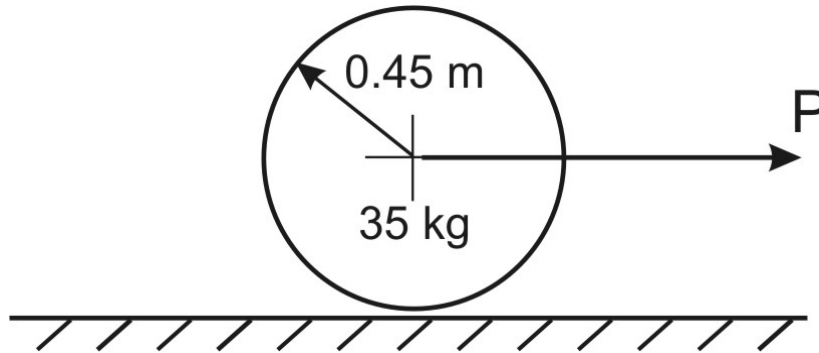


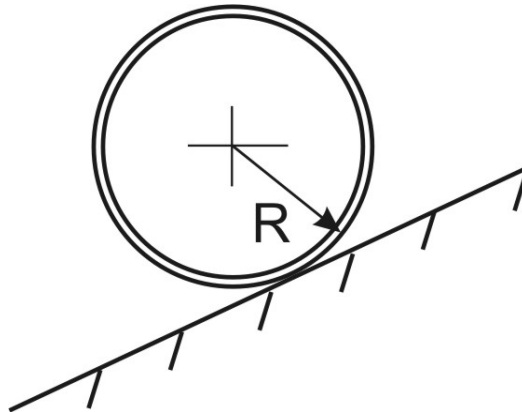
## Dynamics 2 – Tutorial 7

### Bodies and Systems with General Plane Motion

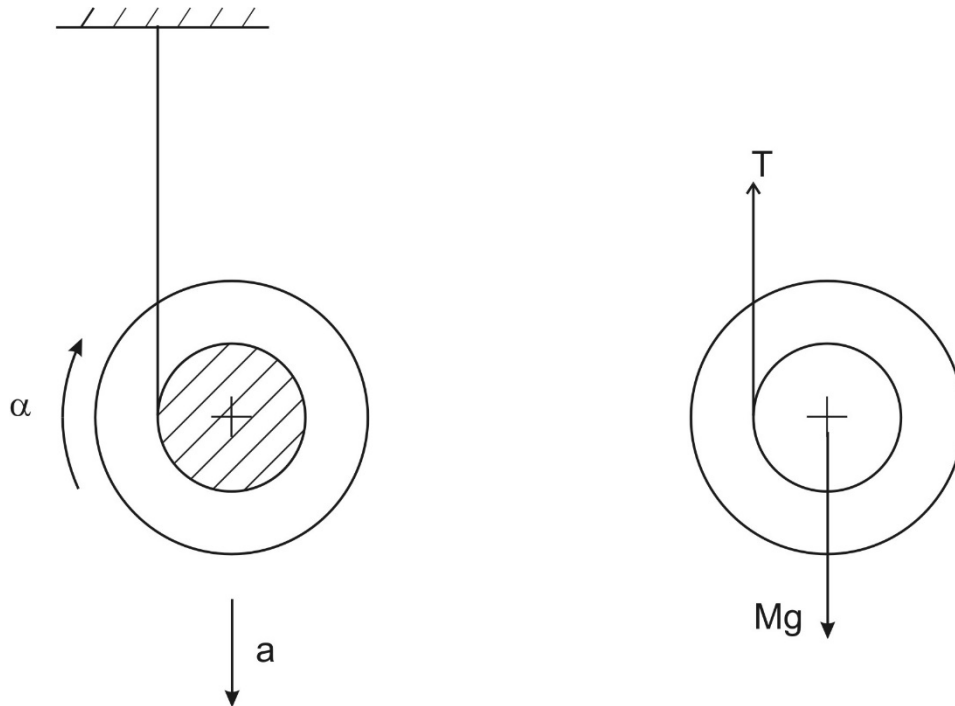
1. A uniform circular disc is being towed along a horizontal surface by means of a wire with a force  $P$ . The disc mass is 35 kg and the radius is 0.45 m. Assuming pure rolling, what force  $P$  is required to give an acceleration of  $6\text{ m/s}^2$ ? What is the friction force at the contact point? If  $\mu = 0.35$  for the surface, is pure rolling possible? [315 N, 105 N, yes]



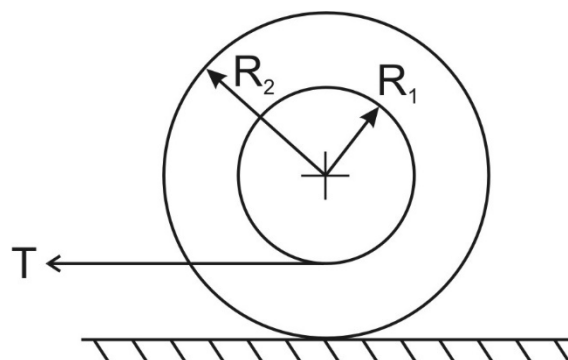
2. A thin steel ring of mass  $M$  and radius  $R$  is placed on an inclined slope, angle  $\theta$ . Assuming pure rolling, show that the ring acceleration down the slope is  $\frac{1}{2}g\sin\theta$  (Hint: what is the moment of inertia of a thin ring at its centre?).



3. The figure shows the cross-section of a big YO-YO, made of two discs joined by a short shaft. The yo-yo is effectively rolling down a vertical slope formed by the string. The total mass is 0.1 kg, the shaft diameter is 24 mm and the yo-yo radius of gyration is 60 mm. The FBD has been partially completed – finish it and find the downwards acceleration. What properties are important for a good yo-yo? [ $0.38 \text{ m/s}^2$ ]



4. A tricky one! The figure shows a cross section of a cable drum on a rough surface. A force  $T$  is being applied to the end of the cable. Assume the drum rolls without slipping on the surface. Determine if the direction of motion of its centre is to the left or right. Get an expression for the acceleration (Hint: assume a direction for the motion and see if you get a positive answer for the acceleration).



5. (Former exam question). A loaded four wheel trolley runs on rails down an incline. The total mass is 400 kg. Treat the wheels as uniform discs of radius 350 mm and 35 kg mass.
- (a) If the trailer were released on a  $15^\circ$  incline what would be its acceleration?
- (b) When the trailer gets up to a speed of 12 m/s brakes are automatically applied to the rear wheels. What brake torque is required for each rear wheel to bring the trailer to rest on the slope in a distance of 40m? [ $2.16 \text{ m/s}^2$ , 326 Nm]

