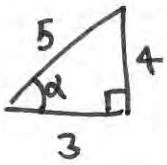
8. $\tan\alpha = \frac{4}{3}$ $\alpha = \tan^{-1}\left(\frac{4}{3}\right) = 53.1$



$\sin\alpha = 0.8$
$\cos\alpha = 0.6$

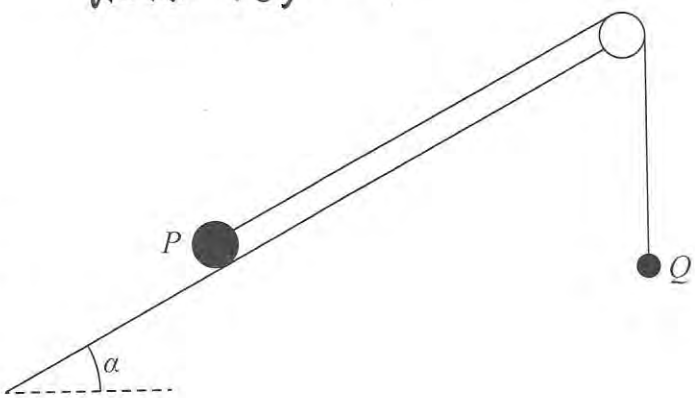


Figure 4

Two particles P and Q have mass 4 kg and 0.5 kg respectively. The particles are attached to the ends of a light inextensible string. Particle P is held at rest on a fixed rough plane, which is inclined to the horizontal at an angle α where $\tan\alpha = \frac{4}{3}$. The coefficient of friction between P and the plane is 0.5. The string lies along the plane and passes over a small smooth light pulley which is fixed at the top of the plane. Particle Q hangs freely at rest vertically below the pulley. The string lies in the vertical plane which contains the pulley and a line of greatest slope of the inclined plane, as shown in Figure 4. Particle P is released from rest with the string taut and slides down the plane.

Given that Q has not hit the pulley, find

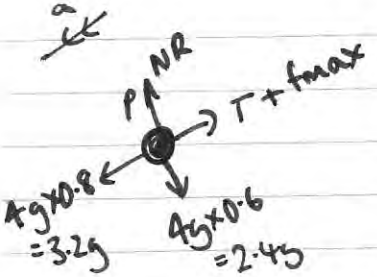
(a) the tension in the string during the motion,

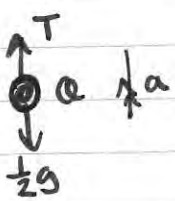
(11)

(b) the magnitude of the resultant force exerted by the string on the pulley.

(4)

$\mu = \frac{1}{2}$





$R \uparrow = ma$

$T - \frac{1}{2}g = \frac{1}{2}a$

$f_{max} = \mu NR = \frac{1}{2} \times 2.4g$
$= 1.2g$

$\leftarrow R \rightarrow = ma \quad 3.2g - T - f_{max} = 4a$

$3.2g - T - 1.2g = 4a$

$2g - T = 4a$

$T - \frac{1}{2}g = \frac{1}{2}a$ +

$\frac{3}{2}g = \frac{9}{2}a \quad \therefore a = \frac{1}{3}g$

$\therefore T = \frac{1}{2}a + \frac{1}{2}g = \frac{1}{6}g + \frac{1}{2}g$

$\therefore T = \frac{4}{6}g \quad \therefore T = \frac{2}{3}g = 6.53\,N$

b) $2T\cos\left(\frac{90-\alpha}{2}\right)$

$= 2\left(\frac{2}{3}g\right)\cos\left(\frac{90 - 53.1}{2}\right)$

$= 12.4\,N$