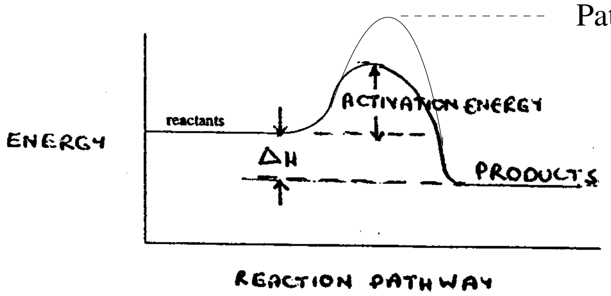
Using & Controlling Reactions *Assignment 6* ***ANSWERS***

1.
(a)



(b) The gases must be heated so the molecules have the necessary (activation) energy. The reaction is exothermic so provides the energy for the reaction to continue.
(c) On the energy profile diagram for (a), draw the reaction pathway if the catalyst were not used.
(d) The catalyst does not change ΔH.
(e) Air and water
(f) The costs of production increase, since loss of NO_2 reduces the amount which can be recycled.

Q2	(a) Silver (b) Lithium	(1) (1)
Q3	(a) Concentration, conversion to suitable for reduction, reduction, refining. (b) - ores with low gangue content don't need concentration - ores which are already in a reduction-suitable form do not require the second step - metals produced in purity during reduction don't need the refining step	(1) (1) (1) (1)
Q4	(a) Note: Information in brackets optional here but if the question was worth more it would be expected. Zinc ore (zinc sulfide and gangue) is crushed and ground to a fine powder. This powder is mixed in a tank with water soluble 'collectors' (which attach to zinc sulfide but not to the gangue) and a frothing agent. Air is blown into the slurry, forming bubbles which the collectors and therefore zinc sulfide rise to the surface with. The zinc sulfide can then be skimmed off the surface (leaving gangue sludge on the bottom) (b) The concentrate is roasted in air to convert zinc sulfide to zinc oxide and sulfur dioxide: $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$ The sulfur dioxide is used to make sulfuric acid, which reacts with the zinc oxide to make a solution of zinc sulfate. $H_2SO_4 + ZnO \rightarrow ZnSO_4 + H_2O$ (c) - diagram shows electrons flowing to cathode (-ve) and some indication the zinc leaves solution at the cathode Electrons flow to the cathode (-ve) so zinc is reduced from Zn^{2+} to Zn.	(1) (1) (1) (1) descriptions included (1) balancing not required (1) balancing not required Note: the two equation marks can also be obtained by giving the Contact Process equations. In whatever case, at least two equations must be given. (1) (1)

Q5	(a) Water is more easily reduced than aluminium ions so aluminium cannot be produced by electrolysis of aqueous aluminium ions. Electrolysis of a melt requires high temperatures (large amounts of energy). (b) Zinc and iron are more easily reduced than aluminium so carbon is a sufficiently strong reducing agent to reduce oxides of zinc and iron to the metal but not aluminium. (c) Electrolysis of a melt. Electrolysing a calcium solution will tend to reduce water instead of calcium	(1) (1) (1) (1) (1) (1) (1) (metals more reactive than zinc are harder to reduce than water) Note: “molten electrolyte” or “non-aqueous electrolyte” may be used in place of “melt”.