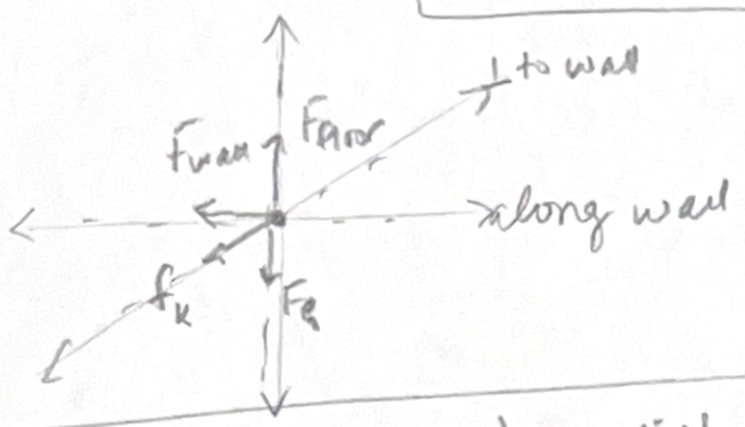
FRQ-8 Solutions

3-dimensional



tangential direction	circular motion
$\Sigma F_t = ma_t$	$\Sigma F_r = ma_r$
$f_k = ma_t$	$F_w = m\left(\frac{v^2}{R}\right)$
	$\frac{f_k}{\mu_k} = m\frac{v^2}{R}$
	$f_k = \frac{mv^2\mu_k}{R}$

a) $f_k = \mu_k F_{wall}$

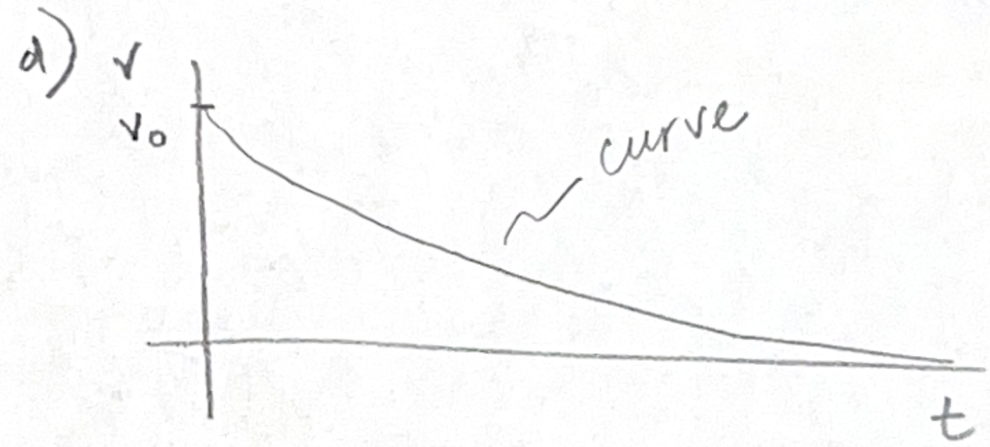
$\frac{f_k}{\mu_k} = F_{wall}$

b) $f_k = ma_t$

$-\frac{mv^2\mu_k}{R} = ma_t$

$-\frac{v^2\mu_k}{R} = a_t$

d)



c) velocity and time, so I need v(t):

$-\frac{v^2\mu_k}{R} = a_t$

$-\frac{v^2\mu_k}{R} = \frac{dv}{dt}$

$-\frac{\mu_k}{R}dt = \frac{dv}{v^2}$

$-\frac{\mu_k}{R}\int dt = \int\frac{dv}{v^2}$

$-\frac{\mu_k}{R}t = \int v^{-2}dv$

$-\frac{\mu_k}{R}t = \frac{1}{-1}v^{-1} + C$

$-\frac{\mu_k}{R}t = -\frac{1}{v} + C$

at $t=0$, $v=v_0$, so

$-\frac{\mu_k}{R}(0) = -\frac{1}{v_0} + C$

$\frac{1}{v_0} = C$

so, $-\frac{\mu_k t}{R} = -\frac{1}{v} + \frac{1}{v_0}$

We want the time when $v = \frac{v_0}{3}$,

so $-\frac{\mu_k}{R}t = -\frac{1}{v_0/3} + \frac{1}{v_0}$

$-\frac{\mu_k}{R}t = -\frac{3}{v_0} + \frac{1}{v_0}$

$-\frac{\mu_k}{R}t = -\frac{2}{v_0}$

$t = \frac{2R}{v_0\mu_k}$

Could I find v(t)?

$-\frac{1}{v} = -\frac{\mu_k t}{R} - \frac{1}{v_0}$

$\frac{1}{v} = +\frac{\mu_k t}{R} + \frac{1}{v_0}$

$\frac{1}{v} = \frac{v_0\mu_k t}{v_0 R} + \frac{R}{Rv_0}$

$\frac{1}{v} = \frac{v_0\mu_k t + R}{v_0 R}$

$v = \frac{v_0 R}{v_0\mu_k t + R}$