Impulse & Momentum Exercises (2 pages; 24/6/20)

See also "Collisions - Reversal of direction".

(1**) Two particles of the same mass are travelling directly towards each other, on a smooth surface. Particle A has a speed which is θ times that of particle B (where $\theta > 0$). The coefficient of restitution between A and B is e.

(i) Find the condition on θ that must apply in order for A to change direction on impact. Also give the condition on e.

(ii) Describe the motion of the particles after they have collided, in the case where $e = 0$.

(iii) Describe the motion of the particles after they have collided, in the case where $e = 1$.

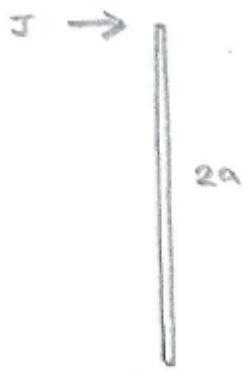
(iv) In the case where $e = \frac{1}{3}$, describe the motion of the particles after they have collided, for the various possible values of θ.

(2**) For two balls colliding directly on a smooth surface, show that kinetic energy is conserved when $e = 1$.

(3***) A spaceship has a geostationary orbit about the earth (ie it stays above the same point on the earth's surface). An astronaut walks from one end of the spaceship to the other. Describe what happens, relative to the earth's surface.

(4***) Impulse on Rod

An impulse J is applied to one end of a thin, uniform rod of length $2a$ and mass m, as shown below. Describe the resulting motion.



(5***) A snooker ball is hit towards a cushion, with speed v, in such a way that it hits each of the four sides of the table. The coefficient of restitution between the ball and the cushions is e. Investigate the speed and direction of the ball.

(6**) Particle A of mass m_A is travelling with speed u on a smooth surface and collides with particle B of mass m_B, which is at rest. If the coefficient of restitution between the particles is e, find a condition involving e, m_A & m_B for A to reverse its direction after the collision.

(7**) Particles A and B have the same mass and are travelling on a smooth surface, along the same line and in the same direction, with the speed of A being λ times that of B, where $\lambda > 1$, so that A and B collide. Show that the direction of A is never reversed.