Question #79449

The rate of a standard reaction is 0.01840 M/s at 25 oC. It is determined that this is too fast, and that the rate should be reduced to 0.0046 M/s. What temperature should the reaction be run at to achieve this?

A. 45 oC

B. 20 oC

C. 15 oC

D. 5 oC

E. 0 oC

Answer:

The right answer is D. 5 °C.

According to the equation [1]:

$$\frac{R_2}{R_1} = Q_{10}^{\frac{T_2-T_1}{10}},$$

where R_1 – is the rate of reaction at 25°C, R_2 – is the rate of reduced reaction, T_1 – is the temperature of standard reaction(T_1=25+273=298 K), T_2 – is the temperature of reduced reaction (In K), Q_{10} – is the Q_{10} temperature coefficient.

For most biological systems, the Q_{10} value is ~ 2 to 3.

$$\frac{0.0046}{0.0184} = Q_{10}^{\frac{T_2-298}{10}}$$

$$0.25 = Q_{10}^{\frac{T_2-298}{10}}$$

If we suggest that Q_{10} is equal to 2, we get the following:

$$0.25 = 2^{\frac{T_2-298}{10}}$$

T_2 should be equal to 278, to be the solution of the equation.

t_2=278-273= 5 °C.

So, the right answer is D. 5 °C.

Reference:

[1] https://en.wikipedia.org/wiki/Q10_(temperature_coefficient)