Exercises

1- A sphere of mass 10 lbs. and moving with velocity 8 ft./sec. overtakes a sphere of mass 8 lbs. and moving in the same direction with velocity 6 ft./sec. If the coefficient of restitution be $\frac{1}{2}$, find the velocities of the spheres after impact and the impulsive reaction between them.

2- Two spheres of masses m , m' impinge. If the collision is direct and V is their relative velocity before impact e is the coefficient of restitution prove that the loss of kinetic energy by impact is

$$\frac{1}{2}\,\frac{m m' V^2 (1-e^2)}{m+m'}.$$

3- Two smooth spheres of the same volume and of masses M , m (M > m) are at rest on a smooth horizontal table. The sphere m is given an impulse I along the line of centers of the two spheres and then impinges on the sphere M. If e is the coefficient of restitution between the two spheres prove that the loss of kinetic energy by impact is

$$\frac{1}{2}(1-e^2)\frac{M I^2}{m(M+m)}.$$

4-A sphere of mass 8 lbs. and moving with velocity 4ft./sec. impinges on a sphere of mass 4 lbs. and moving with velocity 2 ft./sec. , their directions of motion before impact making angles of 30° and 60° with the line of centers. If $e=\frac{1}{2}$ find their velocities and directions of motion after impact.

5- A sphere of mass m and moving with velocity 10 ft./sec. impinges obliquely on a second sphere at rest, whose mass is 2m, in a direction making an angle of 30° with the line of centres. If $e=\frac{1}{2}$ find their velocities and directions of motion after impact.

6- A sphere of mass 5m lbs. and moving with velocity 13 ft./sec., impinges on a sphere, of mass m lbs. and moving with velocity 5 ft./sec., their directions of motion being inclined at angles of $\sin^{-1}\frac{5}{13}$, $\sin^{-1}\frac{3}{5}$ respectively to the line of centers; if the coefficient of restitution be $\frac{1}{2}$, find the magnitudes and directions of their velocities after the impact. Find the impulsive reaction between the two spheres and the loss of kinetic energy by impact.

7- A sphere moving with a velocity of 10 ft. /sec. impinges at an angle of 45° on a smooth plane; find its velocity and direction of motion after the impact; the coefficient of restitution being $\frac{4}{5}$.

8- A sphere of mass m lies on a smooth horizontal table between another sphere of mass m' and a fixed vertical plane. If the sphere m is projected on the table towards m' and the coefficient of restitution between the two spheres and between the sphere m and the plane equals $\frac{3}{5}$. prove that the sphere m comes to rest after collision with the sphere m' to the second time if m' = 15 m.

9-A billiard table in the form of a rectangle of dimensions 8 ft., 6 ft. Find the position of the point on the shorter side from which the ball could be projected and the direction of its initial velocity such that the ball traces a rectangle and returns after collision with the other three sides to its initial position exactly given that e = 4/9.

10-If a ball overtake a ball of twice its own mass moving with one-seventh of its velocity, and if the coefficient of restitution between

them be $\frac{3}{4}$, show that the first ball will, after striking the second ball, remain at rest.

11-Two equal perfectly elastic balls impinge; if their directions of motion before impact be at right angles, show that their directions of motion after impact are at right angles also.

12-A sphere of mass 8 lbs. and moving with velocity 40 ft./sec., overtakes a sphere of mass 12 lbs. and moving with velocity 20 ft./sec. The two spheres form one body. Find its common velocity if the two Spheres were moving before impact:

(i)In the same direction.

(ii)In apposite directions.

14- A ball, moving with a velocity of 10 ft./sec., impinges on a smooth fixed plane in a direction making an angle $\tan^{-1}\frac{3}{4}$ with the plane; if the coefficient of restitution be $\frac{2}{3}$, find the velocity of the ball after the impact.

13- Three equal elastic spheres A, B, C are at rest along a straight line on a smooth horizontal table. A is projected towards B with velocity u. If the coefficient of restitution be $\frac{1}{2}$ for all collisions prove that two collisions only occur between A and B and the ratio between the final velocities of the three spheres is 13 : 15 : 36 .