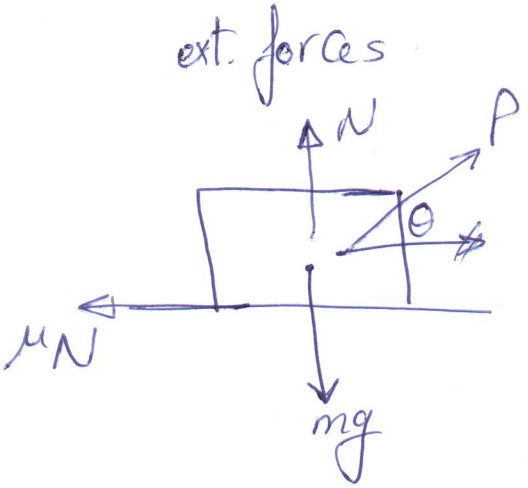
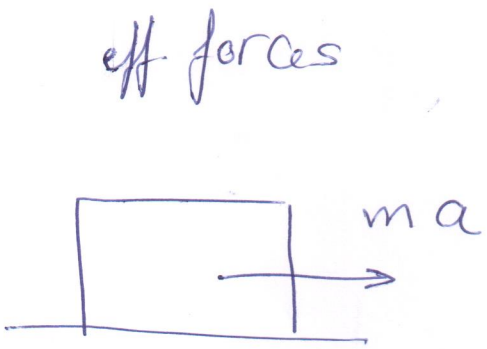
Sheet (3)

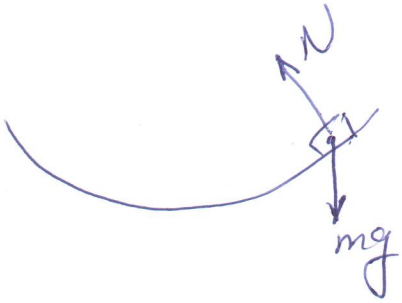
Kinetics of a particle
Forces & acceleration

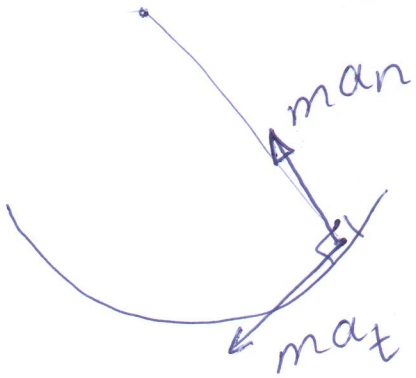
Cart.





Nat.





$$\Sigma F_{x_{ext.}} = \Sigma F_{x_{eff.}}$$

$$\Sigma F_{y_{ext.}} = \Sigma F_{y_{eff.}}$$

Cart.

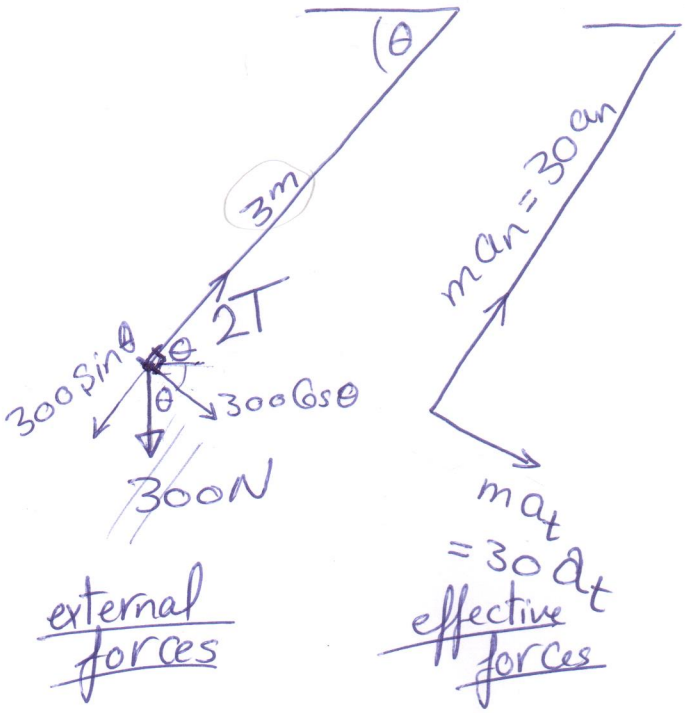
$$\Sigma F_{t_{ext.}} = \Sigma F_{t_{eff.}}$$

$$\Sigma F_{n_{ext.}} = \Sigma F_{n_{eff.}}$$

No 13-60

$\theta = 60^\circ$, $V = 0$

$\theta = 90^\circ$, $V = ??$, $T = ??$



$$\Sigma F_{t_{ext}} = \Sigma F_{t_{eff}}$$

$$300 \cos\theta = 30\, a_t$$

$$\therefore \boxed{a_t = 10 \cos\theta} \longrightarrow (1)$$

$$\Sigma F_{n_{ext}} = \Sigma F_{n_{eff}}$$

$$2T - 300 \sin\theta = 30\, a_n \longrightarrow (2)$$

from (1) $ds = r\, d\theta$ & $a_t = V \frac{dV}{ds}$

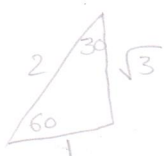
$$V \frac{dV}{ds} = 10 \cos\theta$$

$$V\, dV = 10 \cos\theta\, ds = 10 \cos\theta * r\, d\theta$$

$$\int_0^V V\, dV = 10r \int_{60}^{\theta} \cos\theta\, d\theta$$

$$\frac{V^2}{2} = 10r \left[\sin\theta - \sin 60\right]$$

$$\boxed{V^2 = 20r\left(\sin\theta - \frac{\sqrt{3}}{2}\right)} \longrightarrow (3)$$



from (2) as $a_n = \frac{V^2}{\rho}$

$$2T - 300 \sin\theta = 30 * \frac{V^2}{3}$$

$$2T - 300 \sin\theta = 10 * 20r\left(\sin\theta - \frac{\sqrt{3}}{2}\right)$$

$$T = 150 \sin\theta + 100r\left(\sin\theta - \frac{\sqrt{3}}{2}\right) \longrightarrow (4)$$

at $\theta = 90^\circ$

sub. in (3) $V^2 = 20 * 3\left(\sin 90 - \frac{\sqrt{3}}{2}\right)$ $\therefore V =$ ____ m/s

sub. in (4) $T = 150 \sin 90 + 100 * 3\left(\sin 90 - \frac{\sqrt{3}}{2}\right)$

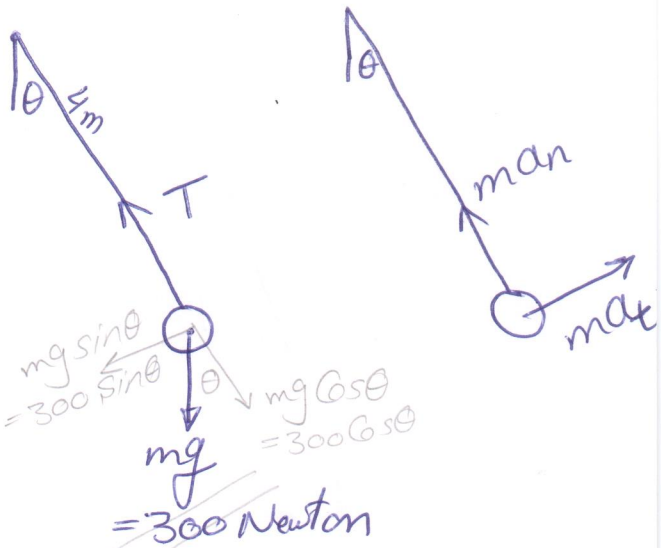
$=$ ____ Newton

No (13-69)

$m = 30\,Kg$, $g = 10\,m/s^2$

$V = 4\,m/s$, $\theta = 0$

$T = ??$, $\frac{dV}{dt} = -we = ??$, $\theta = 20^\circ$



$$\Sigma F_{t_{ext.}} = \Sigma F_{t_{eff.}}$$

$$-300\sin\theta = m a_t$$

$$-300\sin\theta = 30\,\frac{dV}{dt} = 30 * V\frac{dV}{ds} \longrightarrow (**)$$

$$\frac{dV}{dt} = -10\sin\theta \longrightarrow (1)$$

$$\Sigma F_{n_{ext.}} = \Sigma F_{n_{eff.}}$$

$$T - 300\cos\theta = m a_n = 30 * \frac{V^2}{4}$$

$$T = 300\cos\theta + \frac{30}{4}V^2 \longrightarrow (2)$$

from (**) $ds = r\,d\theta$

$$V\frac{dV}{ds} = -10\sin\theta$$

$$\int_4^V V\,dV = -10r\int_0^\theta \sin\theta\,d\theta$$

$$\frac{V^2}{2} - \frac{4^2}{2} = -10 * 4 * (-\cos\theta + \cos 0)$$

($\cos 0 = 1$)

$$V^2 = 4^2 - 80(1 - \cos\theta) \longrightarrow (3)$$

at $\theta = 20$ in (1) from (1) $\frac{dV}{dt} = -10\sin 20 =$ ✓ m/s^2

from (3) in (2)

$$T = 300\cos 20 + \frac{30}{4} * (4^2 - 80(1 - \cos 20))$$

$=$ ✓ Newton

No (13-70)

weight = 50 Newton

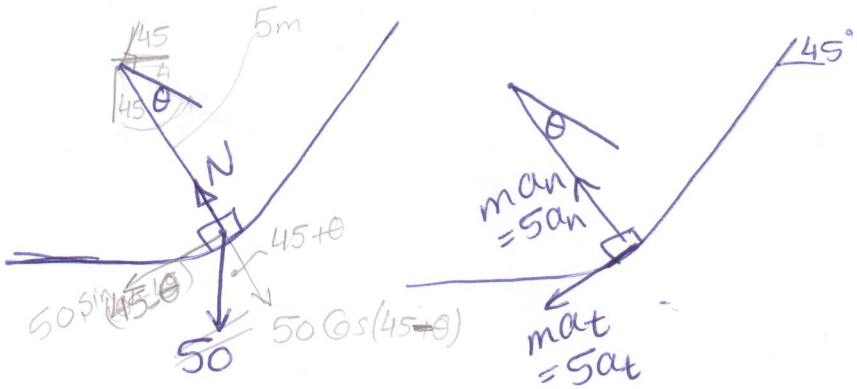
mass = 5 Kg

* $\theta = 0$, $V_A = 2$ m/sec

smooth (Friction = 0)

* $\theta = 30°$, $V_C = ??$, $N_C = ??$

* $\theta = 45°$, $V_B = ??$



$$\Sigma F_{t_{ext.}} = \Sigma F_{t_{eff.}}$$

$$50 \sin(45-\theta) = 5 a_t = 5 * v \frac{dv}{ds} = 5 * v \frac{dv}{r d\theta}$$

$$\int_2^v v\, dv = 10r \int_0^\theta \sin(45-\theta)\, d\theta$$

$$\frac{v^2}{2} - \frac{2^2}{2} = 10 * 5 \left[+\cos(45-\theta) \right]_0^\theta \qquad (* 2)$$

$$v^2 = 2^2 + 100 \left[\cos(45-0) - \cos(45-\theta) \right]$$