Thermochemistry (2019 NHT)

1) 0.50 g of ethane, C_2H_6, undergoes complete combustion in a bomb calorimeter containing 200 mL of water. The water temperature rises from 22.0 °C to 48.5 °C. The thermochemical equation for the combustion of C_2H_6 using this information is

A. $C_2H_6 + 5O_2 \rightarrow 2CO_2 + 3H_2O$ $\Delta H = -1330$ kJ mol^{-1}

B. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ $\Delta H = -3120$ kJ mol^{-1}

C. $C_2H_6 + 5O_2 \rightarrow 2CO_2 + 3H_2O$ $\Delta H = -1560$ kJ mol^{-1}

D. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$ $\Delta H = -2660$ kJ mol^{-1}

Solution

Solution will appear here

2) A student aims to calculate the theoretical amount of energy available to the body from cellular respiration using the oxygen gas, O_2, retained by the body in a normal breath. In this calculation, the student assumes that: • the energy released at normal body temperature is the same as that released at standard laboratory conditions (SLC) • 19.6 mL of O2 is retained by the body in a normal breath. A balanced thermochemical equation for cellular respiration, with glucose as the primary reactant, is shown below.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ $\Delta H = -2816$ kJ mol^{-1}

The theoretical amount of energy produced through cellular respiration from the O_2 retained by the body in a normal breath would be

A. 2.2 kJ

B. 3.7×10^{-1} kJ

C. 7.9×10^{-2} kJ

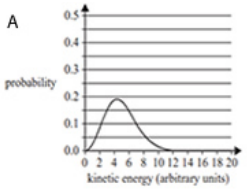
D. 7.9×10^{-4} kJ

Solution

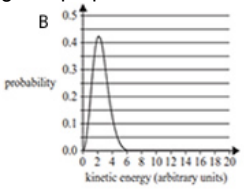
Solution will appear here

3) The Maxwell-Boltzmann distribution curves below represent the kinetic energies of molecules in a reaction with an activation energy, Ea , of 7 arbitrary units. Which one of the following shows the distribution curve with the highest proportion of successful collisions?

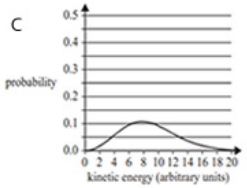
A



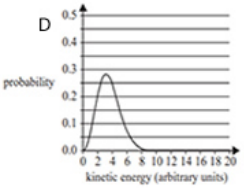
B



C



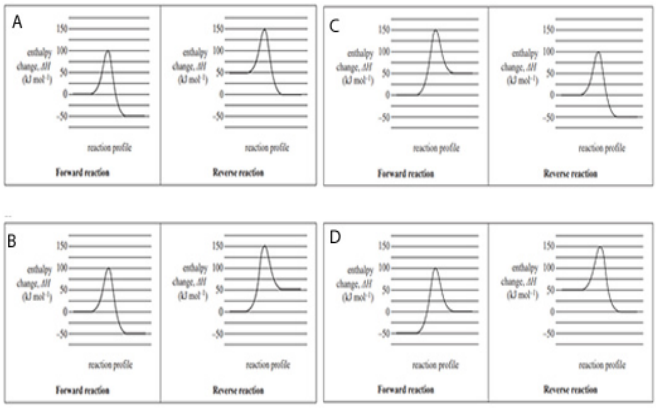
D



Solution

Solution will appear here

4) A reversible reaction has an enthalpy change, ΔH, of –50 kJ mol^{-1} for the forward reaction. Which one of the following pairs of energy profile diagrams, one for the forward reaction and one for the reverse reaction, represents this reaction?



Solution

Solution will appear here

5) Different types of fuels can be used in vehicles with combustion engines. These fuels can be produced from either fossil fuels or from renewable sources. Liquefied petroleum gas (LPG), a fossil fuel used in cars, is mainly made up of propane, C_3H_8.

a. Write a balanced thermochemical equation for the complete combustion of C_3H_8 in air at standard laboratory conditions (SLC).

Solution

Solution will appear here

b. How much energy, in kilojoules, would be produced from the complete combustion of 290 g of C_3H_8 at SLC?

Solution

Solution will appear here

c. What volume of air (21.0% oxygen, O_2, by volume), measured at SLC, would be required to fully combust 68.5 g of C_3H_8?

Solution

Solution will appear here