Discuss and plot the effect of increasing temperature on the electrical conductivity of metals

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Q.17) An object moving with a speed of 25 m/s is uniformly accelerated at a rate of $2m/s^2$. What is the speed after 12 s of acceleration?

Q.18) What is the gravitational force between two balls with masses of 49.5 kg and 0.775 kg, when the center of theses balls was separated by a distance of 0.2m? (Hinte take $G= 6.73x10^{-11}$ $N.m^2/kg^2$).

Q.19) What is the mass of an object moving with speed 0.6c? (c is speed of light in free space)

Q.20) 1.What is a relation for the momentum of photon in term of frequency?

2. Calculate the ionizing energy (in eV) of Li^{++} atom (z=3)?

Q.21) Why should the cross section of potentiometer wire be uniformed?

Q.22) Define Magnetic Dipole Moment ($\vec{\mu}$) for a current carrying loop.

Q.23) What is the moment of inertia of a thin uniform rode of length L and mass m, for an axis perpendicular to the rod at one end?

Q.24) Find the equation of motion of one-dimension harmonic oscillator by using Lagrangian equation?