Long Quiz - 2

- A comet is revolving in an elliptical orbit around a star such that its farthest distance from the star is 12×10^{12} m while its nearest distance is 8×10^{12} m. Find out the mass of the star if the comet moves between these points in roughly 3 years ~ 10^8 s. [You can use G/4 π ~ 5×10^{-12} N m² Kg⁻²]
- In a damped oscillator the kinetic energy decays by 1/4 in some time.
 How much would have the amplitude decayed in this time? If the
 damped oscillator has a oscillation frequency which is half of its natural
 frequency the how much is the decay in amplitude in one cycle of
 oscillation?
- In a unit mass forced oscillator driven by an external force $f \sin(\omega_0 t)$, find out the work done by the force in a half cycle of oscillation in the steady state. For what ϕ it is zero?

(i)
$$Y_7 = a(1+e)$$
 $Y_2 = x_1 + x_2 = 2a = 20 \times 10^{12} \text{ m}$

$$Y_{2} + Y_{2} = 2a = 20 \times$$

$$\Rightarrow a = 10^{13} \text{ m}$$

$$\Rightarrow \frac{2}{3} = \frac{4\pi}{3} = \frac{3}{3} \Rightarrow M$$

$$\mathcal{L}^{2} = \frac{4\pi}{GM} a^{3} \Rightarrow M = \frac{4\pi}{G} \frac{a^{3}}{\mathcal{L}^{2}} \qquad \mathcal{L}^{2}$$

$$\mathcal{L} = 2 \times 10^{8} \text{ S}$$

$$\mathcal{L}^{39} \qquad \mathcal{L}^{35}$$

$$T = 2 \times 10^8 \text{ S}$$

$$M = \frac{\pi}{5 \times 10^{-12}} \times \frac{10^{39}}{10^{16}} = \frac{\pi}{20} \times 10^{35} \text{ kg}$$

$$= \frac{70}{5 \times 10^{-12}} \times \frac{10^{39}}{10^{16}} =$$

$$= \frac{1}{5 \times 10^{-12}} \times \frac{1}{4 \times 10^{16}}$$

$$S(t) = C e^{-\beta t/2} \sin(\widetilde{\omega}t)$$

$$\chi(t) = Ce^{-\beta t/2} \sin(\widetilde{u}t + \beta)$$

$$\tilde{\pi} = C\widetilde{u}e^{-\beta t/2} \cos(\widetilde{u}t + \phi) - c\beta e^{-\beta t/2} \sin(\widetilde{u}t + \phi)$$

$$KE = \frac{1}{2} m \pi^{2} \sim m c^{2} e^{-\beta t} \left[\widetilde{\omega} \omega \widetilde{\omega} t + \beta \right]$$

$$2 - \beta t = -\frac{1}{2} m \pi^{2} \sim m c^{2} e^{-\beta t} \left[\widetilde{\omega} \omega \widetilde{\omega} t + \beta \right]$$

=
$$\frac{m}{2}c^2e^{-\beta t}\left[D\sin(\widetilde{\omega}t+\widetilde{\varphi})\right]^2$$

Such as $\widetilde{\omega}=D\sin(\widetilde{\omega}t+\widetilde{\varphi})$

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 $\Rightarrow \left(\frac{A_1}{A_2}\right) = \left(\frac{KE_1}{KE_2}\right)^{\gamma_2} = \left(\frac{1}{\gamma_4}\right)^{\gamma_2} = 2.$

 $\widetilde{\omega} = \omega/2$, $\beta = \sqrt{4(\omega^2 \cdot \widetilde{\omega}^2)} = 2\sqrt{\omega^2 \cdot \widetilde{\omega}^2}$

This is periodic and decaying
$$W = D \sin \phi$$

amplitude

In time $K \in Amplitude decays as e^{-\frac{Bt}{2}} = A(t_2)$

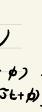
The oscillation amplitude decays as $e^{-\frac{Bt}{2}} = A(t_2)$

A(t₁)

 $\frac{\beta}{\omega} = 2\sqrt{\left(\frac{\omega}{\varpi}\right)^2 - 1} = 2\sqrt{3}$

3 Amplitude becomes 1/2

r = a(1-e)



In one oscillation cycle
$$t = \frac{2\pi}{4}$$

Amplitude decays by $e^{-\frac{8t}{2}} = e^{-\frac{\pi\beta}{4}}$
 $= e^{-2\pi\sqrt{3}}$ times

In one oscillation cycle
$$t = \frac{2\pi}{\omega}$$

Amplitude decays by $e^{-\frac{\pi}{2}t} = e^{-\frac{\pi\beta}{\omega}t}$
 $= e^{-2\pi\sqrt{3}t}$ times

 $= e^{-2\pi\sqrt{3}t}$
 $= e^{-2\pi\sqrt{3}t}$

$$= + c\omega_0 \left[\cos \omega_0 t \cos \phi - \sin \omega_0 t \sin \phi \right]$$

$$d\omega = \int x dt = \int c\omega_0 \left\{ \sin \omega_0 t \left(\cos \omega_0 t \cos \phi - \sin \omega_0 t \sin \phi \right) \right\} dt$$

$$\ln \text{ half cycle of oscillation } t = 2\pi/\omega_0$$

$$\pi/\omega_0$$

$$W = \int c\omega_0 \int dt \left(\cos \phi \sin \omega_0 t \cos \omega_0 t - \sin \phi \sin^2 \omega_0 t \right)$$

$$- \int c\omega_0 \int dt \left(\frac{\sin 2\omega_0 t}{2} \right) \cos \phi - \int dt \left(\frac{1 - \cos 2\omega_0 t}{2} \right) \sin \phi$$

$$= f(\omega_0) \left[\frac{-\cos 2\omega_0 t}{4\omega_0} \right]^{\frac{1}{2}\omega_0} - \frac{\sin 2\omega_0 t}{4\omega_0} \right]^{\frac{1}{2}\omega_0}$$

$$= -\frac{f(\omega_0)}{2} = -\frac{f(\omega_0)}{2} = -\frac{\sin 2\omega_0 t}{4\omega_0} = -\frac{\cos 2\omega_0 t}{4$$