RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2017

FIRST YEAR [BATCH 2016-19]

Date : 24/05/2017 **PHYSICS (General)**

Time : 11 am – 1 pm **Paper :** II Full Marks : 50

[Use a separate Answer Book for <u>each group</u>]

Group – A

(***Answer <u>any four</u> questions***) [4×5]

1. a) What do you mean by degrees of freedom? [1]
   b) Write down the expression for pressure due to an ideal gas according to kinetic theory. [1]
   c) Write the principle of equipartition of energy and prove it from kinetic theory. [1+2]

2. a) Write down Maxwell's law of distribution of velocity. Draw the distribution for two different temperatures T_1 and T_2. [1+1]
   b) Define r.m.s velocity. Calculate r.m.s velocity from Maxwell's velocity distribution law. [1+2]

3. a) State the limitations of van-der-Waals' equation. [2]
   b) Deduce the expression of van-der-Waals' constants in terms of critical constants. [3]

4. a) What is meant by quasi-static change. [2]
   b) A certain quantity of gas is compressed isothermlly until its pressure is doubled. It is then allowed to expand adiabatically until its original volume is restored but its pressure at that time is found to be 0·75 of its initial pressure. Calculate the value of γ for the gas. [3]

5. Calculate the work-done at different stages of a Carnot cycle and the thermal efficiency of the cycle. [5]

6. a) Calculate the increase in entropy when 1 gm of water at 0°C is heated to its boiling point 100°C. Specific heat of water = 1 cal/gram °C. [2]
   b) Two ideal black bodies A and B at temperatures 227°C and 327°C respectively are placed in evacuated enclosure whose walls are blackend and kept at 27°C. Compare their rates of loss of heat. [3]

Group – B

(***Answer <u>any six</u> questions***) [6×5]

7. a) Write Stoke's theorem. [2]
   b) Find the area of the triangle whose vertices are $4\hat{i}-6\hat{j}+2\hat{k}$, $2\hat{i}-2\hat{j}+2\hat{k}$ and $\hat{i}+\hat{j}+\hat{k}$. [3]

8. A force $\vec{F}$ is defined as : $\vec{F}=(2xy+z^3)\hat{i}+(x^2+2y)\hat{j}+(3xz^2-2)\hat{k}$. Prove that $\bar{\nabla}\times\bar{F}=\bar{0}$. Calculate potential $\phi(x,y,z)$ associated with $\vec{F}$. [2+3]

9. Establish the relationship between $\vec{D}$, $\vec{E}$ and $\vec{P}$ where $\vec{D}$ is electric displacement vector, $\vec{E}$ is the electric field and $\vec{P}$ is the dielectric polarisation vector. [5]

10. a) How a small current loop behaves like a magnetic dipole. [3]

b) Define 1 tesla. [1]

c) Write dimension of $\vec{B}$. [1]

11. a) What is self induction? [1]

b) What is coefficient of self inductance. [1]

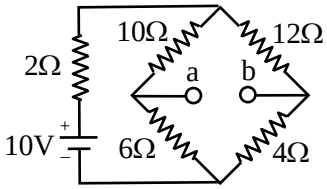
c) Calculate coefficient of self inductance in a long solenoid. [3]

12. a) What is gyromagnetic ratio? [1]

b) A charged particle is moving in a magnetic field $\vec{B}$. Write down the force on the particle. Investigate the motion of the particle and determine the time of revolution. [1+2]

c) Calculate the amount of work done in this case. [1]

13. Find the Thevenin and Norton equivalent circuits with respect to the terminals a, b in the network given below (You have to specify the values of current source, voltage source and internal resistances). Also find the resistance to be connected across a, b to dissipate maximum power. What is this maximum power? [2+2+0·5+0·5]



14. A dc source of e.m.f E is connected across a series RC circuit. Find the expression of charge stored in the capacitor at any time, assuming at t = 0, charge of the capacitor was zero. Define time constant for this circuit. What is the current flowing through this circuit. Show the variation of voltage across the resistance and capacitance with time. [2+1+1+1]

15. a) Consider an inductance L in series with a resistance R, this series RL combination being connected in parallel to a capacitor C. An ac voltage source its connected in parallel to the circuit. Determine the impedance of the circuit. Find the parallel resonant frequency. [2+1]

b) An ac circuit connected to a 220V, 50Hz supply contains a 20H coil of resistance 100 Ω connected in series with a 1·0 μF capacitor. Calculate the power factor and the power consumed in the circuit. [2]

16. a) Define Q-factor of a resonant circuit. [1]

b) What do you mean by bandwidth. Determine the bandwidth for a series LCR circuit. [1+2]

c) How the sharpness of a resonance depends on the Q-factor and bandwidth of a circuit. [1]

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