40th INTERNATIONAL CHEMISTRY OLYMPIAD

UK Round One - 2008

MARKING SCHEME

Notes

Chemical equations may be given as sensible multiples of those given here.

State symbols do not need to be included in the chemical equations to obtain the mark(s).

Answers should be given to an appropriate number of significant figures although the marker should only penalise this once.

Total 62 marks.

Question 1			
		Answer	Marks
(a)		$SiO_2 + C \rightarrow Si + CO_2$ *(also accept $SiO_2 + 2C \rightarrow Si + 2CO$)*	1
(b)	i)	109 °	1
	ii)	$SiHCl_3 + H_2 \rightarrow Si + 3HCl$	1
(c)	i)	$4SiH(OCH_2CH_3)_3 \rightarrow SiH_4 + 3Si(OCH_2CH_3)_4$	1
	ii)	$SiH_4 + 2O_2 \rightarrow SiO_2 + 2H_2O$	1
(d)	i)	$C_x = 2.00 \times 10^{-3} \times 3300\ (1 - 0.95)^{-0.998} = 131$ ppm	2
	ii)	If k is small, $k - 1 \approx -1$ $\therefore\ 10 = 8.00 \times 10^{-6} \times 1300\ (1 - x)^{-1}$ $1 - x = 0.00104$ 0.104% would have to be discarded	2

9 marks

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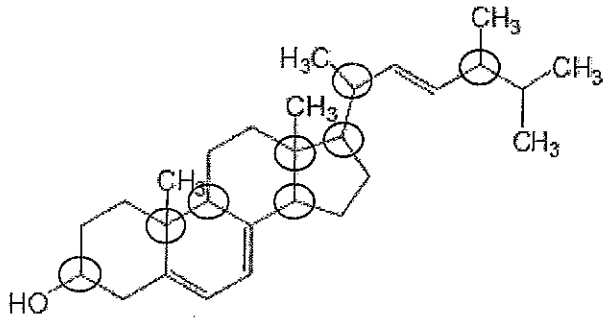
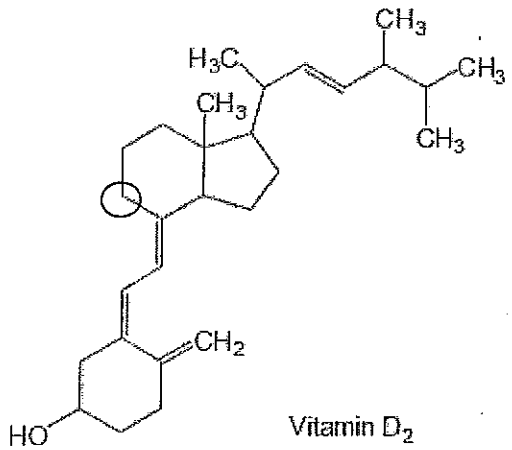
Question 2			
		Answer	**Marks**
(a)		 Ergosterol	3
(b)		 Vitamin D_2	2
(c)		Zero	1
(d)		In 40 min, (42-7) µg/g dry mushroom of vitamin D_2 produced (42-7)/40 = 0.875 µg(g dry mushroom)$^{-1}$min^{-1} $\therefore k$ = 0.0146 µg(g dry mushroom)$^{-1}$s^{-1} *(1 mark for the value of k, and 1 mark for the correct units)*	2
(e)		In 40 min, (14-3) µg/g dry mushroom of vitamin D_2 produced $\therefore$ In 60 min, ((14-3) x 60/40) + 3 = 19.5 µg/g dry mushroom In 10g of dry mushrooms, 19.5 x 10 = 195 µg of vitamin D_2	1
(f)		At 25 °C, $k_{(T)} = A \times e^{(-E_a / (8.314 \times 298))}$ At 35 °C, $2k_{(T)} = A \times e^{(-E_a / (8.314 \times 308))}$ $e^{(-E_a / (8.314 \times 308))} = 2 \times e^{(-E_a / (8.314 \times 298))}$ $-E_a / (8.314 \times 308) = \log_e 2 - E_a / (8.314 \times 298)$ $0.0004036\ E_a - 0.0003905\ E_a = 0.693$ $0.0000131\ E_a = 0.693$ E_a = 53 kJ mol^{-1}	2

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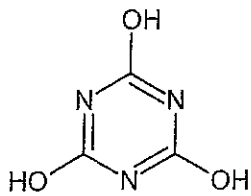
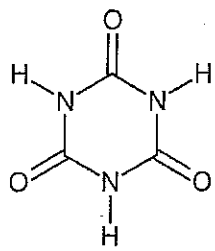
11 marks

Question 3			
		Answer	**Marks**
(a)		$Hg(CNO)_2 \rightarrow Hg + N_2 + 2CO$	1
(b)		$2(-111) - 386 = -608$ kJ mol^{-1}	2
(c)		$O\leftarrow N\equiv C-Hg-C\equiv N\rightarrow O$ (*also accept* $^{-}O-{}^{+}N\equiv C-Hg-C\equiv N^{+}-O^{-}$)	1
(d)		$N\equiv C-O-Hg-O-C\equiv N$ (*also accept* Hg^{2+} $(^{-}C\equiv N^{+}-O^{-})_2$)	1
(e)		Aromatic structure:  Non-aromatic structure: 	2

7 marks

Question 4			
		Answer	**Marks**
(a)		6	1
(b)	i)	Al_2Cl_6	1

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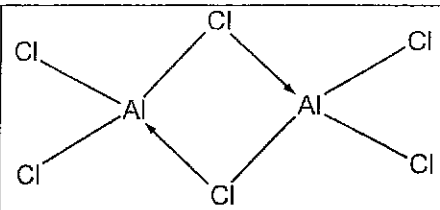
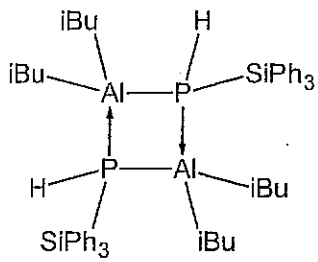
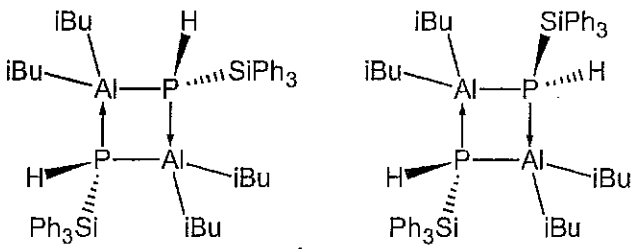
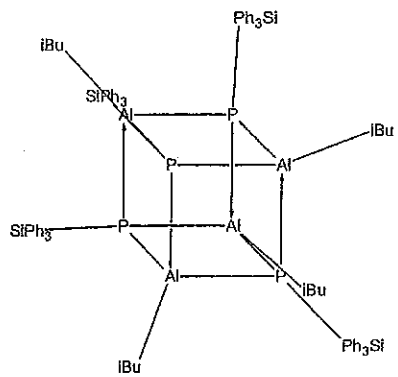
	ii)	 *(Dative bond arrows not essential)*	1
	iii)	8	1
(c)		$AlP + 3H_2O \longrightarrow Al(OH)_3 + PH_3$ (*also accept* $2AlP + 3H_2O \rightarrow Al_2O_3 + 2PH_3$)	1
(d)		6	1
(e)	i)		1
	ii)		2
(f)			3
(g)		methylpropene	1

13 marks

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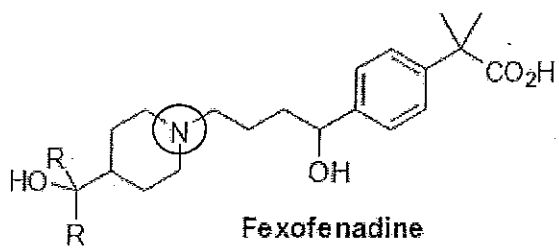
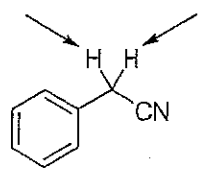
Question 5			
		Answer	Marks
(a)	i)	301	1
	ii)	114	1
	iii)	227	1
(b)		9!/2 = 181440	2
(c)		1- Cysteine 2- Isoleucine 3- Leucine 4- Glutamine 5- Aspartic Acid 6- Cysteine 7- Proline *(Lose one mark for each incorrect amino acid)*	5

10 marks

Question 6			
		Answer	Marks
(a)	i)	 **Fexofenadine**	1
	ii)	(120.14 – 112.00)/112.00 = 36.458 / (RMM of fexofenadine) ∴ RMM of fexofenadine = 501.6	1
	iii)	RMM of structure = (2 x M_r(R)) + 347.4 ∴ 2 x M_r(R) = 501.6 – 347.4 = 154.2 M_r(R) = 77.1 R = C_6H_5 *(accept 'phenyl group')*	1
(b)			1

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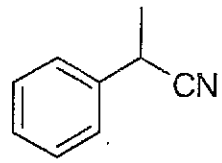
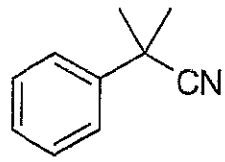
(c)

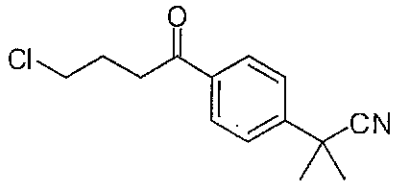
A



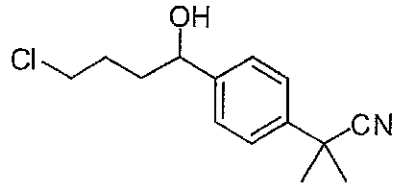
B



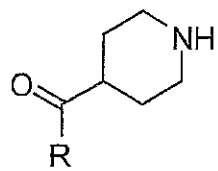
C



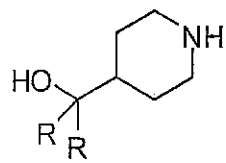
D



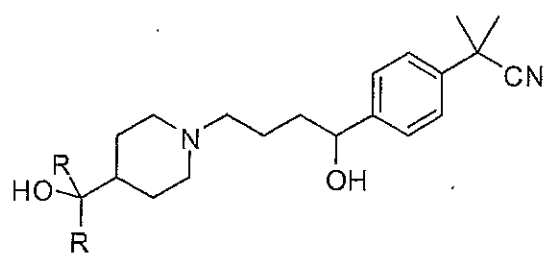
E



F



G



Award 1 mark for each correct structure

Award 1 additional mark if all structures in parts c) are given correctly.

7

1

12 marks

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