

2020

PHYSICS**[HONOURS]****Paper : IV(A)**

Full Marks : 50

Time : 2 Hours

*The figures in the right-hand margin indicate marks.**Candidates are required to give their answers in their own words as far as practicable.***GROUP-A**

1. Answer any **five** questions: 2×5=10
- Define active and passive circuit elements.
 - Differentiate a metal, an insulator and a semiconductor, using band diagram.
 - What do you mean by effective mass?
 - Write down two merits of a CE transistor amplifier over a CB amplifier.
 - Prove that the adiabatic curves of an ideal gas are steeper than isothermal.
 - Show that two reversible adiabats cannot intersect on a P-V diagram according to second law of thermodynamics.
 - State Clausius theorem and write down its integral form.

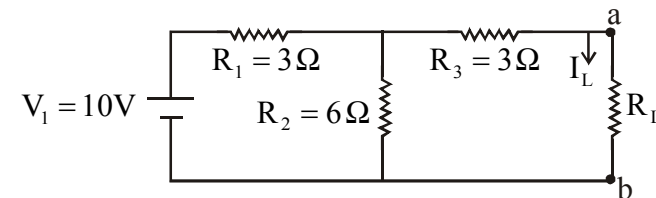
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- h) What do you mean by quasi-static process?

GROUP-BAnswer any **two** questions:

5×2=10

- Define junction capacitance. How is it used in varactor diode? 2+1+2=5
 - Write a short note on "reverse recovery time" for a switching diode. 2+1+2=5
- Write down Richardson's equation for thermionic emission current and explain the thermionic emission constants. 1+2+2=5
 - The space charge limited current in a plane parallel vacuum diode is 80 mA for an anode voltage of 100 V. What is the anode voltage for a space charge limited current of 270 mA? 1+2+2=5
- Draw the equivalent circuit of the following circuit using Thevenin's theorem. Find the current through R_L . 5

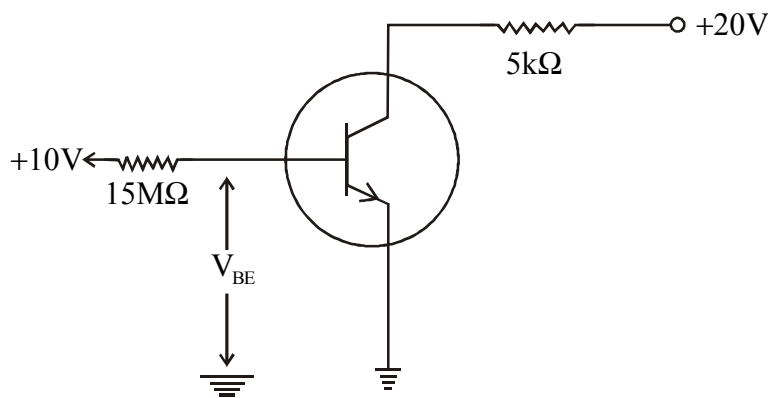


5. Simplify the standard sum of product representation by using 3-variable Karnaugh map $Y = \Sigma m(1,2,5,6)$. Design the circuit diagram to obtain this expression. 3+2=5

Answer any **one** question: 10×1=10

6. a) Discuss the transistor signal hybrid model and define h-parameters.
- b) For a transistor in CE configuration shown in figure, it is formed that for a fixed base current of $30\mu\text{A}$, collector current changes from 3.5mA to 3.7mA when the collector emitter voltage changes from 7.5V to 12.5V .

Calculate the value of α . Calculate V_{CE} if $\beta = 125$ assuming $V_{BE} = 0.7\text{V}$.



- c) What is load line and Q-point for a transistor? 3+4+3
7. Draw a neat circuit diagram of a single stage R-C coupled amplifier. Obtain the expressions for voltage gain in the mid, low and high frequency range and draw the frequency response curve. 2+7+1

GROUP-C

Answer any **two** questions: 5×2=10

8. Establish Maxwell's relations in thermodynamics. 5
9. Show that for a homogeneous fluid

$$C_p - C_v = T \left(\frac{\partial P}{\partial T} \right)_V \left(\frac{\partial V}{\partial T} \right)_P$$

hence show that for van der Waals gas

$$C_p - C_v = R \left(1 + \frac{2a}{VRT} \right)$$

where the symbols have their usual meanings.

3+2=5

10. Find the change of entropy when 1 gm of ice at 0°C is gradually changed to 1 gm of dry steam at 100°C at one atmospheric pressure. [Given : Latent heat of ice at $0^\circ\text{C} = 80 \text{ Cals/gm}$; Latent heat of steam at $100^\circ\text{C} = 540 \text{ Cals/gm}$; Sp. heat of water = 1] 5

11. Deduce the relation, $\frac{dL}{dT} = \frac{L}{T} + (C_2 - C_1)$

where, C_2 and C_1 are the specific heats of the saturated vapour and that of liquid, T is absolute temperature and L is the latent heat of vapourisation.

Explain the significance of negative specific heat of saturated steam. 3+2=5

Answer any **one** question: 10×1=10

12. a) Show that the ratio of adiabatic and isothermal elasticity of an ideal gas is equal to the ratio of two specific heats of the gas.

b) Show that :

i) $TdS = C_v dT + T \left(\frac{\partial p}{\partial T} \right)_v dV$ and

ii) $TdS = C_p dT - T \left(\frac{\partial V}{\partial T} \right)_p dp$

the symbols have their usual meanings.

4+(3+3)=10

13. a) What is Carnot's cycle? Derive an expression for the efficiency of a Carnot's engine directly from T-S diagram.

b) Is it possible for an engine working between 300 K and 150 K to have 60% efficiency? Explain. 2+6+2=10
