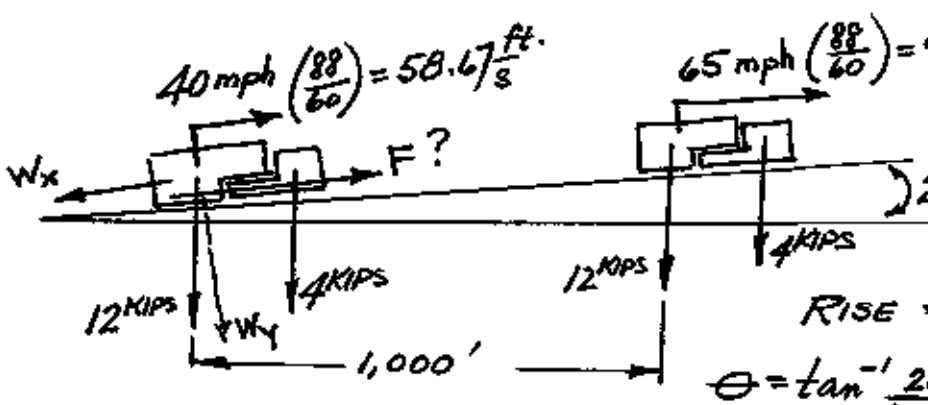
MECH 236 — ENERGY METHOD — 13.16 BEER & JOHNSTON

MILANO



RISE = 2% (1,000 ft) = 20'

$\theta = \tan^{-1}\frac{20}{1000} = 1.146°$

a) AVG. FORCE AT WHEELS of CAB.
∴ FORCE TO HAUL THE LOAD UPHILL 1000'

WORK done on the "particle" = change in K.E. of the particle

Newton: $\Sigma \vec{F}_{\text{on TRUCK}} = m_{\text{TRUCK}} \vec{a}_{\text{motion of truck}}$

Energy: $(\Sigma F)(\text{distance}) = \frac{1}{2} m (V_2^2 - V_1^2)$

$$(-W_x + F)(1{,}000 \cos\theta) = \frac{1}{2}\frac{W_{TOT}}{g}\left[95.33^2 - 58.67^2\right]\frac{ft^2}{s^2}$$

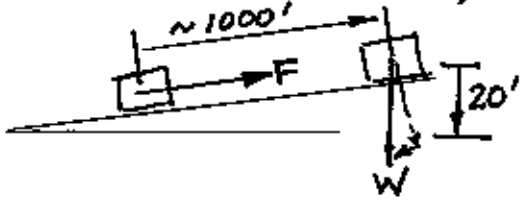
$$\left[-(16\times10^3)(\sin 1.146°) + F\right](10^3 ft.) = \frac{1}{2}\frac{(16\times10^3 lbf)}{32.2\ \frac{1}{s^2}}\left[5.645\times10^3\right]\frac{ft^2}{s^2}$$

$$-320^{lb.} + F^{lb.} = \frac{1}{2}\frac{(16\times10^3)}{32.2\ \frac{ft}{sec^2}}\frac{\left[5.645\times10^3\right]}{10^3 ft.}\frac{ft^2}{sec^2}\ lbf$$

$$F = 1.4026\times10^3 lbf + 320^{lbf} = 1.7226\times10^3\ lbf$$

$$\boxed{F \doteq 1723^{lbf}}$$

SAME RESULTS IF YOU CONSIDERED WORK AS P.E.



$$+F(1000ft) - (16\times10^3 lb.)(20ft.) = \Delta K.E.$$

$$F(10^3) - 320\times10^3 = \frac{1}{2}\frac{(16\times10^3)}{32.2}\left[5.645\times10^3\right]$$

$$F(10^3) = 1.4026\times10^6 + .320\times10^6$$

$$F = \frac{1.7226\times10^6}{10^3} = 1.7226\times10^3$$

$$\boxed{F \doteq 1723\ lbf}$$

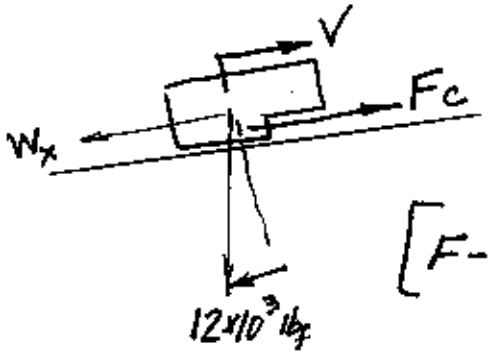
1/2

b.) AVG. FORCE IN COUPLING

You've done this one before. Analyze either the tractor or the trailer.

Think STATICS → FRAMES → ACTION REACTION.

TRAILER = 12 KIPS



WORK = Δ K.E.

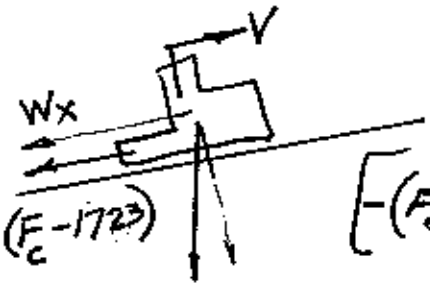
$$(F_c - W_x)10^3 ft = \frac{1}{2} m_{TRAIL.}\left[V_2^2 - V_1^2\right]$$

$$\left[F - (12\times10^3)\sin 1.146^\circ\right]10^3 ft = \frac{1}{2}\frac{(12\times10^3 lbf)}{32.2\ \frac{ft}{s^2}}\left[5.645\times10^3\right]\frac{ft^2}{s^2}$$

$$F_c - (12\times10^3)\sin 1.146 = \frac{12\times10^3}{2(32.2)}\frac{\left[5.645\times10^3\right]}{10^3 ft.}$$

$$\boxed{F_c = 1291.86 \sim 1292\ lbf}$$

TRACTOR = 4 KIPS



WORK = Δ KE

$$\left[-(F_c - 1723) - W_x\right]10^3 ft = \frac{1}{2} m_{TRACTOR}\left[V_2^2 - V_1^2\right]$$

$$-F_c + 1723^{lb.} - 4000\sin 1.146^\circ = \frac{4\times10^3}{2(32.2)}\frac{\left[5.645\times10^3\right]}{10^3 ft.}\frac{ft^2}{s^2}$$

$$-F_c = 350.62 + 4000\sin 1.146^\circ - 1723$$

$$-F_c = -1.2919\times10^3 \Rightarrow \boxed{F_c \doteq 1292\ lbf}$$