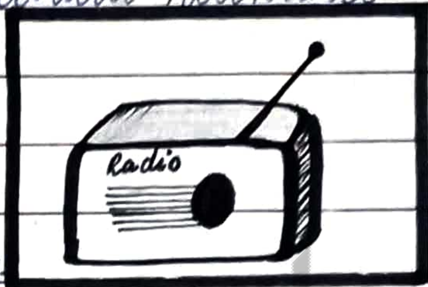
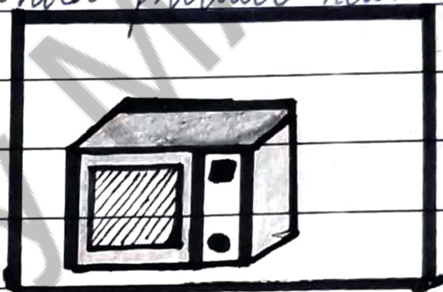
Q. No. 2 (i) Turning a radio (Electrical Reasonance):-

Turning of radio is a good example of electrical resonance, to tune a radio.



- Turn the knob of a radio.
- It changes the natural frequency of electrical circuit of receiver until it becomes equal to the frequency of transmitter.
- Now the resonance produced is "**maximum**."
- The radio begins to receive that waves which produce resonance in it. Hence a station is tuned.

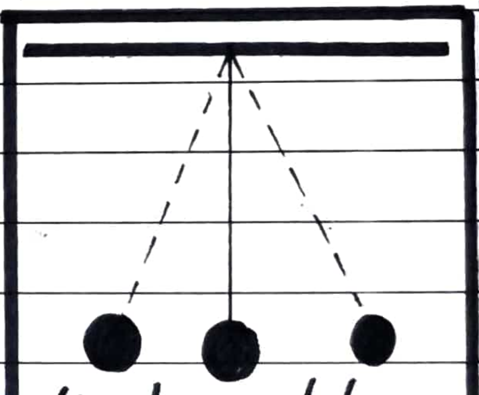
Cooking by microwave oven:-



- Resonance play an important role in heating and cooking.
- The microwaves produced by oven are absorbed due to resonance by water & fat molecules. As a result of increase internal energy food heats up.

Q. No. 2 (ii) Time period of simple pendulum is,

$$T = 2\pi\sqrt{l/g} \rightarrow (i)$$



Simple pendulum

Explanation:- When the length is doubled $l' = 2l$

New time period $T' = 2\pi\sqrt{l'/g}$

Putting $l' = 2l$

$$T' = 2\pi\sqrt{\frac{2l}{g}} \Rightarrow T' = \sqrt{2}\left(2\pi\sqrt{l/g}\right) \quad (ii)$$

Putting value from eq. (i) in (ii)

$$T' = \sqrt{2}\,T$$

Conclusion:- When the length becomes double, the time period increases **$\sqrt{2}$ times.**

Q. No. 2 (iii) **Explanation:-**

$l = 1m$

$$f = \frac{1}{2\pi}\sqrt{g/l}$$

$$f = \frac{1}{2 \times 3.14}\sqrt{\frac{9.8}{1}}$$

$$f = \frac{1}{2 \times 3.14}(3.13)$$

$f = 0.5Hz$

$T = 1/f = \frac{1}{0.5} = 2s$ **(approximately)**

Conclusion:- Thus the frequency of simple pendulum when length is 1m is 0.5Hz.

Q. No. 2 (iv) **Free oscillations:-** A body is said to be executing free vibrations if it oscillates with its natural frequency without the interference of an external force.

For example:- A simple pendulum vibrates freely with its natural frequency that depends only upon length of pendulum.

Forced oscillations:- A body is said to be executing forced vibrations if it oscillates with the interference of an external force.

For example:- (i) If the mass of a vibrating pendulum is struck repeatedly, then forced oscillations are produced.

(ii) The vibrations of factory floor caused by the running of heavy machinery is also an example.

Q. No. 2 (v) Frequency of mass-spring system is,

$$f = \frac{1}{2\pi}\sqrt{k/m}$$

$f_1 = 1/2\pi \sqrt{\frac{k}{m_1}} \longrightarrow (i)$

$f_2 = 1/2\pi \sqrt{\frac{k}{m_2}} \longrightarrow (ii)$

Comparing both equations

$\frac{f_1}{f_2} = \frac{1/2\pi\sqrt{k/m_1}}{1/2\pi\sqrt{k/m_2}}$

$\frac{\sqrt{k/m_1}}{\sqrt{k/m_2}} = \sqrt{\frac{k}{m_1}} \div \sqrt{\frac{k}{m_2}}$

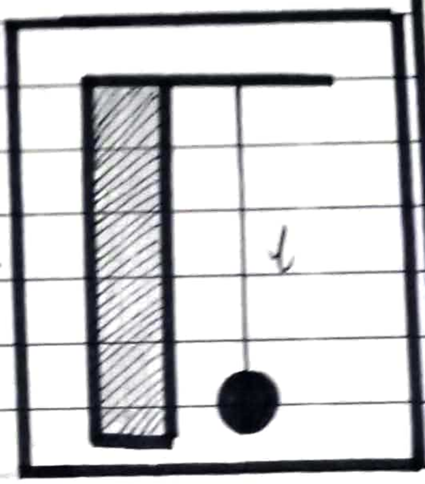
$= \sqrt{\frac{k}{m_1}} \times \sqrt{\frac{m_2}{k}} \Rightarrow \frac{f_1}{f_2} = \sqrt{\frac{m_2}{m_1}}$

Squaring both sides

$\frac{f_1^2}{f_2^2} = \frac{m_2}{m_1} \longrightarrow (iii)$

Conclusion:- From eq. (iii) masses of two bodies attached at the end of a spring in terms of their frequencies f_1 and f_2 can be compared.

Q. No. 2 (vi) In order to find the height of tower we have to determine the length of hanging wire.



- First we attach a bob at the lower end of the wire and make it to vibrate like a simple pendulum.
- Now find the time period of simple pendulum using the stop watch. Let 'l' be the length of hanging wire, then time period of bob is,

Mathematically:-

$T = 2\pi\sqrt{l/g}$ Squaring both sides

$T^2 = 4\pi^2 \frac{l}{g}$

$$l = gT^2/4\pi^2$$

Cutting Line

Q. No. 2 (vii) **Acceleration is zero when velocity is greatest:-**

The velocity and acceleration of a body executing SHM is given

Mathematical form:- $v = \omega\sqrt{x_0^2 - x^2}$ ⟶ (i)

$a = -\omega^2 x$ ⟶ (ii)

Velocity:- At mean position $x = 0$ Putting $x = 0$ in eq (i)

$v = \omega\sqrt{x_0^2 - (0)^2}$ ⇒ ωx_0 **Maximum**

Acceleration:- Putting $x = 0$ in eq (ii)

$a = -\omega^2(0)$

$a = 0$ **Zero**

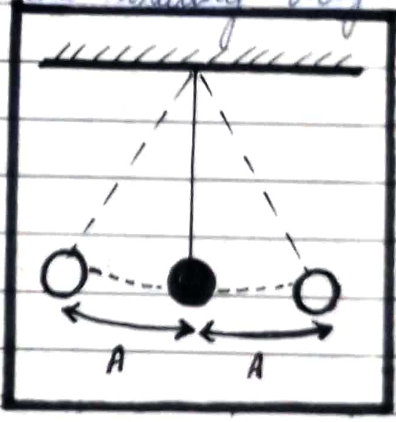
Conclusion:- In S.H.M at mean position the acceleration is zero but the velocity in this case is maximum.

Q. No. 2 (viii) **Explanation:-**

(i) Time period is the time during which the vibrating body completes one round trip.

(ii) In one round trip total distance covered by simple harmonic oscillator is four times greater than its amplitude.

(iii) Total distance coverd = A + A + A + A = 4A



Conclusion:- The total distance covered by the body is **4A**.

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Q. No. 2 (ix) i) Large amplitude certainly does affect the frequency according to formula.

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

ii) But this formula is proved using approximation that amplitude is kept very small until $\sin\theta = \theta$ (approximately) (say angle is less than 5°) It is a good approximation to say that frequency doesn't depend on amplitude.

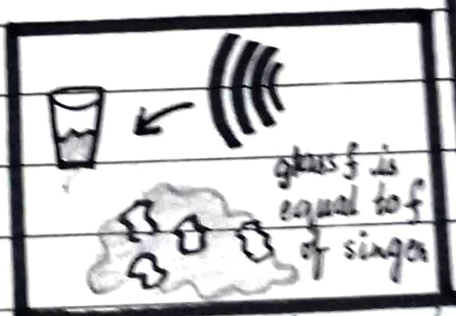
iii) In this small amplitude limit frequency is

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

iv) For larger amplitudes, the frequency will be less than that the above equation predicts.

Q. No. 2 (x) Yes, it is possible to shatter a glass due to resonance.

Explanation:-



i) The glass has a certain frequency of vibration.

ii) When a singer sings a song of the same frequency as the natural frequency of atoms of glass, then two frequencies match and resonance will take place.

iii) Due to resonance the amplitude of vibration increases, energy transferred is maximum and glass can be shattered.

iv) To break the glass you need to broadcast not only a sound that is just the right frequency, but also has a large enough amplitude (**loudness**)