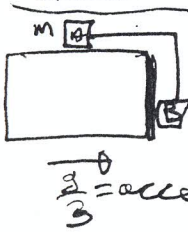
1991:

Q4. "A rectangular block moves across a ~~smooth~~ stationary horizontal surface with acceleration $\frac{g}{3}$": This means we do not have to analyse the forces acting on the block as we are told its acceleration. The question continues in part (i) to say "find the mag^n and dir^n of the resultant forces acting on the particles": we need only analyse forces on the particles.



(i) Particle (A) | (B)

	A	B
MASS	m	M
Accel	$\frac{g}{3}+a$	a (down), $\frac{g}{3}$ (up)
Forces	R, T, mg	T, S, Mg

(NII) ↕: $R-mg=0 \Rightarrow R=mg$ ①

(NII) ↔: $T=m\left(a+\frac{g}{3}\right)$ ②

(NII) ↕: $Mg-T=Ma$ ③

(NII) ↔: $S=M\left(\frac{g}{3}\right)$. ④

Solve ①,②,③,④ for a: ② + ③ $\Rightarrow$ $Mg = Ma + \frac{mg}{3} + ma$.

$\Rightarrow \frac{2g}{3} = 2a \Rightarrow a = \frac{g}{3}$.

$\therefore$ ② $\Rightarrow$ $T = m\left(\frac{g}{3}+\frac{g}{3}\right) = \frac{2mg}{3}$.

$\therefore$ $|R| = mg$, $|S| = \frac{Mg}{3}$ and $|T| = \frac{2mg}{3}$

dir^n R ↑ dir^n S → or ↑ and dir^n T → or ↑ (Daft part!)

(ii) μ same both sides of block.

	A	B
MASS	m	m
Accel	$\frac{g}{3}+f$	f (down), $\frac{g}{3}$ (up)
Forces:	μR, R, T, mg	μS, T, S, mg

Particles to remain at rest relative to block $\Rightarrow$ $f = 0$.

$\therefore$ (NII) $\Rightarrow$ ↕: $R-mg=0 \Rightarrow R=mg$

↔: $T-\mu R = \frac{mg}{3}$ $\Rightarrow$ $T-\mu mg = \frac{mg}{3}$ (*)

↕: $Mg - T - \mu S = 0 \Leftrightarrow S = \frac{Mg}{3}$.

$\therefore mg - T - \frac{\mu mg}{3} = 0$ (**)

Add (*) and (**) $\Rightarrow$ $-\mu mg + mg - \frac{\mu mg}{3} = \frac{mg}{3}$

$\Rightarrow -\frac{4}{3}mg\mu = -\frac{2}{3}mg \Rightarrow \boxed{\mu = \frac{1}{2}}$