



## SUPPLEMENTARY EXAMINATION 2019 (**TARGET PAPER**)

### PHYSICS PAPER - I

#### (Science Groups)

Time Allowed: 2 Hours 40 mins.

Max.Marks: 68

### SECTION 'B'

#### (SHORT – ANSWER QUESTIONS)

(Marks: 40)

**NOTE:** Answer any TEN part questions. All Questions carry equal marks.

Q-2

If one of the rectangular components of force 50N is 25N. Find the other. **OR** Determine a unit vector perpendicular to the plane of  $\vec{A} = 2\hat{i} - 6\hat{j} - 3\hat{k}$  and  $\vec{B} = 4\hat{i} + 3\hat{j} - \hat{k}$  **OR** Give the dimensions of the following physical quantities:

- (a) Torque      (b) Angular Momentum      (c) Pressure      (d) Kinetic Energy  
(e) Gravitational Constant

**OR** Prove that the following equations are dimensionally correct:

(a)  $S = V_i t + \frac{1}{2} a t^2$       (b)  $T = 2\pi \sqrt{\frac{l}{g}}$       (c)  $f = \frac{1}{2l} \sqrt{\frac{F x l}{m}}$       (d)  $V = \sqrt{\frac{T}{\mu}}$       (e)  $V = \lambda f$

- i) Can the magnitude of resultant of two vectors of the same magnitude be equal to either of the vectors? Explain mathematically. **OR** Define product of two vectors? Also Show that the magnitude of cross product of two vectors gives the Area of Parallelogram. **OR** Two vectors  $\vec{A}$  and  $\vec{B}$  are such that  $|\vec{A}| = 3$ ,  $|\vec{B}| = 4$  and  $\vec{A} \cdot \vec{B} = -5$ , Find: a) The angle between  $\vec{A}$  and  $\vec{B}$       b) The length  $|\vec{A} + \vec{B}|$  **OR**

Show that Power is the dot product of force & velocity. **OR** Define Angular velocity and Angular acceleration. Give its units and also Show that: (i)  $v = r\omega$       (ii)  $a = r\alpha$  **OR**

A water pump is needed to lift water through a height of 2.5 m at a rate of 500 gm/minute. Find its minimum horse power. **OR** A water pump is needed to lift water through a height of 2.5 m at a rate of 500 gm/minute. Find its minimum horse power. **OR** Prove that  $|\vec{A} \times \vec{B}|^2 + |\vec{A} \cdot \vec{B}|^2 = \vec{A}^2 \vec{B}^2$

- ii) Why did Newton's formula for speed of sound in air fail? Who corrected the formula? Describe the discrepancy and give the corrected formula. **OR** Calculate the centripetal acceleration and centripetal force on a man whose mass is 80 kg when resting on the ground at the equator. The radius of the earth is  $6.4 \times 10^6$  m. **OR** At what suitable angle is the maximum height of the projectile is  $\frac{1}{3}$  of its range? **OR** Is it possible for two falling bodies of different masses to have the same momentum while striking the ground? Explain.
- iii) Derive an expression for the acceleration of a body moving down an inclined plane when there is friction 'f'. **OR** Why does the slight push on an axle not cause any motion? **OR** A string, 1m long and of mass 0.004 kg is stretched with a force. Calculate the force if the speed of the wave in the string is 140m/s. If one kg mass is attached with it vertically, find the frequency of first and the fundamental harmonic. **OR** A 256 Hz tuning fork produces four beats per second when sounded another fork of unknown frequency. What are the two possible values for the unknown frequency? **OR** Derive the expression for the centripetal acceleration and force in body moving in a circle of radius 'r' with the velocity 'v'?
- iv) Why are X-rays not diffracted by diffracted grating or thin films? **OR** What is the difference Fresnel and Fraunhofer diffraction? Derive Bragg's law for X-ray diffraction. **OR** What is meant by Plane polarization? How does this phenomenon explain that light waves are transverse in nature. **OR** A truck starts from rest at the top of a slope which is 1m high and 49m long. Find its acceleration and speed at the bottom of the slope assuming that friction is negligible. **OR** Prove that  $R = 4H_{\max}$ .
- v) Define a conservative field. Show that gravitational field is the conservative field? **OR** Show by calculation why the acceleration due to gravity at the center of earth is zero. Also calculate the mass of earth or sun. **OR** Establish work-energy equation. **OR** Show that the rate of change of Angular Momentum is equal to Torque? **OR** A wire hangs from a dark high tower so that the upper end is not visible? How can we determine the length of wire? **OR** Calculate the speed of the sound in air  $27^\circ$  C at atmospheric pressure; taking  $\gamma = 1.42$  and  $R = 8.314 \text{ J/mol K}$
- vi) Why do thick lenses possess chromatic and spherical aberrations? Suggest remedies for the rectification of these defects. **OR** Differentiate between interference and beats of sound waves? Elaborate. **OR** State Huygen's Principle? Give the construction and working of Michelson interferometer? **OR**

Find the projection of the vector  $\vec{A} = \hat{i} - 4\hat{j} + \hat{k}$  onto a direction of the vector  $\vec{A} = 4\hat{i} - 4\hat{j} + 7\hat{k}$ .

- vii) How would the weight of substance vary as it is taken from earth to the moon? **OR** Why and how is artificial gravity is created in the spacecraft? Derive a formula for the spinning frequency of the spacecraft to provide the artificial gravity to the occupants. How many times in a second does a spaceship of diameter 30m need to be rotated in order to create the similar gravity as experienced on earth? **OR** What is the value of the gravitational acceleration at a distance of:
- (i) earth's radius above the earth's surface. (ii) Twice earth's radius above the earth's surface.
- viii) A uniform ladder of length 'L' and weight 50N rests against a smooth vertical wall. If the coefficient of friction between the ladder and the ground is 0.40, find the minimum angle ( $\theta_{min}$ ) such that the ladder may not slip. **OR**
- What is meant by the following terms? (ANY FOUR)
- |                          |                     |                   |              |
|--------------------------|---------------------|-------------------|--------------|
| *Centre of mass          | *Angular momentum   | *Unit vector      | *Null Vector |
| *Couple of forces        | *Position vector    | *Couple of forces | *Free Vector |
| *Interference            | *Static equilibrium | *Torque           | *Beats       |
| *Coefficient of Friction | *Centripetal Force  |                   |              |
- OR** A body of mass 32gm attached to the elastic spring performing S.H.M having velocity of 0.4 m/s when the displacement is 8cm. If the spring constant is 0.4 N/m. Calculate a) Total energy b) Amplitude of its motion **OR** Define a Couple? Show that the magnitude of the moment of a couple is given by  $\tau = Fd$ ? **OR** State and Prove the law of conservation Linear momentum? **OR** Derive thin lens formula for the Convex Lens?
- ix) A 100 grams bullet is fired from a 10 kg gun with the speed of 1000 m/s. what is the speed of recoil of gun? **OR** A boy throws a ball upward from a top of a cliff with a speed of 14.7 m/s. On the way it just misses the thrower and fall the ground 49 meters below. Find how long the ball remain in air. **OR** A helicopter weighs 3920 Newtons. (a) Calculate the force on it if it is ascending vertically at a rate of 2 m/s<sup>2</sup>. (b) What will be the force on the Helicopter if it is moving up vertically with a constant speed of 4 m/s. **OR** Why does a bomber aircraft not drop its bombs when it is vertically above the target?
- x) A mortar shell is fired at a target 800m away with the velocity of 100m/s. Calculate the maximum possible value of the launch angle and the minimum time to hit the target. **OR** Find the time period of simple pendulum whose length is 88.2cm and the acceleration due to gravity is 9.8 m/s<sup>2</sup>. **OR** If the tension in the string is doubled, what will be the effect on the speed of standing waves in the string? **OR** A 50 grams bullet is fired into a 10 kg block that is suspended by a long cord so that it can swing as pendulum. If the block is displaced so as its center of gravity rises by 10cm. What was the speed of the bullet?
- xi) A note of frequency 650Hz is emitted from an ambulance. What frequency will be detected by a listener if the ambulance moves (a) at a speed of 18m/s towards the listener. (b) at the speed of 15m/s away from the listener. (speed of sound = 340 m/s) **OR** For simple harmonic motion, will the time period change or not, by doubling the mass of the bob attached to: (a) elastic spring (b) inelastic string? Explain. **OR** If the diameter of the 10<sup>th</sup> Bright Newton's ring is 0.005m when light of wavelength 5883Å is used. What is the radius of curvature of Plano-Convex lens? Also calculate the thickness of air film corresponding to this ring? **OR** A body hanging from a spring is set into motion and the period of oscillation is 0.50s. After the body has come to rest, it is removed. How much shorter will the spring be when it comes to rest.
- xii) Two converging lenses of focal lengths 30 cm and 60 cm are placed in contact. What is the focal length of this combination? Calculate the power of the combination in diopters. **OR** The magnifying power of an astronomical telescope is 9 and length is 100 cm. Determine the focal length of objective and eye-piece. **OR** A compound microscope has an objective with a focal length of 10mm and a tube 232mm long. The final image is produced 250mm from the eye-piece when the object is 10.5mm from the objective. What is the angular magnification? **OR** Two blocks of masses 10.2kg and 4.5kg are attached to the ends of string, 10.2kg block lies on the horizontal surface. Find the tension and acceleration in the string.
- xiii) Green light of wavelength 5400 Å is diffracted by a grating 2000 lines/cm. Compute angular deviation of the third order image. Is the 10<sup>th</sup> order image possible. **OR** Show that the trajectory of the projectile motion is parabolic? **OR** Tarzan swings on a vine of length 4m in a vertical circle under the influence of gravity. When the vine makes an angle of  $\theta = 20^\circ$  with the vertical. Tarzan has a speed of 5ms<sup>-1</sup>. Find: (a) his centripetal acceleration b) tangential acceleration, and c) the resultant acceleration.
- xiv) Interference fringes were produced by two slits 0.25 mm apart on a screen 150 mm from the slits. If ten fringes occupy 3.275mm, what is the wavelength of the light producing fringes? **OR** A parallel beam of X-ray is diffracted by a crystal. The first order maximum is obtained when the glancing angle of incidence is 6.5°. If the distance between the atomic planes of the crystal is 2.8 Å. Calculate the wavelength of the radiation. **OR** An object moves along the straight line from (3, 2, -6) to (14, 13, 9) when a uniform force  $\vec{F} = 4\hat{i} + \hat{j} + 3\hat{k}$  acts on it. Find the Workdone.

## SECTION 'C'

### (DETAILED-ANSWER QUESTIONS)

(Marks: 28)

**NOTE:** Attempt any **TWO** questions from this Section. Draw Neat and Labelled diagrams where necessary.

- Q-4** a) Define Elastic and inelastic collisions. Two non-rotating spheres of masses  $m_1$  and  $m_2$  initially, moving with the velocities  $U_1$  and  $U_2$  respectively in one dimension, collide elastically. Derive the expressions for their final velocities  $V_1$  and  $V_2$ .  
**OR**  
What are the conditions of Simple Harmonic motion. A particle in its state of uniform circular motion. Prove that its projection along one of its diameter executes simple harmonic motion. Also derive expressions for the instantaneous velocity and maximum velocity of the image.  
**OR**  
Define Simple Harmonic Motion and prove that for a small amplitude of vibration, the motion of simple pendulum is simple harmonic motion. Also derive the formula for its time period.
- b) What are Stationary (or Standing) waves? Differentiate between Longitudinal & Transverse waves. Derive the expression for the frequency of stationary waves produced in stretched string vibrating in (i) One loop (ii) two loops (iii) three loops (iv) n loops  
**OR**  
Two bodies of masses  $m_1$  and  $m_2$  are connected to the ends of string passing over a frictionless pulley such that two bodies are moving vertically. Derive the expressions for:  
(i) The acceleration of the bodies (ii) The tension in the string  
What will be the acceleration of the system if  $m_1=3m_2$ ?
- Q-5** a) Define Magnifying Power? Describe the Construction and working of Astronomical Microscope with the help of a ray diagram. Draw the relevant formula for its magnification.  
**OR**  
Define Visual Angle and least distance of distinct vision. An object is placed within the focal length of a convex lens. Derive the formula for its Magnifying Power.
- b) Derive the expression for the variation of acceleration due to gravity with altitude or depth.  
**OR**  
Define Projectile motion? An object is thrown upward with initial velocity  $V_0$  at an angle  $\theta$  with the horizontal. Derive the expression for:  
(i) Time required to maximum height (ii) Maximum Height attained  
(iii) Horizontal Range (iv) Total time of flight
- Q-6** a) Explain Young's double slit experiment and derive the formula for fringe spacing.  
**OR**  
Define Scalar and Vector Products, give one example of each.  
Show that: (i)  $\vec{A} \times \vec{B} \neq \vec{B} \times \vec{A}$  (ii)  $\vec{A} \cdot (\vec{B} + \vec{C}) = \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{C}$  (iii)  $\vec{A} \cdot \vec{B} = \vec{B} \cdot \vec{A}$
- b) What is diffraction of light and what is diffraction grating? Write the conditions of interference of light. Also Derive an expression for the wavelength and frequency of light by using diffracting grating.  
**OR**  
What is Doppler's Effect? Explain this effect analytically when the source of sound moves towards and away from the listener at rest. Write three applications of Doppler's Effect.

----- **BEST OF LUCK** -----

Marked with 'RED BOLD' are the 'MOST IMPORTANT' Questions.

✚ **PEC REGISTERED ENGINEER - BE (NED UET) -**

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