UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

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.

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1 Throughout this question, deduct **one mark only** for sig. fig. error.

(a) **(i)** the volume of solution **A** present in one 'typical ant' is
$7.5 \times 10^{6} \times 1000 = 7.5 \times 10^{3}$ cm^3 (1)

(ii) the volume of pure methanoic acid in one 'typical ant' is
$7.5 \times 10^{3} \times \frac{50}{100} = 3.75 \times 10^{3}$ gives 3.8×10^{3} cm^3

allow ecf on **(i)** (1)

(iii) no. of ants = $\frac{1000}{3.8 \times 10^{3}} = 263157.8947$ gives 2.6×10^{5}

use of 3.75×10^{3} gives $266666.6667 = 2.7 \times 10^{5}$ (1) [3]

(b) **(i)** the volume of solution **A**, in one ant bite is
$\frac{80}{100} \times 7.5 \times 10^{3} = 6.0 \times 10^{3}$ cm^3

allow ecf on **(a)(i)** (1)

the volume of pure methanoic acid in one bite is
$\frac{50}{100} \times 6.0 \times 10^{3} = 3.0 \times 10^{3}$ cm^3

allow ecf on first part of **(b)(i)** (1)

(ii) the mass of methanoic acid in one bite is
$3.0 \times 10^{3} \times 1.2 = 3.6 \times 10^{3}$ g

allow ecf on **(b)(i)** (1) [3]

(c) **(i)** $HCO_2H + NaHCO_3 \rightarrow HCO_2Na + H_2O + CO_2$ (1)

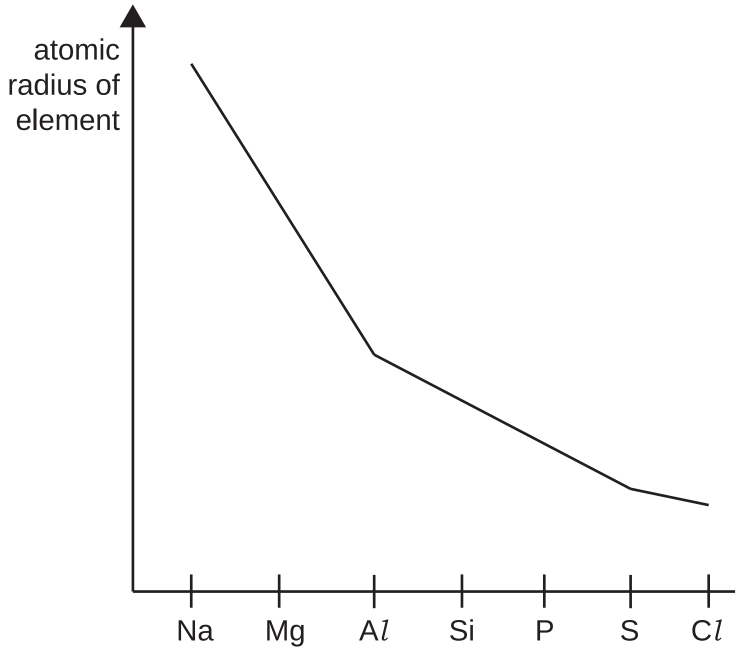
(ii) 46 g $HCO_2H \equiv$ 84 g $NaHCO_3$ (1)

5.4×10^{3} g $HCO_2H \equiv \frac{84 \times 5.4 \times 10^{3}}{46}$ g $NaHCO_3$
$= 9.860869565 \times 10^{3}$
$= 9.9 \times 10^{3}$ g $NaHCO_3$ (1) [3]

[Total: 9]

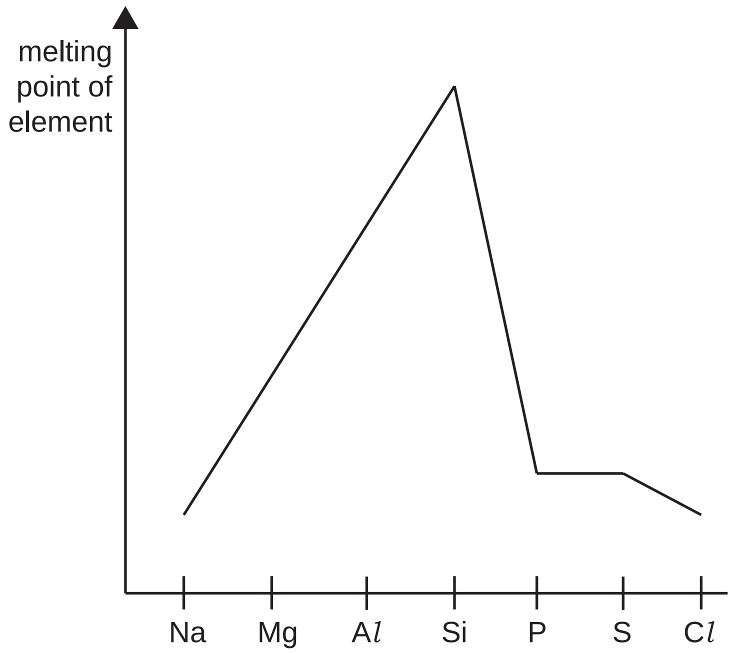
2	**(a)**	there are no inter-molecular forces present between ideal gas molecules ideal gas molecules have no volume collisions between ideal gas molecules are perfectly elastic ideal gas molecules behave as rigid spheres	(any 2)	[2]
	(b)	high temperature low pressure	(1) (1)	[2]
	(c)	**most ideal** ..... neon..... nitrogen..... ammonia..... **least ideal** nitrogen has stronger van der Waals' forces than argon ammonia has hydrogen bonding as well as van der Waals' forces	(1) (1) (1)	[3]
	(d)	with increasing temperature, average kinetic energy of molecules increases intermolecular forces are more easily broken	 (1) (1)	[2]
	(e)	18	(1)	[1]
	(f)	**(i)** both have very similar/same van der Waals' forces	(1)	
		(ii) CH_3F has permanent dipole	(1)	[2]
				[Total: 12]

3 (a)



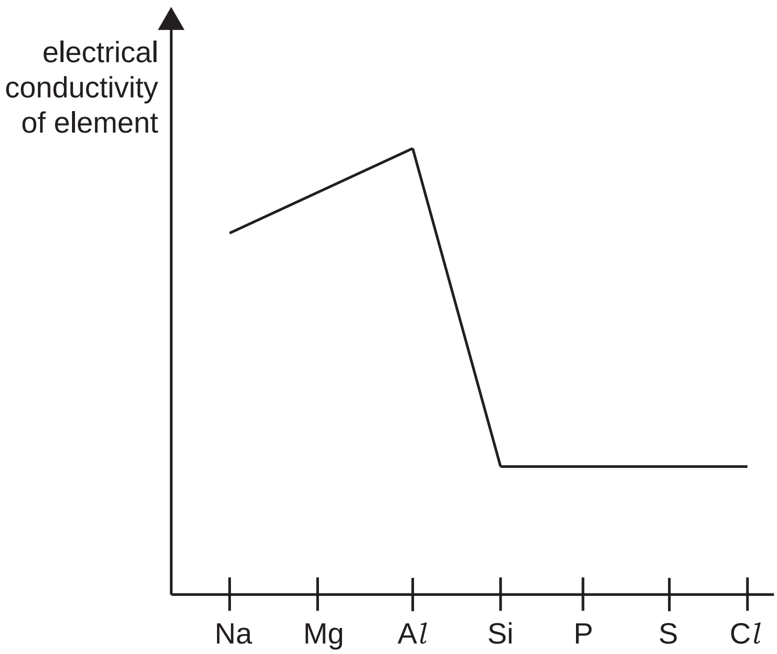
general shape of curve	(1)	
for Na → Ar		
nuclear charge increases	(1)	
electrons are added to same shell	(1)	[3]

(b)



general shape of curve	(1)	
Na, Mg and Al have metallic bonding	(1)	
Si is giant molecular	(1)	
P, S, and Cl are simple molecular	(1)	[4]

(c)



general shape of curve (1)
Na, Mg and Al have increasing no. of outer shell electrons (1)
Si is a semi-conductor (1)
P, S and Cl are covalent/simple molecular (1) [4]

(d) **(i)** Na_2O ionic (1)
SiO_2 covalent (1)
P_4O_6 van der Waals' forces/induced dipoles (1)

(ii) Al_2O_3 **or** SiO_2 (1) [4]

[Total: 15]

4	(a)		$C_9H_{16}O_2$	(1)	[1]
	(b)	(i)	aldehyde **not** carbonyl	(1)	
			secondary	(1)	
			alcohol	(1)	
		(ii)	Br_2/bromine **allow** $KMnO_4/H^+$	(1)	
			decolourised decolourised	(1)	[5]
	(c)	(i)	$CH_3(CH_2)_4COCO_2H$	(1)	
			HO_2CCO_2H **or** CO_2	(1)	
		(ii)	$CH_3(CH_2)_4CH(Cl)CH{=}CHCHO$	(1)	
		(iii)	$CH_3(CH_2)_4CH(OH)CH{=}CHCH_2OH$	(1)	[4]

[Total: 10]

5 **(a)** **(i)** $C_7H_{14}O_2$ (1)

(ii) one (1) [2]

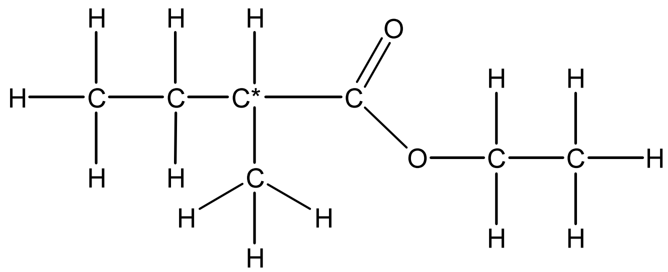
(b) **(i)** $Cr_2O_7^{2-}/H^+$ (1)
from orange (1)
to green (1)

(ii) 2-ethyl-3-methylbutanal/$(CH_3)_2CHCH(C_2H_5)CHO$/the corresponding aldehyde (1)
partial oxidation of alcohol will produce aldehyde (1)

(iii) reflux **because**
the alcohol must be fully oxidised (1) [6]

(c) none (1)
alcohol is tertiary (1)
cannot be oxidised (1) [3]

(d)



correct structure (1)
fully displayed –$CO_2C_2H_5$ group (allow ecf on wrong esters) (1)
correct chiral C atom (allow ecf on wrong esters) (1) [3]

[Total: 14]