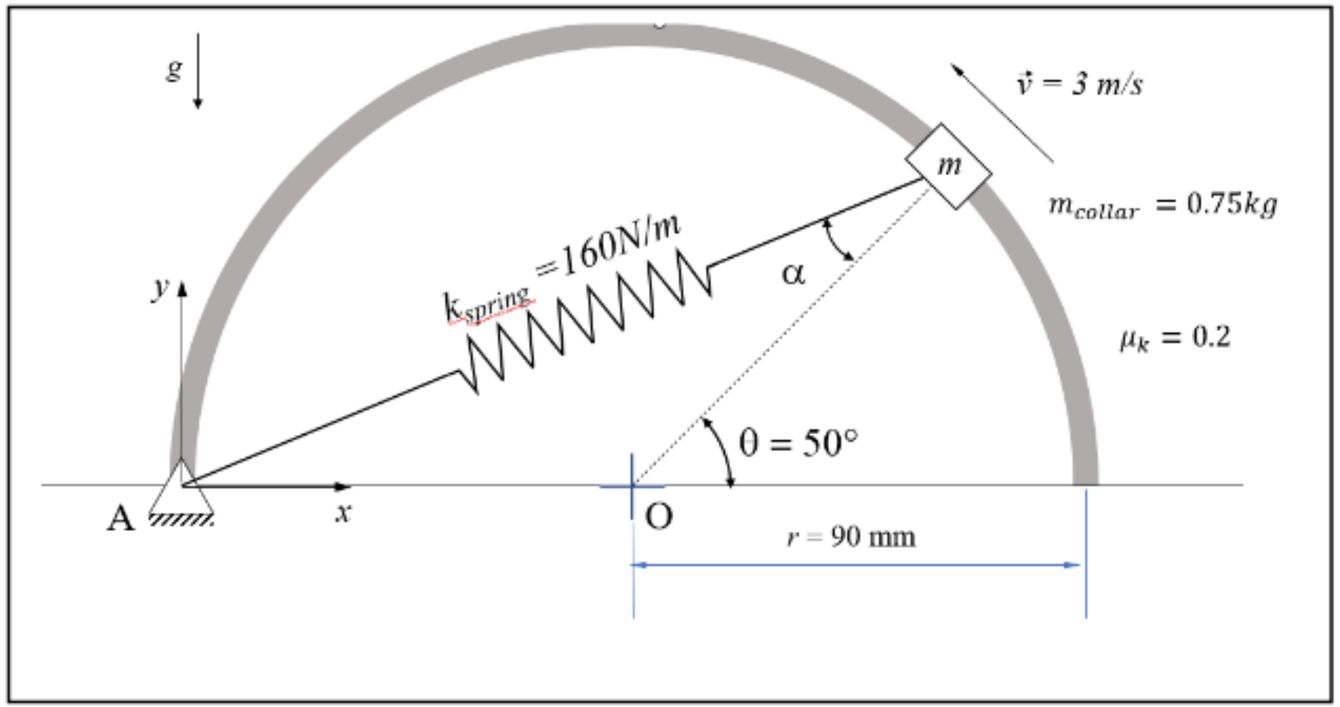
## Question 1

A collar of mass m = 0.75 kg slides along a semi-circular rod of radius r = 90 mm, as shown in the diagram. A spring with k = 160 N/m and unstretched length $s_0$ = 120 mm is connected to the collar at one end and is pinned (at point A) at the other end. The coefficient of kinetic friction between the rod and collar is $\mu_k$ = 0.2.




At the instant shown in the diagram, the collar has a speed of 3 m/s, and θ = 50 degrees. Gravity acts downward with acceleration g.

a) Draw a free body diagram of the collar, showing all forces and their directions (indicate angles θ and α in the diagram). **[3 marks]**