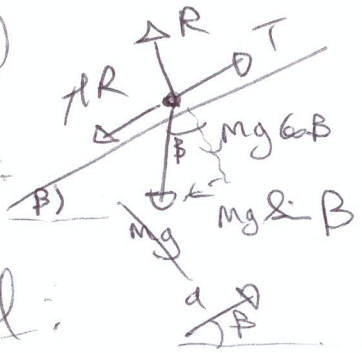
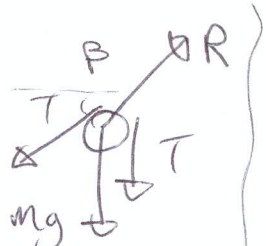
1994 HLC Q4

(i) (A)



forces:

Accel:



(B)

↓ a.

(ii) (A).

$\perp$ plane: $R - mg\cos\beta = 0$ ① $\quad \tan\beta = \frac{5}{12} \Rightarrow \frac{\cos\beta = \frac{12}{13}}{\sin\beta = \frac{5}{13}}$

$\parallel$ plane $T - \mu R - mg\sin\beta = ma$. ②.

(B) $mg - T = ma$. ③.

② + ③ $\Rightarrow$ $T - \mu R - mg\sin\beta = mg - T$.

① $\Rightarrow$ $T - \frac{1}{3}(mg\cos\beta) - mg\sin\beta) = mg - T$.

$\Rightarrow$ $T - \frac{1}{3}\left(mg\frac{12}{13}\right) - mg\frac{5}{13} = mg - T$

$\Rightarrow$ $2T = \frac{4mg}{13} + \frac{5mg}{13} + mg$.

$\Rightarrow$ $\boxed{T = \frac{11mg}{13}}$

(iii) Stage (1) After 2 seconds [at original accel]

③ $\Rightarrow a = \frac{2g}{13}$

$s = ut + \frac{1}{2}at^2$

$s = 0 + \frac{1}{2}\left(\frac{2g}{13}\right)2^2$

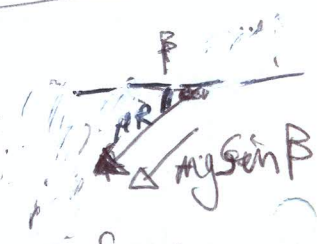
$\boxed{s_1 = \frac{4g}{13}}$ m.

Also. $v = u + at$

$\Rightarrow v = 0 + \left(\frac{2g}{13}\right)2$

$\boxed{v = \frac{4g}{13}\ ms^{-1}}$

Stage (2): Now forces $\parallel$ plane Now



New accel: f ↙

N II $\parallel$ plane:

$mg\sin\beta + \mu mR = mf$

$\Rightarrow g\sin\beta + \mu g\cos\beta = f$.

$\Rightarrow \frac{5}{13}g + \frac{1}{3}\left(\frac{12g}{13}\right) = f$. $\Rightarrow f = \frac{9g}{13}$

down plane

Find s_2: $u = \frac{4g}{13}$ up, $v = 0$, $a = -\frac{9g}{13}$ down, $s = ?$

$v^2 = u^2 + 2as \Rightarrow 0^2 = \left(\frac{4g}{13}\right)^2 + 2\left(\frac{9g}{13}\right)s \Rightarrow \boxed{s = \frac{8g}{117}}$

Total dist $= s_1 + s_2 = \frac{4g}{13} + \frac{8g}{117} = \frac{44g}{117}$.