College of Science
Department of Physics
Date: 13 / 8 / 2015

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

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

1-Multiple Choice Questions:

Q.1) The expectations value of a function $f(x)$ when the wave function depends only on x is given by $<f(x)>=$

(a) $\int_{-\infty}^{\infty} \sqrt{f(x)}\ \psi(x)\,dx$

(b) $\int_{-\infty}^{\infty} f(x)\ \psi(x)\,dx$

(c) $\int_{-\infty}^{\infty} \psi^{*}(x)\, f(x)\ \psi(x)\,dx$

(d) $\int_{-\infty}^{\infty} f(x)\ \psi^{*}(x)\,dx$

Q.2) The coupling of two angular moment, j_1 and j_2 gives the following number of substates:

(a) $j_1 + j_2$ (b) Values from j_1 to j_2, in integer steps.

(c) Values from $|j_1 - j_2|$ to $|j_1 + j_2|$, in integer steps.

Q.3) A particle has a total energy that is less than that of a potential barrier. When the particle penetrates the barrier, its wave function is

(a) A positive constant. (b) Oscillatory.
(c) Exponentially increasing. (d) Exponentially decreasing

Q.4) If a radioactive isotope of silver have a half-life of about 7.5 days. After 15 days the remaining isotope of its original is

(a) 25% (b) 50% (c) 7.5% (d) 15%

Q.5) In Positron Emission:
(a) Z increases by 1 and A remains the same
(b) Z decreases by 1 and A remains the same
(c) Z remains the same and A decreases by 1
(d) Z remains the same and A increases by 1

Q.6) The following reaction: ${}_{1}^{2}H + {}_{1}^{3}H \rightarrow {}_{2}^{4}He + {}_{0}^{1}n$ is called:

(a) Fusion (b) Fission (c) alpha decay (d) beta decay (e) gamma decay

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

Q.7) The units of $\vec{\nabla} \times \vec{H}$ is
(a) Ampere (b) Ampere/m (c) Ampere/m^2 (d) Tesla

Q.8) The trajectory of charged particle in uniform E and B fields is a
(a) straight line (b) a circle (c) helix, (d) not of them.

Q.9) Lenz's law is a consequence of the law of conservation of
(a) induced current, (b) charge, (c) energy, (d) induced e.m.f.

Q.10) An object is 4 cm in front of a converging lens with a focal length of 8 cm, its image is at?
(a) 4 cm (b) 8 cm
(c) -4 cm , (d) -8 cm.

.Q.11) The phase velocity of the wave described by $\psi = A \sin(kx + \sigma t)$ is:

(a) x/t (b) σ/k
(c) A/σ (d) $\pi/2k$

Q.12) An expression for the absolute index of refraction is:

(a) v/c (b) $c / \sqrt{\epsilon\mu}$

(c) $c \sqrt{\epsilon\mu}$ (d) $\sqrt{\epsilon_0\mu_0/(\epsilon\mu)}$

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

Q.13) The space lattice for CsCl crystal is:

(a) simple cubic .

(b)face centered cubic.

(c)body centered cubic.

Q.14) Bragg law can be satisfied only for wavelength:

(a) $\lambda \leq 2d$.
(b) $\lambda > 2d$.
(c) $\lambda = d$.

Q.15) There are:

(a) 14 lattice types in 3 dimensions.

(b) 7 lattice types in 3 dimensions.

(c) 8 lattice types in 3 dimensions.

Q.16) For cross products,
(a) the commutative and associative laws are valid
(b) the commutative and associative laws are not valid
(c) the commutative law is not valid while the associative law is valid
(d) the commutative law is valid while the associative law is not valid.

Q.17) The necessary and sufficient condition that the field $\vec{F}$ be a conservative is that
(a) $\text{div}\,\vec{F} = 0$, (b) $\text{grad}\,\vec{F} = 0$, (c) $\text{curl}\,\vec{F} = 0$, (d) $\text{div grad}\,\vec{F} = 0$.

Q.18) The following equation: $\oint_C M\,dx + N\,dy = \iint_R \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right) dx\,dy$ is the definition of

(a) Green's theorem in the plane

(b) Stoke's theorem

(c) divergence theorem of Gauss

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

Q.19) In stimulated emission process, the number of coherent laser photons are:

(a) 3 (b)1 (c) 4 (d) 2

Q.20) Intensity distribution of transverse laser modes is measured

(a) along the optical axis of the laser

(b) perpendicular to the optical axis of the laser

(c) both A and B

(d) None of them

Q.21) The lifetime of metastable state in comparison to excited state is

(a)smaller (b)greater (c)Equal (d)much greater

Q.22) The relation between permeation and combination is :

(a) $C(n, r) = \frac{p(n,r)}{r!}$

(b) $C(n, r) = p(n,r) * r!$

(c) $C(n,r) = p(n,r)$

(d) None of them

Q.23) The particles, like α – particles, ^{2}H, ^{4}He, mesons, photons and phonons, are appli in

(a) Bose-Einstein (B-E) Statistics

(b) Maxwell - Boltzmann (M – B) statistics

(c)Fermi – Dirac Statistics

(d) Boltzmann thermal distribution law

Q.24) The Monatomic gases has degrees of freedom equal to

(a) $f = 3$ (b)$f = 2$ (c) $f = 1$ (d) $f = 4$

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

Q.25) A 100kgman climbs a ladder to a height of 5m. the work has he made is

(a)zero, (b) 5000N.m , (c) 50000 N.m, (d) 2500 N.m

Q.26) The weight of man at the surface of the earth is 1200N, the weight of this man on the surface of the planet Mars (where $g=3.7m/s^2$) is;

(a) 439N (b) 465 (c) 444N

Q.27) A ball is projected upwards with a velocity of 50m/s at an angle 60^o to the velocity of projectile after 1 second is ;

(a) 45.7 m/s (b) 55.9 m/s (c) 33.5 m/s

Q.28) Theory of relativity is valid only when

(a) Object is moving with large velocity

(b) Observer is moving with large velocity

(c) Both A and B are true

(d) Both A and B are false

Q.29) Which phenomenon is best explained by particle nature of light?

(a) The Doppler effect

(b) The photoelectric effect

(c) Polarization

(d) Interference

Q.30) The velocity of electron in second Bohr orbit as compared to the velocity in first orbit is

(a) Equal

(b) 2 times

(c) One fourth

(d) One half

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

Q.31) Coulomb's law describes the electrostatic force between
(a) charged objects at rest and separated by a distance r,
(b) charged objects not at rest and separated by a distance r,
(c) point electric charges at rest and separated by a distance r,
(d) point electric charges not at rest and separated by a distance r.

Q.32) Electric charge is
(a) quantized but not conserved,
(b) conserved but not quantized,
(c) quantized and conserved
(d) not quantized and not conserved.

Q.33) The magnetic force $\vec{F}_B$ acting on a charged particle moving with velocity $\vec{v}$ through a magnetic field $\vec{B}$ is always
(a) perpendicular to $\vec{v}$ and $\vec{B}$,
(b) parallel to $\vec{v}$ and $\vec{B}$,
(c) parallel to $\vec{v}$ and perpendicular to $\vec{B}$,
(d) perpendicular to $\vec{v}$ and parallel to $\vec{B}$.

Q.34) A 120-Ib person stands on bathroom spring scale while riding in an elevator. If the elevator has upward acceleration of g/4, the weight indicated on the scale is:

(a) 5/4 mg **(b)** 3/4 mg **(c)** 7/5 mg

Q.35) The magnitude of the sum of the two vectors **A**=(1,0,2) and **B**=(0,1,1) is equal to:
(a) $\sqrt{9}$ **(b)** $\sqrt{13}$ **(c)** $\sqrt{11}$

Q.36) If we have two vectors **A=2i+j-K, B=i-j+2k,** the $\boldsymbol{A} \times \boldsymbol{B}$ is equal:

(a) i-5j-3k **(b) 3i-4j+k** **(c) i-5j-2k**

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

2- Short Note Questions

Q.1) The wave function of a particle at given time is given by $\psi(x)=\frac{e^{ikx}}{\sqrt{x^2+a^2}}$, where k and a are constants. Is $\psi(x)$ normalized? If not, find the normalization constant.

Q.2) Hydrogen atom in the state $\psi(\vec{r},t)=\sqrt{\frac{3}{4}}\psi_{100}(\vec{r})\,e^{-iE_1t/\hbar}+\sqrt{\frac{1}{4}}\psi_{211}(\vec{r})\,e^{-iE_2/\hbar}$

What is the probability of measurements which give $E=E_1$?

Q.3) Define the term binding energy, and which particle can be added to the nucleus without affecting its chemical properties?

Q.4) What do you understand by "background radiation"? State two sources of this radiation

Q.5) In magnetism, we can write that $\nabla.\boldsymbol{B}=\mathbf{0}$, what is the meaning of that, then does that valid in the electricity, and why?

Q.6) If the electric field intensity is given by: $\vec{E}=(x\,\hat{x}+y\,\hat{y}+z\,\hat{z})$ volt/m, find the potential difference between $p_1(2,0,0)$ and $p_2(1,2,3)$

Q.7) Light travels from air into an optical fiber with an index of refraction of 1.44:

(a) In which direction does the light bend?
(b) If the angle of incidence on the end of the fiber is 22°. What is the angle of refraction inside the fiber? (c) Sketch the path of light as it changes media

Q.8) A-Monochromatic light falling on two slits 0.016 mm apart produces the fifth-order fringe at an 8.8° angle. What is the wavelength of the light used?

Q.9) Plot (111) plane for a cubic crystal with lattice constant a.

Q.10) What is the difference between hexagonal and hexagonal close packed structures.

Q.11) Convert $2\left(\cos\frac{\pi}{6}+i\sin\frac{\pi}{6}\right)$ into the rectangular form.

Q.12) Find $\vec{A}\times\vec{B}$, where $\vec{A}=2\vec{i}-3\vec{j}-\vec{k}$ and $\vec{B}=\vec{i}+4\vec{j}-2\vec{k}$.

Q.13) What is the requirement needed in the laser active media for achieving minimum value of population inversion?

Q.14) In gaseous lasers, we cannot achieve the population inversion by optical pumping. Why?

Q.15) If the thermodynamic probability is given by the relation $\Omega=\prod_i^M\frac{(N_i+g_i)!}{N_i!\;g_i!}$,

then derive the relation which give us the particle distribution and then classified.

Q.16) 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.

University of Baghdad
College of Science
Department of Physics
Date: 13 / 8 / 2015

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

Short Note Questions

Q.17) A 50 kg object starts from rest and is subject to a constant force of 5N. What is the magnitude and the direction of the acceleration?

Q.18) Two identical objects are separated by a distance of 1m. If the gravitational force between them is 6.7×10^{-9}N, what is the mass of each object? (Hint take G = 6.73×10^{-11} $N.m^2/kg^2$).

Q.19) For the emission line (from **n=4** to **n=1**) of He^+ atom (**z=2**). Calculate:

1. The wavelength of this emission?
2. The velocity and linear momentum of the electron in the innermost orbit (**n=1**)?

Q.20) Compare between ionic bonding and covalent bonding?

Q.21) Complete the following:

(a) The direction of the magnetic field at any point is ..... to the magnetic field line at that point.

(b)..... magnetic poles repel each other, and ..... magnetic poles attract each other.

Q.22) What is the magnitude of the repulsive electrostatic force between two protons separated by 4×10^{-15} m?

Q.23) Obtain Hamilton's equation of motion for a one dimensional harmonic oscillator?

Q.24) Find the force for the following potential energy: $V = \alpha x^2 + \beta y^2 + \gamma z^2 + C$?