ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

**EXAMINATION MATERIAL ZUEB - 2022**

**PHYSICS XI**

**SECTION "C" EXTENDED RESPONSE QUESTION (ERQ)**

**CHAPTER 2: Scalers and Vectors**

**Long Questions:**

1.Two vector A1 and A2 are making angle θ 1 and θ2 with positive X-axes respectively.Find magnitude and direction of resultant vector by rectangular component.

2. Define the cross-product of two vector prove that the magnitude of cross product of two vectors gives of parallelogram.

3. Prove that

A. (B+C) = A.B + A.C

4. Show that commutative property of two vectors is valid for scalar product not for vector product.

**CHAPTER 3: Motion**

| TOPICS | SUB TOPICS |
|---|---|
| Equations of uniformly accelerated rectilinear motion | ❖ $V_f = V_i + at$<br>❖ $S = V_i t + ½ a t^2$<br>❖ $Vf^2 = Vi^2 + 2 a s$ |
| Motion of bodies connected by a string | Case # I<br>When both the bodies move vertically<br>Case # II<br>When one body moves vertically and the other moves on a smooth horizontal surface |
| Momentum of a body | ❖ Law of conservation of momentum<br>❖ Elastic collision in one dimension |
| The Inclined Plane | ---------- |

**Long Questions:**

1. Two bodies of unequal masses are attached to the ends of a string, which passes over a frictionless pulley. If they are hung vertically, derive the expressions for the tension in the string and the acceleration of bodies when the mass-string system is in motion.
2. Two masses $m_1$ and m2 are attached with the ends of a string, which passes over a frictionless pulley, such that the mass m2, is placed on a smooth horizontal plane surface and the mass m, moves vertically downward. Calculate the acceleration of the system.
3. Define momentum and give its S.I. unit. State and prove the law of conservation of linear momentum.
4. Define Elastic collision.
5. Give the definition of force on the basis of Newton's First Law of motion Starting with F=ma, prove this! force is also given by the rate of change of momentum.
6. Two sphere A' and B' of unequal masses moving with initial velocities U1 and U2 (U1> U2) along same line joining their center collide elastically, derive the relation for their final velocities.

7. Two bodies of unequal. Masses are attached to the end of a string w/c passes over frictionless pully. If they are hanged vertically derive the expression for tension in string and acceleration of bodies.

**Numerical:**

1. Two spherical bodies of different masses, moving with different velocities along the same line, collide elastically with one another. Find expression for the final velocity of only one of the two bodies after collision.
2. A car of mass 1600kg moving with an initial velocity of 18 m/s hits another stationary car of mass 1400kg and they lock together. With what velocity do they move after an elastic collision?
3. A car weighing 15400N sin g at 25 m/s if the frictional force acting on it 4000N, how fast is the car moving when it has traveled 30m?
4. A 70gm ball collides with another ball of mass 140gm. The initial velocity of first ball is 9m/s to the right while the second ball is at rest. If the collisions were perfectly elastic, what would be the velocity of the two balls after the collision?
5. A ball is thrown vertically upward from the ground, with a speed of 35 m/s. On its way down, it is caught off a point 6m above the ground. How long did the trip take?
6. A car starts from constant acceleration. During the $5^{th}$ second of its motion, it covers a distance of 65m. Calculate (a) the acceleration of the car.
   (b) the total distance covered by the car during these 8 sec.

**CHAPTER 4: Motion and two dimensions**

| TOPICS | SUB TOPICS |
|---|---|
| Projectile Motion | ❖ Maximum Height of the projectile<br>❖ Range of the projectile<br>❖ The maximum Range |
| Uniform circular motion | ❖ Relation between angular and linear quantities<br>❖ Centripetal acceleration |

**Long Questions:**

1. A shell is fired upward with an angle θ with the horizontal with the speed Vo. Find
   a. The time taken by it to reach the maximum height.
   b. Its horizontal range.
2. Describe projectile motion. Explaining the changes in vertical and horizontal components of velocity. Derive expressions for maximum height and range of a projectile.
3. An object is thrown in air at an angle θ with the horizontal with the velocity Vo. derive the relation. a) The total time of flight
   b) The horizontal range of projectile.
4. A shell is fired at an angle θ with the horizontal with the velocity. Find the expression for maximum height attained.
5. A shell is fired from a gun with velocity V, at an angle with the ground. Derive the expressions for the maximum height and time of the projectile motion.
6. Derive an expression for the centripetal acceleration produced in a body.
7. If a body of mass "m" is moving with a uniform velocity 'v' along a circular path of radius 'r', derive the expression for the centripetal acceleration and centripetal force.

**Numerical:**

1. A rescue helicopter drops a package of emergency ration to a stranded party on the ground. If the helicopter is traveling horizontally at 40m/s at a height of 100m above the ground,

a) Where does the package strike the ground relative to the point at which it was released?
b) What are the horizontal and vertical components of the velocity of the package just before it hits the ground?

2. A machine gun is pointed upward at an angle of 30 degrees with respect to the horizontal and fires a projectile with a velocity of 200m/s. Calculate the range of the projectile and the height of the projectile.
3. A cricket ball is thrown at a speed of 20m/s in a direction 30° to the horizontal. Calculate the maximum height of the ball and horizontal range.
4. A rocket is launched at an angle of $50^{o}$ to the horizontal with an initial speed of 100m/s. It moves along its initial line of motion with an acceleration of 30m/s for 3sec. At this time, the engine fails and the rocket proceeds to move as a free body.

CHAPTER 5: Torque, Angular Momentum and Equilibrium

| TOPICS | SUB TOPICS |
|---|---|
| Torque | ---------- |
| Equilibrium | ❖ First condition of an equilibrium<br>❖ Second condition of an equilibrium |
| Angular Momentum | ❖ Conservation of angular momentum of a particle |

**Long Questions:**

1. Explain First condition of Equilibrium and derive the expression.

**Numericals:**

1. A 15m ladder weighing 600N rests against a smooth wall at a point 12m above the ground. The centre of gravity of the ladder is one third the way up. A man weighing 400N climbs half way up the ladder. Assuming that the wall is smooth, find the reaction of the ground and the wall.
2. A particle of mass 400 gram rotates in a circular orbit of radius 20 cm at a constant rate of 1.5 revolutions per second. Evaluate the angular momentum of the particle with respect to the centre of the orbit.

CHAPTER 7: Work, Power and Energy

| TOPICS | SUB TOPICS |
|---|---|
| Work done against gravitational force | ❖ Work done is independent to the path<br>❖ Work done in a close path is equal to zero |
| Absolute P.E | ---------- |
| Law of conservation of energy | ---------- |

**Long Questions:**

1. Define Absolute potential energy also derive its mathematical representation.

**Numerical:**

1. A Neuron travels a distance of 17m in a time interval of $6.5*10^{-3}$ sec. Assuming its speed was constant, find its kinetic energy. (Mass of neutron = $1.7*10^{-27}$)

**CHAPTER 8: Wave, Motion and Sound**

| TOPICS | SUB TOPICS |
|---|---|
| Characteristics of SHM | ❖ The connection between uniform circular motion and SHM<br>❖ Velocity of a particle moves in a uniform circular motion |
| Energy in waves | ---------- |
| Standing Waves | ---------- |
| Fundamental frequency and Harmonics | ❖ Frequency of first harmonic<br>❖ Frequency of second harmonic<br>❖ Frequency of third harmonic<br>❖ Frequency of $n^{th}$ harmonic |
| Speed of sound waves | ---------- |
| Doppler's Effect | ❖ When the listener is moving and source is at rest<br>❖ When the source is moving and the listener is at rest<br>❖ When both the source and listener are moving |

**Long Questions:**

1. Define Simple Harmonic Motion. Prove that the small amplitude of vibration, the motion of a Simple Pendulum is Simple Harmonic.
2. Derive the expression for the frequency of a stationary wave produced in a stretched string vibrating in (i) one loop (ii) two loops (iii) three loops (iv) 'n' loops.
3. What is Doppler's Effect? Obtain an expression for the apparent frequency heard by a listener. When he moves with a velocity "y" towards a stationary source of sound emitting sound waves of frequency "u"
4. What is doppler's effect? Drive the expression for apparent frequency when source of sound is moving away from listener and moving towards the listener.
5. Explain Newton's formula for the speed of sound. How did LaPlace correct it. What is the effect of temperature on the speed of sound? Derive the relevant formula.
6. What is doppler effect derive apparent frequency of sound heard by listeners.

A )Listener is moving away/ towards stationary source of sound.

B) Source of sound is moving away/ towards stationary listener.

**7.** Define longitudinal & transverse wave. Drive the expression for frequency of stretched string vibrating in one loop , two loop, three loops & n loop.

**Numericals:**

1. A body of mass 0.025 kg attached to a spring is displaced through 0.1m to the right of equilibrium position. If the spring constant is 0.4 N/m and its velocity at the end of this displacement be 0.4 m/s calculate (a) The total energy
   (b) the amplitude of its motion (i.e, maximum displacement).
2. A simple pendulum completes one oscillation in 2 s. Calculate its length when g = 9.8$ms^{-2}$,
   the time period of simple pendulum is given by, $T = 2\pi\sqrt{\frac{l}{g}}$
3. A spring 4 m long resonates in four segments (node at both ends). The frequency of driving system on the spring is 20 hertz. Calculate the speed of the wave in the spring.
4. A standing wave is established in a 2.4m long sting fixed at both ends. The string vibrates in four segments when driven at 200 Hz. Determine the velocity of the wave.

**CHAPTER 9: Nature of Light**

| TOPICS | SUB TOPICS |
|---|---|
| Young's double slit | ---------- |
| Interference of thin film | ---------- |
| Newton's Ring | ---------- |
| Diffraction | ❖ Fresnel Diffraction<br>❖ Fraunhofer Diffraction |
| Diffraction Grating | ---------- |

**Long Questions:**

1. Discuss young's double-slit experiment to measure the wave length of light.
2. What are Newton's rings? Show how Newton's rings can be used to find the radius of curvature of a lens.
3. What is a diffraction grating? How is it used to determine the wave length of light?
4. Describe Yong's double slit experiment. Derive the relevant expression and the formula for fringe spacing.
5. Why are X-rays not diffracted by diffraction grating or thin film.

**Numericals:**

1. How many fringes will pass a reference point if the mirror of a Michelson's interferometer is moved by 0.08mm if the wave length of light used is 5500A°?
2. Interference fringes were produced by two sites 0.25mm apart on a screen 150mm from the slits. If ten fringes occupy 3.275mm. What is the wave length of the light producing fringes.
3. in a double slit experiment, the separation of the slits is 1.9mm and the fringe spacing is 0.31mm at a distance of 1 meter from the slits. Find the wavelength of light?
4. If a diffraction grating produced a 1" order spectrum of light of wavelength 6x107m at an angle of 20° from the normal. What is its spacing and also calculate the number of lines per mm?
5. If a diffracting grating produces a first order spectrum of light of wave length 6 x 10-7 mm at an angle of 20° from the normal. Calculate the number of lines per mm.
6. Newton's rings are formed between a lens and a flat glass surface of wavelength 5.88 x 10 m. If the light passes through the gap at 30° to the vertical and the fifth dark ring is of diameter 9mm. What is the radius of the curvature of the lens?
7. Explain the young double slit experiment and derive the formula for fringes spacing.
8. What are newton rings and derive an expression for radius of nth bright rings.

**CHAPTER 10: Geometrical Optics**

| TOPICS | SUB TOPICS |
|---|---|
| Combination of lenses | ---------- |
| The thin lens formula | ---------- |
| Magnifying Glass | ---------- |
| Compound Microscope | ---------- |
| Telescope | ❖ Astronomical Telescope<br>❖ Galilean Telescope |

**Long Questions:**

1. Two thin convex lenses of focal length f1 and f2 are placed in contact. Derive the formula for the focal length of the combination.
2. With the help of a ray diagram explain the working of a simple Microscope. Derive the relation for its magnifying power.
3. With the help of a ray diagram derive an expression for the magnifying power of a compound microscope.
4. Draw a labelled diagram showing the passage of light ray through an astronomical telescope focused for infinity and obtain an expression for its magnifying power.
5. Define visual angle and least distance of distinct vision. With help of ray diagram derive expression for magnifying power of magnifying glass.

**Numerical:**

1. A chess piece 8cm high is located 10 com from the converging lens whose focal length is 25 cm. what is the nature size and location of the image.
2. A convex lens of focal length 20 cm, is used to form an erect image which is twice as large as the object. Find the position of the object?
3. An object is placed at a distance of 60 cm from a concave lens of focal length 30 cm. Find the position and nature of the image?
4. An astronomical telescope has an objective lens whose power s2 diopters. This lens is placed 60 cm from the eye piece. When the telescope is adjusted for minimum eye strain. Calculate the angular magnification of the telescope.