14.35 A person normally weighing 50 kg stands on a massless platform which oscillates up and down harmonically at a frequency of 2.0 s^{-1} and an amplitude 5.0 cm. A weighing machine on the platform gives the persons weight against time.

(a) Will there be any change in weight of the body, during the oscillation?

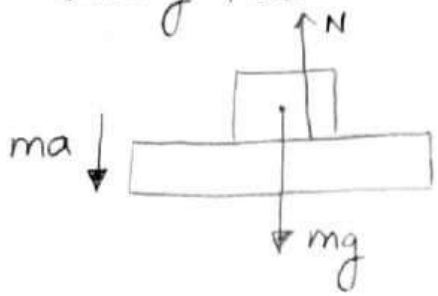
(b) If answer to part (a) is yes, what will be the maximum and minimum reading in the machine and at which position?

Q3

SOLUTION

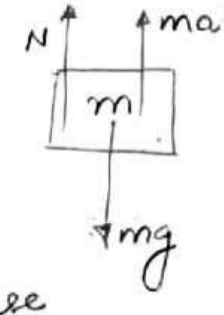
(a) Weight will be due to the Normal force (N).

Taking FBD



Since 'a' depends on 'x', so the value of 'N' will change, causing the weight detected by machine to change as well

(b) for maximum reading,
since we have accelerating platform, lets take pseudo force in consideration.

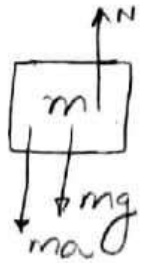


if platform moving down

in this case

$N + ma = mg$ or $N = mg - ma$ { N not max }

when platform moves up



{ Pseudo force acts in opposite to 'a' of frame }

so, here $N = mg + ma$ & in SHM $a_{max} = \omega^2 A$

so, $N_{max} = m(g + \omega^2 A)$

so, now $\omega = 2\pi f = 4\pi$

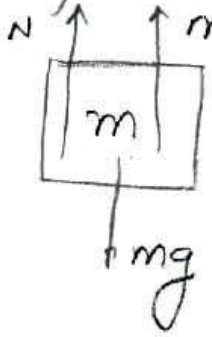
$N_{max} = 50(9.81 + 16\pi^2 \times 5 \times 10^{-2})$

$= 885.28\ N$

when platform moves up and is at lowest point.

For Minimum Reading

when platform moves down



so, $N + ma = mg$

$N = mg - ma$

$N_{min} = m(g - a_{max})$

$= m(g - \omega^2 A)$

$= 50(9.81 - 0.8\pi^2)$

$= 95.71\,N$

when platform moves down and is at highest possible position.