J B Academy, Ayodhya
Half Yearly Examination -2023
M. Mark : 70   Class –XI , Subject-Physics   Time : 3 hr.

General Instructions
1. **There are 33 Questions in all. All questions are compulsory.**
2. **This question paper have five sections.**
3. **All the sections are compulsory.**
4. **Section-A contains sixteen MCQ each of one mark, Section – B contains five questions of two mark each, Section – C contains seven questions of three mark each, Section – D contains two Case Study based questions of four mark each and Section – E contains three long answer questions of five mark each.**
5. **There is no overall choice. However, an internal choice has been provided in one question in Section – B, one question in Section – C and all three questions in Section – E. You have to attempt only one of the choices in such questions.**
6. **Use of Calculators is not allowed.**

SECTION –A [1 mark each]

Q – 1 Which one of the following pairs of physical quantities has the same Dimensional Formula ?

[a] Pressure and Force   [b] Force and Work- done

[c] Work- done and Kinetic energy   [d] Kinetic energy and momentum

Q – 2 The S. I. unit of Impulse is

[a] Kg m/sec   [b] Kg m/sec^2

[c] Joule   [d] Watt

Q – 3 For vectors A = 3i + 2j and B = i – 2j + 3k , the magnitude of (A + B) will be

[a] 4   [b] 5   [c] 6   [d] 7

Q – 4 Which one is the Scalar Quantity ?

[a] Power   [b] Force   [c] Momentum   [d] Impulse

Q – 5 Which one of the following is the Dimensional Formula of Coefficient of Friction .

[a] [M L T^{-2}]   [b]   [M^o L^o T^o]   [c] [M L^2 T^{-2}]   [d]   [M L^2 T^{-3}]

Q – 6 For maximum Range of Projected object , the angle of projection should be

 [a] 0°   [b] 30°   [c] 45°   [d] 60°

Q – 7 A Particle with a velocity of 2m/sec at t = 0 moves along straight line with uniform acceleration of 0.2 m/sec^2. What will be its displacement in 10 seconds ?

[a] 10 meter   [b] 20 meter   [c] 30 meter   [d] 40 meter

Q – 8 Which one is the S. I . unit of Power

[a] Kilowatt –hour   [b] Kilowatt/hour   [c] Watt   [d] Erg

Q – 9 Which one is Non – conservative force

[a] Gravitational force   [b] Frictional force   [c] Magnetic force   [d] Electrostatic force

Q – 10 A Circular wheel of 0.50 meter radius is moving with speed of 10 m/sec . Find the Angular speed of wheel ?

[a] 10 radian /sec   [b] 50 radian/sec   [c] 20 radian /sec   [d] 40 radian/sec

Q – 11 A body moves a distance of 10 meter along a straight line under the action of 5 Newton force . If the work done is 25 Joule , the Angle between Force and direction of motion of the body is

 [a] 60°   [b] 30°   [c] 75°   [d] 45°

Q – 12 A body of mass 'm' tied to one end of a string is made to revolve in a vertical circle . then difference in Tensions in the string at the lowest and the Highest point is equal to

[a] mg   [b] 4mg   [c] 6mg   [d] 8mg

Q – 13 A Force F_1 acting on a 2 kg body Produces an acceleration of 2.5 m/sec^2 . Another force F_2 acting on a 5 kg body produces an acceleration of 2 m/sec^2 . Find the ratio $F_1 : F_2$

 [a] 1:2   [b] 2 : 1   [c] 1 : 4   [d] 4 : 1

Q – 14 The Rocket – Propulsion is based on

 [a] Newton's law of Gravitation   [b] Newton's Third Law

[c] Newton's First law   [d] Kepler's law

Q – 15 The force of Friction between two objects is

[a] Parallel to the contact surfaces   [b] perpendicular to contact surfaces

[c] Inclined at 30° to the contact surfaces   [d] Inclined at 60° to the contact surfaces

Q – 16 A Force of 72 dyne is inclined to the horizontal at an angle of 60° . Find the acceleration in a mass 9 gm , which moves in a horizontal direction ?

 [a] 2 m/sec^2 [b] 4 m/sec^2 [c] 8 m/sec^2 [d] 10 m/sec^2

SECTION –B [2 Mark each]

Q – 17 Write relation between Kinetic energy and momentum of a moving object. How does the kinetic energy of an object change if its momentum is doubled ?

Q – 18 A body is projected horizontally from the top of a tower with a velocity 9.8 m/sec. what time elapses before horizontal and vertical velocities becomes equal?

Q-20 A ball at nest is dropped from a height of 12 meter ; it loses 25 % of its Kinetic energy in striking the ground. Find the height to which it bounces?

Q-21 What do you mean by friction .A body rolled on with a velocity of 8 m/sec come to rest after travelling 4meter. Calculate the coefficient of friction?

<div align="center">(given that   g = 10 m/sec^2)</div>

Q-19 State the law of Parallelogram of vector-addition. List two examples from daily life observation based on this Law.

<div align="center">OR</div>

A body is simultaneously given two velocities one 30 m/sec due east and other 40 m/sec due north. Find the resultant velocity?

<div align="center">

SECTION – C [3 Mark each]

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Q-22 Define Elastic Collision mathematically show that in one dimensional elastic collision the relative velocity of approach before collision is equal to the relative velocity of separation on after collision.

Q-23 A hammer weighing 1 Kg moving with the speed of 10 m/sec strikes the head of a nail driving it 10 cm into a wall, Neglect the mass of nail. Calculate.

   (a) The acceleration during impact.
   (b) The time –interval of impact.
   (c) The received Impulse.

Q-24 Define Angle of repose, Mathematically prove that coefficient of static friction is equal to tangent of angle of repose using a labeled diagram.

Q-25 for the given vector A = 5i + 7j - 3k and B = 2i + 2j + 8k.Calculate the values of

   (A) Scalar Product of A and B.
   (B) Vector Product of A and B.
   (C) Angle between vectors A and B.

Q-26 State Newton second Low of motion. A Constant force acting on a object of mass 3.5 m/sec in 2.5 second .Find the magnitude of force?

Q-27 Derive a relation between linear velocity and angular velocity during uniform circular motion. If a body moves along a horizontal circle of radius 2 meter with constant speed of 10 m/sec . Calculate its angular velocity and centripetal acceleration ?

Q – 28 State Law of conservation of energy . If a body tied to one end of a string is made to revolve in a vertical circle . Derive the expression for the velocity of the body and Tension in the string at any point using labeled diagram.

OR

Prove that power is Scalar product of applied force and velocity. A man weighing 60 kg climbs up a staircase carrying a load 20 kg on his head. The staircase has 20 steps each of height 0.2 meter. If he takes 10 second to climb. Find his power ?

SECTION – D [CASE – STUDY] [4 mark each]

[Read the paragraph and answer the questions]

Q – 29 When a body moves along a circular path with a uniform speed, its motion is said to be uniform circular motion. In uniform circular motion the direction of velocity vector which acts along the tangent to the path changes continuously but its magnitude ($v = r\omega$) always remains constant . so uniform circular motion is an accelerated motion . A body undergoes uniform circular motion is acted upon by an acceleration which is directed along the radius towards the centre of the circular path. This acceleration is called centripetal acceleration. The magnitude of the acceleration is a constant given by

$$\alpha_c = v^2/r = \omega^2 r = (2\pi n)^2 r = 4\pi^2 n^2 r$$

[where term having their usual meanings]

[i] A body executing uniform circular motion has at any instant its velocity vector and acceleration vector

[a] along the same direction   [b] in opposite direction

[c] normal to each other   ]d] not related to each other

[ii] The angular speed of a wheel making 120 revolution /minute is

 [a] π radian/sec   [b] 4π radian/sec   [c] 2 π radian/ sec   ω[d] 4π² radian/sec

[iii] A particle moves with constant speed v along a circular path of radius r and complete one round in time T . the centripetal acceleration of the particle is

[a] 2πv/T   [b] 2πr/T   [c] 2πr²/T   [d] 2πv²/T

[iv] The S.I. unit of centripetal acceleration is

[a] radian/sec   [b] meter/sec   [c] radian/ sec²   [d] meter/sec²

Q- 30 According to Hooke,s Law , when a spring is stretched through distance x , the restoring force F set up in the spring due to its elasticity is such that

$$F = - k x$$

Where k is the force constant or spring constant of the spring . It is the restoring force set up in the spring per unit extension . The work done in stretching the spring through distance x will be

$$W = \frac{1}{2} k x^2$$

This work done is stored as potential energy U of the spring, therefore

$$U = W = \frac{1}{2} k x^2$$

[i] In the formula $W = \frac{1}{2} kx^2$, the dimensional formula of k is

[a] $[M^1 L^0 T^{-2}]$ [b] $[M^0 L^1 T^{-1}]$ [c] $[M^1 L^1 T^{-2}]$ [d] $[M^1 L^0 T^{-1}]$

[ii] A spring of force constant 800 N/m has an extension of 5 cm . The work done in extending it from 5 cm to 15 cm is

[a] 16 Joule   [b] 8 Joule   [c] 32 Joule   [d] 24 Joule

[iii] The c.g.s. unit of spring constant will be

[a] Erg / cm   [b] dyne / cm   [c] Joule / meter   [d] Newton- meter

[iv] Elastic force of a spring is

[a] Conservative force   [b] Non conservative force   [c] Frictional force [d] Non central force

SECTION – E [5 Mark each]

Q – 31 (a) State and prove Work – Energy Theorem using Integration method with the help of labeled diagram.

(b)   A bullet weighing 10 gm is fired with a velocity of 800 m/sec. after passing through a mud wall 1 meter thick, its velocity decreases to 100 m/sec . Find the average resistive force offered by the mud wall ?

OR

(a) What are the conservative force , show that mathematically the Gravitational   Force is a conservative force using labeled diagram.

(b)   A 16 Kg block moving on a frictionless horizontal surface with a velocity of 5 m/sec compresses an spring and comes to rest. If the force constant of spring be 100 n/m, then how much is the spring compressed?

Q – 32 (a) State Law for conservation of momentum and derive this Law by using Newton's Third law of motion.

[b] A 30 kg Shell is flying at 48 m/sec. When it explodes, its one part of 18 Kg stops, while the remaining part flies on. Find the velocity of the later.

OR

[a] Derive the formula for maximum speed with which the vehicle can move safely along circular turn on the level road using required labeled diagram.

[b] While launching a Rocket of mass 2×10^4 kg, a force of 5×10^5 Newton is applied for 20 seconds. Calculate the velocity attained by the Rocket at the end of 20 seconds?

Q – 33 [a] Derive Third equation of motion for uniformly accelerated object by using Calculus method .

[b] A racing car accelerates on a straight road from rest to a speed of 180 Km/h in 25 seconds. Assuming uniform acceleration of car throughout. Find the distance covered in this time ?

OR

[a] What do you mean by projectile motion, Obtain expression for Flight time (T), height (H) and Horizontal Range (R) if an object projected with intial velocity 'u' making an angle ǝ with the horizontal .

[b] An aircraft executes a horizontal track of radius 1 km with a steady speed of 900 Km/h. Find the centripetal acceleration acting on it ?