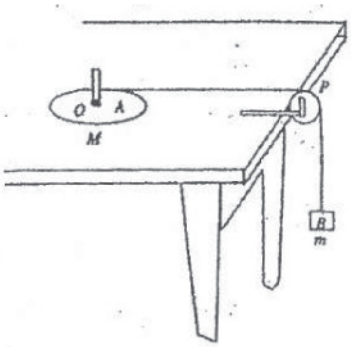
1. A uniform circular disc A of mass M and radius R is mounted horizontally on a smooth table so that it is free to rotate about a frictionless axle passing through its centre O. A light string which is tightly wrapped few times around the circumference of the disc passes over a **light** pulley P and carries a weight B of mass m at the free end as shown in the figure. The moment of inertia of the disc about axis of rotation, $I = \frac{1}{2} MR^2$. The system is held at rest with the string taut and released at time $t = 0$.



(a) What type of motions will A and B have ?

A .....

B .....

(b) (i) If the angular acceleration of the disc A is α and the acceleration of the weight B is a, write down the relation between a and α. *(one line)*

(ii) What is the relation between the torque (Γ) acting on the disc and α.

Γ = ...

(C) After a short time if the string breaks suddenly, what will happen to the motions of A and B.

A : .....

B : .....

(d) After the string has broken as mentioned in (c), a second disc of the same radius but of mass $M/2$ which is at rest is dropped symmetrically on the disc A. The two discs were found to stick together and rotate.

(i) What principle would you use to determine the new angular velocity of the discs ? *(one line)*

(ii) Under what condition is the above principle valid. *(one line)*

(iii)If the angular velocity of disc A prior to dropping the second disc is ω_0, find the new angular velocity of the discs in terms of ω_0. *(3 lines)*

(e) Instead of the string breaking as mentioned in (c), suppose the axle breaks and the disc becomes free to move.

(i) What type of motion will A have ?*(one line)*

(ii) Will the angular acceleration of A remain same as in (b) (i) ? Explain you answer. *(2 lines)*