CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9701 CHEMISTRY

9701/23 Paper 2 (AS Structured Questions), maximum raw mark 60

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

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1 (a) (i)

S atom has 6 **and C** atom has 4 electrons (1)

S=C double bonds (4 electrons) clearly shown (1)

(ii) linear **and** 180° (1) [3]

(b) (i) $CS_2 + 3O_2 \rightarrow CO_2 + 2SO_2$ (1)

(ii) enthalpy change when 1 mol of a substance (1)

is burnt in an excess of oxygen/air

or is completely combusted

under standard conditions (1) [3]

(c)

	CS_2	+	$3O_2$	$\rightarrow$	CO_2	+	$2SO_2$
$\Delta H_f^{\ominus}$/kJ mol^{-1}	x				–395		2(–298)

(1)

$\Delta H_{reaction}$ = –395 + 2(–298) – x = –1110 kJ mol^{-1} (1)

gives x = –395 + (–596) + 1110 = +119 kJ mol^{-1} (1) [3]

(d) (i) $CS_2 + 2NO \rightarrow CO_2 + 2S + N_2$

or

$CS_2 + 2NO \rightarrow CO + 2S + N_2O$

correct products (1)

correct equation (1)

(ii) from –2 to 0 **both** required (1) [3]

[Total: 12]

2 (a) (i) if the conditions of a system in equilibrium are changed (1)

the position of equilibrium moves so as to reduce that change (1) [2]

(ii) lower temperature (1)

because the forward reaction is exothermic (1)

higher pressure (1)

because the forward reaction shows a reduction in volume
or
there are fewer molecules/moles on RHS of equilibrium (1) [4]

(b)

	CO_2	+	H_2	⇌	CO	+	H_2O
initial moles	0.70		0.70		0.30		0.30
equil. moles	(0.70–x)		(0.70–x)		(0.30+x)		(0.30+x)
equil. concn.	$\frac{(0.70-x)}{1}$		$\frac{(0.70-x)}{1}$		$\frac{(0.30+x)}{1}$		$\frac{(0.30+x)}{1}$

(1)

$K_c = \frac{(0.30+x)^2}{(0.70-x)^2} = 1.44$ (1)

gives x = 0.25 (1)

at equilibrium,
$n(CO_2) = n(H_2) = 0.70 - 0.25 = 0.45$ moles
and
$n(CO) = n(H_2O) = 0.3 + 0.25 = 0.55$ moles (1) [4]

[Total: 10]

3 (a) (i) He **or** Ne **or** Ar **or** Kr (1)

(ii) P **or** As (1)

(iii) Br (1)

(iv) Na allow Ar (1)

(v) Si (1)

(vi) P allow Si (1)

(vii) C*l* **or** F **or** Br (1) [7]

(b) (i) any **two** from P_4O_6, SO_2 and Cl_2O_7 (1+1)

(ii) Al_2O_3 **or** SiO_2 (1)

(iii) $MgSO_3$ (1) [4]

(c) (i) Si is giant molecular/giant covalent **or**

P, S, and C*l* are simple molecular (1)

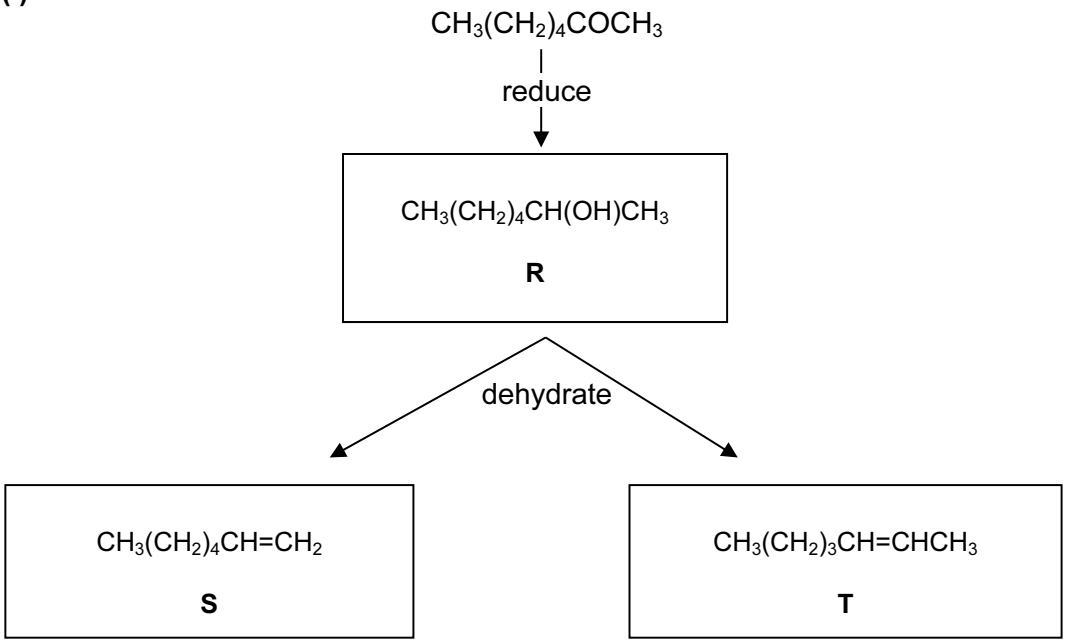
(ii) the molecules are S_8, P_4, Cl_2 (1)

larger molecules have more electrons (1)

and hence greater van der Waals' forces (1) [4]

[Total: 15]

4 (a) (i)



one mark for each correct compound, **R**, **S** and **T**

allow correct *cis* **and** *trans* versions of compound **T** for 2 marks (3 × 1)

(ii) reduction

$NaBH_4$ **or** $LiAlH_4$ **or** H_2/Ni **or** Na/C_2H_5OH (1)

dehydration

P_4O_{10}/P_2O_5 **or** H_3PO_4 **or** conc. H_2SO_4 **or** Al_2O_3 (1) [5]

(b)

Tollens' reagent	NO REACTION
HCN	$CH_3(CH_2)_4C(OH)CH_3$ | CN
$K_2Cr_2O_7/H^+$	NO REACTION

one mark for each correct answer (3 × 1) [3]

(c) Na_2CO_3 **or** $NaHCO_3$ effervescence/colourless gas
or
Na colourless gas
or
PCl_3/PCl_5 etc. steamy fumes
or
C_2H_5OH/conc. H_2SO_4 sweet smell of ester
or
$K_2Cr_2O_7/H^+$ orange solution becomes green

correct reagent (1)

correct observation (1) [2]

[Total: 10]

5 (a) (i) $CH_2=CHCO_2H$ (1)

(ii) $BrCH_2CHBrCH_2OH$ (1)

(iii) product is $HOCH_2CH(OH)CH_2OH$

correct addition across >C=C< (1)

original $–CH_2OH$ remains (1)

(iv) HO_2CCO_2H (1) [5]

(b) (i) nucleophilic substitution (1)

(ii) oxidation (1) [2]

(c) (i) **step I**

H_2 (1)

heat with Ni catalyst (1)

step II

acidified $K_2Cr_2O_7$ (1)

heat **or** distil off product (1)

(ii) structural isomerism
or
functional group isomerism (1) [5]

(d) **both** oxidation **and** reduction have occurred **or**

disproportionation has taken place (1) [1]

[Total: 13]