Q⑤/ Are the following binary operations comm. or not?

(a) $a*b = a+b-ab \quad \forall a,b \in (R,*)$

sol.: let $a,b \in R$

$a*b = a+b-ab$ --- ①

$b*a = b+a-ba$ --- ②

$\therefore$ ① = ②

$\therefore$ $*$ is comm.

(b) $(a,b)*(c,d) = (a+c, b+d) \quad \forall (a,b),(c,d) \in (R\times R,*)$

sol.: Let $(a,b),(c,d) \in R\times R$

$(a,b)*(c,d) = (a+c, b+d)$ --- ①

$(c,d)*(a,b) = (c+a, d+b)$ --- ②

$\therefore$ ① = ②

$*$ is comm.

$\forall a,b \in (Q,*)$

(c) $a*b = 0$

sol.: Let $a,b \in Q$

$a*b = 0$ --- ①

$b*a = 0$ --- ②

$\therefore$ ① = ②

$*$ is comm.