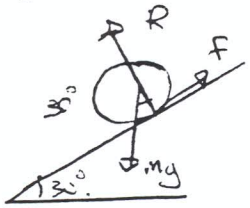
(a) Notes

1986

(b)

Forces



Masses:

Linear: m

Rotational: $\frac{1}{2} m r^2$

Accel:

Linear: $\ddot{x}$ at $30°$

Rotational: $\ddot{\theta}$

NII:

Linear

Rotational.

$\parallel$ to plane:

$$-F + \frac{mg}{2} = m\ddot{x} \quad (1)$$

$\perp$ to plane

$$R - mg\frac{\sqrt{3}}{2} = 0 \quad (2)$$

$$F \cdot r = \left(\tfrac{1}{2} m r^2\right)\ddot{\theta}$$

$$F = \tfrac{1}{2} m r \ddot{\theta} \quad (3)$$

Disk geometry $\Rightarrow \ddot{x} = r\ddot{\theta}$.

$(3) \Rightarrow F = \frac{1}{2} m\ddot{x}$.

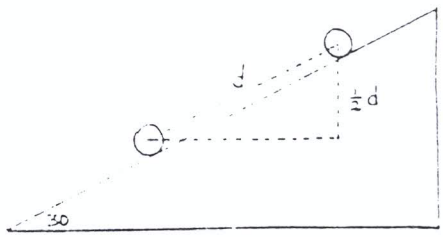
$(1) \Rightarrow -\frac{1}{2} m\ddot{x} + \frac{mg}{2} = m\ddot{x}$

$\Rightarrow \frac{mg}{2} = \frac{3}{2} m\ddot{x}$

$\Rightarrow \frac{g}{3} = \ddot{x}$

using Conservation of Energy

(c)



Gain in K.E. = Loss in P.E.

$\frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = mgh$

$\frac{1}{2}mv^2 + \frac{1}{2}(\frac{1}{2}mr^2)\omega^2 = mg(\frac{1}{2}d)$

$\frac{3}{4}mv^2 = \frac{1}{2}mgd$

$v^2 = \frac{2gd}{3}$

$v^2 = u^2 + 2fs$

$\frac{2gd}{3} = 0 + 2fd$

Ans. $f = \frac{g}{3}$ m/s^2