同济大学课程考核试卷（A 卷）

2012 － 2013 学年第 一 学期

命题教师签名： 审核教师签名：

课 号： 12400105 课 名： University Physics (II)

考试考查：

此卷选为：期中考试()、期终考试(√)、重考( )试卷

Department_____ID_____Name_____Score_____
_____

You have 120 minutes to finish this exam paper.

You can use Chinese when write down the answer.

You can use your dictionary.

Do not cheat.

1-15， 4 points each

1   In a Young's double-slit experiment, the slit separation is doubled. To maintain the same fringe spacing on the screen, the screen-to-slit distance D must be changed to:

A. D/2

B. D/$\sqrt{2}$

C. D*$\sqrt{2}$

D. 2D

E. 4D

[   ]

2   Monochromatic light, at normal incidence, strikes a thin film in air. If λ denotes the wavelength in the film, what is the thinnest film in which the reflected light will be a maximum?

A. Much less than λ

B. λ/4

C. λ/2

D. 3λ/4

E. λ

[   ]

3 Consider a single-slit diffraction pattern caused by a slit of width a. There is a minimum if Sinθ is equal to:

A. exactly λ/a

B. slightly more than λ/a

C. slightly less than λ/a

D. exactly λ/2a

E. very nearly λ/2a

[   ]

4 When light of a certain wavelength is incident normally on a certain diffraction grating, the line of order 1 is at a diffraction angle of 25°. The diffraction angle for the second order line is:

A. 25 degrees

B. 42 degrees

C. 50 degrees

D. 58 degrees

E. 75 degrees

[   ]

5 Two events occur on the x axis separated in time by Δt and in space by Δx. A reference frame, traveling at less than the speed of light, in which the two events occur at the same time:

A. exists no matter what the values of Δx and Δt

B. exists only if $\Delta x/\Delta t < c$

C. exists only if $\Delta x/\Delta t > c$

D. exists only if $\Delta x/\Delta t = c$

E. does not exist under any condition

[   ]

6   A spectral line of a certain star is observed to be "red shifted" from a wavelength of 500nm to a wavelength of 1500nm. Interpreting this as a Doppler effect, the speed of recession of this star is:

A. 0.33c

B. 0.50c

C. 0.71c

D. 0.8c

E. c

[   ]

7   The diagram shows the graphs of the stopping potential as a function of the frequency of the incident light for photoelectric experiments performed on three different materials. Rank the materials according to the values of their work functions, from least to greatest.
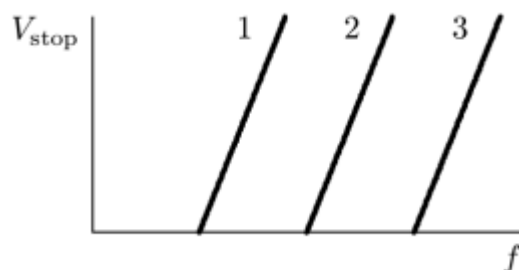
A. 1, 2, 3

B. 3, 2, 1

C. 2, 3, 1

D. 2, 1, 3

E. 1, 3, 2

[   ]

8   Of the following, Compton scattering from electrons is most easily observed for:

A. microwaves

B. infrared light

C. visible light

D. ultraviolet light

E. x rays

[   ]

9   Consider the following three particles:

1. a free electron with speed v_0

2. a free proton with speed v_0

3. a free proton with speed $2v_0$

Rank them according to the wavelengths of their matter waves, least to greatest.

A. 1, 2, 3

B. 3, 2, 1

C. 2, 3, 1

D. 1, 3, 2

E. 1, then 2 and 3 tied

[   ]

10   An electron is in a one-dimensional trap with zero potential energy in the interior and infinite potential energy at the walls. A graph of its probability density P(x) versus x is shown. The value of the quantum numbernis:

A. 0

B. 1

C. 2

D. 3

E. 4

[   ]

11 The magnetic quantum number m_l is most closely associated with what property of an electron in an atom?

A. Magnitude of the orbital angular momentum

B. Energy

C. z component of the spin angular momentum

D. z component of the orbital angular momentum

E. Radius of the orbit

[   ]

12   The Pauli exclusion principle is obeyed by:

A. all particles

B. all charged particles

C. all particles with spin quantum numbers of 1/2

D. all particles with spin quantum numbers of 1

E. all particles with mass

[   ]

13   According to the kinetic theory of gases, the pressure of a gas is due to:

A. change of kinetic energy of molecules as they strike the wall

B. change of momentum of molecules as the strike the wall

C. average kinetic energy of the molecules

D. force of repulsion between the molecules

E. rms speed of the molecules

[   ]

14   If the temperature T of an ideal gas is increased at constant pressure the mean free path:

A. decreases in proportion to $1/T$

B. decreases in proportion to $1/T^2$

C. increases in proportion to T

D. increases in proportion to T^2

E. does not change

[   ]

15   A Carnot heat engine operates between 400K and 500K. Its efficiency is:

A. 20%

B. 25%

C. 44%

D. 80%

E. 100%

[   ]

16-18   10   points each

16   A Newton's rings apparatus is to be   used   to determine the   radius   of curvature of a lens. The radii of the   nth and   (n + 20)th   bright   rings   are   measured and   found   to   be   0.162   and   0.368 cm, respectively,   in   light of   wavelength   546 nm.   Calculate   the   radius   of curvature   of the lower   surface   of   the lens.

17 **(a)** By using the de Broglie relation, derive the Bohr condition $mvr = n$ for the angular momentum of an electron in a hydrogen atom.

(b) Use this expression to show that the allowed electron energy states in hydrogen atom can be written as $E_n=$

(c) How would this expression be modified for the case of a triply ionized beryllium atom Be(Z=4)?

18 (a) An ideal gas initially at pressure p_0 undergoes a free expansion until its volume is 3.00 times its initial volume. What then is the ratio of its pressure to p_0? **(b)** The gas is next slowly and adiabatically compressed back to its original vol-ume. The pressure after compression is $(3.00)^{1/3}p_0$. Is the gas monatomic, diatomic, or polyatomic? **(c)** What is the ratio of the average kinetic energy per molecule in this final state to that in the initial state?

19 Reading (10')

After that run ended in October for its scheduled winter shut-down, Fabiola Gianotti, spokesperson for ATLAS, and Tonelli, then spokesperson for CMS, delivered a special seminar to an overflowing audience in the main CERN auditorium. Both detectors independently found suggestive bumps in the data.

What's more, these tell tale hints of a Higgs boson corroborated one another. Both ATLAS and CMS reported several dozen events above the expected background in which two photons came blazing out with combined energies of 125 billion electron volts, or 125 GeV. (GeV is the standard unit of mass and energy in particle physics, about equal to a proton mass.) If proton collisions had created short-lived Higgs bosons, they could have decayed into these photons. Each experiment also found a few surplus events in which four charged leptons (electrons or muons) carried off similar total energies. These could also have been the result of a Higgs. Such a concurrence of signals was unprecedented. It suggested that something real was beginning to appear in the data.

Yet given the stringent norms of particle physics, none of the signals observed in 2011 were strong enough to allow for claims of a "discovery." Data peaks and bumps like this had often proved ephemeral, mere random fluctuations. And the successful spring 2012 run, which generated more proton collisions in 11 weeks than had come in during all of 2011, could easily have washed out the nascent data peaks, smothering them in background noise.

Question :a)　For a proton to have the mass of the Higges boson, How much energy is needed at least to accelerate it? what is the speed of the proton then?

b) Is Higgs bosons charged or not? Why ?