

電郵 _____

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手機 _____

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得分 _____

(以下每題 8 分)

高級組 (答在本頁 **To answer on this page**)

1. 落體受阻力 v^n , v 是速度, n 是正數, 求終端速度表示式. Under the resistive force v^n , v =speed, n =positive number, what is the expression of terminal speed of a falling object?
2. 凡得瓦爾氣體方程的兩修正項是考慮什麼因素 What are the reasons of two factors added in the Van der Waals equation?

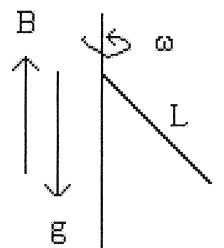
3. 波動的繞射以什麼作基準及分爲那 2 類 What are the two kinds of wave diffraction and how to classify them?

4. 爲什麼超導體沒有電阻 Why superconductor has no resistance?

5. 順(低-高)頻率序, 列出電磁波譜的波段名稱(分全波譜至少 6 波段)From low to high frequency, list the whole electromagnetic spectrum at least in 6 ranges.

(以下每題 10 分)

6. 金屬棒長 L 質量 M 繞軸以 ω 速轉動如圖示, B =磁場, g =重力場, 求棒兩端的電位差
Metal bar length L and mass M is rotating about an axis with ω speed as shown under B and g fields, to find the voltage difference between two ends of the bar.



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7. 在實驗室中靜止的 μ 介子壽命是 2.2×10^{-6} s. 但當 μ 介子以 0.98 光速直線運動時, μ 介子從誕生至蛻變的時間內行進了多遠距離 The life-time of μ muon in rest is 2.2×10^{-6} s, what is the distance travels by muon after generated and moving in a speed of $0.98c$?

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8. 當電子作圓周運動時會損失能量 When electron moved in circle will lose its energy, 輻射功率 P it radiates power $P = \frac{e^6}{96 (\epsilon_0)^3 r^4 c^3 m^2 \pi^3}$, $m=9.11 \times 10^{-31}$ kg, $e=1.6 \times 10^{-19}$ C, $\epsilon_0=8.854 \times 10^{-12}$ F/m, c =光速(light speed), r =半徑(radius), 考慮此情形, 求氫的電子從 $r=5.29 \times 10^{-11}$ m 的軌道落到質子上的時間 Considering this condition, find the time for the electron of hydrogen drops from its orbit ($r=5.29 \times 10^{-11}$ m) onto the proton.

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9. 空氣泡從水下 H 深浮上, 水下 h 深的壓力 $p=p_0 + \rho gh$ 和溫度 $T=T_0 - ah/H$, a =常數, ρ =水密度, (p_0, T_0, V_0) =水面空氣泡的壓力, 溫度和體積, 空氣泡上浮時吸熱, 求水面空氣泡內能的增加量 Air bubble floats from H depth of water. At h depth the pressure $p = p_0 + \rho gh$ and the temperature $T = T_0 - ah/H$, a =constant, ρ =water density, (p_0, T_0, V_0) = the pressure, temperature and volume of air bubble at the surface. Find the increase of internal energy of surface bubble..

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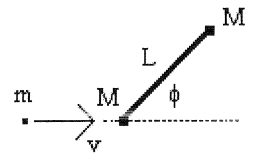
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10. 光滑平面上，兩質點 M 由長 L 輕棒相連，質點 m 初速 v 如圖示與一 M 成 ϕ 角相撞後沿原路徑以 $v/2$ 速率彈回，求相撞後輕棒質心的速度，及輕棒繞質心的轉動速率 On smooth plane two masses M are connected by light bar with length L. Mass m with velocity v forming angle ϕ to the bar as shown collides with one M and is rebounded to the same coming path with speed of $v/2$. Find the velocity of mass center of the bar and the angular velocity of the bar.



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11. a). 瞳孔半徑 1.5mm，求人眼在 10m 外仍能分辨兩分離點的最小距離 The radius of pupil is 1.5mm, find the distance between two points, that can be resolved by eye, 10 m away from eye.

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b). 質點受 x, y 方向的振動力 Mass point reacts to x, y forces, $x = A_1 \cos(\omega t + \phi_1)$, $y = A_2 \cos(\omega t + \phi_2)$, 質點軌跡是 point trajectory is $(x^2/A_1) + (y^2/A_2) - [2xy \cos(\Delta \phi)]/A_1 A_2 = \sin^2(\Delta \phi)$, $\Delta \phi = \phi_2 - \phi_1$, 繪各 $\Delta \phi$ 的軌跡 Draw trajectory for $\Delta \phi = 0, = \pi/4, = \pi/2, = 3\pi/4, = \pi, = 5\pi/4, = 3\pi/2, = 7\pi/4$.

