$$|Z_m| = \left(b^2 + \left(\omega m - {}^{k}\!/\!_{\omega}\right)^2 \right)^{\frac{1}{2}}$$

$$\text{Displacement amplitude} = \frac{F_0}{\omega |Z_m|}$$

At low frequencies; $|Z_m| \rightarrow$ [ ] So; $x \rightarrow$ [ ] (i.e.. This is not zero!!)

i.e. At **low** frequencies, the motion is ……...

At high frequencies; $|Z_m| \rightarrow$ [ ] So; $x \rightarrow$ [ ]

i.e. At **high** frequencies, the motion is ……

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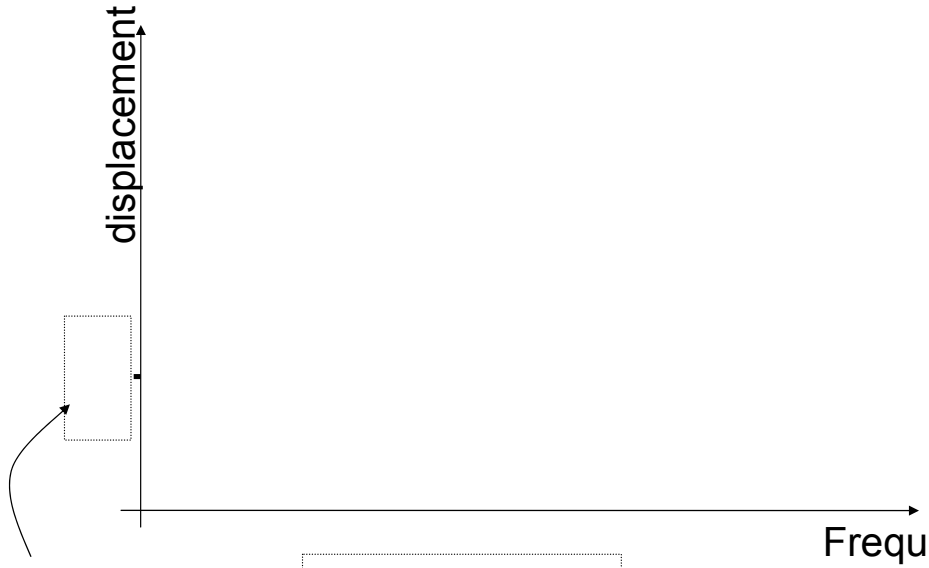
Drawing the variation of displacement with frequency;



Low frequency limit, Stiffness controlled

Frequency of max. amplitude

$$\omega = \sqrt{\frac{k}{m} - \frac{b^2}{2m^2}}$$

High frequency goes to ……, Mass controlled

Dr. Pete Vukusic, Exeter University: PHY 1106: Waves and Oscillators (Lecture 7)

Behaviour of velocity versus frequency

If the expression for displacement;

then differentiating gives velocity, i.e.

The …….. is in phase with the driving force except for the ……. ϕ associated with ……

Complex numbers and phase.

Harmonic oscillators can be conveniently represented by $\exp(j\omega t)$.

e.g. for a.c. driving voltages, $V_0 e^{j\omega t}$

e.g. for sinusoidal forces, $F_0 e^{j\omega t}$

In addition to mathematical convenience, j is an operator which is associated with …….

i.e. multiply a complex number (or any number) by j and you ……. its phase by ….. degrees (…… radians).

$$|Z_m| = \left(b^2 + \left(\omega m - {}^{k}/_{\omega}\right)^2\right)^{\frac{1}{2}}$$

At low frequencies; $|Z_m| \rightarrow$ So; $\dot{x} \rightarrow$

At high frequencies; $|Z_m| \rightarrow$ So; $\dot{x} \rightarrow$

Resonance occurs when velocity is a maximum;

i.e. when …… is a minimum.

Velocity resonance at

DRAW GRAPH!

II. 4 Power supplied to the oscillator by the driving force

• There is ……. …….. in the system.

• This …… is provided by the driving force.

• We find that the amplitude and phase of a driven oscillator adjust themselves;

• so that the average power supplied by the ……. just equals that which is dissipated by the …… force.

(Pain p55)

Calculation of Instantaneous power P.

$$\left[\text{Velocity} = \frac{F_0}{|Z_m|}\cos(\omega t - \phi)\right]$$

Inst. Power = (inst. driving force) × (inst. velocity)

Calculation of Average power P_{av}.

[Pain p63-64]

Define the average power as;

Solution; →

So; $$\text{Average power}: P_{av} = \frac{F_0^{\,2}}{2|Z_m|}\cos\phi$$

We say that the term ……. is the power factor.

$Z_m =$

This we know.

This we've met and comes from argand diagram

This we haven't met but it also comes from the argand diagram

So by substitution,

$$\text{Average power supplied}: P_{av} =$$

Question:

At what frequency will the "average power dissipated" be a maximum?