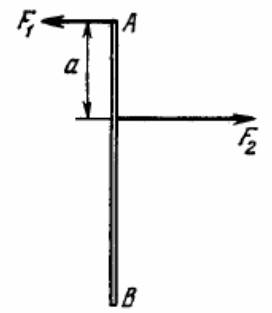
Q.1 A thin uniform rod AB of mass m=1kg moves translationally with acceleration of $2m/s^2$ due to two antiparallel forces F_1 and F_2 as shown in thee figure. The distance between t the points at which forces are applied is a=20cm. besides it is known that F_2=5N. Find the length of the rod.



[Ans. L= 1m]

Q.2 A force F_1= Aj is applied to a point whose radius vector r_1=ai, while a force F_2= Bi is applied to the point whose radius vector r_2= bj. Both radius vectors are determined relative to the origin of coordinates O, I and j are unit vectors of x and y axis, a,b,A, B are constants. Find the arm l of the resultant force relative to the point O.

[Ans. $\frac{|aA-bB|}{\sqrt{A^2+B^2}}$]

Q.3 A thin uniform square plate with side L and mass *M* can rotate freely about a stationary vertical axis coinciding with one of its sides. A small ball of mass m flying with velocity v at right angles to the plate strikes elastically the centre of it. Find:(a) the velocity of the ball v' after the impact; (b) the horizontal component of the resultant force which the axis will exert on the plate after the impact.

[Ans. $\frac{3m-4M}{3m+4M}$v, F =$\frac{8Mv^2}{l\left(1+\frac{4M}{3m}\right)^2}$]

Q.4 A vertically oriented uniform rod of mass *M* and length *L* can rotate about its upper end. A horizontally flying bullet of mass m strikes the lower end of the rod and gets stuck in it; as a result, the rod swings through an angle a. Assuming that *m << M,* find:(a) the velocity of the flying bullet;(b) the momentum increment in the system "bullet-rod" during the impact; what causes the change of that momentum;(c) at what distance *x* from the upper end of the rod the bullet must strike for the momentum of the system "bullet-rod" to remain constant during the impact.

Q.5 A uniform rod of mass m = 5.0 kg and length *1*= 90 cm rests on a smooth horizontal surface. One of the ends of the rod is struck with the impulse *J* = 3.0 N• s in a horizontal direction perpendicular to the rod. As a result, the rod obtains the momentum *p* = 3.0 N • s. Find the force with which one half of the rod will act on the other in the process of motion.

[Ans. 9N]

Q.6 A smooth uniform rod *AB* of mass *M* and length *L* rotates freely with an angular velocity ω_0, in a horizontal plane about a stationary vertical axis passing through its end A. A small sleeve of mass m starts sliding along the rod from the point A. Find the velocity
v' of the sleeve relative to the rod at the moment it reaches its other end *B.*

[Ans. V'= $\frac{\omega_0 L}{\sqrt{1+\frac{3m}{M}}}$]

Q.7 A uniform solid cylinder of mass m and radius *R* is set in rotation about its axis with an angular velocity coo, then lowered with its lateral surface onto a horizontal plane and released. The coefficient of friction between the cylinder and the plane is equal to *μ.*
Find: (a) how long the cylinder will move with sliding; (b) the total work performed by the sliding friction force acting on the cylinder.

[Ans. (a) $t = \frac{\omega_0 R}{3\mu g}$, $W = -\frac{m\omega_0^2 r^2}{6}$]