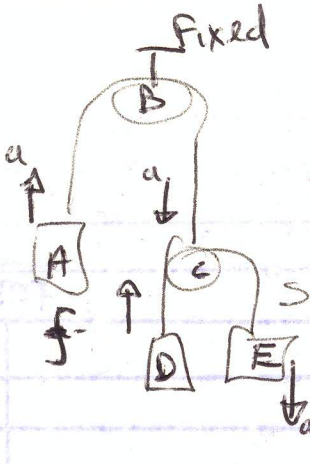
1976 Q3



	A	B	C	D	E
MASS	3m		0	2m	M
ACCEL	a ↑		a ↓	f − a ↑	a + f ↓
FORCES	T ↑, 3mg ↓		S ↓, S ↓	S ↑, 2mg ↓	S ↑, Mg ↓
N II	T − 3mg = 3ma		T = 2S	S − 2mg = 2m(f − a)	Mg − S = M(a + f)
	(1)		(2)	(3)	(4)

(1) $T - 3mg = 3ma$.

(2) $T = 2S$.

(3) $S - 2mg = 2m(f - a)$

(4) $Mg - S = M(a + f)$

WANT TO ELIMINATE a AND f.

$S - 2mg = 2mf - 2ma$.

(3) + 2 × (4): $2Mg - 2S = 2ma + 2Mf$

$-S = 4mf$.

$\Rightarrow f = \frac{-S}{4m}$.

But (1) $\Rightarrow$ $a = \frac{1}{3m}(T - 3mg)$

$\therefore$ (3) $\Rightarrow$ $S - 2mg = 2m\left(\frac{-S}{4m}\right) - 2m\left[\frac{1}{3m}(T - 3mg)\right]$

But (2) $\Rightarrow$ $S - 2mg = -\frac{S}{2} - \frac{2}{3}[2S] + 2mg$.

$\Rightarrow \Rightarrow S + \frac{S}{2} + \frac{4}{3}S = 4mg$.

$\Rightarrow \frac{6 + 3 + 8}{6} S = 4mg$.

$\Rightarrow \frac{17}{6} S = 4mg$.

$\Rightarrow S = \frac{24mg}{17}$.

(2) $\Rightarrow T = 2\left(\frac{24mg}{17}\right) = \frac{48mg}{17}$ lbf