FRICTION

1. The opposing force which comes into play tangentially between two surfaces so as destory the relative motion between them is called friction.

2. Friction can be reduced by i) polishing the surface in contact, ii) using lubricants between the surfaces in contact, iii) using ball bearing between the surfaces in contact and iv) streaming vahicles.

3. The resistance encountered by a body in static friction while tending to move under the action of an external force is called static fricion. It is always equal and opposite to the applied force till the static friction reaches a maximum value. Static friction is a self adjusting force which increase till it reaches a maximum value.

4. The resistance encountered by a rolling body on a surface is known as rolling friction.

5. Laws of friction: i) The friction force is independent of the area of contact. ii) The fricitional force is directly propoetional to the normal reaction.

6. Laws of rolling friction: i) The smaller the area of contact the lesser will be the rolling friction. ii) The large the radius of the rolling body, the lesser will be the rolling friction. iii) The rolling friction is directly proportional to the normal reaction.

7. The angle made by the resultant of the normal reaction and the limiting friciton with normal reaction is called angle of friction.

   Coefficient of static friction $\mu_s = \tan\phi$.

8. Acceleration of a body on a rough horizontal force, $a = \frac{P - f_k}{m} = \frac{P - \mu_k mg}{m}$

   whe P is the applied force and m is the mass of the body.

9. Angle of repose is defined as the angle if inclination of a plane with respect to horizontal for which the body will be limiting equilibrium on the inclined plane. if α is the angle of repose $\mu_s = \tan\alpha$.

10. If the frictional force between a body and a surface is equal to the weight of the body, what is the coefficient of static friction.

    $\because \mu = \frac{f}{N}$; $\mu = 1$

11. How much work is done to move a body up a rough inclined plane of length s, making an angle θ with horizontal is

    $\because W = Fs$

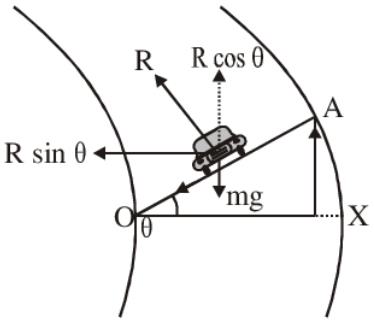
    $= mg(\sin\theta + \mu_k \cos\theta)$ s.

12. The acceleration, velocity and time taken by a body sliding along a smooth horizontal surface can be obtained by putting $\mu_k = 0$. i.e. $a = g\sin\theta$, $v = \sqrt{2g\ell\sin\theta}$ and $t = \sqrt{2\ell / g\sin\theta}$. The force to move up the plane with uniform velocity is $F = mg\sin\theta$

13. Pulling force $F = \frac{W\sin\phi}{\cos(\theta - \phi)}$ and pushing force $F = \frac{W\sin\phi}{\cos(\theta + \phi)}$ where W is the weight of body, ϕ is the angle of friction and θ is the angle made by F with the horizontal.

14. Banking of Roads

This phenomenon of raising outer edge of the curved road above the inner edge is called banking of road.



$$v = \left[\frac{rg(\mu_s + \tan\theta)}{(1 - \mu_s \tan\theta)}\right]^{1/2}$$

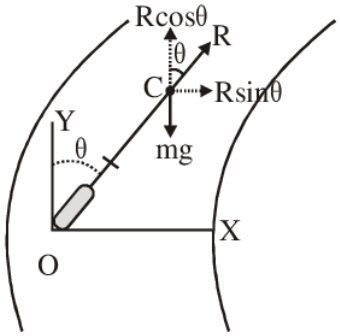
If $\mu_s = 0$, i.e., if banked road is perfectly smooth, then from the above eqn.

$$v_0 = (rg\tan\theta)^{1/2}$$

from equation

$$\tan\theta = v_0^2 / rg$$

Bending of Cyclist



$$\tan\theta = \frac{v^2}{rg}.$$