InkChemistry

QUESTION WORKBOOK

The Maxwell–Boltzmann distribution, temperature and catalysts

Kinetics · Unit C05

AQA 3.1.5.2, 3.1.5.3, 3.1.5.5 · OCR A 3.2.2

15 questions · 51 marks

PRINT EDITION

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SECTION A · Short, 1 to 2 marks

A1 MBD-Q2

State where the most probable energy and the mean energy are found on a Maxwell–Boltzmann distribution. [2]

A2 MBD-Q9

Identify each catalyst as heterogeneous or homogeneous: chlorine atoms catalysing the decomposition of ozone gas in the stratosphere, and solid nickel catalysing the reaction of hydrogen gas with liquid vegetable oils. [2]

SECTION B · Standard, 3 to 5 marks

B1 MBD-Q10

Draw a Maxwell–Boltzmann distribution for a sample of gas, labelling both axes. Mark the most probable energy, the mean energy and an activation energy, Ea, and shade the area that represents the molecules able to react. [5]

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B2 MBD-Q19 Draw an enthalpy profile for an exothermic reaction with and without a catalyst, labelling the activation energy of each route and ΔH, and explain why the catalyst does not change the equilibrium yield of a reversible reaction. [5]

B3 MBD-Q14 Compare the effect of raising the temperature with the effect of adding a catalyst on the Maxwell–Boltzmann distribution and on the rate of a reaction. [4]

B4 MBD-Q3 Explain why a Maxwell–Boltzmann distribution starts at the origin and never meets the energy axis at high energy, and state what the total area under the curve represents. [3]

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B5 MBD-Q5 Explain why increasing the temperature increases the rate of a reaction between two gases. [3]

B6 MBD-Q6 Explain why a rise in temperature of only 10 °C can nearly double the rate of a reaction. [3]

B7 MBD-Q7 Explain, with reference to the Maxwell–Boltzmann distribution, how a catalyst increases the rate of a reaction. [3]

B8 MBD-Q12 Suggest why a car's catalytic converter removes very little carbon monoxide in the first minute after a cold engine is started. [3]

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B9 MBD-Q13 Suggest why raising the temperature from 20 °C to 30 °C increases the rate of a reaction with a large activation energy by a greater factor than the rate of a reaction with a small activation energy. [3]

B10 MBD-Q15 Evaluate the statement: 'a catalyst works by giving the reactant molecules the extra energy they need to react'. [3]

B11 MBD-Q20 Suggest why making ethanoic acid from methanol and carbon monoxide with a rhodium catalyst, $CH_3OH(l) + CO(g) \rightarrow CH_3COOH(l)$, is more sustainable than oxidising hydrocarbons to a mixture of products. [3]

B12 MBD-Q21 Justify the statement that, for a reaction with a large activation energy, raising the temperature of the mixture by 10 °C increases the rate more than doubling the concentration of a reactant does. [3]

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SECTION C · Long, 6 marks or more

C1 MBD-Q17 Discuss the advantages and disadvantages, to a company making a product by an exothermic reversible reaction between gases, of using a heterogeneous catalyst rather than a higher temperature to obtain a useful rate. [6]

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