A pendulum has a natural (angular) frequency of $\omega_0 = 4$ Hz, a damping rate of $\gamma = 0.3$ Hz and a driving constant $F_0 = 2\,\frac{m}{s^2}$. If it is shaken exactly at the resonance frequency, what is the pendulum oscillation amplitude after any sort of irregular oscillations at the beginning have finished?

- 1.7
- 0.8
- 3.3
- 2.4

Correct Answer

Score: 1

Correct Answer: 1.7

If a periodic driving force acts on a harmonic oscillator exactly with the resonance / natural frequency of the oscillator ω_0 , what happens when there is no damping?

- The amplitude in that case scales linear with the resonance frequency.
- There is no oscillation, the oscillator just moves to position x=0.
- The amplitude becomes zero (overdamping).
- In time, the amplitude becoms larger and larger approaching infinity (resonance catastrophe).

Correct Answer

Score: 1

Correct Answer: In time, the amplitude becoms larger and larger approaching infinity (resonance catastrophe).

Question

By which phase does a driven oscillator lag behind the driving force if driven exactly on resonance?

Options

- ✔ pi/2
- ✘ pi
- ✘ 0
- ✘ pi/3

A wave bounces back and forth between two reflecting ends (this is called a resonator). The ends are $L = \frac{17}{3}$ units apart. Which of the following wavelengths can form a standing wave within the resonator?

- $\frac{34}{9}$
- $\frac{85}{24}$
- $\frac{272}{123}$
- $\frac{85}{39}$

Correct Answer

Score: 1

Correct Answer: $\frac{34}{9}$

A sine wave y(x,t) has amplitude 0.3 , wavenumber 5 and angular frequency 0.9 . Identify the matching equation:

- y(x,t)= $0.3 \sin(5x + \text{-}0.9t)$
- y(x,t)= $5 \sin(0.9x + \text{-}0.3t)$
- y(x,t)= $0.9 \sin(5x + \text{-}0.3t)$
- y(x,t)= $0.3 \sin(0.9x - 5t)$

Correct Answer

Score: 1

Correct Answer: y(x,t)= $0.3 \sin(5x + \text{-}0.9t)$

Which of the following <u>does not</u> satisfy the 1D wave equation for wave velcoity V? (Eq. 13) *Hint: you do not have to differentiate anything to solve this question!*

- $\tanh^2\left(-\frac{1}{4}(x - \mathrm{Vt})^2\right)$
- $\sin\left((x - \mathrm{Vt})^2\right)$
- $\cos^2\left(\frac{\mathrm{Vt} + x}{9}\right)$
- $\cos^2\ (tx)$

Correct Answer

Score: 1

Correct Answer: $\cos^2\ (tx)$

Which of the following correctly describes an electro-magnetic plane wave?

- There are magnetic fields and electric fields. Their strengths oscillates in time. The fields always point in orthogonal directions. The direction of propagation of the wave is perpendicular to both fields.
- It consists of magnetic fields that change in time and electric fields that are constant in time, where both are parallel to the propagation direction of the wave.
- The wave consists of electric- and magnetic fields, that are parallel to each other but point perpendicular to the propagation direction of the wave.
- It consists of electric fields that change in time and magnetic fields that are constant in time, where both are orthogonal to the propagation direction of the wave.

Correct Answer

Score: 1

Correct Answer: There are magnetic fields and electric fields. Their strengths oscillates in time. The fields always point in orthogonal directions. The direction of propagation of the wave is perpendicular to both fields.

Pull the following electro-magnetic wave types into an order from small frequency (top) to large frequency (bottom)

- Radio waves
- Near Ultra-violet
- Far Ultra-violet
- Soft X-ray
- Gamma ray

Correct Answer

Score: 1

Correct Answer:
Radio waves

Near Ultra-violet

Far Ultra-violet

Soft X-ray

Gamma ray

Which of the following is meant by "wave diffraction"?

If a wave amplitude becomes very high, non-linear effects may occur and the superposition principle breaks down.

When placing an object into the path of a plane wave, the object will cast a shadow behind it, where the wave cannot reach.

When we add two waves of slightly different wavelengths, the sum of them shows a slow oscillation of the amplitude on top of a fast oscillation.

After passing through a narrow slit, waves will not only propagate in their original direction of propagation, but also slightly sideways, into the geometrical shadow.

Correct Answer

Score: 1

Correct Answer: After passing through a narrow slit, waves will not only propagate in their original direction of propagation, but also slightly sideways, into the geometrical shadow.

Which of the following is meant by "wave interference"?

- If we look at a certain point x within a wave, the wavefuction shows oscillations in time.
- If a wave amplitude becomes very high, non-linear effects may occur and the superposition principle breaks down.
- In the same medium, waves of different wavelength may propagate with a different velocity.
- Two incoming waves can add up or reduce each other, depending on their phase difference.

Correct Answer

Score: 1

Correct Answer: Two incoming waves can add up or reduce each other, depending on their phase difference.