Ex 10-3
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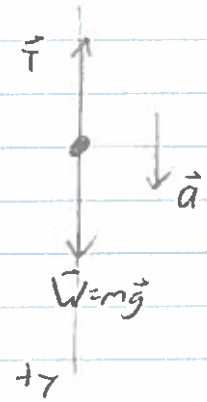
The block moves linearly – apply NII for translation

The cylinder rotates – apply NII for rotation.

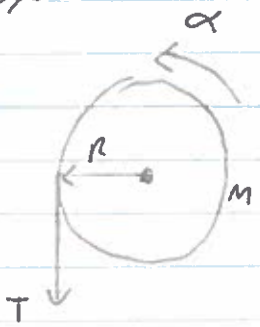
FBD for block



NII: $\Sigma F_y = ma = W - T$

$T = m(g-a)$ (1)

For cylinder



NII: $\Sigma \tau = I\alpha = ?$

Torque: $\tau = RT = I\alpha$

$T = \frac{I\alpha}{R}$

$I = \frac{1}{2}MR^2$ for solid cylinder

as $a = R\alpha$ $\therefore T = \frac{1}{2}MR\alpha = \frac{1}{2}Ma$ (2)

(1) = (2) $mg - ma = \frac{1}{2}Ma$

$(\frac{1}{2}M + m)a = mg$

$a = \frac{mg}{(\frac{1}{2}M + m)}$

(ii) $T = 2mg - \frac{m^2 g}{\frac{1}{2}M + m}$

$= \frac{mg}{\frac{1}{2}M + m}$

(i) $T = \frac{1}{2}Ma = \frac{\frac{1}{2}Mmg}{(\frac{1}{2}M + m)}$

$T = \frac{mg}{(1 + 2m/M)}$