**OCR**

RECOGNISING ACHIEVEMENT

How FAR, How FAST

**Mark Scheme 2813/01**

**January 2002**

## ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the **final** version of the Mark Scheme.
   <u>You are advised to destroy all draft versions.</u>

2. Please mark all post-standardisation scripts in red ink. A tick (✓) should be used for each answer judged worthy of a mark. Ticks should be placed as close as possible to the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks (½) should never be used.

3. The following annotations may be used when marking. <u>No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.</u>

   | | | |
   |---|---|---|
   | x | = | incorrect response (errors may also be underlined) |
   | ^ | = | omission mark |
   | bod | = | benefit of the doubt (where professional judgement has been used) |
   | ecf | = | error carried forward (in consequential marking) |
   | con | = | contradiction (in cases where candidates contradict themselves in the same response) |
   | sf | = | error in the number of significant figures |

4. The marks awarded for each <u>part</u> question should be indicated in the margin provided on the right hand side of the page. The mark <u>total</u> for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5. In cases where candidates are required to give a specific number of answers, (e.g. 'give three reasons'), mark the first answer(s) given up to the total number required. Strike through the remainder. In specific cases where this rule cannot be applied, the exact procedure to be used is given in the mark scheme.

6. Correct answers to calculations should gain full credit even if no working is shown, unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates, who may then gain partial credit even if their final answer is not correct.)

7. Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

8. An element of professional judgement is required in the marking of any written paper, and candidates may not use the exact words that appear in the mark scheme. If the science is correct <u>and</u> answers the question, then the mark(s) should normally be credited. If you are in doubt about the validity of any answer, contact your Team Leader/Principal Examiner for guidance.

| | | | |
|---|---|---|---|
| **Abbreviations,** | / | = | alternative and acceptable answers for the same marking point |
| **annotations** | ; | = | separates marking points |
| **and** | NOT | = | answers which are not worthy of credit |
| **conventions** | ( ) | = | words which are not essential to gain credit |
| **used in the** | ___ | = | (underlining) key words which must be used to gain credit |
| **Mark Scheme** | ecf | = | error carried forward |
| | AW | = | alternative wording |
| | ora | = | or reverse argument |

1. (a)(i)    the enthalpy change when **1 mole** of compound/substance is formed          ✓
             from its **elements** under **standard conditions** (of temperature and pressure)  ✓
                                                                                        [2]

   (ii)    temperature of 298K (or 25 °C)                                                ✓
           pressure of 1 atmos (or 100 kPa or 101 kPa)                                   ✓
                                                                                        [2]

   (b)(i)    a reaction that gives out heat/energy to its surrounds or in which the reactants
             react with a decrease in internal enthalpy/energy.   [NOT temperature rise]    ✓

                                                                                        [1]

   (ii)    e.g. combustion/burning of fuels (*or* stated fuel, e.g. alkanes) *or respiration or*
           metabolism *or* (unbalanced) equation representing this.
           [NOT just 'burning' on its own]                                                 ✓

                                                                                        [1]

   (c)(i)   $\Delta H$      = 4(-242) - 2(+51) - 9          (✓ for x2 and x4)
                            = -968 - 102 - 9              (✓ for the correct signs)
                            = -1079 kJ mol$^{-1}$         (✓ for the answer) *ecf*
            *(see separate list of alternatives)*
                                                                                        [3]

   (ii)    Because the products are **gases** (if products are identified, both must be correct)
           [NOT low activation energy]                                                      ✓

                                                                                        [1]

                                                                              Total: [10]

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2. (a)   at a high temperature (accept any stated temperature above 0°C)                           ✓

                                                                                                  [1]

   (b)   photosynthesis requires (only) **light.** or 'energy from the sun'
         [NOT heat, or heat from the sun]                                                          ✓

                                                                                                  [1]

   (c)(i)   6(O-H) + 6(C=O)                                                                         ✓

            =      6 x 464 + 6 x 750
            =      7284 (kJ mol$^{-1}$)                                                        ✓ ecf

                                                                                                  [2]

      (ii)   3(O=O) + 4(C-H) + 2(C-C) + 2(C-O) + 2(O-H) + C=O                                      ✓

             =      3 x 498 + 4 x 413 + 2 x 347 + 2 x 358 + 2 x 464 + 750
             =      6234 (kJ mol$^{-1}$)                                                       ✓ ecf
                    (see separate list of alternatives.  allow [1] if only C-C is omitted)

                                                                                                  [2]

      (iii)  $\Delta H$  = 7284 - 6234
                          = + 1050 kJ mol$^{-1}$    ecf (i.e. (i)-(ii))                             ✓

                                                                                              [1] ecf

   (d)   diagram                                                                                   ✓

         [to include:  $C_3H_8O_3$ + 3$O_2$ as product
                and    $\Delta H$ or '+1050', drawn to be consistent with answer to part (iii) above]
                                                                                                  [1]
                                                                                          Total: [8]

3. (a)(i)    distribution curve ($T_1$):

            starts at( 0,0) and goes to a maximum                    ✓

            right hand side tails off to x-axis exponentially                    ✓

            [it can *reach* the axis, but not cross it]

                                                                 [2]


(ii)    second curve ($T_2$):

            starts at (0,0) and has its maximum at a lower ordinate value                    ✓

            and to the right of the $T_1$ maximum                    ✓

                                                                   [2]


(b)    the (minimum) energy that molecules/particles need to have in order to react
*or* energy required for effective collisions
*or* minimum energy needed for a reaction to occur
*or* energy needed to break bonds [NOT the energy needed to start a reaction]  ✓

                                                                   [1]


(c)    *at higher temperature:*

            more molecules have $E > E_a$     [NOT just 'more molecules have higher energy']
                ✓

            ∴ greater chance of reacting on collision (*or* more **successful** collisions)     ✓

            [NOT just 'more collisions']
            ∴ faster reaction *or* increased rate                    ✓u/c
               (*or* accept the converse arguments at a lower temperature)

                                                            [3]


(d)(i)

                 **B** < **C** < **D** < **A**
             smallest $E_{act}$                largest $E_{act}$

                                                  ✓✓
            (all correct: [2]
                (*either* C<D<B<A  *or*  C<D<A<B,  i.e.one in wrong place: [1])

                                                            [2]


(ii)    no bonds broken in B $\Rightarrow$ low $E_{act}$                    ✓

            the others go in order of bond energies                    ✓  [2]
               (*or* wtte – e.g. A has the greatest bond energy)

                                                         Total: [12]

4. (a)     a catalyst speeds up a reaction (without being used up).    ✓
         it offers a different route    ✓
         of lower activation energy    ✓

                                                       [3]

    (b)     heterogeneous    ✓

                                                       [1]

    (c)     needs to happen in a closed system
         no change in macroscopic properties
         forward and backward reactions continue to proceed
         but at the same **rate** as each other [NOT same *extent*]

                                       any two ✓✓
                                                    [2]

    (d)(i)     *(When a system in dynamic equilibrium is subjected to a change in conditions....)*
         the (position of) **equilibrium** [NOT reaction] will shift (*or* be restored)    ✓
         in the direction that minimises the effect of the change
         *or* opposes the change [NOT negates or cancels the change]    ✓

                                                       [2]

      (ii)     pressure
         equilibrium shifts to the left    ✓
                 because 9 moles of gas on LHS and 10 moles of gas on RHS
                 *or* less particles on left hand side of equation    ✓u/c

         temperature
                 equilibrium shifts to the left hand side    ✓
                 because reaction is exothermic *or* $\Delta H$ is negative    ✓u/c

                                                       [4]

    (e)     To speed up reaction.    ✓
                 *or* To obtain a reasonable yield at reasonable rate.

                                                       [1]

                                                  Total: [13]

5. (a)(i)    ammonia is acting as a base/alkali/proton acceptor        ✓
           [NOT ammonia reacts with/absorbs protons]

                                                             [1]

       (ii)    $M_r$ for $(NH_4)_2SO_4$ = 132.1                            ✓
                       $2 \times 17 \longrightarrow 132.1$        *(mark. for 2 x 17)*     ✓
                   $\therefore\ 100 \longrightarrow 132.1 \times 100/34$
                           **= 388-390 g**                           ✓ecf

                                                              [3]

       (iii)    fertiliser                                                 ✓
                                                              [1]

     (b)      **Gas/$CO_2$ is evolved/given off** *or* reaction **fizzes**.                 ✓

             $MgCO_3 + 2HNO_3 \longrightarrow Mg(NO_3)_2 + H_2O + CO_2$

             correct formulae of reagents                                 ✓
             equation balanced                                                ✓

                                                              [3]
                                                    Total: [8]

6.          CFCs affect the **ozone** layer                                           ✓
         C-Cl bond breaks with UV *or* energy from sunlight                   ✓
         giving Cl **radicals** *or* Cl• *or* Cl **atoms** (the Cl can be read into an equation, but
         'radical'/'atom' has to be in words)                                           ✓
         homogeneous                                                          ✓
         catalysis                                                                ✓

         **word** explanation of how Cl acts as a homogeneous catalysis (e.g. it is
         regenerated)                                                               ✓

         mention of chain reaction                                                ✓
         hence one Cl breaks down many $O_3$                                   ✓
         $Cl + O_3 \longrightarrow ClO + O_2$                                        ✓
         $ClO + O \longrightarrow Cl + O_2$   *or*   $ClO + O_3 \longrightarrow Cl + 2\ O_2$           ✓
         [ignore $O_3 \longrightarrow O_2 + O$]

                                                10 points: any 8 score
                               Q of w C (at least one sensible sentence):     ✓

                                                              [9]

                                                    Total: [9]

***Additions to the markscheme:***        ***2813/01***        ***January 2002***

Q1 (c) (i)        correct value:                                                    ***-1079***  >        [3]

          ecf values:                if one sign wrong:                -857    >        [2]
                                                       +857    >        [2]

                  if L & R signs wrong                +1079 >        [2]
                  for any other 2 signs wrong                >        [0]

                  if no x4 $H_2O$                -353    >        [2]
                  if no x2 $N_2H_4$                -1028  >        [2]

           if no x4 $H_2O$ & L & R signs wrong        +353    >        [1]
           if no x2 $N_2H_4$ & L & R signs wrong        +1028  >        [1]

              if no x4 & one sign wrong        -131    >        [1]
                                                +131    >        [1]

              if no x2 & one sign wrong        -908    >        [1]
                                            +908    >        [1]

           if no x2 & no x4 but signs are right        -302    >        [1]
           if no x2 & no x4 & signs are wrong        +302    >        [0]

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Q2 (c) (i)        correct value:                                ***+7284***                >        [2]

          ecf values:                if no x6 (twice)+1214                >        [1]
                  if x 6 (twice) but arithmetic error        various        >        [1]

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    (c) (ii)        correct value:                                ***+6234***                >        [2]

        ecf values:
        if x3, x4, x2, x2, x2 all OK, but arithmetic error        various        >        [1]
        if **one** multiplier omitted (but correct maths)        various        >        [1]
        if more than one multipier omitted        various        >        [0]
        if one or more bond types is omitted        various        >        [0]

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    (c) (iii)        correct value:                                ***+1050***                >        [1]

          allow ecf for [ans to (i)] – [ans to (ii)] various                >        [1]