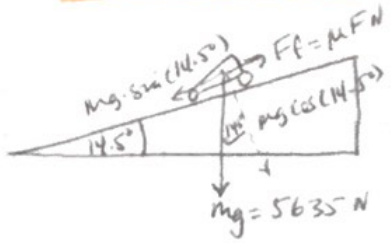
Ramp Problems - Solns

①



Compare force up ramp (friction) w Force down the ramp (component of mg parallel to ramp)

$F_f = \mu F_N = (0.21 \times 5635 \cdot \cos(14.5°)) = 1145.7\,N$

$F_{down} = mg \cdot \sin(14.5°) = 5635 \cdot \sin(14.5°) = 1410.9\,N$

YES, car will roll.

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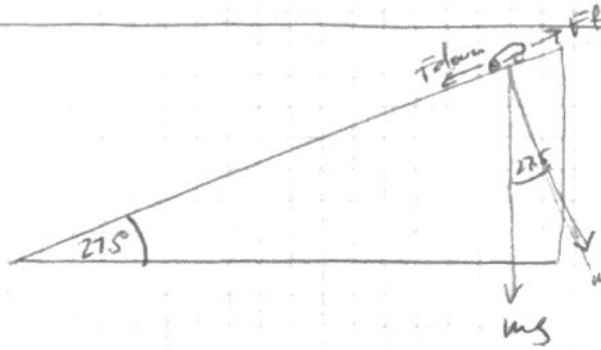
②



a) $F_{net} = ma$

$F_f = (0.44)(mg \cdot \cos(27.5°)) = 2868.4\,N$

$F_{down} = mg \cdot \sin(27.5°) = 3393.9\,N$ + 1100 N

$\Sigma F = 525.3\,N$ down + 1100 N (engine) $= 1625.3\,N$

b) $accel = \frac{\Sigma F}{m} = \frac{1625.3\,N}{750\,kg} = 2.17\,\frac{m}{s^2}$

c) $v^2 = u^2 + 2as = 0^2 + 2(2.17)(425) = 1844.5$ $\quad v = 42.9\,\frac{m}{s}$

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③ What force needed to accelerate car from rest up a 425 m hill?

★ This question is very badly written ★ (H/A)

I will assume this is the same hill (27.5°) incline

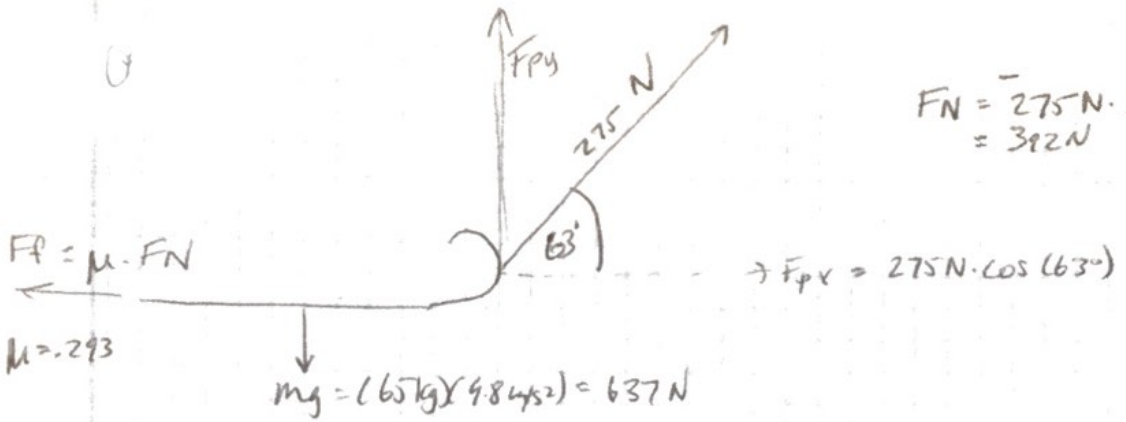
If $t = 45$ s, $u = 0$ and $s = 425$ m $\quad a = ?$

$s = \frac{1}{2}at^2 \Rightarrow \quad a = \frac{2s}{t^2} = \frac{2(425)}{(45)^2} \rightarrow 0.42\,\frac{m}{s^2}$ up hill only

If car was supposed to accelerate up and down hill in 45 sec,

$s = \frac{1}{2}at^2 = \quad a = \frac{2s}{t^2} = \frac{2(850)}{(45)^2} \rightarrow 0.84\,\frac{m}{s^2}$

- over



$F_N = 275N \cdot \sin(63) + mg$
$= 392N$

$\rightarrow F_{px} = 275N \cdot \cos(63°)$

(a) Net Force = $275N \cdot \cos(63°) - \mu F_N$ $= (.293)(392)$ = **9.94 N**

b) $a = \frac{\Sigma F}{m}$ **.15 $\frac{m}{s^2}$**

c) $t = ?$ to drag sled 75 m

$S = \frac{1}{2} a t^2$ $t = \sqrt{\frac{2S}{a}} = \sqrt{\frac{2(75)}{.15}}$ = **3.23**

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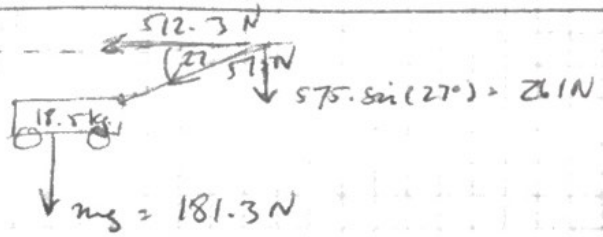
(5)



(a) $\Sigma F_{up} + \Sigma F_{down} = 0$ $F_N = 181.3N + 261N$ = **442.3 N**

(b) $F_{friction}$ = opposing force (constant speed)

= **512.3 N**

(c) $\mu = \frac{F_f}{F_N} = \frac{512.3N}{442.3}$ = **1.16**