S.H.M Honours (1979)

8(a) $v^2 = \omega^2(a^2 - x^2) \Rightarrow v = \omega(a^2 - x^2)^{\frac{1}{2}}$

$\text{accel} = \frac{dv}{dt} = \omega \frac{d(a^2-x^2)^{\frac{1}{2}}}{dt}$ Remember ω a constant

$\Rightarrow \text{accel} = \omega \; \frac{1}{2}(a^2-x^2)^{-\frac{1}{2}} \cdot \frac{d(a^2-x^2)}{dt}$

$= \frac{\omega}{2} \frac{1}{(a^2-x^2)^{\frac{1}{2}}} \; -2x \frac{dx}{dt}$

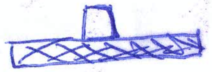
$= \frac{\omega}{2} \left[\frac{v}{(a^2-x^2)^{\frac{1}{2}}}\right](-2x)$

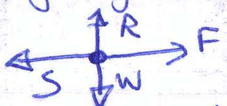
$= -\omega [\omega] x$

$\boxed{\text{accel} = -\omega^2 x}$ $\Rightarrow$ SHM q.e.d

$a = 5,\ x = 4,\ v = 6 \Rightarrow 6^2 = \omega^2(5^2 - 4^2) \Rightarrow 36 = \omega^2(9)$
$\Rightarrow \omega^2 = 4$

$a = 5,\ x = 2.5,\ \omega^2 = 4 \Rightarrow v^2 = 4(5^2 - (2.5)^2)$
$\Rightarrow v^2 = 75$
$\Rightarrow v = 8.66\ ms^{-1}$.

8(b)    Force diagram for Block



S, force due to SHM motion of platform.
$S = -m\omega^2 x$
So S a maximum for x = amplitude = .75m
[redacted] [Next need ω 20 oscillations = 60 secs
1 oscillation = 3 secs
$\Rightarrow T = 3\text{sec}$
$\Rightarrow \frac{2\pi}{\omega} = 3 \Rightarrow \boxed{\omega = \frac{2\pi}{3}\text{sec}}$]

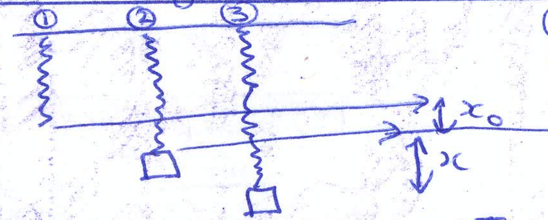
$\therefore |S_{max}| = +(m)\left(\frac{2\pi}{3}\right)^2(.75)$

But for block to stay in contact with platform we must have $S_{max} = F$

But $F = \mu R$ and $R = W \Rightarrow F = \mu mg$

$\therefore S_{max} = \mu mg$
$\Rightarrow m\left(\frac{2\pi}{3}\right)^2\left(\frac{3}{4}\right) = \mu mg$
$\Rightarrow \mu = \left(\frac{2\pi}{3}\right)^2\left(\frac{3}{4}\right)\frac{1}{g}$
$\Rightarrow \mu = \frac{\pi}{3g} = \frac{3.14}{3(9.8)} = .107$

1985:



① Natural length
② equilibrium
③ Displaced x below

$A = 10\text{cm} = .1\text{m}$ Period $2 \Rightarrow \omega = \frac{2\pi}{2} = \pi$

$\boxed{A = .1,\ \omega = \pi}$ Key

(i) $\Rightarrow v^2 = \omega^2(A^2 - x^2)$
$= \pi^2((.1)^2 - 0^2)$ $x = 0$ at point of equilibrium.
$v^2 = .01\pi^2$
$\Rightarrow \boxed{v = .1\pi}\ ms^{-1}$.

(ii) Time $q \to 0$: $|q0| = 2\text{cm}$ $x = A \sin \omega t$.
$.02 = .1 \sin \pi t$.
$\Rightarrow t = \frac{1}{\pi}\sin^{-1}(.2)$

Time $0 \to p$ $t = \frac{1}{\pi}\sin^{-1}(.2)$

$\Rightarrow \boxed{\text{Time} = \frac{2}{\pi}\sin^{-1}(.2)}$

No nett gravity effect in the oscillation about the point of equil.

The gravity determines where the point of equilibrium is going to be.