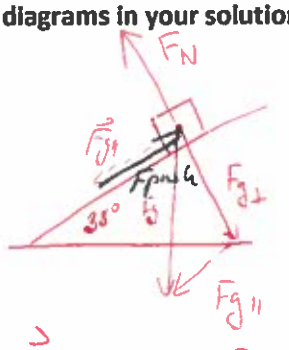
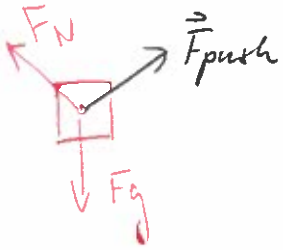
PHYSICS 12 FORCES – REVIEW

1. Consider a 25.0-kg object on an inclined plane with a degree of elevation of 35°.

a) If the surfaces are frictionless what force and at what direction is required to keep the object at rest? **Include 2 diagrams in your solution – an FBD and a sketch of the situation.**





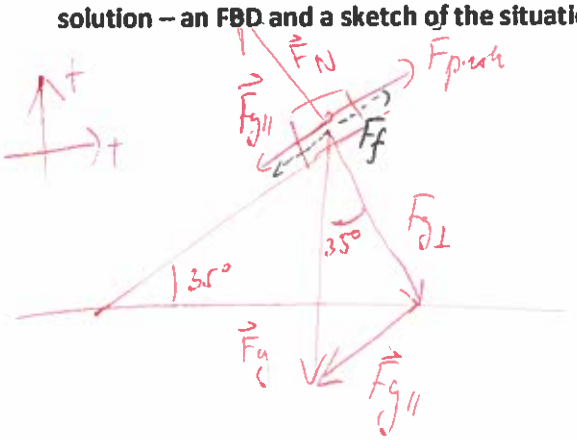
$\|\vec{F}_{push}\| = \|\vec{F}_{g\parallel}\|$

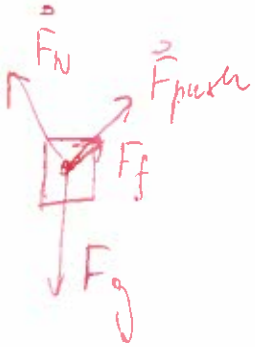
$= mg \cdot \sin 35°$

$= 140.5\ N$

$\therefore \vec{F}_{push} = 140.5\ N$ [up the inclined plane]

b) What force is needed to keep the object at rest if the coefficient of static friction is 0.14? **Include 2 diagrams in your solution – an FBD and a sketch of the situation.**





$\vec{F}_{net} = 0$

$= \vec{F}_N + \vec{F}_{g\perp} + \vec{F}_{g\parallel} + \vec{F}_{push} + \vec{F}_f$

$= 0$

$0 = -140.5 + 28.1 + F_{push}$

$140.5 = 28.1 + F_{push}$

$\therefore \vec{F}_{push} = 112.4\ N$ [up the plane]

$\vec{F}_f = \|\vec{F}_N\| \cdot \mu_s$

$= (mg\cos 35)(0.14)$

$= (25)(9.8)(\cos 35°)(0.14)$

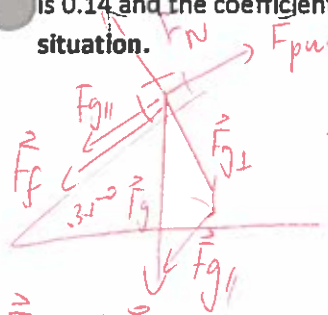
$= 28.1\ N$ [up the plane]

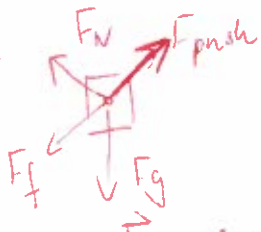
$F_{g\parallel} = mg\sin\theta$

$= (25)(9.8)(\sin 35°)$

$= 140.5\ N$

c) What is the acceleration of the object if it is pushed with force of 300 N [up the plane]. The coefficient of static friction is 0.14 and the coefficient of kinetic friction is 0.10? **Include 2 diagrams in your solution – an FBD and a sketch of the situation.**





$\vec{F}_{net} = \vec{F}_N + \vec{F}_{g\perp} + \vec{F}_{g\parallel} + \vec{F}_f + \vec{F}_{push}$

$= -140.5 - 20.07 + 300$

$= 139.43$ [up the plane]

$\vec{F}_f = \|\vec{F}_N\| \cdot \mu_k$

$= (mg\cos 35°)(0.10)$

$= 20.07$ N [down the plane]

$\vec{F}_{g\parallel} = mg\sin\theta$

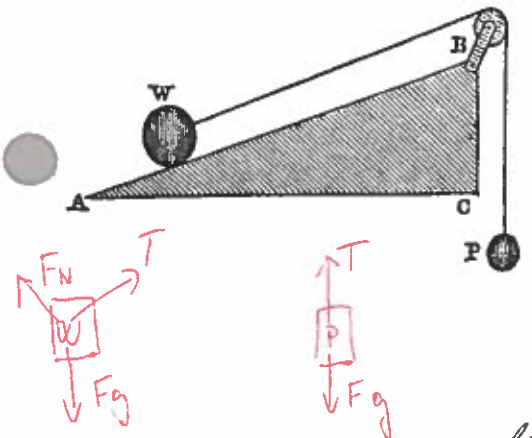
$= 140.5$ N [down p]

$\vec{F}_{net} = m\vec{a}$

$a = \frac{139.43}{25}$

$a = 5.6$ m/s² [up the plane]

2. a) What mass of object P is required in order for the system to remain at rest, provided that the coefficient of static friction is 0.25 and the angle at A is 20°? and $m_w = 4.0$ kg



W: $T = F_{g\parallel}$

$T = mg\sin\theta$

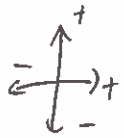
$= (40)(9.8)(\sin 20°)$

$\therefore T = 13.41$ N

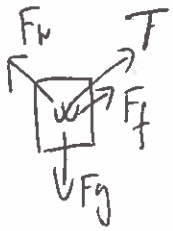
P: $T = F_g$

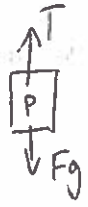
$13.41 = m(9.8)$

$\therefore m = 1.37$ kg



b) What would be the acceleration of the two masses if $m_p = 0.5$ kg? and $\mu_k = 0.20$





- $a_p = a_w = a$
- $T_p = T_w = T$

$\vec{F}_{net_p} = \vec{T} + \vec{F}_g$

$+m_p a = T - F_g$

$a = \frac{T - m_p g}{m_p}$

$\vec{F}_{net_w} = \vec{T} + \vec{F}_f + \vec{F}_N + \vec{F}_{g\perp} + \vec{F}_{g\parallel}$

$-m_w a = T + F_f - F_{g\parallel}$

$a = \frac{T + (mg\cos A)\mu_k - mg\sin A}{-m_w}$

$a = \frac{T - 4.9}{0.5} = \frac{T + 7.37 - 13.41}{-4.0}$

$-4T + 19.6 = 0.5T + 3.685 - 6.705$

$-4.5T = -22.62$

$T = 5.03$ N

$\therefore a = \frac{5.03 - 4.9}{0.5}$

$a_p = 0.26 \frac{m}{s^2}$ [up]

$a_w = 0.26 \frac{m}{s^2}$ [down the plane]

Textbook: p77#17, p 95 #6-10, p109 #14-16, p110 #18-21, p 115 #22, p121 #23-25