分生組丙

八十五學年度 生命科學 系（所） 生醫組丙 組碩士班研究生入學考試

科目 近代物理 科號 1102 1402 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

(20%) 1 .Among the following Nobel Price winners, choose 4 cases and describe their accomplishments in details 。

1901 ： W. K. Rontgen　　1915 ： W. H. Bragg and W. L. Bragg
1921 ： A. Einstein　　1935 ： J. Chadwick
1938 ： E. Fermi　　1957 ： C. N. Yang and T. D. Lee

Hint ： You may choose items from the following ～
discovery of X-ray ，
discovery of spontaneous radioactivity ，
discoveries regarding the laws governing the blackbody radiation ，
analysis of crystal structure using x-rays ，
discovery of the law of the photoelectric effect ，
discovery of the wave nature of electrons ，
discovery of the neutron ，
discovery of nuclear reactions brought about by slow neutrons ，
discovery of parity violation 。

(10%) 2 .Doppler effect is the phesnomenon that the frequency of a wave increases/decreases as the source approaches/recedes the observer. A driver was stopped by the policeman for passing the intersect at the red light, yet the driver claimed that he saw a green light. According to Doppler effect, do you think the driver should get a ticket of speeding instead ?

(20%) 3 .Give two examples of modern technology applied to biological researches, Explain the physics principles behind the technology 。

(20%) 4 .(a)Derive the expression for energy levels of a hydrogen atom 。

(b)Find the wavelength of the Balmer series, which is the transition between an initial state of $n \geq 3$ and a final state of n=2. Give the values of $3 \rightarrow 2$ and $4 \rightarrow 2$ in units of $\mathring{A}$ 。

(c)Suppose we replace the electron of a hydrogen atom by a muon ($q_\mu = q_e$, and $m_\mu = 207\ m_e$), what are the wavelengths of $3 \rightarrow 2$ and $4 \rightarrow 2$ transitions ?

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(30%) 5 .A particle of mass m and energy E is moving in one dimensional potential well discribed by

$$V(x) = \begin{cases} 0 & \text{where } -a/2 < x < a/2 \\ \infty & \text{othewise} \end{cases}$$

(a)Derive the expression for $\psi(x, t)$;

(b)Calculate $\langle x^2 \rangle$ and $\langle x \rangle$, determine

(c)Calculate $\langle p^2 \rangle$ and $\langle p \rangle$ 。

Name	Symbol	Value	Units
Speed of light	c	2.99792×10^{8}	m/sec
Vacuum permittivity	ε_0	8.85419×10^{-12}	coul/volt-m
Planck's constant	h	6.62608×10^{-34}	joule-sec
		$=4.13567 \times 10^{-15}$	eV-sec
	$\hbar = h/2\pi$	1.05457×10^{-34}	joule-sec
		$=6.58212 \times 10^{-16}$	eV-sec
Elementary charge	e	1.60218×10^{-19}	coul
Electron mass	m_e	9.10939×10^{-31}	kg
Avogadro's number	N_A	6.02214×10^{23}	mol^{-1}
Boltzmann's constant	k	1.38066×10^{-23}	joule/Kelvin
		$=8.61739 \times 10^{-5}$	eV/Kelvin
Atomic mass unit	u	1.66054×10^{-27}	kg

$\hbar = 1.054 \times 10^{-27}$ erg-sec (Planck's constant divided by 2π)
$e = 4.80 \times 10^{-10}$ esu (magnitude of electron charge)
$m = 0.911 \times 10^{-27}$ g (electron mass)
$M = 1.672 \times 10^{-24}$ g (proton mass)
$a_0 = \hbar^2/me^2 = 5.29 \times 10^{-9}$ cm (Bohr radius)
$e^2/a_0 = 27.2$ ev (twice binding energy of hydrogen)
$c = 3.00 \times 10^{10}$ cm/sec (speed of light)
$\hbar c/e^2 = 137$ (reciprocal fine structure constant)
$e\hbar/2mc = 0.927 \times 10^{-20}$ erg/oersted (Bohr magneton)
$mc^2 = 5.11 \times 10^{5}$ ev (electron rest energy)
$Mc^2 = 938$ Mev (proton rest energy)
1 ev $= 1.602 \times 10^{-12}$ erg
Wavelength associated with 1 ev/c = 12,400 Å
Temperature associated with 1 ev = 11,600°K