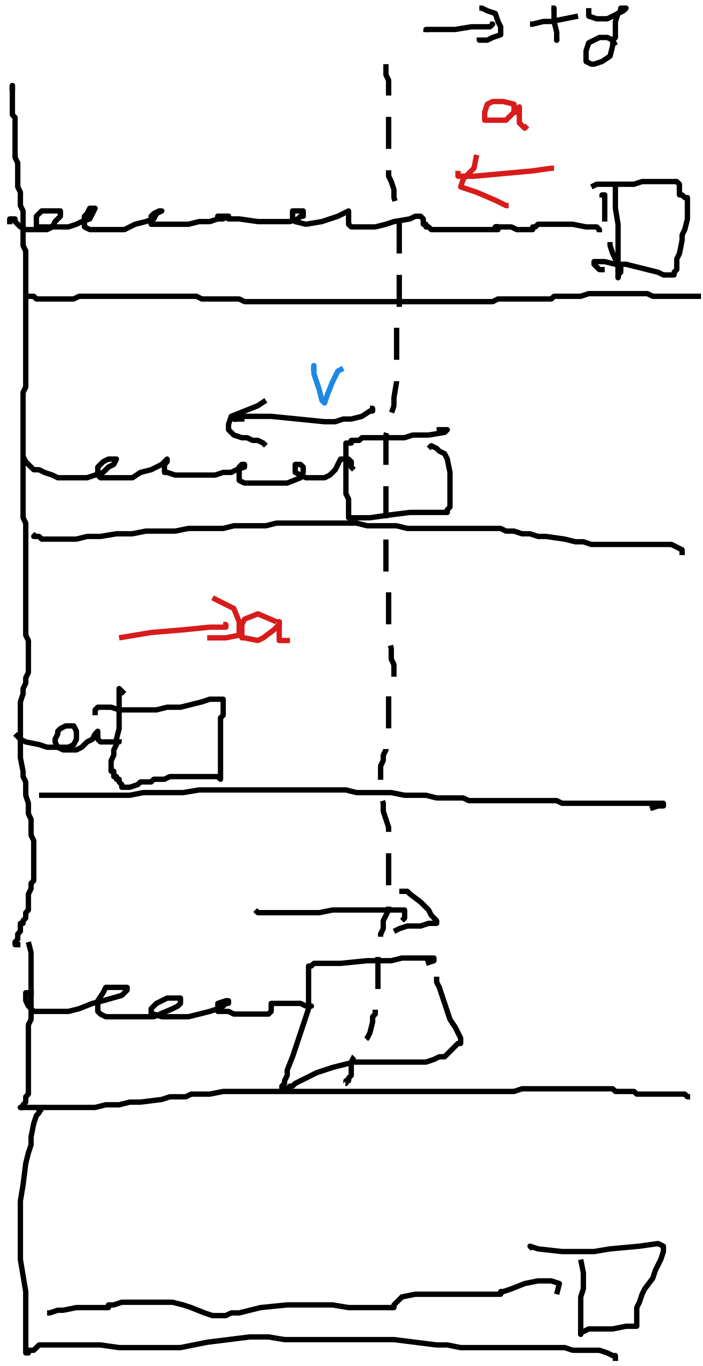
$t = 0$ turning point

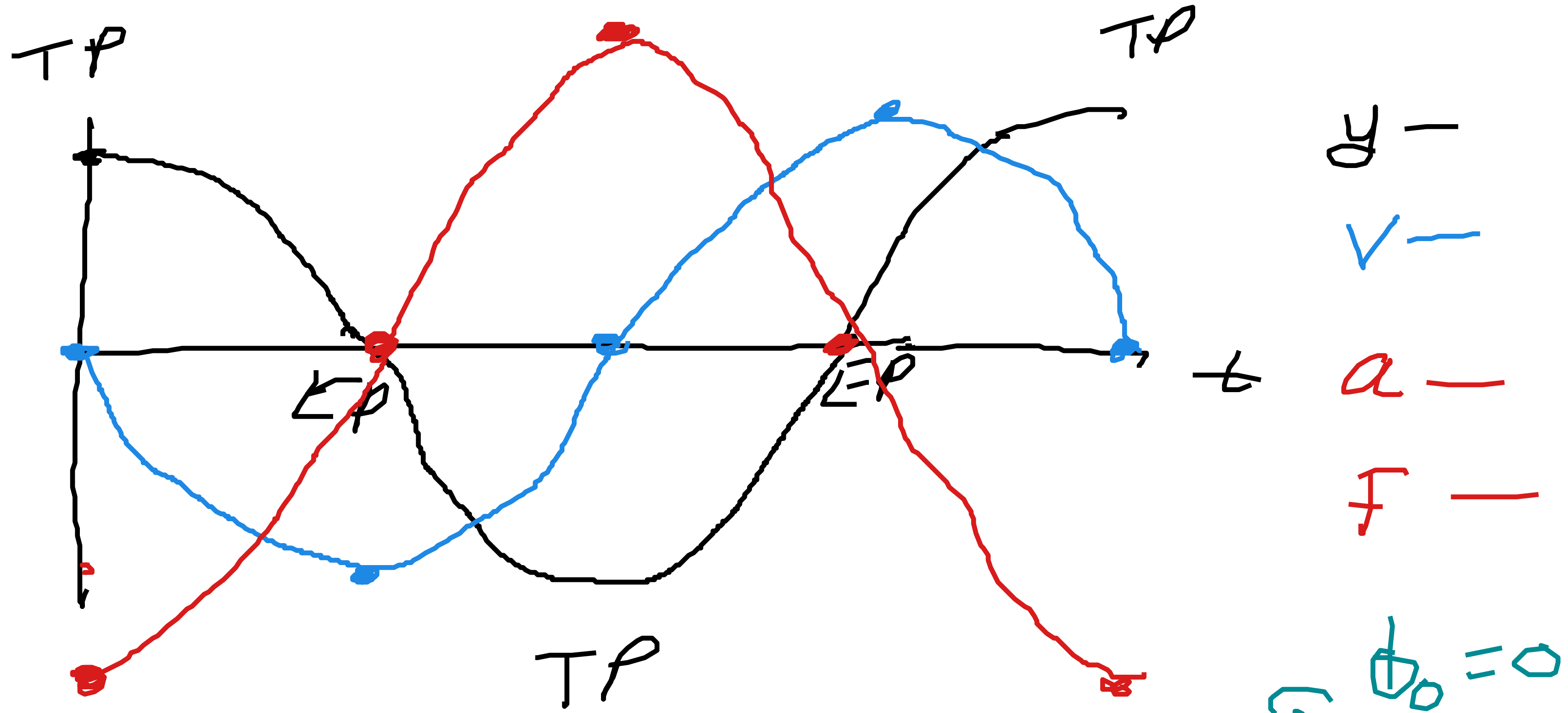
$t = \frac{1}{4}T$ eq. point

$t = \frac{1}{2}T$ turning point

$t = \frac{3}{4}T$ eq. point

$t = T$





$$y(t) = A\cos(2\pi f t + \phi_0)$$

$$v(t) = -2\pi A f \sin(2\pi f t + \phi_0)$$

$$a(t) = -4\pi^2 f^2 A \cos(2\pi f t + \phi_0)$$

$$\boxed{V_{max} = 2\pi A f} \qquad \boxed{a_{max} = 4\pi^2 f^2 A}$$

$$f = \frac{V_{max}}{2\pi A} \qquad (2\pi f)^2 A$$

$$v(t) = -4\sin(8\pi t)$$

f? $4\ \text{Hz}$ $\frac{8\pi}{2\pi}$

A?

$$v(t) = -4\sin(8\pi t) + 0$$

$$v(t) = -2\pi A f \sin(2\pi f t + \phi_0)$$

$4 = 2\pi A f$ $\qquad$ $\frac{8\pi}{2\pi} = \frac{2\pi f}{2\pi}$

$4 = 2\pi A(4)$

$A = \frac{1}{2\pi}$ $\qquad$ $f = 4$

Aside

Line: $y = mx + b$

force
F

displacement
d

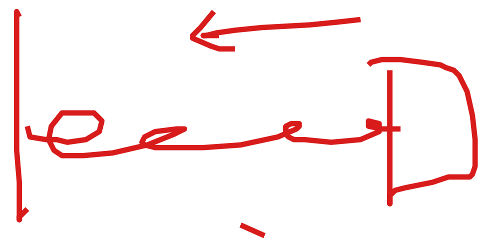
fit of
$F = 5d$

Block on spring

$$a_{max} = 4\pi^2 f^2 A$$

ΔL

$F = ky$



$$a_{max} = \frac{F_{max}}{m}$$

$$= \frac{k\,y_{max}}{m} = \frac{kA}{m}$$

$$4\pi^2 f^2 \cancel{A} = \frac{k\cancel{A}}{m}$$

$$\sqrt{f^2} = \sqrt{\frac{k}{4\pi^2 m}}$$

$$\boxed{f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}} \qquad \boxed{T = 2\pi\sqrt{\frac{m}{k}}}$$

Suppose $m = 3\,kg$ and $f = 4\,Hz$ Find k.

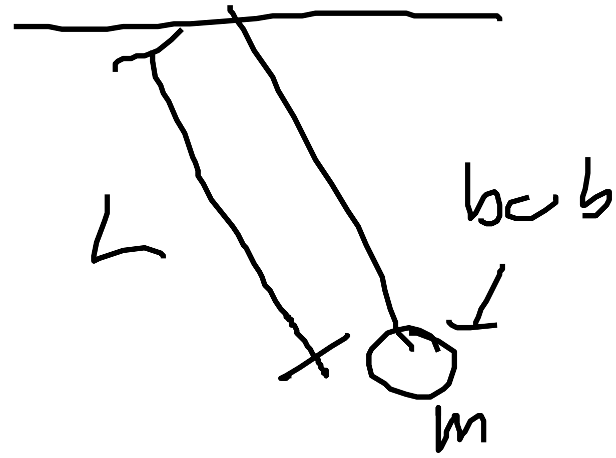
$$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

$$4 = \frac{1}{2\pi}\sqrt{\frac{k}{3}} \leftarrow \frac{\sqrt{k}}{\sqrt{3}}$$

$$\left(2\pi \times 4 \times \sqrt{3}\right)^2 = \left(\sqrt{k}\right)^2$$

$$\left(8\pi\sqrt{3}\right)^2 = k$$

Pendulum



$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}} \leftarrow g = 9.8\ m/s^2$$

$$T = 2\pi\sqrt{\frac{L}{g}}$$