Mark Scheme 2813/01
June 2005

HOW FAR? HOW FAST?

2(a) when the conditions on a system in equilibrium are changed (1)

the equilibrium moves to minimise the effects of the change/

counteract/ resist/ oppose the change(1) [2]

(b)(i) becomes brown/ darker/ colour more intense (1)

moves towards LHS/ towards NO_2 (1)

forward reaction is exothermic/ **reverse** reaction is endothermic (1) [3]

(ii) becomes less brown/ pale/ colourless (1)

moves towards RHS/ towards N_2O_4 (1)

fewer moles on RHS (1) [3]

(c)(i) because nitrogen starts as NO_2 in oxidation number +4 (1)

and forms (HNO_3) oxidation state +5 and (HNO_2) oxidation state +3 (1) [2]

(ii) internal combustion engine/ vehicular transport/ lightning (1) [1]

(d)(i) H^+/ hydrogen (1) [1]

(ii) $2H^+ + CaCO_3 \rightarrow Ca^{2+} + CO_2 + H_2O$

$CO_3^{\bar{2}} + 2H^+ \rightarrow H_2O + CO_2$

formation of CO_2 (1)

rest of equation (1) [2]

(iii) stone crumbles/ decays/ corrode/ dissolve after reaction/ chemically eroded (1) [1]

[Total: 15]

1(a)(i) bonds broken

(N—N) + (O=O) + 4(N—H) = 163 + 497 + 4(390) = 2220 (kJ mol^{-1}) (1)

bonds made

(N≡≡≡N) + 4(ŌH) = 945 + 4(463) = 2797 (kJ mol^{-1}) (1)

broken ΔH is +ve and made ΔH is –ve (1)

enthalpy of reaction = −577 (kJ mol^{-1}) (1) [4]

(ii) $\frac{577}{32}$ = 18.0 (kJ) (1) [1]

(b) N-N bond is weak/ higher Ea for ammonia/ rate too slow for ammonia/ too much energy to break bonds in ammonia / hydrazine is liquid/ do not need pressurised containers/ more moles/ lots of gas produced by hydrazine/ more energy per mole produced by hydrazine (1) [1]

(c)(i) as a base (1) ..... accepts a proton/H^+/ **neutralises** an acid/ reacts with acid to form salt/ has a **lone** pair of electrons (1) [2]

(ii) fertiliser (1) [1]

(iii) manufacture of explosives/ dyes/ nitric acid/ fibres/ ammonium nitrate/ urea/ refrigeration/ cleaning agents/ fertiliser (if not allowed in (ii) (1) [1]

[Total: 10]

4(a) catalyst alters rate of reaction/ lowers Ea (1)

remains unchanged **after** the reaction/ is not changed at the **end** of the reaction BUT negated by does not take part in reaction (1) [2]

(b) homogeneous catalyst and reagents are in the same state (1)

heterogeneous catalyst and reagents in different states (1)

example of homogeneous eg H^+ in esterification/ $\dot{C}l$ with ozone/ named enzyme (1)

example of heterogeneous eg iron in Haber process/ rhodium, platinum, palladium in catalytic converters/ pumice/ conc. sulphuric acid in dehydration of ethanol, zeolite/ aluminium oxide/ silicon dioxide in cracking (1)

equation for heterogeneous/ homogeneous catalysed reaction (1)

mode of action of heterogeneous catalyst - gases adsorbed/ bonds forming between reactants and catalyst (1)

bonds weakened allowing reaction to take place (1)

product gases desorbed/ description of desorption (1)

[7 max]

[Total: 9]

Mark Scheme for Unit 2813/01, June 2005 - ERRATUM

See page 16 of the main booklet.
As part of the printing process, the font change has lost the correct symbol: (Δ) has become a square.

The page should read as follows:

3(a) (enthalpy change) when 1 mole of substance/ element/ compound (1)
NOT energy needed

is completely burnt (1) [2]

(b) $C_3H_7OH(l) + 4½ O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$

correctly balanced equation (1)

state symbols (species must be correct) (1)

[2]

(c)(i) $\Delta H = mc\Delta T$ (1)

$\Delta H = 50 \times 4.18 \times 12.8 = 2675$ (J) = 2.68 (kJ) (1)

[2]

ignore sign

(ii) Mr propan-1-ol = 60 (1) (1)

number moles = 0.00167 (1)
[2]

(iii) $\Delta H = -(1608$ (kJ mol^{-1})(1) [1]

(ii) heat losses (1)

thermal capacity of beaker ignored (1)

conditions were non-standard (1)

combustion could be incomplete (1)

propan-1-ol evaporates (1)

water evaporates (1)

[2max]

[Total: 11]