An ideal gas is at 25°C. If the average kinetic energy of the gas atoms is tripled, what is the new temperature in °C?

Given:

Initial temperature of gas: $T_1 = 25^0C = 298\ K$

Final kinetic energy (KE_2) = 3 × initial kinetic energy (KE_1)

Determine: final temperature of gas: T_2

Initial kinetic energy of gas:

$$KE_1 = (3/2)k_BT_1 \text{ ----------(1)}$$

Final kinetic energy of gas:

$$KE_2 = (3/2)k_BT_2 \text{ ----------(2)}$$

k_B is Boltzmann constant and has a value of $1.38 \times 10^{-23}\ m^2\ kg\ s^{-2}\ K^{-1}$

But given $KE_2 = 3KE_1$ ----------(3)

Substituting (1) & (2) in (3):

$$(3/2)k_BT_2 = 3 \times (3/2)k_BT_1 \text{ ----------(4)}$$

Simplifying (4):

$$T_2 = 3 \times T_1 \text{ ----------(5)}$$

Substituting for T_1 i n (5):

$T_2 = 3 \times 298 = 894\ K$

$T2 = 894 - 273 = 621^0\ C$