

MARK SCHEME for the October/November 2007 question paper

9701 CHEMISTRY

9701/02

Paper 2 (Theory 1), maximum raw mark 60

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Mark schemes must be read in conjunction with the question papers and the report on the examination.

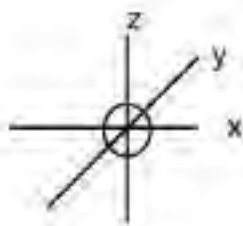
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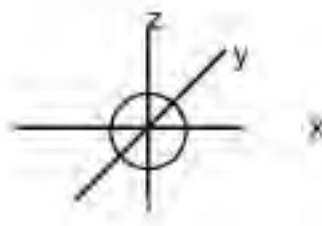
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1 (a)



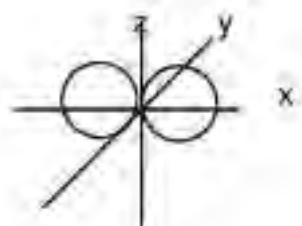
1s

spherical (1)



2s

larger spherical (1)



2p_x

double lobes along the x-axis (1)

[3]

(b) (i) attraction between bonding electrons and nuclei (1)

attraction is electrostatic (1)

(ii) H₂ s-s **overlap** clearly shown

must **not** be normal dot/cross diagram (1)

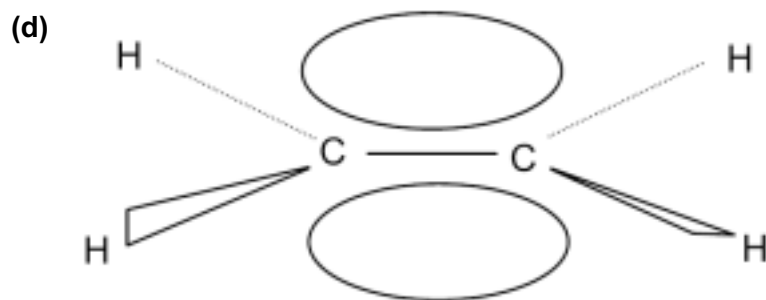
HCl s-p **overlap** clearly shown

overlap must involve s and p orbitals (1) [4]

(c) (i) bonding electrons are unequally shared **or**
the molecule has a dipole/ δ^+ and δ^- ends to molecule (1)

(ii) the H and Cl atoms have different electronegativities
or chlorine is more electronegative than hydrogen (1) [2]

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allow two 'sausages' above **and** below the C-C axis

or two p orbitals **overlapping** sideways

to form one (localised) π bond over two carbon atoms

(1) [1]

(e) $\Delta H_f^\ominus = 2(-393.7) + 2(-285.9) - (-1411)$

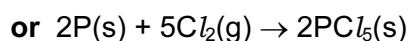
$= + 51.8 \text{ kJ mol}^{-1}$ (units given in qu.)

(3)

penalise errors: no 2 for -393.7
 no 2 for -285.9
 wrong sign for $-(-1411)$

[3]

[Total: 13]



equation

(1)

state symbols

(1) [2]

(b) (i) giant ionic lattice (may be in diag.)

(1)

strong ionic bonds

(1)

(ii) simple molecular **or** discrete molecules

(may be shown in a diagram)

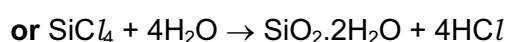
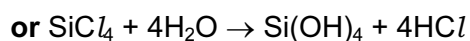
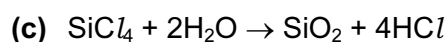
(1)

with **weak** intermolecular forces **or**

weak van der Waals' forces

between them

(1) [4]



(1) [1]

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(d) NaCl pH is 7 allow neutral (1)

PCl_5 pH is between 1 and 4

do **not** allow acidic (1) [2]

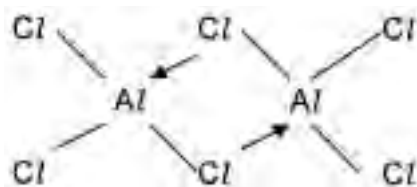
(e) (i) 460 K Al_2Cl_6 (1)

1150 K AlCl_3 (1)

(ii) correct **dot-and-cross** diagram for AlCl_3 (1)

(iii) correct displayed structure for Al_2Cl_6 (1)

two correct co-ordinate bonds (1)



[5]

[Total: 14]

3 (a) P_4 (1)

S_8 (1)

Cl_2 (1) [3]

(b) (i) highest S_8 P_4 Cl_2 lowest

allow S ... P ... Cl **or** names (1)

(ii) from S_8 to P_4 to Cl_2

there are fewer electrons in each molecule (1)

hence weaker van der Waals' forces (1) [3]

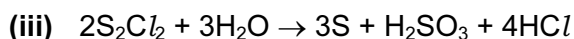
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(c) (i) $S_2Cl_2 = (2 \times 32.1) + (2 \times 35.5) = 135.2$

$$n(S_2Cl_2) = \frac{2.7}{135.2} = 0.0199 = 0.02 \quad (1)$$

$$0.02 \text{ mol } S_2Cl_2 \rightarrow \frac{0.96}{32.1} = 0.03 \text{ mol S}$$

$$1.0 \text{ mol } S_2Cl_2 \rightarrow \frac{0.03 \times 1.0}{0.02} = 1.5 \text{ mol S} \quad (1)$$



correct products (1)

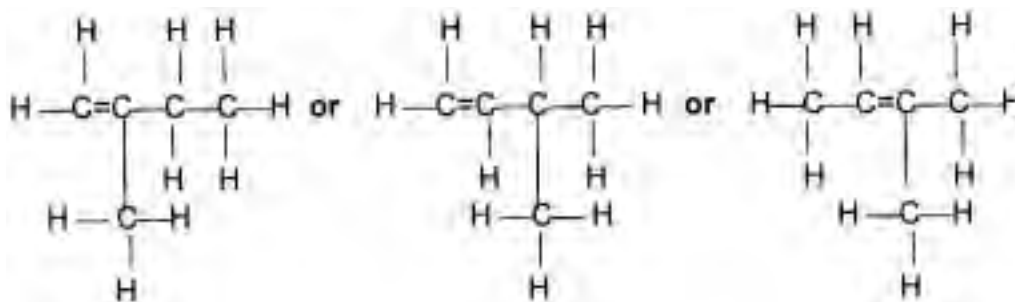
balanced equation (1) [4]

(d) oxidation product is H_2SO_3 (1)

reduction product is S (1) [2]

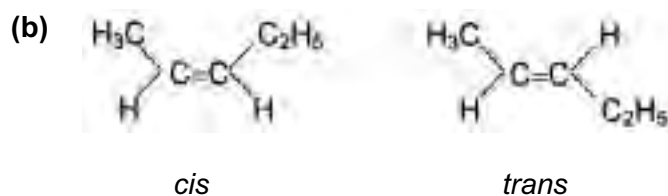
[Total: 12]

4 (a)



H atoms must be shown.

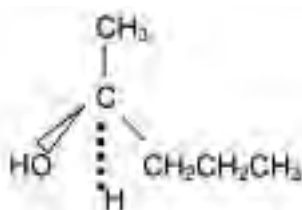
Structure must not contain any CH_3 groups (1) [1]




(1) [2]



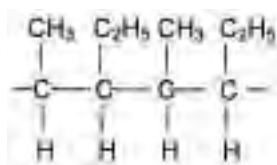
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- (d)  correct compound (1)
- correct mirror object/mirror image relationship in 3D (1) [2]

- (e)  e.g. cyclopentane structure

allow methylcyclobutane **or** dimethylcyclopropane (1) [1]

- (f) e.g.



two repeat units must be shown
relative positions of $-\text{CH}_3$ and $-\text{C}_2\text{H}_5$ may differ from those shown above (1) [1]

[Total: 9]

- 5 (a) (i) $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$ allow $\text{MnO}_4^-/\text{H}^+$ (1)
- (ii) from orange to **or** purple to colourless
green **or** green/blue (1) [2]
- (b) (i) to ensure complete oxidation of $-\text{CH}_2\text{OH}$
or to keep reactants in the reaction flask (1)
- (ii) CH_3CHO /ethanal (1) [2]
- (c) (i) CH_3I /iodomethane (1)
- (ii) nucleophilic substitution **or** hydrolysis (1) [2]

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(d) step I

red P + I₂ **or** HI(aq) **or** KBr/conc H₃PO₄ **or** PI₃ (1)

heat **but** room temperature for PI₃ (1)

step II

KCN in aqueous ethanol (1)

in aqueous ethanol, heat under reflux (1)

allow aqueous ethanol in either place

step III

aqueous mineral acid (**not** nitric acid)

or NaOH(aq) then aqueous mineral acid (1)

heat (1) [6]

[Total: 12]