RECOGNISING ACHIEVEMENT

CONFIDENTIAL
January 2006


## SUBJECT OFFICER: Steven Evans

| CHECKED BY | APPROVED <br> (Tick or initials <br> or signature) | DATE |
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## ADVICE TO EXAMINERS ON THE ANNOTATION OF SCRIPTS

1. Please ensure that you use the final version of the Mark Scheme. You are advised to destroy all draft versions.
2. Please mark all post-standardisation scripts in red ink. A tick (3) 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 () should never be used.
3. The following annotations may be used when marking. No comments should be written on scripts unless they relate directly to the mark scheme. Remember that scripts may be returned to Centres.
```
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
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4. The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total 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 and 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, annotations and conventions used in the Mark Scheme | $I$ $=$ alternative and acceptable answers for the same marking point <br> $;$ $=$ separates marking points <br> NOT $=$ answers which are not worthy of credit <br> ( ) $=$ words which are not essential to gain credit <br>  $=$ (underlining) key words which must be used to gain credit <br> ecf $=$ error carried forward <br> AW $=$ alternative wording <br> ora $=$ or reverse argument |
| :---: | :---: |


| Mark Scheme <br> Page 1 of 5 |  | Unit Code 2854 | $\begin{gathered} \text { Session } \\ \text { Jan } \end{gathered}$ | $\begin{aligned} & \text { Year } \\ & 2006 \end{aligned}$ | Vers | rsion inal |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Question | Expected Answers |  |  |  |  | Marks |
| 1 a | idea of contrast, eg "lettering/it absorbs more light"; "white stands out better" |  |  |  |  | 1 |
| 1 bi | $\mathrm{NiSO}_{4} / \mathrm{NiCl}_{2} / \mathrm{Ni}\left(\mathrm{NO}_{3}\right)_{2}$ $\mathrm{NaH}_{2} \mathrm{PO}_{2}$ or potassium salt but NOT acid |  |  |  |  | 2 |
| 1 b ii | pH goes down (1); <br> H+ formed (1) |  |  |  |  | 2 |
| 1 b iii | $\mathrm{H}_{3} \mathrm{PO}_{3}$ |  |  |  |  | 1 |
| 1 ci | $0(1) ;+1$ (1); +3(1); one mark for second two if signs follow numbers |  |  |  |  | 3 |
| 1 c ii | Redox - oxidation states change (unless refers to element other than P ) / $\mathrm{P} / \mathrm{H}_{2} \mathrm{PO}_{2}{ }^{-}$is both oxidised and reduced /exchange of electrons/ no proton exchange NOT just reference to oxidation and/or reduction. |  |  |  |  | 1 |
| 1 di | nitrogen dioxide/nitrogen(IV) (di)oxide IGNORE gaps |  |  |  |  | 1 |
| 1 dii | $\mathrm{Ni}+2 \mathrm{HNO}_{3} \rightarrow \mathrm{NiO}+2 \mathrm{NO}_{2}+\mathrm{H}_{2} \mathrm{O}(2)$ <br> Balanced equation with water molecules and/or hydrogen ions not cancelled(1) |  |  |  |  | 2 |
| 1 e | Reacts with acids (to neutralise them)/ accepts protons (1) IGNORE references to alkali/solubility reactants correct for $\mathrm{NiO}+\mathrm{HCl} / \mathrm{HNO}_{3} / \mathrm{H}_{2} \mathrm{SO}_{4} / \mathrm{H}^{+}$(1) correct equation (1) |  |  |  |  | 3 |
| 1 fi | complete reaction (with water)/ fully dissociated/ almost fully dissociated/ Ka> 1 <br> (1) IGNORE references to ability to donate protons <br> $\mathrm{HNO}_{3}$ (ignore "+aq") $\left.\longrightarrow \rightleftharpoons\right) \mathrm{H}^{+}+\mathrm{NO}_{3}$ - or reaction with H 2 O to give $\mathrm{H}_{3} \mathrm{O}^{+}$ (1) <br> ALLOW equation for other strong acids. Accept "general" acid such as HA, provided there is an arrow rather than an equilibrium sign.. |  |  |  |  | 2 |
| 1 fii | $\mathrm{pH}=2(1)$ |  |  |  |  | 1 |
| 1 g |  <br> line starting and continuing parallel across to 700 at least (1); super black line more than half-way below black paint (1) |  |  |  |  | 2 |
|  |  |  |  |  |  | 21 |


| Mark Scheme Page 2 of 5 |  | $\begin{aligned} & \hline \text { Unit Code } \\ & 2854 \end{aligned}$ | $\begin{gathered} \text { Session } \\ \text { Jan } \end{gathered}$ | $\begin{aligned} & \hline \text { Year } \\ & 2006 \end{aligned}$ | Version Final |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2 ai | $\mathrm{C}_{21} \mathrm{H}_{20} \mathrm{O}_{3} \mathrm{Cl}_{2}$ (2) completely correct (order immaterial) <br> (1) one error; |  |  |  | 2 |
| 2 aii | two from: ether, alkene, chloro(alkene)/halo/halogeno NOT cylcoalkane |  |  |  | 2 |
| 2 a iii |  <br> (1) each |  |  |  | 2 |
| 2 a iv | 2 (chlorine) atoms/same groups (ora) on one carbon (of double bond) |  |  |  | 1 |
| 2 bi | $\mathrm{CH}_{3}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{CH}_{2}-\mathrm{OH}$ Allow more structured (1) NOT C-H-O |  |  |  | 1 |
| 2 b ii | four from: <br> A large $\mathrm{K}_{\mathrm{ow}}$ means more in fat/octan-1-ol/non-polar solvents <br> B octan-1-ol "resembles" fat/ is non-polar; <br> C pesticides must be more soluble in fat than water/ easily absorbed in fat/organic; <br> D they can pass from spraying solution (into insect)/ not leached off/ insoluble in water/ high concentrations not needed; <br> $E$ in the fatty tissues of insect they do damage |  |  |  | 4 |
| 2 c | cor <br> or shown skeletally (1) <br> (1) Allow sodium salt of acid. |  |  |  | 2 |
| 2 d | two from <br> higher $\mathrm{K}_{\text {ow }}$; <br> smaller quantities have the same effect; break down quicker/ more completely/ in water more specific on certain pests (AW) inactive when outside insects |  |  |  | 2 |
| 2 ei | radical ignore substitution(1) (uv) light (1); |  |  |  | 2 |
| 2 e ii | $\mathrm{Br}, \mathrm{H}(1)$ in either order. |  |  |  | 1 |
| 2 e iii | $\mathrm{CN}^{-} / \mathrm{KCN} / \mathrm{HCN}$ |  |  |  | 1 |
|  | CN/KCN/HCN |  |  |  | 20 |


| Mark Scheme <br> Page 3 of 5 |  | Unit Code 2854 | $\begin{gathered} \text { Session } \\ \text { Jan } \end{gathered}$ | $\begin{aligned} & \hline \text { Year } \\ & 2006 \end{aligned}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 3 ai | $(1 \mathrm{x}) 10^{-8}(1)$; mol dm ${ }^{-3}$ (1) mark separately provided concn is $10^{-7}$ or smaller |  |  |  | 2 |
| 3 aii | $K_{w}=\left[\mathrm{H}^{+}\right] \times\left[\mathrm{OH}^{-}\right]$stated or implied (1); <br> $\left[\mathrm{OH}^{-}\right]=1 \times 10^{-6}\left(\mathrm{~mol} \mathrm{dm}^{-3}\right)$ units not essential (1) |  |  |  | 2 |
| 3 b | five from the following: <br> $\mathrm{CO}_{2}$ <br> $\mathrm{A} \mathrm{CO}_{2}$ has instantaneous dipole-induced dipole between molecules; <br> $\mathrm{BBCO}_{2}$ forms hydrogen bonds with water (2); <br> B Reference to permanent/induced dipole - permanent/induced dipole (1); <br> C detail of imf, eg diagram; <br> ions <br> D electrostatic forces between ions; <br> E ions form ion-dipole bonds with water (or description); <br> F hydration description; <br> G detail (eg diagram); <br> reasons <br> H water forms hydrogen bonds with itself; <br> J more hydrogen bonds broken than made for $\mathrm{CO}_{2} / \mathrm{imf}$ in water stronger than in $\mathrm{CO}_{2}$; <br> K imf between ions and water stronger than hydrogen bonds/ stronger than imf in $\mathrm{CO}_{2}$; <br> QWC Written in sentences, spelling, punctuation and grammar correct (allow one error) SEE QWC rules |  |  |  | 1 |
| 3 c | (i) lattice energy/enthalpy (1) <br> (ii) enthalpy (change) of hydration/solvation <br> (iii) enthalpy (change) of solution (1) <br> allow symbols, eg $\Delta H$ |  |  |  | 3 |
| 3 d | $\Delta S_{\text {tot }}$ must be positive for process to occur $\Delta S_{\text {sys }}$ must be positive (1); and greater than $\Delta H / T$ (1) |  |  |  | 3 |
| 3 ei | $K_{\mathrm{a}}=\left[\mathrm{H}^{+}\right]\left[\mathrm{HCO}_{3}^{-}\right] /\left[\mathrm{CO}_{2}\right]$ (1) |  |  |  | 1 |
| 3 eii | $\begin{aligned} & \frac{\left[\mathrm{HCO}_{3}^{-}\right]}{\left[\mathrm{CO}_{2}\right]} \quad=K_{d} /\left[\mathrm{H}^{+}\right](1) \text { stated or implied, ecf from c(i) } \\ & =4.5 \times 10^{-7} / 1 \times 10^{-8}(1) \text { ecf from first mark if all four quantities given; } \\ & =45(1) \text { ecf if any marks scored previously } \end{aligned}$ |  |  |  | 3 |
| 3 e iii | $\mathrm{Mr} \mathrm{NaHCO} 3=84$ stated or implied (1); $\left[\mathrm{NaHCO}_{3}\right]=\left[\mathrm{CO}_{2}\right]$ stated or implied (1) <br> $=3.3 \times 10^{-2} \times 84=2.8 \mathrm{~g}$ (1) ALLOW 2.78 |  |  |  | 3 |
| 3 e iv | ( $\mathrm{H}^{+}$added) Equilibrium (position) moves to left (1); restoring $\mathrm{pH} / \mathrm{pH}$ does not change much (AW) (1) because $\left[\mathrm{HCO}_{3}^{-}\right]$large (similar to $\left[\mathrm{CO}_{2}\right]$ )/acts as sink for $\mathrm{H}^{+}(1)$ |  |  |  | 3 |
|  |  |  |  |  | 26 |

\begin{tabular}{|c|c|c|c|c|c|c|}
\hline \multicolumn{2}{|l|}{\begin{tabular}{l}
Mark Scheme \\
Page 4 of 5
\end{tabular}} \& Unit Code
\[
2854
\] \& \[
\begin{gathered}
\text { Session } \\
\text { Jan }
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\] \& \[
\begin{aligned}
\& \text { Year } \\
\& 2006
\end{aligned}
\] \& \& \\
\hline 4 a \& \multicolumn{5}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
crude oil \\
solvent/fuel/cleaning agent/source of named chemical
\end{tabular}}} \& 1 \\
\hline 4 b \& \& \& \& \& \& 1 \\
\hline 4 c \& \multicolumn{5}{|l|}{\begin{tabular}{l}
\(1000 \times 46 / 28\) (1) stated or implied \\
\(=1.6 \mathrm{~kg}\) (1) ecf provided these three numbers used in expression 2 sf (1) mark separately, provided answer follows from some working shown (or answer correct)
\end{tabular}} \& 3 \\
\hline 4 di \& \multicolumn{5}{|l|}{\begin{tabular}{l}
(forward) reaction exothermic ora (1) plus one from \\
Yield too low (AW)(1); \\
equilibrium (position) moves to left when temperature raised (1) ora rate increases with increased temperature
\end{tabular}} \& 3 \\
\hline 4 dii \& \multicolumn{5}{|l|}{cost with some discussion(1); compressor/thick walls (AW) of plant (1)} \& 2 \\
\hline 4 ei \& \multicolumn{5}{|l|}{\[
\begin{aligned}
\& K_{\mathrm{p}}=\mathrm{pC}_{2} \mathrm{H}_{5} \mathrm{OH} / \mathrm{pH}_{2} \mathrm{O} \mathrm{pC}_{2} \mathrm{H}_{4} \\
\& \text { partial pressures shown correctly (NOT square brackets - ignore round } \\
\& \text { brackets) (1) } \\
\& \text { terms in correct sequence (1) mark separately even if square brackets shown }
\end{aligned}
\]} \& 2 \\
\hline 4 e ii \& \multicolumn{5}{|l|}{\(4 / 21 \times 35=5 \times 10^{-3} / 5.4 \times 10^{-3}(1) \mathrm{atm}^{-1}\) (1) both ecf from e(i). Allow \(5.44 \times 10^{-3}\)} \& 2 \\
\hline 4 fi \& \multicolumn{5}{|l|}{two from: (3400) O-H (1); (2900) C-H (1); (1050) C-O (1)} \& 2 \\
\hline 4 fii \& \multicolumn{5}{|l|}{C-H (allow C-O if chosen above) (1) O-H not used as in \(\mathrm{H}_{2} \mathrm{O}\) (in breath) (1) allow answers to count also for 4 fi if this is incomplete or blank} \& 2 \\
\hline 4 g i \& \multicolumn{5}{|l|}{\begin{tabular}{l}

 \\
(1) each
\end{tabular}} \& 2 \\
\hline 4 g ii \& \multicolumn{5}{|l|}{(potassium/sodium) dichromate/ correct formula (1); (sulphuric) acid/correct formula (1)} \& 2 \\
\hline 4 h \& \multicolumn{5}{|l|}{distilling flask connected with no leaks to (1); water condenser on side, sloping down (1); ignore fractionating tower; ignore thermometer rest of detail: reagents labelled (minimum - line on flask), collection vessel, not sealed, water connections correct (1)} \& 3 \\
\hline 4 i \& \multicolumn{5}{|l|}{\begin{tabular}{l}
i.r. Two pairs from: \\
ethanal \(\mathrm{C}=\mathrm{O}\) different (1); 1720-1740/not 1700-1725 ora (1) \\
no O-H ora (1) 2500-3200 (1) no C-O ora (1) 1050-1300 (1) \\
nmr Four from: \\
both 2 peaks (1), two hydrogen/proton environments (1); 3:1 ratio of peak height/ area (1); \(3: 1\) hydrogen atoms (1) both 2.2 (1) CH 3 CO (1) \\
QWC logical, correct use of three words from list (2) \\
logical, correct use of two words from list (1) \\
bond, absorption, wavenumber, peak, proton, environment, (chemical) shift, relative intensity
\end{tabular}} \& 8

2 <br>
\hline
\end{tabular}

| Mark Scheme <br> Page 5 of 5 |  | $\begin{aligned} & \hline \text { Unit Code } \\ & 2854 \end{aligned}$ | $\begin{gathered} \text { Session } \\ \text { Jan } \end{gathered}$ | $\begin{aligned} & \text { Year } \\ & 2006 \end{aligned}$ |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 5 ai | They make black together/ they can make any colour/ they are (sub) primaries |  |  |  |  | 1 |
| 5 a ii | Decompose at $400^{\circ} \mathrm{C}$ |  |  |  |  | 1 |
| 5 bi | azo |  |  |  |  | 1 |
| 5 b ii | four from: <br> delocalised electrons; <br> ring; <br> above and below ring of carbons/plane of atoms; <br> six electrons/ one electron from each carbon is not involved in other bonding; <br> not attached to particular carbons/spread out over all carbons/benzene ring |  |  |  |  | 4 |
| 5 ci | solubility (in water)/ acidity |  |  |  |  | 1 |
| 5 c ii | conc sulphuric acid (1); reflux if sulphuric acid mentioned (1) |  |  |  |  | 2 |
| 5 c iii | hydrogen on ring is replaced (by $-\mathrm{SO}_{3} \mathrm{H}$ ) (1) |  |  |  |  | 1 |
| 5 c iv | positive ion/molecule with partial positive charge (1); attracted to area of negative charge/high electron density (1); accept pair of electrons to form a bond (1) |  |  |  |  | 3 |
| 5d | excitation of electrons/ movement from lower to higher energy level (1); absorbs in visible (1); <br> transmits the complementary colour (1); <br> $(\Delta) E=h v /$ energy difference related to frequency (1), <br> 2 maximum if emission is described |  |  |  |  | 4 |
|  |  |  |  |  |  | 18 |

