

(6 pages)

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B.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2023

Sixth Semester

Mathematics — Core

DYNAMICS

(For those who joined in July 2017–2020)

Time : Three hours

Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The time of flight of a projectile is _____

- (a) $\frac{u \sin 2\alpha}{g}$ (b) $\frac{u^2 \sin^2 \alpha}{g}$
(c) $\frac{2u \sin \alpha}{g}$ (d) $\frac{u^2 \sin^2 \alpha}{2g}$

2. The maximum horizontal range of the projectile is _____

- (a) $\frac{u}{g}$ (b) $\frac{u^2}{g}$
(c) $\frac{u \sin \alpha}{g}$ (d) $\frac{u^2 \sin \alpha}{g}$

3. If the sphere is perfectly elastic $e=1$, then the loss of Kinetic energy is _____

- (a) 0 (b) 1
(c) $u \sin \alpha$ (d) $\frac{1}{2} \cos^2 \alpha$

4. The ball is perfectly elastic if _____

- (a) $v=0$ (b) $v=u$
(c) $u=0$ (d) $u = \sin \alpha$

5. The period of simple harmonic motion is _____

- (a) $\frac{2\pi}{\mu}$ (b) $\frac{2\pi}{\sqrt{\mu}}$
(c) $\frac{\pi}{\sqrt{\mu}}$ (d) $\frac{\pi}{\mu}$

5. The displacement of simple harmonic motion is _____

- (a) $x = a \cos \sqrt{\mu t}$ (b) $x = a \cos t$
(c) $x = \cos \sqrt{\mu t}$ (d) none of these

7. The radial component of velocity is _____

- (a) $r\theta$ (b) $r\dot{\theta}$
(c) \dot{r} (d) $\dot{r}\dot{\theta}$

8. The transverse component of acceleration is _____

- (a) $\frac{1}{r} \frac{d}{dt}(r\dot{\theta})$ (b) $\frac{1}{r} \frac{d}{dt}(r^2\dot{\theta})$
(c) $\frac{1}{r} \frac{d}{dt}(r^2\dot{\theta})$ (d) $\frac{1}{r} \frac{d}{dt}(r\dot{\theta})$

9. The differential equation of a central orbit is _____

- (a) $u + \frac{du}{d\theta} = \frac{p}{h^2 u^2}$ (b) $u^2 + \frac{d^2 u}{d\theta^2} = \frac{p}{h^2 u^2}$
(c) $u + \frac{d^2 u}{d\theta^2} = \frac{p}{h^2 u^2}$ (d) $u^2 + \frac{d^2 u}{d\theta^2} = \frac{p}{hu}$

10. Pedal equation of the circle is _____

- (a) $r = 2ap$ (b) $r^2 = 2ap$
(c) $r^2 = 2a^2 p$ (d) $r = 2a^2 p$

PART B — (5 × 5 = 25 marks)

Answer ALL questions choosing either (a) or (b).

11. (a) Find the horizontal range of a projectile.

Or

(b) Derive the range on an inclined plane.

12. (a) Explain the Newton's experimental law.

Or

(b) Explain the direct impact of two smooth spheres.

13. (a) Write a short note on simple harmonic motion.

Or

(b) Explain the change of origin in SHM.

14. (a) Derive the radial and transverse components of velocity.

Or

(b) Explain the equation of motion in polar coordinates.

15. (a) Explain the $(p-r)$ equation of the central orbit.

Or

- (b) Derive the $(p-r)$ equation of the parabola.

PART C — (5 × 8 = 40 marks)

Answer ALL questions choosing either (a) or (b).

16. (a) Show that the path of a projectile is a parabola.

Or

- (b) Show that for a given velocity of projection the maximum range down an inclined plane of inclination α bears to the maximum range up the inclined plane the ratio $\frac{1 + \sin \alpha}{1 - \sin \alpha}$.

17. (a) Find the loss of kinetic energy due to oblique impact of two smooth spheres.

Or

- (b) A smooth sphere of mass m impinges obliquely on a smooth sphere of mass M which is at rest. Show that if $m = eM$, the directions of motion after impact are at right angles.

18. (a) Explain the geometrical representation of a simple harmonic motion.

Or

- (b) Show that the energy of a system executing SHM is proportional to the square of the amplitude and of the frequency.

19. (a) Explain the equiangular spiral.

Or

- (b) Explain the velocity and acceleration in polar coordinates.

20. (a) Explain the differential equation of central orbits.

Or

- (b) Find the law of force towards the pole under which the curve $r^n = a^n \cos n\theta$.