



Date: 08-04-2019
Time: 09:00-12:00

Dept. No.

Max. : 100 Marks

SECTION – A

Answer ALL questions.

(10 × 2 = 20)

1. State principle of physical independence of forces.
2. What are absolute units of force in different systems?
3. What is the time of flight of a projectile?
4. Defining enveloping parabola.
5. Give an example of a Simple Harmonic Motion.
6. What is meant by amplitude of a Simple Harmonic Motion?
7. A point P describes with a constant angular velocity about O the equiangular spiral $r = ae^{\theta}$, O being the pole of the spiral. Find the transverse component of the acceleration.
8. Define apse.
9. State of theorem of perpendicular axes for moment of inertia.
10. Define moment of inertia.

SECTION – B

Answer any FIVE questions

(5 × 8 = 40)

11. A train of mass 200 tons is running at the rate of 40 m.p.h. down an incline of 1 in 120. Find the resistance necessary to stop the train in half a mile.
12. A particle of mass m slides down a rough inclined plane of inclination α . Discuss the motion if μ is the coefficient of friction.
13. Show that the greatest height which a particle with initial velocity u can reach on a vertical wall at a distance a from the point of projection is $\frac{u^2}{2g} - \frac{a^2g}{2u^2}$.
14. From a point on the ground at a distance p from the foot of a vertical wall, a ball is thrown at an angle of 45° which just clears the wall and afterwards strikes the ground at a distance q on the other side. Show that the height of the wall is $\frac{pq}{p+q}$.

15. A particle moving in a straight line with simple harmonic motion. Its velocity has values 5 ft/sec and 4 ft/sec when their distances from the mean position are 2ft and 3ft respectively. Find the length of its path and period of its motion.
16. The speed v of a particle moving along the x axis is given by $v^2 = n^2(8bx - x^2 - 12b^2)$. Show that the motion is a simple harmonic with centre at $x = 4b$ and amplitude $2b$. Find the time from $x = 5b$ to $x = 6b$.
17. Derive the differential equation of a central orbit.
18. Find the moment of inertia of a uniform circular ring.

SECTION – C

Answer any TWO questions.

(2 × 20 = 40)

19. (a) An engine and train weigh 420 tons and engine exerts a force of 7 tons wt. (i) If resistance of motion be 14 lbs. wt/ton, find the time the train will take to acquire a velocity of 30 m.p.h. from rest. (ii) If now steam is shut off, find the distance the train will run before coming to rest. (iii) Find this distance, if the brakes are also applied assuming resistance due to brakes is 126 lbs. wt./ton.
 (b) Show that the velocity with which a particle must be projected down a smooth inclined plane of length l and height h so that the time of descent shall be the same as taken by another particle in falling freely through a distance equal to the height of the plane is $\frac{l^2 - h^2}{l} \sqrt{\frac{g}{2h}}$. **(10+10)**
20. Show that path of a projectile is a parabola. **(20)**
21. (a) Find the resultant of two simple harmonic motions of same period in the same straight line.
 (b) Find the law of force for the central orbit $r = ae^{\theta \cot \alpha}$. **(10+10)**
22. (a) State and prove parallel axis theorem for moment of inertia.
 (b) Find the moment of inertia of a thin uniform parabolic lamina bounded by the parabola $y^2 = 4a(h - x)$ and about the y axis. **(10+10)**

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