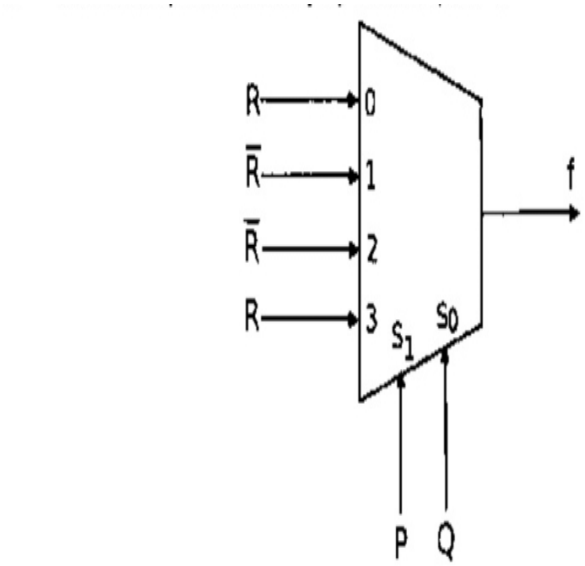
Name: N.Srinivas
Batch: COMETFWC036
Date: 10 September 2025

GATE 2010 CS, 9^{th} Question Analysis

Q.9

Question: The Boolean expression for the output f of the multiplexer shown below is:



Options:

(A) $\overline{P} \oplus Q \oplus R$

(B) $P \oplus Q \oplus R$

(C) $P + Q + R$

(D) $\overline{P + Q + R}$

Solution:

The output of a 4:1 multiplexer is:

$f = I_0 \cdot \overline{P} \cdot \overline{Q} + I_1 \cdot \overline{P} \cdot Q + I_2 \cdot P \cdot \overline{Q} + I_3 \cdot P \cdot Q$

Substitute the given inputs:

$I_0 = R, \quad I_1 = \overline{R}, \quad I_2 = \overline{R}, \quad I_3 = R$

So,

$f = R \cdot \overline{P} \cdot \overline{Q} + \overline{R} \cdot \overline{P} \cdot Q + \overline{R} \cdot P \cdot \overline{Q} + R \cdot P \cdot Q$

Truth Table

P	Q	R	f
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

This matches the truth table for:
$f = P \oplus Q \oplus R$

Hardware Implementation

The above problem is implemented and tested in hardware using Arduino UNO board. Here we implemented Sevensegment and blinked the LED as per truth table and verified the expression.

Required Components & Pin Connections

S.No	Component
1	Arduino Uno Board
2	Breadboard
3	LEDs (1)
4	7474 IC (1)
5	Resistors: 220Ω (2)
6	Jumper Wires
7	USB Cable

Component	Arduino Pin
Input P (Q1)	Digital 2
Input Q (Q2)	Digital 3
Input R (Q3)	Digital 4
Output D (7474)	digital 8
Output clk(7474)	digital 9
GND	GND
VCC	5V

Code Uploading Steps

1. Create a Assembly project
2. Write The code in main.c
3. Run the Assembly project with command "avra filename.asm". It will compile the code and creates .hex file
4. Copy the .hex file to ArduinoDriod folder
5. connect the Arduino UNO to mobile with OTG cable
6. Upload the hex file using "upload precomplied" option
7. Observe the ouput and verify the expression

Final Answer:

$$\boxed{f = P \oplus Q \oplus R}$$