



**UNIVERSITY OF THE PUNJAB**  
**B.A. / B.Sc. (Composite) Annual Exam - 2019**

Subject: Physics  
 PAPER: A

Roll No. ....  
 MAX. TIME: 3 Hr.  
 MAX. MARKS: 50

**NOTE: Attempt FIVE questions in all by selecting at least TWO questions from each section.**

**Section-I**

Q.1. a) If a vector field is represented by a point function  $\vec{V}$ , then prove that, 4+2  

$$\text{div } \vec{V} = \frac{\partial V_x}{\partial x} + \frac{\partial V_y}{\partial y} + \frac{\partial V_z}{\partial z}$$
. Also show that  $\text{div } \vec{V} = \vec{\nabla} \cdot \vec{V}$

b) If  $\vec{A} = x^2 y \hat{i} - 2xz \hat{j} + 2yz \hat{k}$ , find  $\text{curl } \text{curl } \vec{A}$  4  
 Q.2. a) What is a conical pendulum? Derive the equation for the period of motion of 1+5  
 conical pendulum.

b) Consider an automobile is moving on a banked roadbed around a curve having 4  
 radius of curvature R and the angle of banking  $\theta$ . Prove that speed of  
 automobile is the same as the speed of bob of a conical pendulum.

Q.3. a) What is a rigid body? Derive the expression for the total work done and total 1+3+3  
 external torque acting on a rigid body.

b) A sphere, a cylinder and a hoop start from rest and roll down the same incline. 3  
 Which body gets to the bottom first?

Q.4. a) State and prove Kepler's laws of orbit and Areas. 1+3+3  
 b) Determine the mass of the earth from period T and radius r of the moon's orbit 3  
 about the earth. (T=27.3 d and r = 3.82x10<sup>5</sup> km)

Q.5. a) What is relativistic energy? Show that total relativistic energy is equal to sum 1+5+1  
 kinetic energy and rest mass energy. Explain when relativistic kinetic energy is  
 reduced to classical kinetic energy.

b) What is momentum of a proton moving at a speed of  $v = 0.86c$ ? Give the answer 3  
 in the unit of MeV/c.

Q.6. a) Write Note on any two of the following. 5+5  
 i) Surface tension ii) Work- energy theorem  
 iii) Conservation of energy in the system of particles

PTO

## Section-II

Q7. a) Show that motion of a mass-spring system is simple harmonic. Derive equation of motion and solution of mass-spring system. Also deduce the formula for angular frequency of mass-spring system. 2+2+2  
+1

b) The period of disk of radius 10.2 cm executing small oscillation about a pivot at its rim is measured to be 0.784 s. Find the value of  $g$ , the acceleration due to gravity at that location. 3

Q.8. a) Describe the conditions for maxima and minima for double slit interference arrangement. Also derive the equation for the linear distance on the screen between two adjacent maxima. What is the role of convex lens to form an image on screen at finite distance from the slit? 3+3+1

b) A double slit experiment is performed with blue-green light of wavelength 512 nm. The slits are 1.2 mm apart and the screen is 5.4 m from the slits. How far apart are the bright fringes as seen on the screen? 3

Q.9. a) What is the difference between dispersion and resolving power? Show that in grating both dispersion and resolving power increases with order number. 1+3+3

b) A diffraction grating has  $1.2 \times 10^4$  rulings uniformly spaced over a width  $W=2.50$  cm. It is illuminated at normal incidence by yellow light from sodium vapor lamp. This light contains two closely spaced lines of wavelengths 589.00 nm and 589.59 nm (a) At what angle does the first order maximum occur for the first of these wavelengths (b) What is the angular separation when these two lines (in first order). 3

Q.10. Write note on any TWO of the following. 5+5

- i) Wave speed    ii) Beats    iii) Polarization by reflection



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**NOTE: Attempt FIVE questions in all, selecting ONE question from Section-I and FOUR questions from Section-II.**

**SECTION – I**

*(Thermodynamics)*

- Q#1.(a) What is an ideal gas? Derive an expression for work done on an ideal gas during isothermal and isochoric processes.  
(b) Calculate work done by an external agent in compressing 1.12 moles of oxygen from volume of 22.4 L and 1.32 atm pressure to 15.3 L at same temperature.  
(c) Why does the boiling temperature of a liquid increase with pressure? (5,3,2)
- Q#2.(a) Define Entropy and derive an expression for the change in entropy in a reversible process.  
(b) A heat pump acting as refrigerator is used to heat a house. The temperature of the house is  $-9^{\circ}\text{C}$  and the interior is kept at  $21^{\circ}\text{C}$ . Find the maximum co-efficient of performance of the heat pump.  
(c) Give some examples of ir-reversible process in nature. (5,3,2)

**SECTION – II**

*(Electricity & Magnetism)*

- Q#3 (a) Define an electric field and derive the electric field due to a ring of charge.  
(b) An electric dipole is placed at rest in a uniform external electric field. Discuss its motion.  
(c) Calculate the magnitude of electric field due to an electric dipole moment  $3.56 \times 10^{-29}$  c-m at a point 25.4 mm away along bisector axis. (5,3,2)
- Q#4.(a) What is an Electric dipole? derive an electric potential due to dipole at a point having distance (r).  
(b) What is electric potential at the surface of gold nucleus? The radius is  $7 \times 10^{-15}$  m and atomic number is 79.  
(c) If you know (E) only at a given point, can you calculate "V" at that point. (5,3,2)
- Q#5.(a) What is dielectric? Show that dielectric medium inserted between capacitor plates increases capacitance of the capacitor.  
(b) How much energy is stored in  $2.0 \text{ m}^3$  of air due to fair weather electric field of strength of 150V/m.  
(c) What is effect of dielectric on original electric field of a capacitor? (5,3,2)

**P.T.O.**

Q#6.(a) Discuss the growth of charge and growth of current in RC-series circuit and define capacitive time constant.

(b) In an RC-series circuit  $\epsilon = 11 \text{ V}$ ,  $R = 1.42 \text{ M}\Omega$  and  $C = 1.80 \mu\text{F}$  Calculate,

(i) Time constant

(ii) Find the maximum charge that will appear on the capacitor during charging.

(iii) How long does it take for charge to build up to  $15.5 \mu\text{C}$ .

(c) What is the unit of electromotive force? Define it. (5,3,2)

Q#7.(a) State and explain Ampere's law, write its integral and differential form.

(b) Solenoid has a length  $1.33 \text{ m}$  and diameter  $2.6 \text{ cm}$  and carries current of  $17.8 \text{ A}$ . The magnetic field inside the solenoid is  $22.4 \text{ mT}$ . Find the length of wire forming the solenoid?

(c) Consider a magnetic field line. Is the magnitude of (B) constant or variable along a line? (5,3,2)

Q#8.(a) State and explain Faraday's law of electromagnetic induction for a coil of N-turns by giving the significance of negative sign. Write its integral and differential form.

(b) A circular TV antenna has a diameter of  $11.2 \text{ cm}$ . The magnetic field of TV signal is normal to the plane of loop. At one instant of time its magnitude is changing at the rate of  $157 \text{ mT/s}$ . Find the emf induced in the antenna.

(c) In Faraday's law of electromagnetic induction, does the induced emf depend on the resistance of the circuit? (5,3,2)

Q#9.(a) Discuss RLC series circuit and derive the relation for impedance and resonance frequency.

(b) At what frequency would a  $6 \text{ mH}$  inductor and  $10 \mu\text{F}$  capacitor have the same reactance?

(c) Define rms value and power factor in AC circuit. (5,3,2)

Q#10 Write notes on any Two of the following:

(i) Carnot Cycle

(ii) Second Law of Thermodynamics

(iii) Lorentz force and its application

(iv) Capacitors with dielectrics

(5,5)



**NOTE: Attempt FIVE questions, selecting TWO questions from Section – I, at least ONE question from each Section – II and Section – III.**

**SECTION-I**

- Q.1: (a) Write down the essential conditions for the electronic oscillator. Explain that how a transistor can be used as an oscillator. 2+7
- (b) What is the crystal structure of a semiconductor like Si and Ge 01
- Q.2: (a) What is the PN-junction? Discuss the characteristics of a forward bias and reverse bias semiconductor diode. 1+4+3
- (b) Would you expect doping to change the resistivity of a silicon by very much? 2
- Q.3: (a) What is a NAND-gate? Write its Boolean expression and truth table. Draw the electronic circuit of NAND gate as diode transistor logic (DTL) and verify by this circuit the given truth table. 1+1+2+5
- (b) Do pure semiconductor obey ohm's law? 01

**SECTION-II**

- Q.4: (a) What is a photo electric effect? Explain it with experiment and discuss the different results concluded from the experiment. 1+2+3
- (b) Show that Planck constant has the dimensions of angular momentum. 01
- (c) The stopping potential for photo electrons emitted from the surface of a metal is 1.43 V. What is the wave length of incident light? 3
- Q.5: (a) Present at least three experiments, which give the evidence that moving particles have the wave aspect. 7
- (b) The wavelength of the yellow spectral emission line of sodium is 589nm. At what kinetic energy would an electron have the same de Broglie wavelength. 3
- Q.6: (a) What is a wave function and its properties? Apply the Schrödinger wave equation to find the momentum and energy of a particle trapped in a one dimensional box. Also discuss the waves associated with a particle in different modes. 1+2+7

**SECTION-III**

- Q.7: (a) Write down the basic postulates of Bohr's atomic theory. Using them discuss the quantization energy of electron in hydrogen atom. 3+4
- (b) When an electron jumps from  $3^{th}$  to  $2^{nd}$  orbit in hydrogen atom, find the frequency of emitted line in Balmer spectrum. 3
- Q.8: (a) Describe the spontaneous emission, stimulated emission and inverse population. Write down the basic properties of LASER. 1 ½ + 1 ½ + 1 ½ + 2 ½
- (b) A He-Ne Laser emits a light of wavelength of 32.8 nm and has an out put power of 2.3mW. How many photons are emitted each minute by this laser when operating? 3
- Q.9: (a) Define the mass deficit and binding energy. Draw the curve for binding energy per nucleon verses mass number. Explain the stability of the elements with reference to this curve. 7
- (b) Find the total energy required to separate the nucleons of  $^{120}_{50}\text{Sn}$  Where mass of  $^{120}_{50}\text{Sn} = 120.906800\text{U}$ , mass of proton = 1.007825U and mass of neutron = 1.008665U. 3
- Q.10: Explain the basic process of thermonuclear fusion. 10