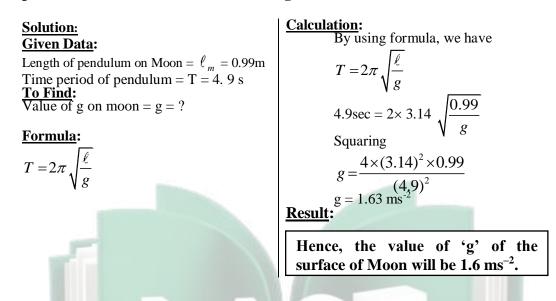


NUMERICAL PROBLEMS (U.B+A.B)10.1 The time period of a simple pendulum is 2s. What will be its length on Earth? What will be its length on the moon if $g_m = g_e / 6$? Where $g_e = 10 \text{ms}^{-2}$. (FSD-G1)-2015 Solution: **Calculation: <u>Given Data</u>:** Time period of simple pendulum = T = 2(i) For Earth $T = 2\pi \sqrt{\frac{\ell_e}{g_e}}$ By taking square on both sides, we have sec. Value of 'g' on Earth = $g_e = 10 \text{ ms}^{-2}$ Value of 'g' on Moon = g_m = $\frac{g_e}{6} = \frac{10}{6} = 1.6 \,\mathrm{ms}^{-2}$ $T^2 = 4\pi^2 \frac{\ell_e}{g_e}$ 6 6 To Find: or (i) Length of pendulum on earth = $\ell_e = ?$ or $\ell_e = \frac{T^2 \times g_e}{4\pi^2}$ By putting the values, we have (ii) Length of pendulum on moon = $\ell_{\rm m} = ?$ Formula: $\ell_e = \frac{(2)^2 \times 10}{4 \times (3.14)^2} = \frac{4 \times 10}{4 \times 9.86}$ $T=2\pi\sqrt{\frac{\ell}{g}}$ (ii) For Moon (ii) $\ell_{e} = 1.02 m$ $T^{2} = \frac{4\pi^{2}\ell_{m}}{g_{m}}$ $\ell_{m} = \frac{T^{2}g_{m}}{4 \times \pi^{2}}$ **Result:** Hence, the length of pendulum on Earth and on Moon will be 1.02 m and 0.17 m respectively. By putting the values, we have $\ell_m = \frac{\left(2\right)^2 \times 1.6}{4 \times \left(3.14\right)^2} = \frac{6.44}{39.44}$

 $\ell_{\rm m} = 0.17 \,{\rm m}$

A pendulum of length 0.99 m is taken to the Moon by an astronaut. The period of 10.2

pendulum is 4.9s. What is the value of g on the surface of the moon? the (MTN-G2)-2015



Find the time periods of a simple pendulum of 1 meter length, placed on Earth and on moon. The value of g on the surface of moon is 1/6th of its value on Earth. When 10.3 g_e is 10ms⁻². (ii)

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Solution:
Given Data:
Length of simple pendulum =
$$\ell = 1$$
m
Value of 'g' on Earth = $g_e = 10 \text{ ms}^{-2}$
Value of 'g' on Moon = $g_m = 1.62 \text{ ms}^2$
Time period on earth = $T_e = ?$
Time period on moon = $T_m = ?$
Formula:
 $T = 2\pi \sqrt{\frac{\ell}{g}}$
Calculation:
(i) For Earth:
 $T = 2\pi \sqrt{\frac{\ell_e}{g_e}}$
 $T_e = 2(3.14) \sqrt{\frac{1}{1.67}}$
 $T = 2\pi \sqrt{\frac{\ell_e}{g_e}}$
 $T_e = 2(3.14) \sqrt{\frac{1}{10}}$
 $T_e = (6.28) \sqrt{0.1}$
 $T_e = (6.28) \sqrt{0.1}$
 $T_e = 1.985 \text{ sec.}$
 $T_e = 2\text{ sec. Ans}$
(ii) For Moon:
 $T_m = 2\pi \sqrt{\frac{\ell_m}{g_m}}$
 $T_m = 2(3.14) \sqrt{\frac{1}{1.67}}$
 $T = 2(3.14) \sqrt{\frac{1}{1.67}}$
 $T = 2(3.14) \sqrt{\frac{1}{1.67}}$
 $T = 2\pi \sqrt{\frac{\ell_e}{g_e}}$
 $T = 2\pi \sqrt{\frac{\ell_e}{g_e}}$

10.4 A simple pendulum completes one vibration in two seconds. Calculate its length when g = 10.0 ms⁻² Solution:

<u>Given Data</u>: Time period of second pendulum = T =

Gravitational acceleration = $g = 10 \text{ ms}^{-2}$

<u>To Find</u>:

2sec

Length of simple pendulum = ℓ = ? **Calculation:**

$$T = 2\pi \sqrt{\frac{\ell}{g}}$$

Squaring on both sides

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

 $\ell = \frac{T^2 g}{4\pi^2}$ $\ell = \frac{(2)^2 \times 10}{4 \times (3.14)^2}$ $\ell = \frac{\cancel{4} \times 10}{\cancel{4} \times 9.85}$ $\ell = 1.02 \text{ m}$ <u>**Result:**</u>

Hence, the length of simple pendulum will be 1.02 m.

10.5 If 100 waves pass through a point of a medium in 20 seconds, what is the frequency and the time period of the wave? If its wavelength is 6cm, calculate the wave speed.

Solution: **Given Data:** No. of waves passed through a point = n = 100Time taken = t = 20sWavelength = $\lambda = 6$ cm = 0.06 m **To Find:** (i) Frequency of wave = f = ?(ii) Time period of wave = T = ?(iii) Speed of wave = v = ?Formula: (i) $f = n/t \frac{\text{no. of waves passed}}{\text{Time taken}}$ (ii) Time period of wave $= T = \frac{1}{f}$ (iii) Speed of wave $= v = f\lambda$ **Calculation:** (i) By using formula, we have $f = \frac{n}{t}$ $f = \frac{100}{20}$

f = 5Hz
(ii) As, we know that

$$T = \frac{1}{f}$$

$$T = \frac{1}{5Hz}$$

$$T = 0.2 \text{ sec}$$
(iii) By using wave equation, we have

$$V = f \lambda$$

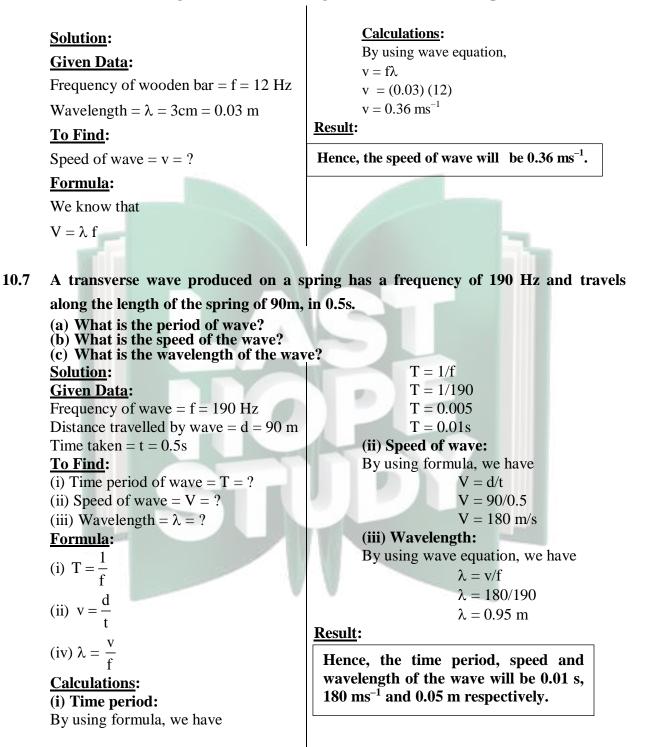
$$V = 5 \times 0.06$$

$$V = 0.3 \text{ ms}^{-1}$$

Result:

Hence, the frequency, time period and speed of the wave will be 5 Hz, 0.2 s and 0.3 ms⁻¹ respectively.

10.6 A wooden bar vibrating into the water surface in a ripple tank has frequency of 12Hz. The resulting wave has a wavelength of 3cm. What is the speed of the wave?



- 10.8 Water waves in a shallow dish are 6.0 cm long. At one point, the water moves up and down at a rate of 4.8 oscillations per second.
 - (a) What is the speed of the water waves?
 - (b) What is the period of the water waves?

Solution: **Calculations:** (i) Time period: Given Data: Length of dish = d = 6.0 cm = 0.06 mBy using formula, we have Frequency of wave = f = 4.8 HzT = 1/fTo Find: T = 1/4.8(i) Speed of waves = ? T = 0.21 s(ii) Time period of waves = ? (ii) Speed of waves: By using formula, we have Formula: V = d/t(i) $v = \frac{d}{d}$ V = 0.06/0.21V = 0.29 m/s(ii) T = **Result:** Hence, the speed and time period of water wave will be 0.29 ms⁻¹ and 0.21 s respectively.

10.9 At one end of a ripple tank 80 cm across, 5 Hz vibrator produces waves whose wavelength is 40mm. Find the time the waves need to cross the tank.

Solution:	v = (5) (0.04) = 0.2 m/s
Given Data:	Know by using formula, we have
Distance travelled = $d = 80 \text{ cm} = 0.8 \text{ m}$	$\mathbf{v} = \frac{\mathbf{d}}{\mathbf{d}}$
Frequency = $f = 5Hz$	$V = -\frac{1}{t}$
Wavelength = $\lambda = 40$ mm = 0.04 m	So, $t = \frac{d}{d}$
To Find:	So, $t = \frac{d}{v}$
Time taken by the wave $= t = ?$	t = 0.8/0.02
Formula:	t = 4s
(i) $v = \frac{d}{t}$	<u>Result</u> :
t <u>Calculation</u> :	Hence, time taken by the wave to cross the tang will be 4s.
Using wave equation	

 $v = f\lambda$

10.10 What is the wavelength of the radio waves transmitted by an FM station at 90 MHz? Where $1M = 10^6$, and speed of radio wave is $3 \times 10^8 \text{ms}^{-1}$.

Solution:	Calculation:
Given Data:	By wave equation,
Frequency of radio waves $= f = 90 \text{ MHz}$	$\lambda = rac{\mathbf{v}}{\mathrm{f}}$
$f = 9 \times 10^7 Hz$	
Speed of radio waves = $v = 3 \times 10^8 \text{ms}^{-1}$, 3×10 ⁸
<u>To Find</u> :	$\lambda = \frac{3 \times 10^8}{9 \times 10^7}$
Wave length of the radio waves = λ = ?	3×10 ⁸⁻⁷
Formula:	$\lambda = \frac{3 \times 10^{8-7}}{9.0}$
According to the wave equation	$\lambda = 3.333 \mathrm{m}$
$v = f \lambda$	Result:
$\lambda = v/f$	Hence, the wavelength of the radio waves
	transmitted by an FM station will be 3.33
	transmuted by an FIVI station will be 5.55
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