RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2019

SECOND YEAR (BATCH 2018-21)

Date : 19/12/2019 — **PHYSICS (General)**

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

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

Group – A

Answer <u>any four</u> questions from Question Nos. <u>1 to 6</u>: [4×5]

1. a) Show graphically the energy distribution curve of gas molecules. Hence discuss how it is different from velocity distribution curve. [3]

   b) If the r.m.s. velocity of H_2 at N.T.P. is 1.84 Km/s, calculate the r.m.s. velocity of O_2 at N.T.P. Molecular weights of H_2 and O_2 are 2 and 32 respectively. [2]

2. a) 2 mole of hydrogen gas at 30°C are mixed with one mole of helium gas at 60°C. Find the temperature of the mixture. [3]

   b) State and explain the principle of equipartition of energy. [2]

3. a) What do you understand by equation of state? Express the equation for real gases in terms of virial-coefficients. Define Boyle temperature from the equation. [3]

   b) What are the critical constants of a gas? [2]

4. a) Discus briefly the considerations which led Van-Der-Walls to modify the gas equation. [2]

   b) Using Berthelot's equation of state $\left(p+\frac{a}{TV^2}\right)(v-b)=RT$. Show that the critical constants are given by $P_C=\frac{1}{12b}\sqrt{\frac{2aR}{3b}}$; $V_C=3b$ and $T_C=\sqrt{\frac{8a}{27Rb}}$. [3]

5. a) Deduce an expression for the work done in an adiabatic expansion of a perfect gas in terms of temperature. [3]

   b) A quantity of air at N.T.P is adiabatically compressed to $\frac{1}{5}$ th of its volume. Calculate the rise of its temperature. γ for air = 1.41. [2]

6. Define entropy. What is its physical significance? Show that entropy remains constant in a reversible process but increases in a irreversible process. [1+1+3]

Group – B

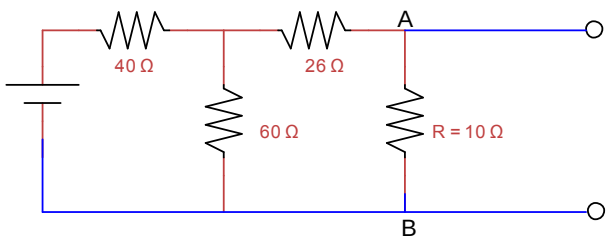
Answer <u>any six</u> questions from Question Nos. <u>7 to 16</u>: [6×5]

7. Deduce an expression for magnetic field due to circular current loop. Show variation of magnetic field along the axis of circular loop graphically. [3+2]

8. Show that it two coils having co-efficient of self inductance L_1 and L_2 are mutually coupled together so that the whole of the flux from one coil links with the other, then the mutual inductance between the two coils is given by $M=\sqrt{L_1L_2}$. [5]

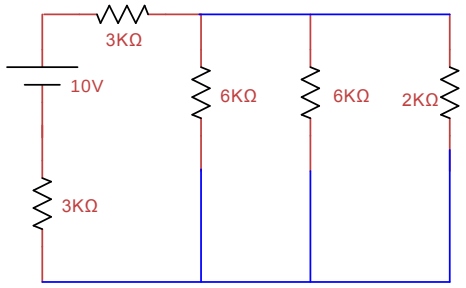
9. Establish the equation of continuity relating the charge density and current density at a point in a medium. [5]

10. Apply Thevenin's theorem to determine the current through the resistor R in the adjoining circuit and its terminal potential difference. [5]



11. a) State Thevenin's theorem in circuit network.

    b) Using Thevenin's theorem, find the current through the 2KΩ resistor in the circuit given below: [2+3]



12. A charged capacitor is allowed to discharge itself through a resistance. Show graphically the time variation of current in the circuit. [3+2]

13. a) What do you mean by motional emf? [2]

    b) Two coils with self-inductance L_1 and L_2 respectively, having mutual inductance M. Find an expression for their co-efficient of coupling (K). [3]

14. A 40μF capacitor in series with a 2000 ohms resistor is connected across a 200 Volt D.C. source. Determine (i) the initial current (ii) the time constant (iii) the value of the current when time is equal to time constant. [2+1+2]

15. a) Under what conditions can current be supplied to an AC circuit without delivering power to it? [2]

    b) A capacitor of 250 pF is connected in parallel with a coil having inductance of 16mH and effective resistance 20Ω. Calculate: (i) the resonance frequency and (ii) circuit impedance at resonance. [2+1]

16. a) A DC source of voltage V is suddenly applied to a circuit containing a resistance R and an inductor L in series. Write down the instantaneous emf equation and hence find the value for the instantaneous current. [3]

    b) A relay has an inductance of 10H and a resistance of 100Ω and operate with a current of 2mA. How long will the relay take to operate when a p.d. of 0.5V is suddenly applied across it? [2]

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