CLASS XI PHYSICS (THEORY)

HALF YEARLY EXAMINATION 2022-23

MM-70 **TIME ALLOWED-3 Hrs**

General Instructions:

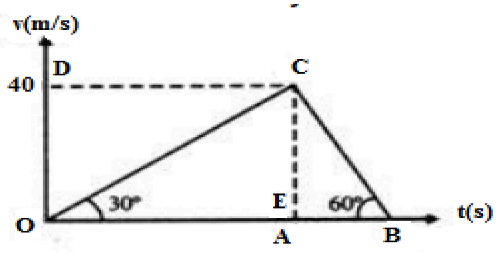
(1) There are 35 questions in all. All questions are compulsory

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E. All the sections are compulsory.

(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.

(4) There is no overall choice. However, an internal choice has been provided in section B, C, and D. You have to attempt only one of the choices in such questions.

(5) Use of calculators is not allowed.

Q.No.	Questions	Marks
	SECTION-A	
1.	Size of the nucleus is - (a) 10^{-10} m (b) 10^{-15} m (c) 10^{-9} m (d) 10^{-12} m	1
2	The dimensional formula for Planck's constant is- (a) [MLT] (b) $[ML^2T^{-1}]$ (c) $[M^2L^2T^{-1}]$ (d) $[ML^1T^{-1}]$	1
3	What is the ratio of the average acceleration during the intervals OA and AB in the velocity-time graph as shown below?  (a) ½ (b) ⅓ (c) 1 (d) 3	1
4	Which of the following remains constant if a body travels with constant acceleration? (a) Time (b) Velocity (c) Displacement (d) None of the above	1
5	If for two vectors **A** and **B, A×B=0** the vectors- (a) Are perpendicular to each other (b) Are parallel to each other (c) Act at an angle of 60° (d) Act at an angle of 30°	1
6	Time of flight of a projectile is 10 sec and its range is 500m.The maximum height reached by it is	1

	(a)50m (b)80m (c)100m (d)125m	
7	A force of 49 N is just able to move a block of mass 10 kg on a rough horizontal surface. The coefficient of friction is (a) 0 (b) 0.5 (c) 0.7 (d) 1	1
8	Find the angle between force $\vec{F} = (3\hat{\imath}+4\hat{\jmath}+5\hat{k})$ unit and displacement $\vec{d} = (5\hat{\imath}+4\hat{\jmath}+3\hat{k})$ unit. (a) cos-1(23/25) (b) cos-1(21/29) (c) sin-1(1/2) (d) sin-1(2/5)	1
9	A body of mass 20 kg is initially at a height of 3 m above the ground. It is lifted to a height of 2 m from that position. Its increase in potential energy is: (a) 100 J (b) 392 J (c) 60 J (d) -100 J	1
10	Two masses 1 g and 4 g are moving with equal kinetic energies. The ratio of the magnitudes of their linear momenta is: (a) 4 : 1 (b) 1 : 2 (c) 2 : 1 (d) 1 : 6	1
11	During the perfectly elastic collision, which of the following is conserved? (a) Linear momentum of the each body is conserved. (b) Kinetic energy of the each body is conserved. (c) Linear momentum of the system is conserved. (d) None of the above.	1
12	On which of the following factor does the moment of inertia of an object not depend upon (a) Axis of rotation (b) Angular velocity (c) Distribution of mass (d) Mass of an object	1
13	When the torque acting on the system is zero, which of the following is constant? (a) Linear impulse (b) Linear momentum (c) Force (d) Angular momentum	1
14	When does the moment of inertia of a body come into the picture? (a) When the motion is rotational (b) When the motion is linear (c) When the motion is along a curved path (d) None of the above	1
	Directions (For questions 15 to 18): These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you are required to choose any one of the following four responses. (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion. (b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion. (c) If the Assertion is correct but Reason is incorrect. (d) If both the Assertion and Reason are incorrect.	
15	**Assertion:** When we change the unit of measurement of a quantity, its numerical value changes. **Reason:** Smaller the unit of measurement smaller is its numerical value.	1

16	**Assertion** : Two particles of different mass, projected with same velocity at same angles. The maximum height attained by both the particle will be same. **Reason** : The maximum height of projectile is independent of particle mass.	1
17	**Assertion:** The kinetic energy, with any reference, must be positive. **Reason:** In the expression for kinetic energy, the velocity appears with power of 2.	1
18	**Assertion:** If momentum of a body increases by 50% its kinetic energy will increase by 125%. **Reason:** Kinetic energy is proportional to square of momentum.	1
	SECTION-B	
19	Deduce dimensional formula for the following physical quantities- (I) Gravitational Constant (II) Power	2
20	The displacement (in m) of a particle moving along X axis is given by $x= 15t+6t^2$. Calculate (I) Instantaneous velocity at t=2 s (II) Instantaneous acceleration	2
21	A shell of mass 0.02 Kg is fired by a gun of mass 100 Kg. If the muzzle speed of shell is 80 m/s, What is the recoil speed of the gun? OR A Bats man hits back a ball straight in the direction of the bawler without changing its initial speed of 12 m/s. If the mass of the ball is 0.15 Kg , determine the impulse imparted to the ball.(Assume linear motion of the ball)	2
22	What is spring constant of a spring? Give its SI unit and dimensional formula.	2
23	How does kinetic energy of a moving ball change if its speed is reduced to half of original speed? Take mass of ball = 4 kg and original speed =20 m/s.	2
24	Define radius of gyration of a body rotating about an axis. On what factors does it depends?	2
25	Two identical particles move toward each other with velocity 2v and v respectively. What is the velocity of the center of mass?	2
	SECTION-C	
26	The velocity v of water waves depends on the wavelength λ, density of water ρ and acceleration due to gravity g. Deduce by the method of dimensions the relationship between these quantities.	3
27	Deduce all three equations of motion for uniformly accelerated motion by graphical method.	3
28	Show that Newton's second law of motion is the real law of motion OR A body of mass 5 Kg is acted upon by two perpendicular forces of 8 N and 6 N. Give the magnitude and the direction of the acceleration of the body.	3

29	Deduce the relation between torque and angular momentum. Find the torque of a force(7 $\hat{\imath}$-3 $\hat{\jmath}$-5 $\hat{k}$) about the origin which acts on a particle whose position vector is ($\hat{\imath}$+ $\hat{\jmath}$- $\hat{k}$) OR Define moment of inertia of a body. Give its units and dimension. Explain the physical significance of moment of inertia.	3
30	A circular plate of uniform thickness has diameter of 56 cm. A circular portion of diameter 42 cm is removed form one edge of the plate. Find the center of mass of remaining portion.	3
	SECTION-D	
31	(a) A projectile is fired with a velocity u making an angle θ with the horizontal. Show that its trajectory is a parabola. (b) Prove that the maximum horizontal range is four times the maximum height attained by the projectile, When fired at an inclination so as to have maximum horizontal range. **OR** Define centripetal acceleration. Derive an expression for the centripetal acceleration of a particle moving with uniform speed v along a circular path of radius r. Find the magnitude of centripetal acceleration of a particle on the tip of a fan blade , 0.30 meter in diameter, rotating at 1200 rev/minute.	5
32	(a) Define the term static friction, limiting friction and kinetic friction. Draw the graph between friction and applied force on any object and show static friction, limiting friction and kinetic friction varied with applied friction f. (b) Determine the maximum acceleration of the train in which a box lying on its floor will remain stationary, given that the coefficient of static friction between the box and the train's floor is 0.15. Take g =10 m/s^2 **OR** (a) What is meant by banking of road? Derive an expression for the velocity of a car on a banked circular road having coefficient μ. Hence write an expression for optimum velocity. (b) A bend in the level road has a radius of 100 m. find the maximum speed which a car turning this bend may have without skidding, if the coefficient of friction between the tyres and road is 0.8.	5
33	(a) State the law of conservation of mechanical energy. Show that the total mechanical energy of a body falling freely under gravity is conserved.	5

	(b) How high must a body be lifted to gain an amount of potential energy must be equal to kinetic energy it has when moving at speed 20 m/s ? The value of acceleration due to gravity at a place is g=10 m/s^2 **OR** (a) Define elastic collision and discuss it for two bodies in one dimension. Calculate the velocities of body after collision. (b) Two balls bearings of mass m each moving in opposite direction with equal speed v collide head on with each other. Predict the outcome of the collision, assuming it to be perfectly elastic.	
	SECTION-E	
34	According to Newton's second law of motion, F=ma, where F is force required to produce an acceleration a in a body of mass m. if a =0, then F=0 i.e. no external force is required to move a body uniformly along a straight line. If a force act on a body for t seconds, the effect of force is given by impulse = F x t = change in linear momentum of body. With the help of passage given above, chose the appropriate alternative for each of following questions: (I) a cricket ball of mass 150 g is moving with a velocity of 12 m/s and is hit by a bat so that the ball is turned back with a velocity of 20m/s. if duration on contact between the ball and bat is 0.01 s the impulse of force is (a) 7.4 Ns (b) 4.8 Ns (c) 1.2 Ns (d) 4.7 Ns (II) Average force exerted by the bat is (a) 480 N (b)120 N (c)1200 N (d)840 N (III) The force action, whose linear momentum changes by 20 kg m/s in 10 s is (a) 2 N (b)20 N (c)200 N (d) 0.2 N (IV) An impulsive force of 100 N acts on a body for 1 s. What is the change in its linear momentum (a) 10 Ns (b) 100 Ns (c) 1000 Ns (d) 1 Ns	4
35	Read the following passage and choose appropriate answers of questions. The time rate of the total angular momentum of a system of particles about a point (taken as the origin of our frame of reference) is equal to the sum of the external torques (i.e. the torques due to external forces) acting on the system taken about the same point. $\tau_{ext}=dLdt$ If $\tau_{ext}=0$ $dLdt=0$ or L = constant. Or $I\omega=constant$ Thus, if the total external torque on a system of particles is zero, then the total angular momentum of the system is conserved, i.e. remains constant.	4

	With the help of above comprehension, choose the most appropriate alternative for each of the following questions: (I) Which of the following can be explained with the help of conservation of angular momentum? (a). Driving (b). Ice- skating (c). Diving (d). running (II) For angular momentum to be conserved what must be true about the net torque of the system? (a). Net torque is constant. (b). Net torque increases. (c). Net torque decreases. (d). Net torque is zero. (III) A person sits on a freely spinning lab stool that has no friction in its axle. When this person extends her arms, (a) her moment of inertia increases and her angular speed decreases. (b) her moment of inertia decreases and her angular speed increases. (c) her moment of inertia increases and her angular speed increases. (d) her moment of inertia increases and her angular speed remains the same. (IV) Two children, Ahmed and Ankur , ride on a merry-go-round. Ahmed is at a greater distance from the axis of rotation than Ankur. Which of the following are true statements? (a) Ankur and Ahmed have the same tangential speed. (b). Ahmed has a greater tangential speed than Ankur. (c). Ankur has a greater angular speed than Ahmed. (d). Ankur has a smaller angular speed than Ahmed	