InkChemistry

QUESTION WORKBOOK

Catalysis: heterogeneous, homogeneous and autocatalytic

Transition metals · Unit C14

AQA 3.2.5.6 · OCR A 5.3.1

17 questions · 55 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 CHH-Q1
State the meaning of the terms heterogeneous catalyst and homogeneous catalyst. [2]

A2 CHH-Q14
Suggest why the hydrogen fed to an ammonia plant is first treated to remove sulfur compounds. [2]

A3 CHH-Q20
Suggest why nitrogen dioxide can catalyse the oxidation of sulfur dioxide even though nitrogen is not a transition metal. [2]

SECTION B · Standard, 3 to 5 marks

B1 CHH-Q5
Explain how vanadium(V) oxide acts as a catalyst in the Contact process. Include the two equations for the catalysed route. [5]

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B2 CHH-Q12 Calculate E°_{cell} for each of the two steps in the Fe^{2+}-catalysed reaction between $S_2O_8^{2-}$ and I^-. $E^{\circ}(S_2O_8^{2-}/SO_4^{2-}) = +2.01$ V, $E^{\circ}(Fe^{3+}/Fe^{2+}) = +0.77$ V and $E^{\circ}(I_2/I^-) = +0.54$ V. [4]

B3 CHH-Q15 Compare the way vanadium(V) oxide catalyses the Contact process with the way Fe^{2+} ions catalyse the reaction between $S_2O_8^{2-}$ and I^-. [4]

B4 CHH-Q2 Describe the three steps by which a solid catalyst speeds up a reaction between gases. [3]

B5 CHH-Q3 Explain why a good heterogeneous catalyst must adsorb reactants neither too strongly nor too weakly. [3]

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B6 CHH-Q6 Explain why the platinum and rhodium in a catalytic converter are spread as a thin layer on a ceramic honeycomb. [3]

B7 CHH-Q7 Explain why a car fitted with a catalytic converter must not run on leaded petrol. [3]

B8 CHH-Q9 Suggest whether Mn^{3+}/Mn^{2+} (E° = +1.51 V) and V^{3+}/V^{2+} (E° = -0.26 V) could each catalyse the reaction between $S_2O_8^{2-}$ and I^-. $E^\circ(S_2O_8^{2-}/SO_4^{2-})$ = +2.01 V and $E^\circ(I_2/I^-)$ = +0.54 V. [3]

B9 CHH-Q10 Describe the shape of a graph of $[MnO_4^-]$ against time for the reaction of acidified manganate(VII) with ethanedioate ions. [3]

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B10 CHH-Q11 Explain why the reaction between manganate(VII) and ethanedioate ions speeds up after it has started. [3]

B11 CHH-Q16 Suggest how the graph of $[MnO_4^-]$ against time changes when a little manganese(II) sulfate is added to an acidified ethanedioate solution before the manganate(VII), and why. [3]

B12 CHH-Q17 Calculate the number of platinum atoms in a catalytic converter that contains 1.50 g of platinum. Ar of Pt = 195.1, L = 6.022×10^{23} mol^{-1}. [3]

B13 CHH-Q18 Explain how nitrogen dioxide acts as a homogeneous catalyst for the oxidation of sulfur dioxide in the atmosphere. Include equations. [3]

SECTION C · Long, 6 marks or more

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C1
CHH-Q8

Explain, with equations, why the reaction between peroxodisulfate ions and iodide ions is slow, how Fe^{2+} ions catalyse it, and how the reaction profile of the catalysed reaction differs from that of the uncatalysed one. [6]

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