Taylor expansion

$$U(x_0+\delta x) = U(x_0) + \frac{1}{1!}\frac{dU(x_0)}{dx}\delta x + \frac{1}{2!}\frac{d^2U(x_0)}{dx^2}\delta x^2$$
$$+ \frac{1}{3!}\frac{d^3U(x_0)}{dx^3}\delta x^3$$
$$+ \dots$$

But $\frac{dU(x_0)}{dx} = 0$

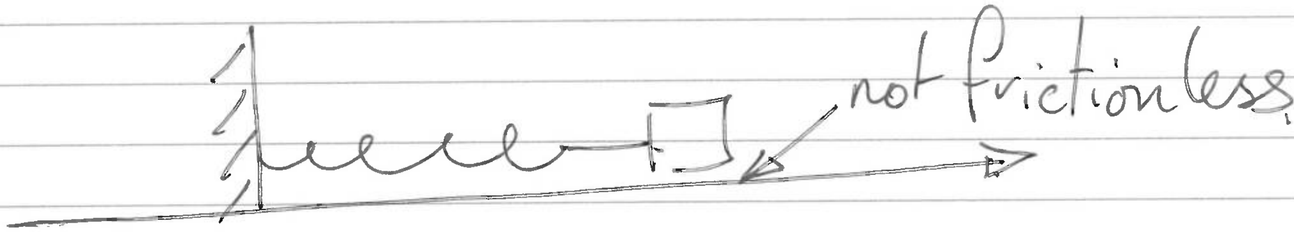
So $U(x_0+\delta x) \approx U(x_0) + \frac{1}{2}\frac{d^2U(x_0)}{dx^2}\delta x^2$

Just a const and so not important
∴ can set to 0

ie parabolic potential.

∴ S.H.M. everywhere.

Just consider 2 more case. You will look at these on Thursday



Typically friction $-bv$

So $F_{Tot} = -kx - bv = -kx - b\dot{x}$

From N2.

$$m\ddot{x} + b\dot{x} + kx = 0$$

or $\ddot{x} + \gamma\dot{x} + \omega_0^2 x = 0$

b/m $\quad$ k/m "natural" S.H.M ω.

Now actual behaviour depends on level of damping.

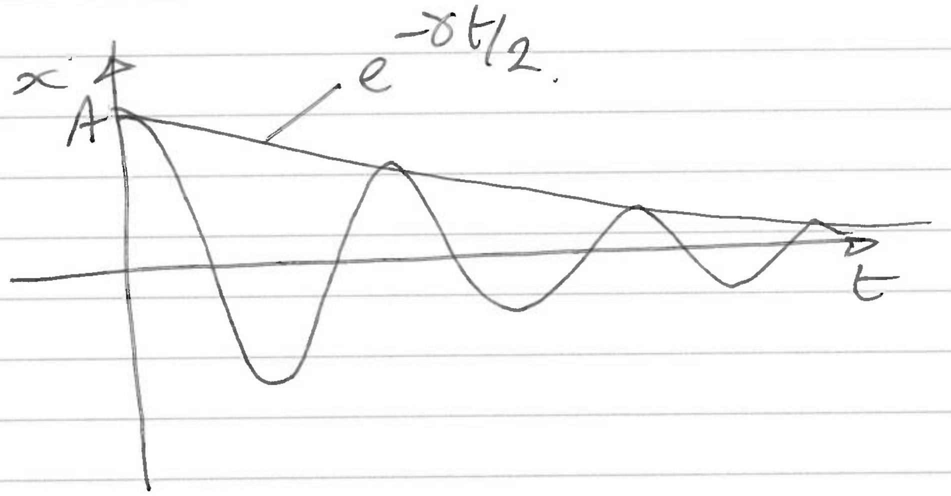
but in light damping case.

$$x = A e^{-\gamma t/2} \cos(\omega t + \phi)$$

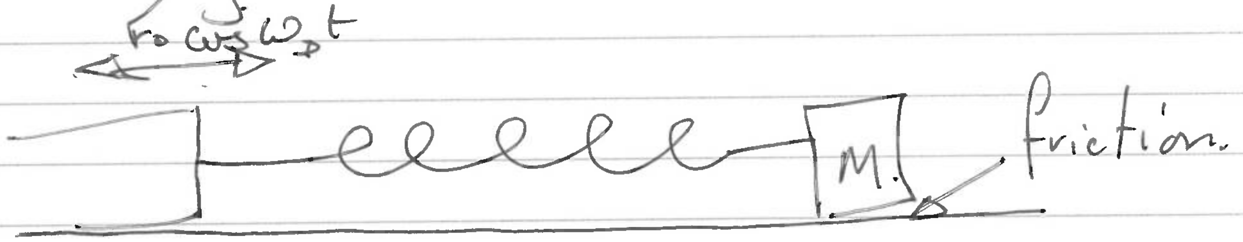
often 0

where $\omega = \sqrt{\omega_0^2 - \left(\frac{\gamma}{2}\right)^2}$.

$$= \sqrt{K/m - \frac{b^2}{4m^2}}.$$



Finally Driven



$$\ddot{x} + \gamma \dot{x} + \omega_0^2 x = F_0 \cos(\omega_D t)$$