

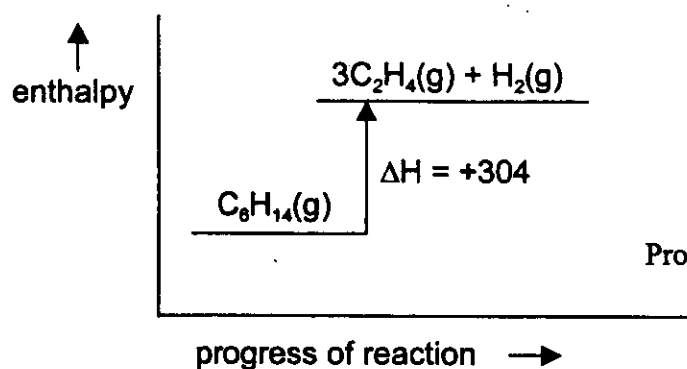


RECOGNISING ACHIEVEMENT

HOW FAR, HOW FAST?
Mark Scheme 2813/01
January 2003

- 1 (a)(i) the energy required to break 1 mole of bonds ✓
✓ [2]
- (ii) bonds broken: $5x(\text{C-C}) + 14x(\text{C-H}) = 1750 + 5740 = 7490$ ✓
bonds formed: $3x(\text{C=C}) + 12x(\text{C-H}) + (\text{H-H})$ ✓
 $= 1830 + 4920 + 436 = 7186$ ✓
- $\Delta H = (+)304 \text{ kJ mol}^{-1}$ ✓ [3]

(b)



Labels ✓
Products higher than reactant (ecf from a(ii)) ✓
 ΔH shown ✓

[3]

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- 2 (a) $\Delta H_r^\circ = 4 \times 90 + 6 \times (-242) - 4 \times (-46) = -908 \text{ kJ mol}^{-1}$ ✓✓✓ [3]
- (b)(i) a change in conditions *or* a disturbance will cause a shift in the (position of) equilibrium ✓
in the direction that minimises/opposes/reduces/attempts to balance
out/compensates for [NOT cancels out] the effect of the change ✓ [2]
- (ii) the equilibrium will move to the left hand side ✓
because there are fewer moles (of gas on that side) ✓ [2]
- (c)(i) (heterogeneous) catalyst *or* to speed up the reaction *or* to increase surface area ✓ [1]
- (ii) to allow time for the (slow) reaction to take place (on the surface) *or* to allow adsorption to take place ✓ [1]
- (d) $4\text{NO} + 2\text{H}_2\text{O} + 3\text{O}_2 \longrightarrow 4\text{HNO}_3$, balancing of oxygen ✓
balancing of C and H ✓ [2]

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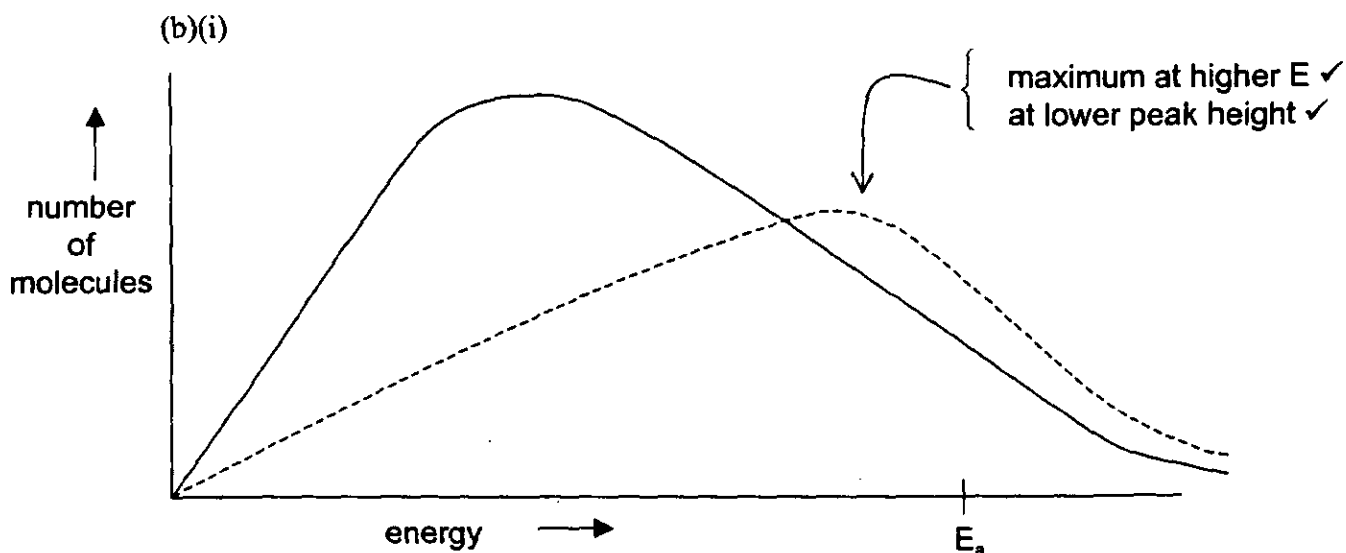
2813/01

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January 2003

- 3 (a) *any 2 of:*
- forward rate = reverse rate (*not concentration of reactants and products are equal*)
 - can be approached from either direction *or* reversible reaction *or* (constant) change from reactants to products and vice versa
 - no change in overall macroscopic properties (*or* one specified property, e.g. colour/concentration) *or* appears to have stopped
 - takes place in a closed system
- ✓✓ [2]
- (b)(i) (orange means that the solution has become weakly) **acidic** ✓
- adding $\text{CO}_2(\text{g})$ pushes each of the above equilibria to the right hand side *or* forms more products ✓ [2]
- (ii) (conc sulphuric acid provides) $\text{H}^+(\text{aq})$ ions ✓
- (adding $\text{H}^+(\text{aq})$ pushes the) equilibria/reactions over to the left hand side *or* favours the reverse reaction ✓ [2]
- 6

- 4 (a) more molecules of the reagent in the same space *or* molecules closer together ✓
- leading to more chance of *or* greater frequency/rate of collisions ✓ [2]



- maximum at higher E ✓
- at lower peak height ✓ [2]

(check that the line is NOT steeper at the start, or turned up at the end, and that it crosses the original line to the right of the maximum)

- (ii) higher proportion of/more molecules have $E > E_a$ at T_2 ✓
- therefore more collisions are effective/successful OWTTE ✓ [2]
- 6

- 5 (a)(i) effervescence/fizzing/gas evolved ✓ [1]
- (ii) $\text{H}_2\text{SO}_4 + \text{Na}_2\text{CO}_3 \longrightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O} + \text{CO}_2$
 Na_2SO_4 ✓
 $\text{H}_2\text{O} + \text{CO}_2$ ✓ [2]
- (b)(i) ammonia is a base/alkali/proton acceptor/electron pair donor ✓ [1]
- (ii) $(\text{NH}_4)_2\text{SO}_4 = 2 \times (14 + 4) + 32 + 4 \times 16 = 132$ ✓
 $\% \text{N} = 100 \times 28/132$
 $= 21.2\%$ ✓ [2]
- (iii) as a fertiliser ✓ [1]
- 7
-

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- process A is photosynthesis. [1]
- process B is respiration *or* the burning/combustion of food [1]
- process C is combustion *or* the/burning of fuels [1]

- process A occurs in plants [1]
- process B occurs in animals [1]
- process C occurs in cars etc [1]

- process A is endothermic; process B and process C are exothermic
 ([2] for all three correct, [1] for two correct, [0] for only one correct) [2]

- the energy of sunlight is 'captured' in photosynthesis/process A (OWTTE) [1]

9 max 7

