

2850 Chemistry (Salters): Chemistry for Life

January 2004

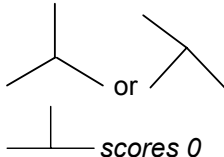
Mark Scheme

The following annotations may be used when marking:

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

Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
()	=	words which are not essential to gain credit
___ (underlining)	=	key words which <u>must</u> be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

Question	Expected Answers	Marks
1 a	$ \begin{array}{cccc} & \text{H} & \text{H} & \text{H} & \text{H} \\ & & & & \\ \text{H} & -\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $	1
1 b i	Takes up less room/ greater (energy) density ignore references to flammability, storage, transport, leakage	1
1 b ii	M_r butane = 58 (1); Mol butane = $2.9/M_r$ (= 0.05 mol) (1); <i>ecf from M_r</i> Volume = mol x 24 = 1.2 dm ³ (1) <i>ecf if there has been a clear attempt to calculate moles (OR moles clearly stated) and this value is multiplied by 24.</i>	3
1 c i	C ₃ H ₈	1
1 c ii	alkane(s)	1
1 c iii	-2860 to -2890 (<i>sign essential</i>) (1); <i>Accept -2900 (answer to 2 sf)</i> similar gap each time (AW) (1) <i>Can be shown on table</i> IGNORE "same pattern", "follows trend", references to bonds Mark separately	2
1 d i	 (2) (1) for full structural, dots or C atoms shown; scores 0 (2 -)methylpropane (1) <i>Ignore, commas, dashes and gaps ecf from structure</i>	3
1 d ii	likely to auto-ignite/pre-ignite/pink/knock/combust spontaneously (1); less/prevented <i>depends on first</i> (1); methylpropane <i>ecf from d (i)/answer to d(i) has higher rating</i> (1); (more) branched (1) " <i>Branched isomer</i> " can score both of last two marking points <i>not just "butane is straight-chained"</i> Ignore references to volatility	4
1 e	nitrogen/N ₂ from the air/ atmosphere/from compound in fuel(1); combusts/is oxidised/reacts/ combines /bonds with oxygen/O ₂ / correct equation (1); <i>ignore "incomplete" before combustion.</i> in the heat/spark/high/ extreme temperature (1) <i>mark separately</i>	3
1 f i	2CO + 2NO → N ₂ + 2CO ₂ correct species, wrongly balanced/correctly balanced with N (1); correctly balanced with N ₂ (2) <i>allow doubled or halved etc</i>	2

1 f ii	<p>2. Bonds weaken/ broken/ molecules broken (1) 3. New bonds / molecules form (1) 4. Product s/ less harmful gases/ named gases/new molecules leave/ diffuse from surface / go into air(1) <i>Can score from diagram provided words or labels are present</i> <i>Score more than one marking points on same line if appropriate. Sequence must be correct.</i></p>	3
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2 a i	11 (1) 13(1); 11(1) <i>ecf on electron number from proton number.</i>	3
2 a ii	protons and neutrons	1
2 b	radioactive (1); decay(1) <i>mark separately</i>	2
2 b ii	${}_{12}^{24}\text{Mg}$ (1) for ${}_{12}^{24}$; (1) for element consistent with atomic number (except sodium)	2
2 c i	Geiger (- Muller)/G M/spark counter /tube/meter <i>Allow phonetically</i> <i>NOT photographic plate</i>	1
2 c ii	Two from: leukaemia/cancer/ radiation/cell/tissue/blood vessel damage/rapid division of cells (1); cells/ tissue/ molecules being ionised/ radical formation(1); mutations/ DNA damage (1) <i>NOT "too much salt in body" etc</i>	2
2 c iii	Longer – little radiation to measure/ lasts longer than needed (for investigation)/ longer exposure (to radiation) than necessary/ prevent repeat investigation(AW) Shorter – short burst of radiation (AW)/ decays before measurement made/isotope detected/ does not pass round body in time <i>"(15 hours) allows enough time for measurements to be made" (AW) scores (1) if no other marks scored</i> <i>Incorrect interpretation of half life statement is CON</i>	2
2 d i	$\text{Na} \rightarrow \text{Na}^+ + \text{e}^-$ or $\text{Na} + \text{e}^- \rightarrow \text{Na}^+ + 2\text{e}^-$ <i>Ignore s.s. and correct nuclear symbol on electron or atom and ion (must be the same)</i>	1
2 d ii	follows dotted line up to magnetic field <i>and</i> moves in straight line if emerges from magnetic field (1); then less curved(1) <i>follows dotted line completely scores zero</i>	2

3 a i	$ \begin{array}{ccccccc} & & \text{H} & & & & \\ & & +\cdot & & & & \\ & & \cdot\cdot & & \cdot\cdot & & \\ \text{H} & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ & & +\cdot & & +\cdot & & +\cdot \\ & & \cdot\cdot & & \cdot\cdot & & \\ & & \text{H} & & \text{H} & & \text{H} \end{array} $ <p>shared pairs (1); can be "side by side" eg $\cdot\cdot$ lone pairs (<i>can be same or different symbols</i>) (1)</p>	2
3 a ii	A 109 ± 2 (1); B $107 - 110$ (1) <i>degree sign need not be shown.</i>	2
3 b	M_r values N_2O_4 92 methylhydrazine 46 (1); ratio 5/4 used (1); <i>460/184 used scores both marks</i> calculated answer <i>ecf*</i> (1) <i>must have "g" to score.</i> 2 sig figs (1) <i>award separately</i> $\frac{25 \times 92 \times 5}{46 \times 4} = 62.5 \text{ g}$ 63 g to 2sf <i>* eg 50 g (no 5/4) scores 3</i> <i>NB Watch for erroneous M_r values of 204/82 giving 62.2 g (62 g to 2 sf)</i> <i>Can score last two marks only</i>	4
3 c i	CH_3NHNH_2 (1) <i>allow methylhydrazine or small errors in formula which leave meaning clear</i>	1
3 c ii	$\text{N}_2(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{N}_2\text{O}_4(\text{l})$ idea of nitrogen and oxygen as reagents (can be N & O) (1); completely correct (1) State symbols (1) <i>if either mark scored</i>	3
3 d i	$\Delta H_1 = (5 \times -20) + (4 \times +54) = (+)116$ (1); $\Delta H_2 = (12 \times -286) + (4 \times -393) = (-)5004$ (1); (1) for both signs correct (<i>ecf</i>) <i>if failure to multiply by coefficients, (1) for +34 <u>and</u> - 679, including signs</i>	3
3 d ii	$\Delta H = \Delta H_2 - \Delta H_1$ Allow $H_2 - H_1$ or $\Delta_2 - \Delta_1$ or numerical values from d(i)	1
3 d iii	$\Delta H = (-5004 - 116) = -5120 \text{ kJ mol}^{-1}$ (<i>ecf*</i> from d(i) or d(ii)) " + " sign <i>must be given if relevant</i> (1) <i>*failure to multiply by coefficients in (d)(i) gives -713</i>	1
3e i	Temperature <u>greater than 25 °C/298K/</u> pressure <u>greater than 1 atm</u> (1)	1
3 e ii	gases formed from liquids (1); more molecules/particles formed (1) <i>NOT more substances formed or 2 reactants to 3 products</i>	2

4 a i	basic/ alkali(ne) <i>Allow proton acceptor/ pH high/>7 in solution</i>	1
4 a ii	$\text{Mg(OH)}_2 + 2 \text{HCl} \rightarrow \text{MgCl}_2 + 2\text{H}_2\text{O}$ <p>(1) (1) (i.e. water formed) <i>mark separately</i> (1) for balancing <i>if one other mark scored</i> <i>accept halved, doubled etc Ignore ss.</i></p>	3
4 b i	2	1
4 b ii	CaCO ₃	1
4 b iii	magnesium carbonate	1
4 b iv	hydrogen/ H ₂ <i>NOT H</i>	1
4 c i	<p><i>Four from</i></p> <p>SIZE: Calcium/"It" has larger atom/ more electron <u>shells</u>/electrons further from nucleus <i>ora</i> (1);</p> <p>ATTRACTION: electron(s) held less tightly/more shielding/ less attraction to nucleus/protons <i>ora</i> (1);</p> <p>EASE OF LOSS: electron(s) more easily lost/got rid of/ ion formed more easily/ less energy needed to remove electron(s) <i>ora</i> (1)</p> <p>REACTIVITY: more reactive <i>ora</i>(1);</p> <p>Group 2/ Mg and Ca/ Metals react by losing electrons (1)</p>	4
4 c ii	$\text{Mg}^+(\text{g}) \rightarrow \text{Mg}^{2+}(\text{g}) + \text{e}^-/\text{e}$ <p>balanced equation for formation of a positive Mg ion/any $\text{Mg}^+ \rightarrow \text{Mg}^{2+}$ (1); <i>ignore correct nuclear symbols</i> correct equation (1); <i>allow correct nuclear symbols on electron only</i> state symbols (1); <i>if at least one mark already scored</i></p>	3