ARMY PUBLIC SCHOOL, DHAULA KUAN.

HALF YEARLY EXAMINATION

CLASS XI Physics

Time Allowed: 3 Hours *Maximum Marks: 70*

General Instructions

1. *All questions are compulsory. There are 26 questions in all.*
2. *This question paper has five sections: Section A, Section B, Section C, Section D and Section E.*
3. *Section A contains five questions of one mark each, Section B contains five questions of two marks each, Section C contains twelve questions of three marks each, Section D contains one value based question of four marks and Section E contains three questions of five marks each.*
4. *There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.*

Section A

1. State the number of significant figures in the following: (i) 6.032 (ii) 0.0006032. (1)
2. What is the apparent weight of a man of mass 60 kg who is standing on a lift which is moving up with a uniform speed? Take g = 10 m/s^2 (1)
3. Why does a heavy rifle not kick as strongly as a light rifle using the same cartridges? (1)
4. A truck and a car have the same kinetic energy. Which one will have greater momentum and why? (1)
5. A spring is stretched. Is the work done by stretching force positive or negative? Is the potential energy of the spring positive or negative? (1)

Section B

6. A calorie is a unit of energy and it equals about 4.2 J where 1J = 1 kg m^2 s^{-2}. Suppose we employ a system of units in which the unit of mass equals α kg, the unit of length equals β m, the unit of time is γ s. Show that a calorie has a magnitude 4.2 $\alpha^{-1}\beta^{2}\gamma^{2}$ in terms of the new units.
(2)

OR

The resistance of a metallic wire is given by $R = V/I$, where V is the potential difference and I is the current. In a circuit the potential difference across resistance is V= (8+0.5) V and current in circuit I = (4+0.2) A. What is the value of resistance with its percentage error?

7. Two trains A and B of length 400 m each are moving on two parallel tracks with a uniform speed of 72 km/h in the same direction, with A ahead of B. The driver of B decides to overtake A and accelerates by 1m/s^2. If after 50 second, the guard of B just brushes past the driver of A, what was the original distance between them?
(2)
8. Draw velocity- time graphs for the uniformly accelerated motion in the following cases: (i) u = + ve, a = + ve. (ii) u = - ve, a = + ve
(iii) u = + ve, a = -ve (iv) u = - ve, a = - ve
where u is initial velocity and a is acceleration. (2)
9. A batsman deflects a ball by an angle of 90° without changing its initial speed which is equal to v m/s. What is the impulse imparted to the ball? Mass of the ball is M kg. (2)
10. Force F acting on a particle of mass m moving along a circular path of radius r with a constant angular velocity ω is given by $F = mr\omega^2$. Show that the equation is dimensionally correct.
(2)

Section C

11. A steel ball of radius r is allowed to fall under gravity through a viscous liquid of coefficient of viscosity η. After some time the ball attains a constant velocity v. The terminal velocity depends upon weight of the ball (mg), the coefficient of viscosity η, the radius of the ball r. By method of dimension determine the relation expressing terminal velocity.
(3)

12. Derive the equations of motion (i) $v = u + at$, (ii) $s = ut + 1/2\ at^2$, where the symbols have their usual meaning.
(3)

13. A police jeep on petrol duty on national highway was moving with a speed of 54 km/h. It finds a thief rushing up in a car at the rate of 126 km/h in the same direction. Police sub inspector fired at the car of the thief with his service revolver with a muzzle speed of 100 m/s. With what speed will the bullet hit the car of thief?
(3)

14. The position of a particle is given by: $\mathbf{r} = 3t\,\mathbf{i} - 2t^2\,\mathbf{j} + 4\mathbf{k}$ where t is in second and r to be in metre.
(i) Find velocity and acceleration.
(ii) What is the magnitude of velocity of the particle at t =2s? (3)

15. State parallelogram law of vector addition. Find analytically the magnitude and direction of the resultant of two vectors inclined at an angle θ. (3)

OR

Define centripetal acceleration. Derive an expression for centripetal acceleration acting on a particle in uniform circular motion.

16. Draw position-time graph for zero, positive and negative relative velocity? (3)

17. A body of mass 0.40 kg moving initially with a constant speed of 10 m/s to north is subject to a constant force of 8 N directed towards the south for 30 s. Take the instant the force is applied to be t = 0, the position of the body at that time to be x = 0, predict its position at t=100 s.
(3)

18. Define angle of repose. Show that coefficient of limiting friction is equal to the tangent of angle of repose.
(3)

19. Show that total mechanical energy of a freely falling body remains constant throughout the fall.
(3)

20. Show that Newton's second law of motion is the real law of motion. (3)

21. Derive an expression of elastic potential energy stored in a stretched spring. (3)

22. Show that gravitational force is a conservative force. (3)

Section D

23. Ram went to a circus show along with his parents. There he saw an item named "globe of death". A big size hollow sphere of steel rods with gaps in between was placed at the centre part of arena. The spherical shell had a door. Then suddenly a person riding a motorcycle rushed up towards the globe, entered into it through the door, completed vertical circles inside the globe and then escaped from the door. Ram was amazed because the motorcyclist did not fall even when he was upside down at the upper part of his vertical loop inside the globe of death. After viewing the circus show, when he returned to his home, he asked his father about this item. His father explained him the basic principle of successful looping the vertical loop by the motorcyclist.

(i) If globe of death has a radius of 5m, what should be the minimum speed of motorcyclist at the top point of vertical circle executed by him so that he can maintain his equilibrium?

(ii) What values were displayed by Ram and his father? (4)

Section E

24. Show that the path of a projectile projected at an angle θ from horizontal is parabolic in shape. Also obtain expression for horizontal range. At what angle of projection the horizontal range is maximum?
(5)

OR

(i) Establish the relation $v = r w$ for uniform circular motion.

(ii) Define uniform circular motion and give the direction of the acceleration.

(iii) Calculate the angular velocity of rotation of earth about its own axis. Also find the linear speed of particle situated on the surface of earth. Given radius of earth is 6400km.

25. What is the need of banking of road? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle θ. The coefficient of friction between the wheel and road is μ. Hence write expression for optimum speed for frictionless curved banked road.
(5)

OR

(i) Derive an expression for acceleration of an object sliding down on an inclined plane (θ). The coefficient of friction between the two surfaces is μ.

(ii) A block of mass 1kg is placed on an inclined plane inclined at an angle of 30° to the horizontal. If the coefficient of friction between the block and plane is 0.2, what force should be applied to keep the body from sliding down the plane? Use $g = 10\ m/s^2$.

26. A small body tied to one end of the string is whirled in a vertical circle. Represent the forces on diagram when the string makes an angle θ with initial position below the fixed point. Find an expression for the tension in the string. Also find the tension and velocity at the lowest and highest points respectively.

OR (5)

Define elastic collision. Derive an expression for velocities of two bodies after such a collision. Show that coefficient of restitution is one for elastic collision.