Name: N.VaraLakshmi
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Question 1

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

(A) $(P \oplus Q \oplus R)'$

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

(C) $P + Q + R$

(D) $(P + Q + R)'$

Solution

This is a 4:1 multiplexer with select lines P (MSB) and Q (LSB). The data inputs are connected as:

P	Q	Selected Input
0	0	R
0	1	R'
1	0	R'
1	1	R

So, the output function becomes:

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

Group and simplify:

$$f = R(\overline{P}\,\overline{Q} + PQ) + R'(\overline{P}Q + P\overline{Q})$$

This gives:

$$f = R \cdot \text{XNOR}(P, Q) + R' \cdot \text{XOR}(P, Q) \Rightarrow f = P \oplus Q \oplus R$$

Hence, the correct answer is (B).