KATHMANDU UNIVERSITY
End- Semester Examination
February/March, 2018

Marks scored:

Level : B.Sc.
Year : IV

Course : PHYS 402
Semester: I

Exam.Roll No.:

Time: 30 mins.

F.M. : 20

Registration No.:

Date : MAR 0 4 2018

SECTION "A"

[20 Q.×1=20 marks]

Choose and tick the most appropriate answer.

1. The maximum kinetic energy that the electron can lose by collision with a hydrogen atom is..... of its initial energy
   [a] 1/ 1840 [b] 1/460 [c] 1/3680 [d] 1/4

2. The energy necessary to raise an atom to its first excited state is called
   [a] resonance potential [b] ionization potential
   [c] binding energy [d] activation energy

3. Which one of the following equations correctly represents the condition of electrical breakdown of a gas?
   [a] $\gamma\left(e^{\alpha d}-1\right)=1$ [b] $\gamma\left(e^{\alpha d}+1\right)=1$ [c] $\gamma\left(e^{2\alpha d}+1\right)=1$ [d] $\gamma=e^{\alpha d}-1$

4. The number of electron in Debye sphere in a plasma with n= 10^{16} /m^3 and KT_e = 2 eV is approximately equal to
   [a] 135 [b] 0.14 [c] 1.5 × 10^5 [d] 4.8 × 10^4

5. Which one of the following statements is NOT correct?
   [a] A criterion for an ionized gas to be a plasma is that it be dense enough that λ_D is much smaller than L.
   [b] A criterion for an ionized gas to be a plasma is that it be dense enough that λ_D is much larger than L.
   [c] λ_D increases with increasing KT_e.
   [d] The plasma is quasineutral if one can take $n_i \approx n_e \approx n$.

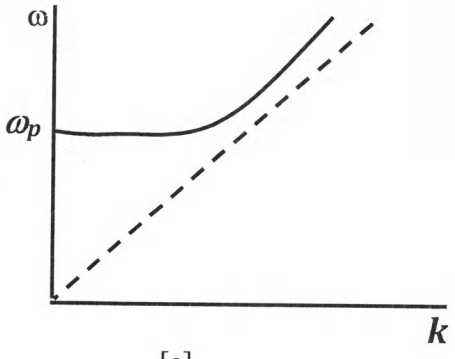
6. Larmor radius for a 10-keV electron in the earth's magnetic field of 5×10^{-5} T is equal to
   [a] 6.8cm [b] 3.4 m [c] 6.75m [d] 3.4 cm

7. An electron is travelling at right angles to a uniform magnetic field of flux density 1.2 mT with a speed of 8 × 10^6 m s^{-1}, radius of circular path followed by electron is
   [a] 1.9 cm [b] 3.6 cm [c] 3.8m [d] 3.8 cm

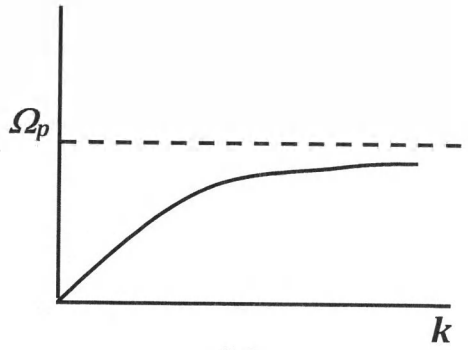
8. If μ be the mobility of electrons in a plasma in absence of magnetic field, the mobility μ_H in the presence of magnetic field H will be given by
   [a] $\mu_H=\frac{\mu}{1-\omega_H{}^2\tau^2}$ [b] $\mu_H=\frac{\mu}{1+\omega_H\,\tau}$ [c] $\mu_H=\frac{\mu}{1+\omega_H{}^2\tau^2}$ [d] $\mu_H=\mu$

9. Electron plasma waves are basically
[a] constant frequency waves but turn into constant velocity wave at short wavelength.
[b] constant frequency waves but turn into constant velocity wave at long wavelength.
[c] constant velocity waves but turn into constant frequency wave at short wavelength.
[d] constant velocity waves but turn into constant frequency wave at long wavelength

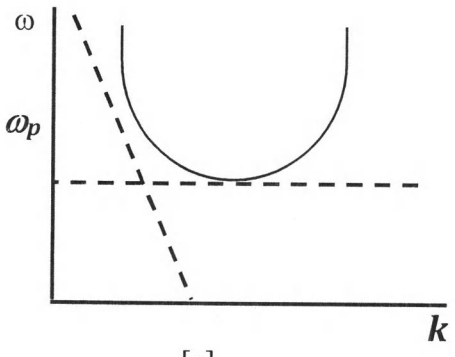
10. Which one of the following figures correctly represents the dispersion curve for waves in plasma?



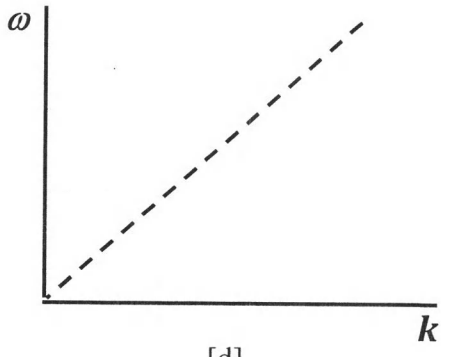
[a]



[b]



[c]



[d]

11. Which one of the following statement is true regarding the radiation from plasma ?
[a] loss of energy by cyclotron radiation is proportional to T_e^2
[b] loss of energy by Bremsstrahlung radiation is proportional to T_e
[c] Bremsstrahlung radiation mostly occurs in the IR region
[d] cyclotron radiation mostly occurs in the UV region

12. The diffusion of electrons in a plasma is
[a] directly proportional to collision frequency in absence of magnetic field
[b] inversely proportional to collision frequency in absence of magnetic field
[c] inversely proportional to collision frequency in presence of magnetic field
[d] always directly proportional to collision frequency

13. The frequency of electron oscillation in a plasma is found to be 9 GHz measured by microwave diagnostic method. The density of electron in the plasma must be
[a] 10^{18} m^{-3} [b] 10^{18} cm^{-3} [c] 10^{20} m^{-3} [d] 10^{9} m^{-3}

14. The root mean square velocity of gas molecules is equal to

[a] $\sqrt{\frac{2kT}{m}}$ [b] $\sqrt{\frac{8\pi kT}{m}}$ [c] $\sqrt{\frac{3kT}{m}}$ [d] $\sqrt{\frac{2kT}{\pi m}}$

15. Which one of the following statement is true?

[a] The photo-ionization cross section for gases is smaller than the ionization cross section caused by electron collisions.

[b] The photo-ionization cross section for gases is slightly larger than the ionization cross section caused by electron collisions

[c] The photo-ionization cross section is always equal to the ionization cross section caused by electron collisions

[d] The photo-ionization cross section for gases is many order larger than the ionization cross section caused by electron collisions

16. In gaseous discharge system, the trapping effect of charge particle of mobility μ caused by the high frequency alternating field E of frequency ω and amplitude A applied between two electrodes separated by a distance d is specified by ,

[a] $\frac{2\mu E}{\omega d}$ [b] $\frac{2E}{\omega\mu d}$ [c] $\frac{\mu E}{\omega d}$ [d] $\frac{\omega d}{2\mu E}$

17. The Balmer series of hydrogen atom fall in

[a] X-rays region [b] UV region [c] visible region [d] IR region

18. Which one of the following statement is true?

[a] the electron density in ionosphere is larger than in gas discharge

[b] the electron density in ionosphere is smaller than the inter planetary plasma

[c] in a weakly ionized plasma temperature of electron and ions are nearly the same

[d] degree of ionization in low temperature non-thermal plasma is about 10^{-4}

19. In a plasma, if $B \simeq 0.32\,T$ and $n \simeq 10^{18}\,m^{-3}$, the cyclotron frequency for electrons will be

[a] much smaller than the plasma frequency

[b] much larger than the plasma frequency

[c] approximately equal to the plasma frequency

[d] double the value of plasma frequency

20. A temperature of 10^8 K, required for fusion to occur at a sufficient rate in a thermonuclear fusion reactor, corresponds to particle energies of about

[a] 1 keV [b] 10 keV [c] 100 keV [d] 1 MeV

KATHMANDU UNIVERSITY
End- Semester Examination
February/March, 2018

Level : B.Sc.
Year : IV
Time : 2 hrs. 30 mins.

Course : PHYS 402
Semester: I
F.M. : 55

SECTION "B"
[5 Q.×4=20 marks]

1. What do you mean by the plasma state of matter? Outline the important differences between a hot and a cold plasma.

2. Write a short note on kinetic pressure in a partially ionized gas. Compute the pressure, in atmospheres, exerted by a thermonuclear plasma on its container. Assume $KT_e = KT_i = 20$ keV, $n = 10^{21}$ m^{-3}, and $p = nKT$, where $T = T_i + Te$.

3. Calculate λ_D for the following plasmas and verify that these plasmas satisfy the condition $N_D >> 1$.

Plasma	n_e (m^{-3})	T_e (K)
Dense hot plasma	10^{22}	10^6
Interstellar gas	10^3	10^2

4. Describe the three criteria for an ionized gas to be a plasma.

5. What is meant by mobility of a charged particle in a plasma? Deduce the expression for the mobility of an electron in the presence of uniform electric field E.

OR

Write a short note on microwave diagnostics of plasma with the help of well labeled diagram.

SECTION "C"
[5 Q.×7=35 marks]

6. What is the maximum energy transfer in an elastic collision between an electron and atom (ion) ? Deduce the expression for the ratio of energy transfer E_t to initial kinetic energy E_i of the electron.

OR

Explain the Townsend theory of ionization by collision and deduce the condition of gaseous breakdown. What are the limitation of this theory?

7. Describe the effect of magnetic field (H) on the diffusion of electrons and explain how the diffusion varies with H/P (where P is the pressure).

OR

Describe the motion of electrons and ions in a region of uniform electric field and magnetic field. Also trace the trajectories of the particles.

8. Write down the major types of radiation by which energy is lost from a plasma. Describe the condition under which plasma radiate like a black body.

9. Describe the mechanism of oscillation in a plasma and hence deduce the expression for plasma frequency. Compute the plasma frequency in a controlled thermonuclear plasma with a density of about 10^{22} (m^{-3}).

10. Describe the theory of Langmuir double probe and explain the current-voltage characteristics of a typical plasma using the probe. Explain how it is used to determine the electron temperature (T_e) and density (n_e) in a plasma.