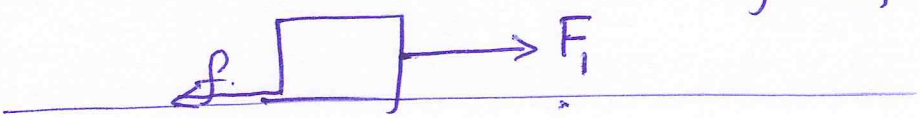
FRICTION

- between solids.
  - When there is no relative motion between surfaces. the force of friction acting in this case is called static friction
    - μ_s ← coefficient of static friction
  - When there is relative motion between the solid surfaces the force of friction acting in this case is called Kinetic friction
    - μ_k ← coefficient of kinetic friction
- friction between liquids (Viscosity)

1) If body is at rest and no force is acting on the body, then force of friction is zero.

2) If force is applied ~~to~~ to ~~pull~~ the body and it does not move, the friction acts in a direction opposite to tendancy of motion with a magnitude equal to the force applied.

$f = F_1$



3) If the force applied on the body is increased, the force of friction will adjust to the magnitude of force applied. till the point the body starts moving,

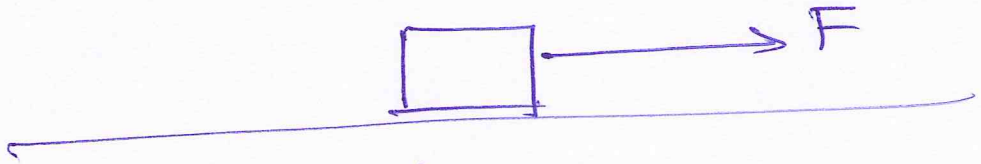
and after ...

$$f_{max} = \mu N$$

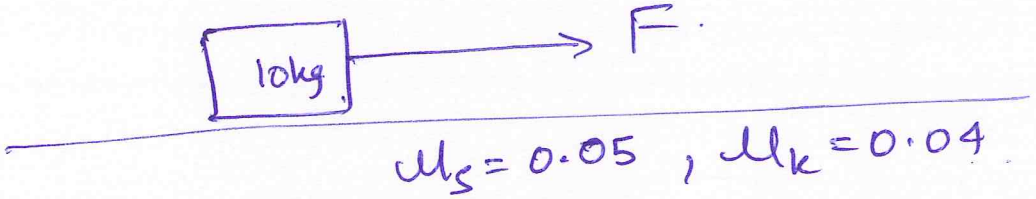
μ is coefficient of friction.

$$f \leq \mu N$$

$f_{max} = 5\ N$



F	f
2 N	2 N
4 N	4 N
5 N	5 N
6 N	5 N

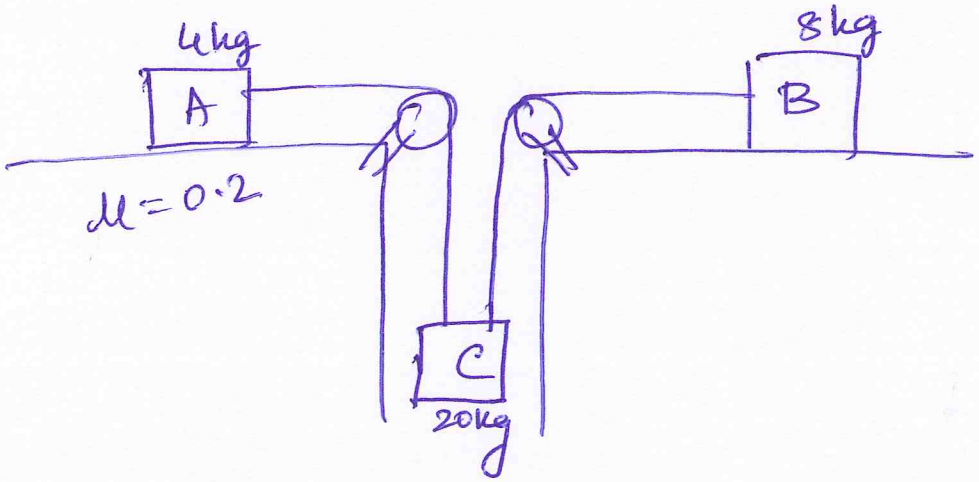


$f_{max} = 100 \times 0.05$
$= 5\ N$

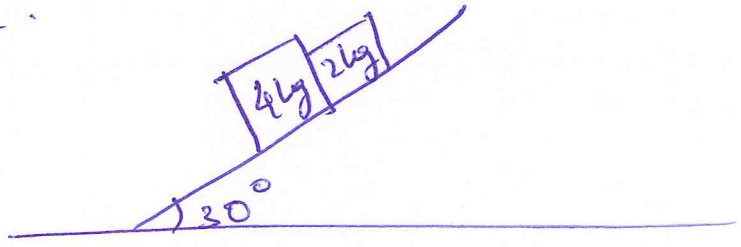
$\mu_s = 0.05$, $\mu_k = 0.04$

F	f	a.
4 N	4 N	0
5 N	5 N	0
6 N	4 N	$0.2\ m/s^2$ $F - f_k = ma$.
10 N	4 N	$0.6\ m/s^2$ $F - f_k = ma$.

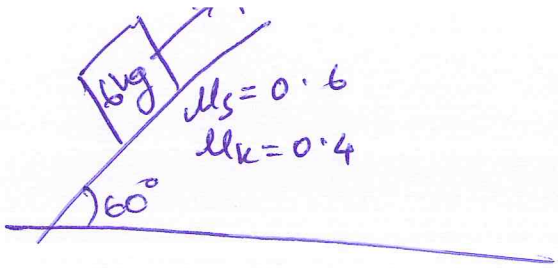
Q1 Consider the situation shown in figure. The ~~bbt~~ block B moves on a frictionless surface, while coefficient of friction between A & surface on which it moves is 0.2. Find acceleration with which the masses move and also the tension in strings. ($g = 10\ m/s^2$)



Q2 ~~Suffoke a block of mass 1kg~~ If two blocks in contact sliding down an inclined surface of inclination 30°. The friction coefficient between the block of mass 2kg and incline is $\mu_1 = 0.2$ & between 4kg and incline is $\mu_2 = 0.3$. Find acceleration of 2kg block.



Q3



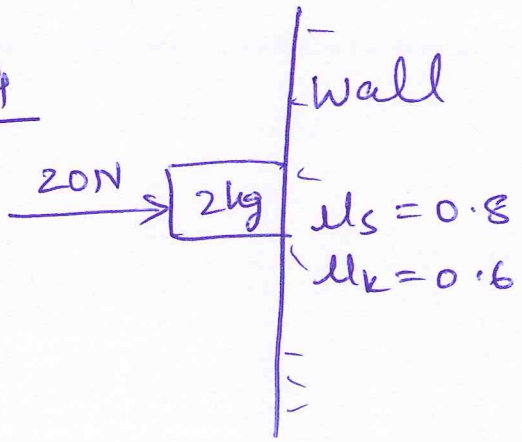
Find F

a) to keep block stationary

b) move block downwards with const velocity

c) move block upwards with acceleration $4 m/s^2$

Q4

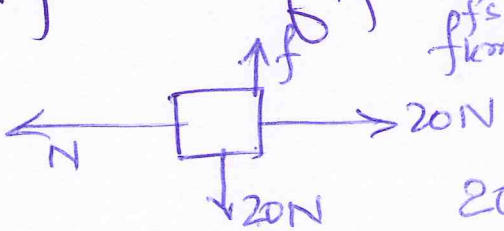


Find acceleration & force of friction

$f_{s\,max} = 20 \times 0.5 = 16$

$f_{k\,max} = 20 \times 0.6 = 12N$

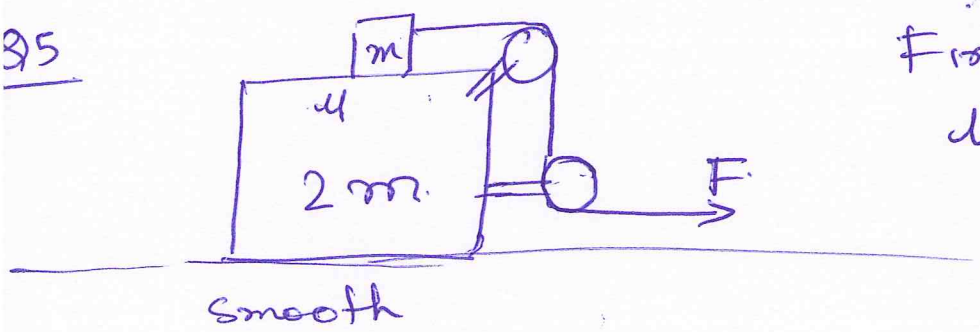
$N = 20N$



$20 - 12 = 2a$

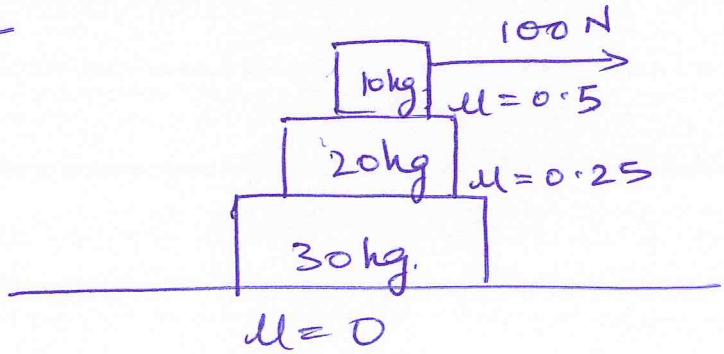
$a = 4 m/s^2$

Q5



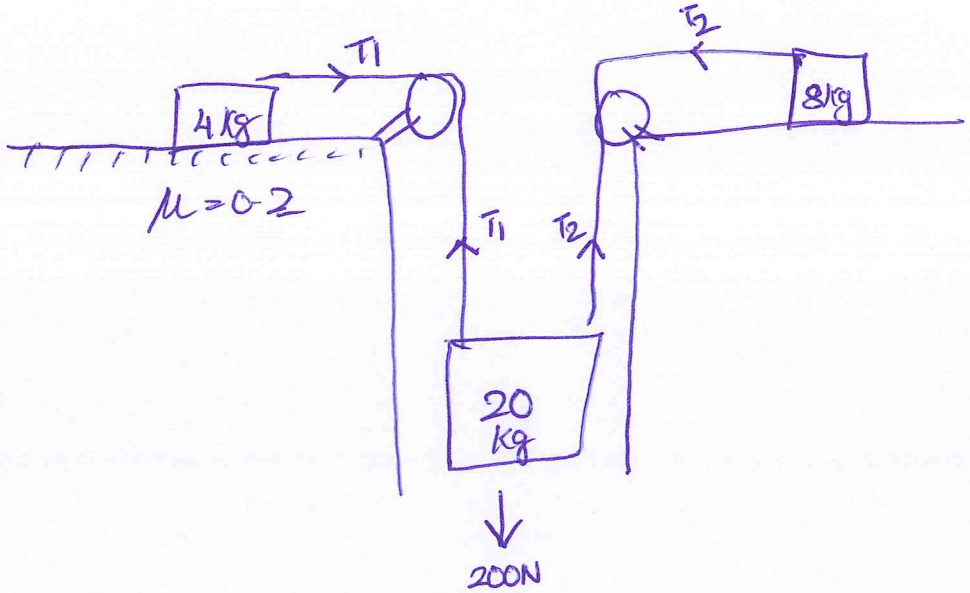
Find ~~minimum~~ minimum μ to avoid slipping

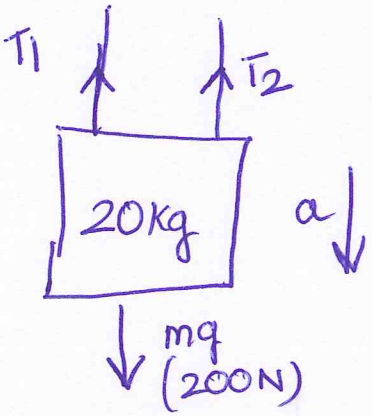
Q6



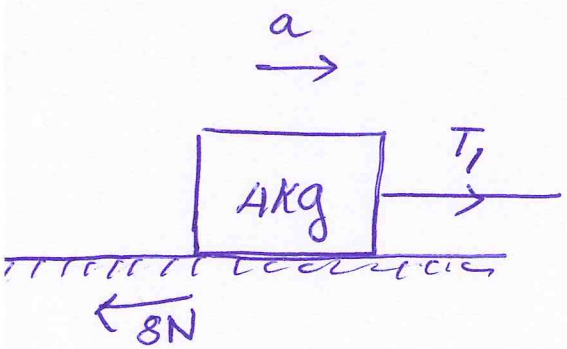
Find acceleration of all blocks.

1)



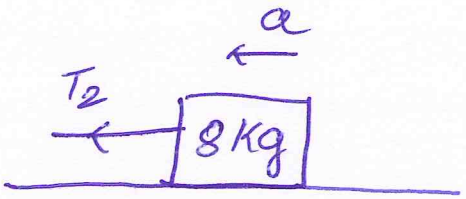


$$200 - (T_1 + T_2) = 20a$$



$$f_{max} = 40 \times 0.2$$
$$= 8N$$

$$T_1 - 8 = 4a$$
$$T_1 = 4a + 8$$



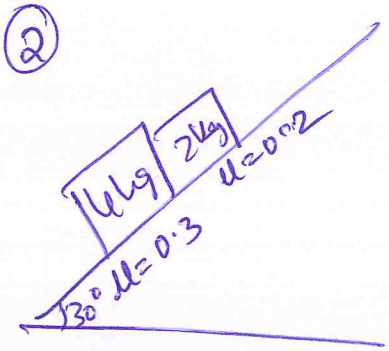
$$T_2 = 8a$$

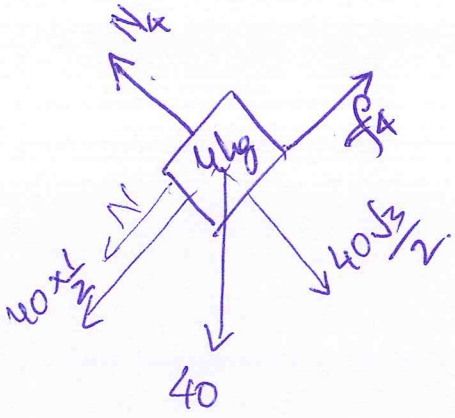
$$200 - (4a + 8 + 8a) = 20a$$
$$192 = 32a$$
$$a = 6\,m/s^2$$

$$T_2 = 8 \times 6$$
$$= 48N$$

$$T_1 = 24 + 8$$
$$= 32N$$

(2)





$N_4 = \frac{40\sqrt{3}}{2}$.

$f_4 = \mu_4 N_4$

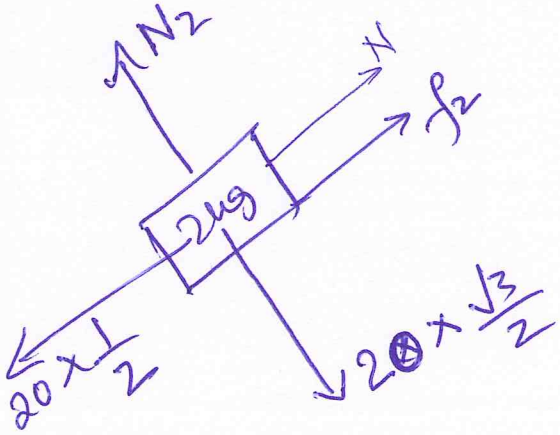
$= 0.3 \times \frac{40\sqrt{3}}{2}$

$40 \times \frac{1}{2} - 0.3 \times \frac{40\sqrt{3}}{2} = 4a_4$

$\frac{20}{4}\left(1 - \frac{3\sqrt{3}}{10}\right) = a_4$

$a_4 = 5\left(1 - \frac{3\sqrt{3}}{10}\right)$

$= 5 - 1.5\sqrt{3}$



$N_2 = \frac{20\sqrt{3}}{2}$.

$f_2 = \mu_2 N_2$

$= 0.2 \times \frac{20\sqrt{3}}{2} = 2\sqrt{3}$

$20 \times \frac{1}{2} - 2\sqrt{3} = 2a_2$

$a_2 = 5 - \sqrt{3}$

$$40 \times \frac{1}{2} - 0.3 \times \frac{40\sqrt{3}}{2} + N = 4a.$$

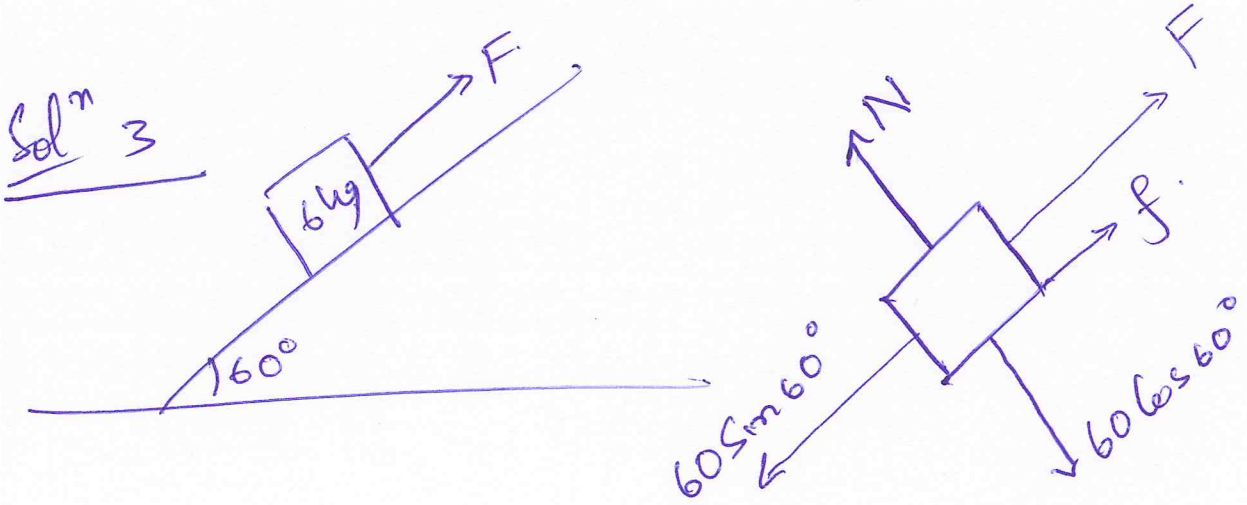
$$+ \quad 20 \times \frac{1}{2} - 2\sqrt{3} - N = 2a.$$

$$60 \times \frac{1}{2} - 8\sqrt{3} = 6a.$$

$$a = \frac{30 - 8\sqrt{3}}{6}$$

$$= \left(5 - \frac{4\sqrt{3}}{3}\right) m/s^2$$

Sol^n 3



$N = 60 \cos 60^\circ = 30N$

$f_{max\,s} = 0.6 \times 30 = 18N$

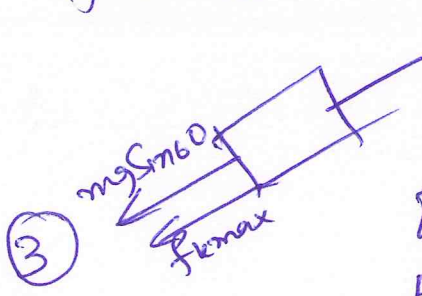
$f_{max\,k} = 0.4 \times 30 = 12N$

① $60 \sin 60^\circ = f_{s\,max} + F$

$(30\sqrt{3} - 18) = F$

② $60 \sin 60^\circ = f_{k\,max} + F$

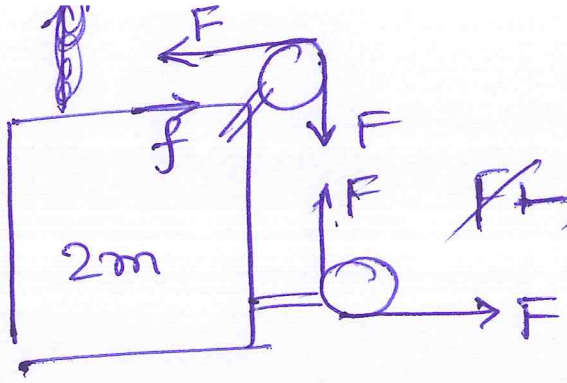
$(30\sqrt{3} - 12) = F.$



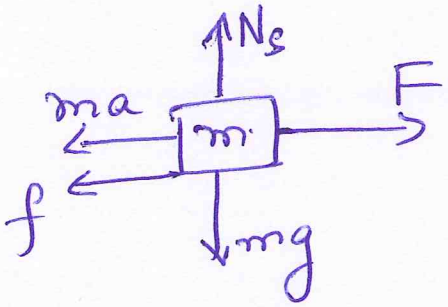
③ $F - mg \sin 60 - f_{k\,max} = 6 \times 4.$

$F = 24 + 30\sqrt{3} + 12 = (36 + 30\sqrt{3})N$

Sol^{n}s



$$\cancel{F} + \cancel{F} + f = 2ma.$$



$$F = f + ma.$$

$$N_s = mg$$

$$F = 3ma$$

$$a = \frac{F}{3m}.$$

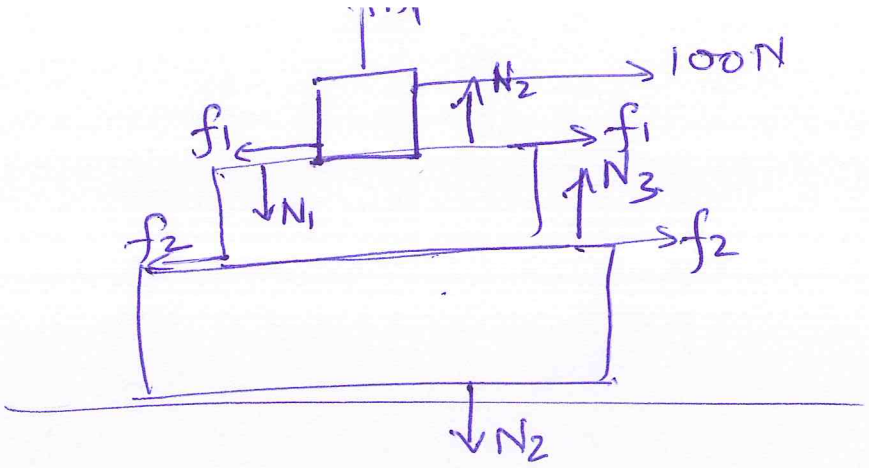
$$f = 2ma.$$

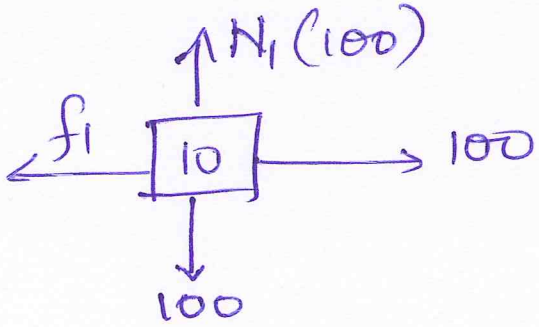
$$f = 2\cancel{m} \times \frac{F}{3\cancel{m}} = \frac{2F}{3}.$$

$$f \leq \mu mg.$$

$$\frac{2F}{3} \leq \mu mg$$

$$\frac{2F}{3mg} \leq \mu$$



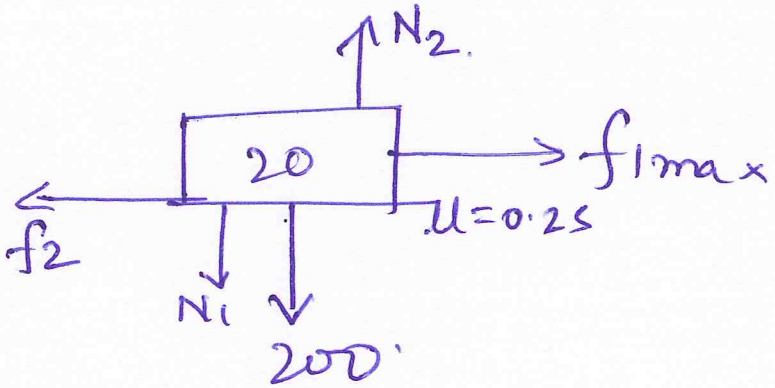


$N_1 = 100$

$f_{1max} = 0.5 \times N_1 = 50N$

$100 - 50 = 10 a_1$

$a_1 = 5 m/s^2$



$N_2 = 200 + N_1$

$= 300.$

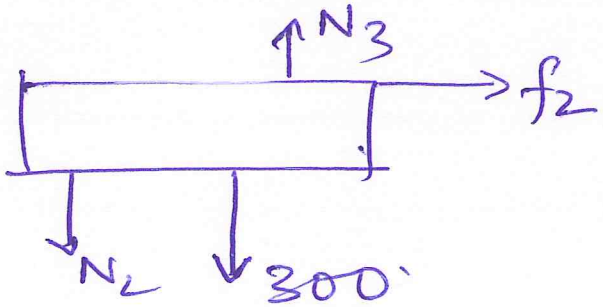
$f_{2max} = 0.25 \times N_2$

$= 75N$

$f_2 = 50N.$

$a_{rel\,3} = 0$

$f_2 = 50N$



$f_2 = 50a.$

$a = \frac{50}{50} m/s^2$