Motion of a Body Down an Inclined Plane

Inclilned plane

It is a wooden plane made smooth by putting a glass sheet over it. It is hinged at one end of a broad wooden base having a slot at the other end. A protractor helps in keeping the plane inclined to any known angle. A friction less pulley is provided at the upper free end of the inclined plane (Fig. 8.01).

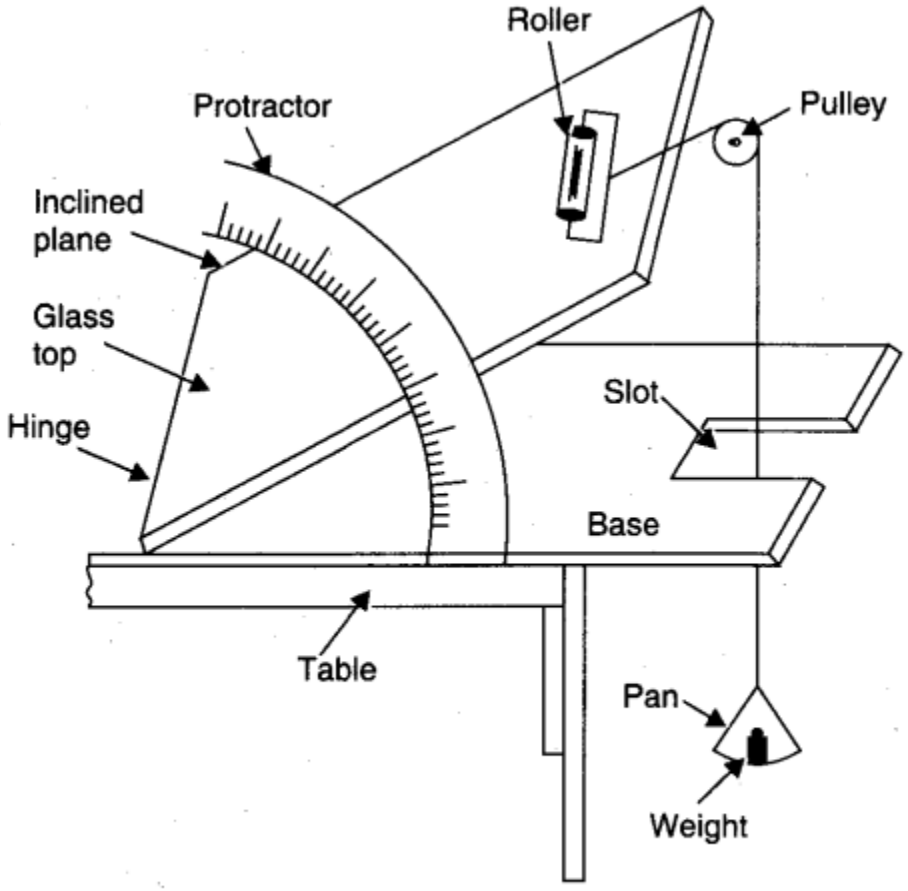

Fig. 8.01. Inclined plane.

Motion of a body down an inclined plane

Let a body of mass m is placed over an inclined plane, inclined at an angle θ with horizontal (Fig. 8.02). Its weight mg acts vertically downward. The component mg cos θ of the weight acting normally downward on the plane balances upward normal reaction R of the in dined plane. Component mg sin θ of the weight acting parallel to the inclined plane downwards, produces motion in the body.

Let the body be tied to a thread on the upward side. Let the thread pass,over a friction less pulley at the top of the inclined plane. Let a pan with some weights in it be tied to

lower free end of the thread.

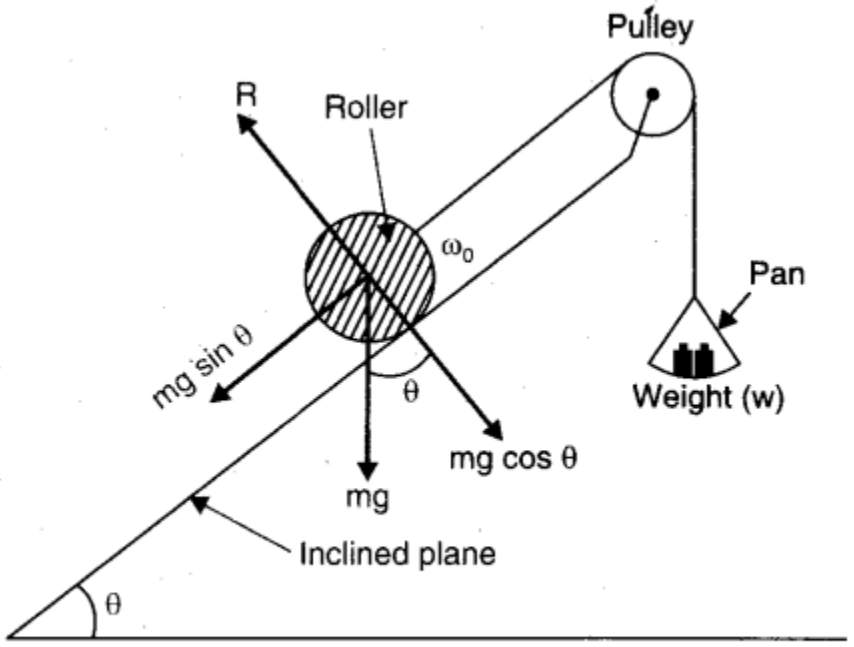

Fig. 8.02. Motion of a body down an inclined plane.

A total weight W=Mg which equals to mg sin θ, will keep the body balanced in its position f on the inclined plane, in case the surface of inclined plane is friction less. A slightly greater weight will make the body move up on the plane. A slightly lesser weight will make the body move down on the plane.

Thus the downward force acting on the body kept on the inclined plane, can be determined. The change in the value of this force with change of angle can also be studied.

Effect of friciton of inclined plane on the motion of the body

The results of the previous article are disturbed due to presence of friction offered by inclined plane to the motion of the body. By its nature, force of friction (F) will act downward when body moves upward and it will act upward when body moves downward.

Hence, if total weight $W_1 = M_1 g$ makes the body move up, we have

$mg \sin \theta + F = W_1 = M_1 g$

Similarly, if total weight $W_2 – M_2 g$ makes the body move down, we have

$mg \sin \theta – F = W_2 = M_2 g$

Adding, we get

$2 mg \sin \theta = W_1 + W_2 = (M_1 + M_2) g$

or
$$mg \sin \theta = \frac{W_1 + W_2}{2} = \frac{(M_1 + M_2) g}{2} \Rightarrow m \sin \theta = \frac{(M_1 + M_2)}{2}$$

which is corrected value of the downward force (corrected due to friction) acting on the body kept on the inclined plane.