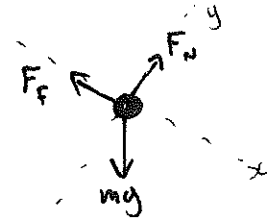
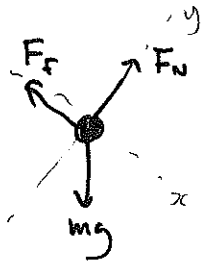
Dynamics on an INCLINED PLANE

1. 

b. 6.2N

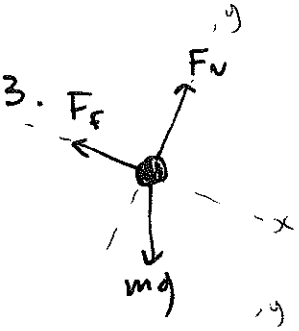
c. 1.3N up the ramp

2. 

b. 36N

c. 19N up the ramp

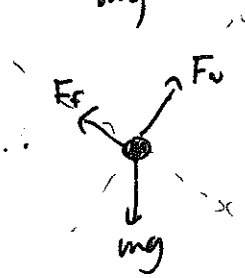
d. 0.53

3. 

b. 11N

c. Yes! ($mg\sin 31^\circ > \mu_s F_N$)

d. 1.3 m/s^2 down the ramp



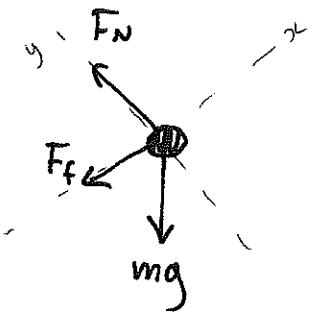
a. 26N

b. Yes → $F_{gx} = 31.98\ldots N$

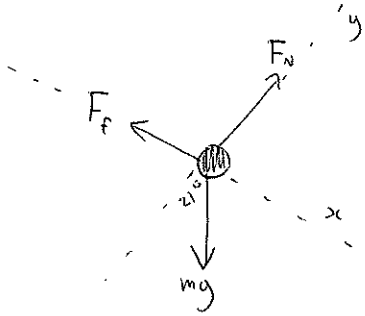
$F_{fs} = 19.945\ldots N$

c. 3.4 m/s^2 down the ramp

5. 11 m/s^2 down the ramp



6. A constant $\vec{v} \Rightarrow \vec{a} = 0\ m/s^2$



$\Sigma \vec{F}_x = 0$

$F_f = mg\sin 21^\circ = 2212.56372N$

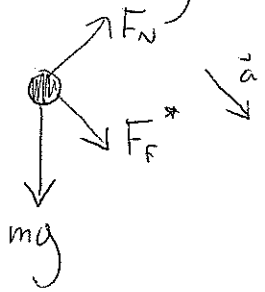
$\vec{F}_f = 2200N$ uphill

B. Same FBD: $\Sigma \vec{F}_x = m\vec{a}$

$F_f - mg\sin\theta = ma$ → $F_f = ma + mg\sin 21^\circ = 2993.76372N$

$\vec{F}_f = 3.0 \times 10^3 N$ uphill

6. Truck slowing means $\vec{a}$ is down hill.



* I have assumed that F_f will need to help F_{gx}, If I am wrong answer will be negative, and I will fix the direction.

$$\Sigma \vec{F}_x = m\vec{a}$$

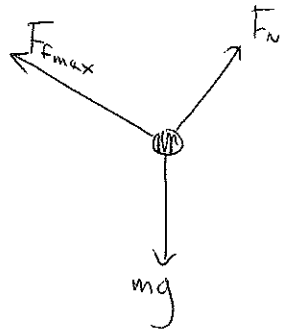
$F_f + mg\sin\theta = ma$ (all same dir'n, all same sign)

$F_f = ma - mg\sin\theta = 559.4362795N$

$\vec{F}_f = 560N$ down hill

D. Max $\vec{a}$ will occur when $\Sigma \vec{F}$ is maximized. This will occur when $\vec{F}_{f_s}$ is maximized. $0 \le F_f \le \mu F_N$; so set $F_f = \mu F_N$.

i



$\Sigma F_y = 0$

$F_N = mg\cos 21°$

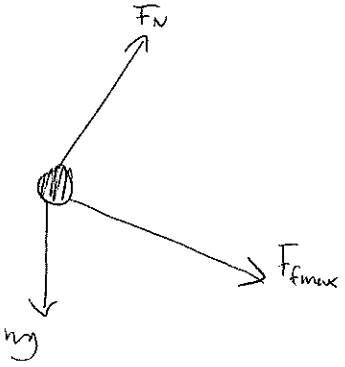
$\Sigma \vec{F}_x = m\vec{a}$

$\mu F_N - mg\sin\theta = ma_{max}$

$\mu mg\cos\theta - mg\sin\theta = ma_{max}$

$\vec{a}_{max} = 3.6\ m/s^2$ uphill

ii



$\Sigma \vec{F}_y = 0$

$F_N = mg\cos 21°$

(notice that changing the x-dir'n did not affect the y-dir'n)

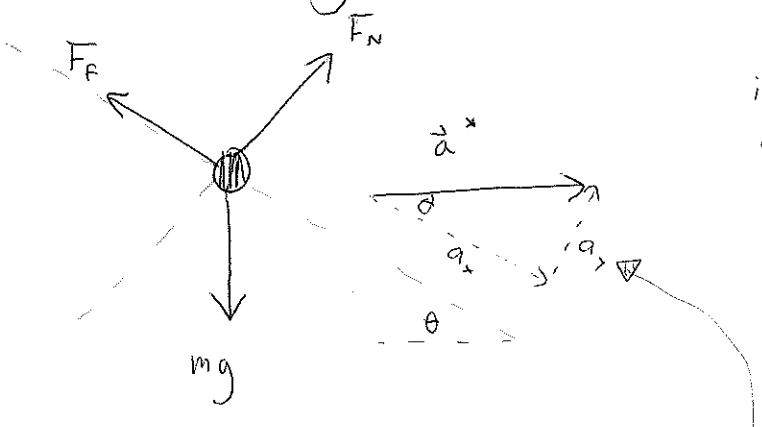
$\Sigma \vec{F}_x = m\vec{a}$

$\mu F_N + mg\sin\theta = ma_{max}$

$\mu mg\cos\theta + mg\sin\theta = ma_{max}$

$\vec{a}_{max} = 11\ m/s^2$ down hill

7. Object is 42kg block.



* Notice $\vec{a}$ does not lie on x or y axis, it must be broken into components!

$$\sum \vec{F}_y = m\vec{a}_y$$

* Again, $\vec{a}_x \neq 0$, $\vec{a}_y$ is in the $+\hat{y}$ dirn!

$$F_N - mg\cos\theta = ma\sin\theta$$

$$F_N = ma\sin\theta + mg\cos\theta$$

$\vec{F}_N = 430N$ up, away from ramp