GPN1-LS10

GPN1-LS10

__C__ 1 可嘗試次數= 2 分數= 1 聲波在空氣中傳播的速度約為___ m/s? (A)10 (B)30 (C)340 (D)30000 (E)3×10^8

__E__ 2 可嘗試次數= 2 分數= 1 光波在空氣中傳播的速度約為___ m/s? (A)10 (B)30 (C)340 (D)30000 (E)3×10^8

__D__ 3 可嘗試次數= 2 分數= 1 頻率的單位是? (A)秒 (B)公尺 (C)公斤 (D)Hertz (E)焦耳

__B__ 4 可嘗試次數= 2 分數= 1 聲波是一種橫波還是縱波? (A)橫波 (B)縱波

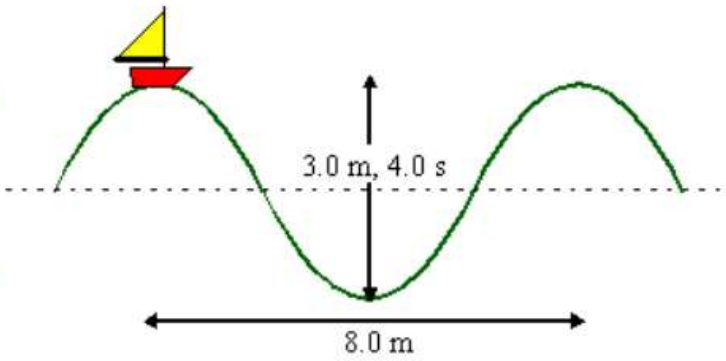
__D__ 5 可嘗試次數= 2 分數= 1 下列何者為非力學波? (A)聲波 (B)水波 (C)繩波 (D)電磁波 (E)彈簧波

__B__ 6 可嘗試次數= 1 分數= 1 所有的波動現象都必須滿足下列哪一個公式? (A)波速=波長x週期 (B)波速=波長x頻率 (C)波速=振幅x週期 (D)波速=振幅/週期 (E)波速=頻率/週期

__A__ 7 可嘗試次數= 2 分數= 1 下列哪一個數學函數可以適當的描述一個波動現象? (A) $\sin(\frac{2\pi}{\lambda}x - \frac{2\pi}{T}t)$ (B)$\sin(x) + t$ (C)$\sin(t) + x$ (D)$\sin(x) + \sin(t)$

Problem 2

一位漁民注意到他的船由於水面的波浪而周期性地上下移動。船從最高點到最低點需要4.0 s，總距離為3.0 m。漁夫看到波峰相距 8.0 m。 計算波移動的速度，振幅，頻率，波長和周期。 (05小題)



速度=_____ m/s

08: **ANS:=1.0**

振幅=_____ m

09: **ANS:=1.5**

頻率=_____ Hz

10: **ANS:=0.125**

波長=_____ m

11: **ANS:=8**

周期=_____ s

12: **ANS:=8**

$T=8$, $A=3/2=1.5$, $\lambda=8$

$f=\frac{1}{T}=\frac{1}{8}=0.125$

$v=\lambda f=8\cdot\frac{1}{8}=1$

Problem 2

無線電波以光速傳播，3×10^8 m/s。 (a) AM 無線電波的頻率範圍為 530 kHz 至 1600 kHz。這對應的波長范圍是多少？ (b) FM 波的波長為 2.77 m 至 3.40 m。計算對應的頻率。 (02小題)

(a) AM 無線電波的頻率為 530 kHz，對應的波長=_____ m

13: **ANS:=566**

(b)FM 波的波長為 2.77 m，對應的頻率=_____ Hz

14: **ANS:=1.08E8**

$$\lambda_1 = \frac{c}{f_1} = \frac{3\times10^8}{530\times10^3} = 566$$

$$f_1 = \frac{c}{\lambda_1} = \frac{3\times10^8}{2.77} = 1.08\times10^8$$

Problem 3

為了使頻率為 60.0 Hz 的橫波具有 0.800 m 的波長，必須以多大的張力拉伸長度為 5.00 m、質量為 0.160 kg 的繩索？ (01小題)

張力=_____ N

15: **ANS:=73.7**

$v = \lambda f = 0.8(60) = 48$

$v = \sqrt{\frac{F}{\mu}} = \sqrt{\frac{F}{\frac{0.16}{5}}}$ $F = 48^2 \cdot \frac{0.16}{5} = 73.73$

Problem 3

橫波在承受 6.00 N 張力的弦中以 20.0 m/s 的速度傳播。在同一弦中波速為 30.0 m/s 需要多大的張力？ (01小題)

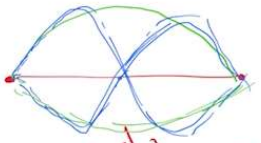
張力=_____ N

16: **ANS:=13.5**

$v \propto \sqrt{F}$ $\frac{20}{30} = \frac{\sqrt{6}}{\sqrt{F'}}$, $F' = \frac{9}{4} \cdot 6 = 13.5$

Problem 4

某一弦上的波以 50.0 m/s 的速度移動。繩子長 7.5 m。如果(a)兩端固定，基本共振或駐波頻率是多少？(b)如果一端是空間的，基本頻率是多少？ (02小題

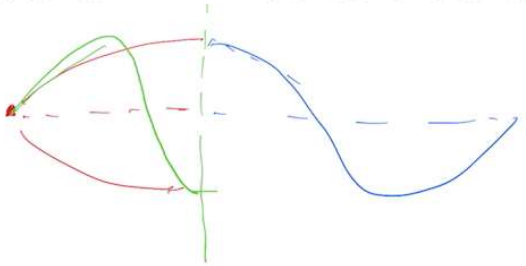


$L = n(\frac{\lambda}{2})$

$\lambda = \frac{2L}{n}$

$f = \frac{v}{\lambda} = \frac{50}{2(7.5)}n$

$= 3.33n$



$L = \frac{\lambda}{4}, \frac{3\lambda}{4}, \frac{5\lambda}{4}, \cdots = \frac{2n-1}{4}\lambda$

$n=1, \lambda_1 = 4L, f_1 = \frac{v}{\lambda_1} = \frac{50}{4(7.5)} = 1.667$

(a)兩端固定，基本駐波頻率=_____ Hz

17: **ANS:=3.33**

(b)一端固定一端空間，基本駐波頻率=_____ Hz

18: **ANS:=1.67**

Problem 4

一根長度為 4.35 m、質量為 137 g 的金屬絲承受 125 N 的張力。一個駐波已經形成，它有七個節點，包括端點。這個波的頻率是多少？什麼是基頻？ (02小題)

(a)這個波的頻率=_____ Hz

19: **ANS:=43.4**

(b)基頻=_____ Hz

20: **ANS:=7.24**

$v = \sqrt{\frac{125}{0.137/4.35}} = 63$

$\lambda = \frac{L}{3} = \frac{4.35}{3} = 1.45$

$f = \frac{v}{\lambda} = \frac{63}{1.45} = 43.45$

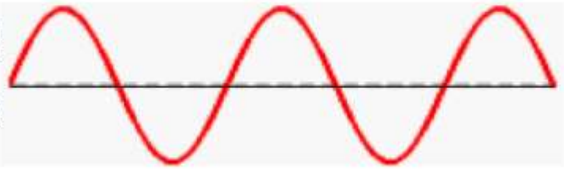
$L = n(\frac{\lambda}{2})$

7節美 $\Rightarrow n=6, L=3\lambda$

$n=1 \Rightarrow \lambda_1 = 2L, f_1 = \frac{63}{2(4.35)} = 7.24$

Problem 5

在駐波實驗室，實驗室合作夥伴調整機械振盪器的頻率，以便在 1.38 m 長的彈性繩中能夠產生駐波，當調整頻率為79.42 Hz時可以產生如圖中所顯示的駐波。請計算繩波的波速。 (01小題)



繩波的波速=_____ m/s

$\lambda = \frac{1.38}{2.5} = 0.552$

$v = \lambda f = (0.552)(79.42)$

$= 43.84$

21: **ANS:=43.8**

Problem 5

一根 144 cm長的繩索在三次諧波（三段等長部分，3rd harmonics）中振動時，在 17.6 秒內恰好經歷了 64 個完整的振動週期。 計算繩索中波的速度。 (01小題)

速度=_____ m/s

$f = \frac{64}{17.6} = 3.636$

$L = 1.5\lambda$

$\lambda = \frac{1.44}{1.5} = 0.96$

$v = \lambda f = 3.49$

22: **ANS:=3.49**

Problem 6

只要振幅足夠高，人耳就可以檢測到大約 20.0Hz 到大約 20,000Hz 頻率範圍內的聲音。計算對應於頻率f = 200 Hz的波長。 (a)空氣中的波 (v = 343 m/s)；(b) 對於水中的波浪 (v = 1480 m/s)。 (02小題)

$\lambda = \frac{v}{f} = \frac{343}{200} = 1.925$

(a)空氣中的波長=_____ m

23: **ANS:=1.72**

$= \frac{1480}{200} = 7.4$

(b)水中的波長=_____ m

24: **ANS:=7.4**

Problem 6

某個弦的三個連續諧振頻率是 175、245 和 315 Hz。 (a) 基頻是多少？ (b) 如果這根弦上的橫波速度為 125 m/s，求弦的長度？ (02小題)

(a)基頻=_____ Hz

25: **ANS:=35**

(b)如果這根弦上的橫波速度

26: **ANS:=0.893**

(a) The ratio of these three frequencies is 175:245:315, or 535:735:935, or 5:7:9.

(b) For a string fixed at both ends, the resonant frequencies are given by $f_n = n\frac{v}{2L}$, where n = 1, 2, 3, 4, ? For a string fixed at only one end, the resonant frequencies are given by $f_n = n\frac{v}{4L}$, where n = 1, 3, 5, 7, … Since the given sequence has only odd numbers, we may conclude that the string is fixed at only one end.

(c) The fundamental frequency is the greatest common factor of the sequence, so f_1 = 35.0 Hz.

(d) Since $f_1 = \frac{v}{4L}$, we can rearrange this equation to find the length,

$$L = \frac{v}{4f_1} = \frac{125 m/s}{4 \times 35 Hz} = 0.893 m$$

__A__ 27 可嘗試次數= 2 分數= 1　下列哪一位科學家成功的發現光具有干涉現象? (A)Young (B)Maxwell　(C)Hertz　(D)Faraday　(E)Einstein

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__B__ 28 可嘗試次數= 2 分數= 1　光的雙狹縫實驗證實的光是哪一種運動行為? (A)粒子性　(B)波動性　(C)粒子與波動二象性

__A__ 29 可嘗試次數= 1 分數= 1　在光的雙狹縫實驗當中，當光行進的路徑長度為波長的整數倍時，會有亮紋還是暗紋發生? (A)亮紋　(B)暗紋

__A__ 30 可嘗試次數= 1 分數= 1　光經過單一個狹縫是否能夠在屏幕上出現黑白相間的條紋? (A)是 (B)否

__B__ 31 可嘗試次數= 2 分數= 1　光在單一狹縫要發生繞射現象必須光的波長和狹縫寬度之間的相互關係應該是如何? (A)波長遠小於狹縫寬度　(B)波長接近於狹縫寬度

__B__ 32 可嘗試次數= 2 分數= 1　那一位科學家預言自然界中存在電磁波? (A)Einstein　(B)Maxwell (C)Farady　(D)Newton　(E)Bohr

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__D__ 33 可嘗試次數= 2 分數= 1　一個波長約為10公分的電磁波其頻率約為若干Hz? (A) 3000　(B) 3×10^5　(C) 3×10^7　(D) 3×10^9　(E) 5×10^5　(F) 5×10^7　(G) 5×10^9

__F__ 34 可嘗試次數= 2 分數= 1　無線電波是由哪一位德國物理學家在實驗中證實他的存在? (A)馬克斯威爾　(B)波爾　(C)普朗克　(D)愛因斯坦　(E)海森堡　(F)赫茲

__A__ 35 可嘗試次數= 2 分數= 1 在電磁波中電場振動的方向與磁場振動的方向有何關係? (A)互相垂直 (B)在同一條線上，方向可相反也可相同 (C)在同一條線上，方向相反 (D)在同一條線上，方向相同 (E)無特定關係

__C__ 36 可嘗試次數= 2 分數= 1 關於光與電磁波的敘述，下列何者正確? (A)光波不需介質傳播，電磁波則需要介傳播 (B)光波是電場的振動，電磁波則包括電場及磁場 (C)光波與電磁波具有相同的傳播速度 (D)光波沒有干涉現象，電波有干涉現象

__E__ 37 可嘗試次數= 2 分數= 1 可見光的波長範圍界於下列何者之間? (A)200 mm ~ 800 mm (B)400 mm ~ 700 mm (C)200 μm ~ 800 μm (D)400 μm ~ 700 μm (E)400 nm ~ 700 nm

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__D__ 38 可嘗試次數= 2 分數= 1 水分子可被交替的電場旋轉，下列何種電磁波對其旋轉運動最有效率 (A)無線電波 (B)紅外線 (C)X-光 (D)微波 (E)紫外線

__G__ 39 可嘗試次數= 2 分數= 1 X-射線的波長約為 (m) ? (A)1000 (B)10 (C)1 (D)0.1 (E)10^{-3} (F)10^{-6} (G)10^{-10}

__E__ 40 可嘗試次數= 2 分數= 1 黃光的波長為500 nm，請計算其頻率為若干 Hz ? (A)6×10^{12} (B)2×10^{14} (C)3×10^{13} (D)6×10^{13} (E)6×10^{14}

__F__ 41 可嘗試次數= 2 分數= 1 下列電磁波當中何者的頻率最高? (A)無線電波 (B)紅外線 (C)微波 (D)紫外線 (E)X-射線 (F)γ-射線

Problem 10

A stretched string has a mass per unit length of 5.00 g/cm and a tension of 10.0 N. A sinusoidal wave on this string has an amplitude of 0.12 mm and a frequency of 100 Hz and is traveling in the negative direction of an x axis. If the wave equation is of the form $y(x,t) = y_m \sin(kx \pm \omega t)$, what are (a) y_m, (b) k, (c) ω, and (d) the correct choice of sign in front of ω?

一根被拉伸的弦的單位長度質量為 5.00 g/cm，張力為 10.0 N。該弦上的正弦波振幅為 0.12 mm，頻率為 100 Hz，並沿 x 軸的負方向傳播 . 如果波動方程的形式為 $y(x,t) = y_m \sin(kx \pm \omega t)$，那麼 (a) y_m, (b) k , (c) ω 和 (d) 在 ω 前面正確選擇符號？ (04小題)

(a)y_m=_____ mm

42: **ANS:=0.12**

(b)k=_____ 1/m

43: **ANS:=141**

(c)ω=_____ rad/s

44: **ANS:=628**

(d) the correct choice of sign in front of ω, Enter 1 for + and -1 for −. sign=_____

45: **ANS:=1**

(a) The amplitude of the wave is y_m=0.120 mm.

(b) The wave speed is given by $v = \sqrt{\tau/\mu}$, where τ is the tension in the string and μ is the linear mass density of the string, so the wavelength is $\lambda = v/f = \sqrt{\tau/\mu}\,/f$ and the angular wave number is

$$k = \frac{2\pi}{\lambda} = 2\pi f\sqrt{\frac{\mu}{\tau}} = 2\pi(100\,\text{Hz})\sqrt{\frac{0.50\,\text{kg/m}}{10\,\text{N}}} = 141\,\text{m}^{-1}.$$

(c) The frequency is f = 100 Hz, so the angular frequency is

$$\omega = 2\pi f = 2\pi(100\ \text{Hz}) = 628\ \text{rad/s}.$$

(d) We may write the string displacement in the form $y = y_m \sin(kx + \omega t)$. The plus sign is used since the wave is traveling in the negative x direction. In summary, the wave can be expressed as

$$y = (0.120\,\text{mm})\sin\left[\left(141\,\text{m}^{-1}\right)x + \left(628\,\text{s}^{-1}\right)t\right].$$

Problem 11

100 g wire is held under a tension of 250 N with one end at $x = 0$ and the other at $x = 10.0$ m. At time $t = 0$, pulse 1 is sent along the wire from the end at $x = 10.0$ m. At time $t = 30.0$ ms, pulse 2 is sent along the wire from the end at $x = 0$. At what position x do the pulses begin to meet?

100 g 線在 250 N 的張力下保持，一端位於 $x = 0$，另一端位於 $x = 10.0$ m。 在時間 $t = 0$，脈衝 1 從 $x = 10.0$ m 處的末端沿導線發送。 在時間 $t = 30.0$ ms，脈衝 2 從 $x = 0$ 的末端沿導線發送。 脈沖在什麼位置 x 開始相遇？ (01小題)

---

x=____ m

46: **ANS:=2.63**

23. The pulses have the same speed v. Suppose one pulse starts from the left end of the wire at time $t = 0$. Its coordinate at time t is $x_1 = vt$. The other pulse starts from the right end, at $x = L$, where L is the length of the wire, at time $t = 30$ ms. If this time is denoted by t_0 then the coordinate of this wave at time t is $x_2 = L - v(t - t_0)$. They meet when $x_1 = x_2$, or, what is the same, when $vt = L - v(t - t_0)$. We solve for the time they meet: $t = (L + vt_0)/2v$ and the coordinate of the meeting point is $x = vt = (L + vt_0)/2$. Now, we calculate the wave speed:

$$v = \sqrt{\frac{\tau L}{m}} = \sqrt{\frac{(250\,\text{N})(10.0\,\text{m})}{0.100\,\text{kg}}} = 158\,\text{m/s}.$$

$$x = \frac{10.0\,\text{m} + (158\,\text{m/s})(30.0\times10^{-3}\,\text{s})}{2} = 7.37\,\text{m}.$$

The distance from the right end is $L - x$ = (10.0 m – 7.37 m) = 2.63 m.

Problem 11

A string along which waves can travel is 2.70 m long and has a mass of 260 g. The tension in the string is 36.0 N. What must be the frequency of traveling waves of amplitude 7.70 mm for the average power to be 85.0 W?

一波可以沿著其弦長 2.70 m，質量為 260 g傳播。 弦的張力為 36.0 N。要使平均功率為 85.0 W，振幅為 7.70 mm 此行進波的頻率必須是多少？ (01小題)

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the frequency of traveling waves=_____ Hz

47: **ANS:=198**

$$f = \frac{1}{2\pi y_m}\sqrt{\frac{2P_{\text{avg}}}{\mu\sqrt{\tau/\mu}}} = \frac{1}{2\pi(7.70\times10^{-3}\,\text{m})}\sqrt{\frac{2(85.0\,\text{W})}{\sqrt{(36.0\,\text{N})(0.260\,\text{kg}/2.70\,\text{m})}}} = 198\ \text{Hz}.$$

Problem 12

Find the speed of the wave of the following equation: All quantities are in SI units. (02小題)

$$0.004\sin(4x-7t),$$

wave speed=_____ m/s

48: **ANS:=1.75**

$$0.002[20x-4t]^{0.5},$$

wave speed=_____ m/s

49: **ANS:=0.2**

$$y(x,t)=f(kx-\omega t);\ \rightarrow v=\frac{\omega}{k}$$

Problem 13

Two identical traveling waves, moving in the same direction, are out of phase by $\pi/2$ rad. What is the amplitude of the resultant wave in terms of the common amplitude y_m of the two combining waves?

兩個相同的行波，以相同的方向移動，相位相差 $\pi/2$ rad。 就兩個組合波的共同振幅 y_m 而言，合成波的振幅是多少？ (01小題)

---

the amplitude of the resultant wave=_____ y_m

50: **ANS:=1.41**

$$y = y_m \sin(kx - \omega t) + y_m \sin(kx - \omega t + \phi)$$
$$= 2y_m \cos(\tfrac{1}{2}\phi) \sin(kx - \omega t + \tfrac{1}{2}\phi)$$

$$y = y_m \sin(kx - \omega t) + y_m \sin(kx - \omega t + \phi) \; = 2y_m \cos\left(\tfrac{1}{2}\phi\right) \sin\left(kx - \omega t + \tfrac{1}{2}\phi\right),$$

where $\phi = \pi/2$. The amplitude is

$$A = 2y_m \cos\left(\tfrac{1}{2}\phi\right) = 2y_m \cos(\pi/4) = 1.41y_m .$$

Problem 13

What phase difference between two identical traveling waves, moving in the same direction along a stretched string, results in the combined wave having an amplitude 1.50 times that of the common amplitude of the two combining waves? Express your answer in (a) degrees, (b) radians, and (c) wavelengths.

兩個相同的行進波沿著拉伸的弦在相同方向上移動，兩波具有相同的振幅、波長和頻率，但是他們的相位不同。請問他兩者的相位差必須是多少，才能使得兩波的合成波的振幅是單一行進波振幅的1.5倍。 以 (a)度、(b)弧度和(c)波長表達相位差。 (03小題)

(a)phase difference,
ϕ=_____ degree

51: **ANS:=82.8**

(a)phase difference,
ϕ=_____ rad

52: **ANS:=1.45**

(a)phase difference,
ϕ=_____ wavelength

53: **ANS:=0.23**

(a) Let the phase difference be ϕ. $2y_m \cos(\phi/2) = 1.50y_m$, which gives

$$\phi = 2\cos^{-1}\left(\frac{1.50y_m}{2y_m}\right) = 82.8°.$$

(b) Converting to radians, we have $\phi = 1.45$ rad.

(c) In terms of wavelength (the length of each cycle, where each cycle corresponds to 2π rad), this is equivalent to 1.45 rad/2π = 0.230 wavelength.