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

UNIVERSITY *of* CAMBRIDGE
International Examinations

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
           $7.5 \times 10^{-3} \times \dfrac{50}{100} = 3.75 \times 10^{-3}$ gives 3.8×10^{-3} cm^3

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

      (iii) no. of ants = $\dfrac{1000}{3.8 \times 10^{-3}} = 263157.8947$ 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
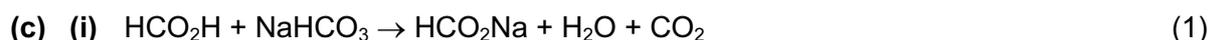 $\dfrac{80}{100} \times 7.5 \times 10^{-3} = 6.0 \times 10^{-3}$ cm^3

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

           the volume of pure methanoic acid in one bite is
           $\dfrac{50}{100} \times 6.0 \times 10^{-3} = 3.0 \times 10^{-3}$ 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 $HCO_2H \equiv \dfrac{84 \times 5.4 \times 10^{-3}}{46}$ 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   (1)
low pressure   (1)   [2]

   (c) **most ideal** ..... neon..... nitrogen..... ammonia..... **least ideal**   (1)
nitrogen has stronger van der Waals' forces than argon   (1)
ammonia has hydrogen bonding as well as van der Waals' forces   (1)   [3]

   (d) with increasing temperature,
average kinetic energy of molecules increases   (1)
intermolecular forces are more easily broken   (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)
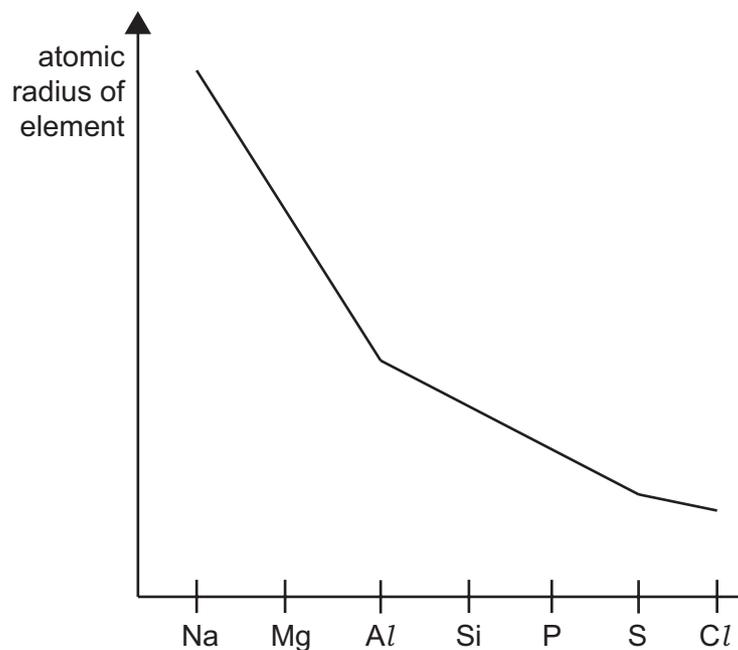
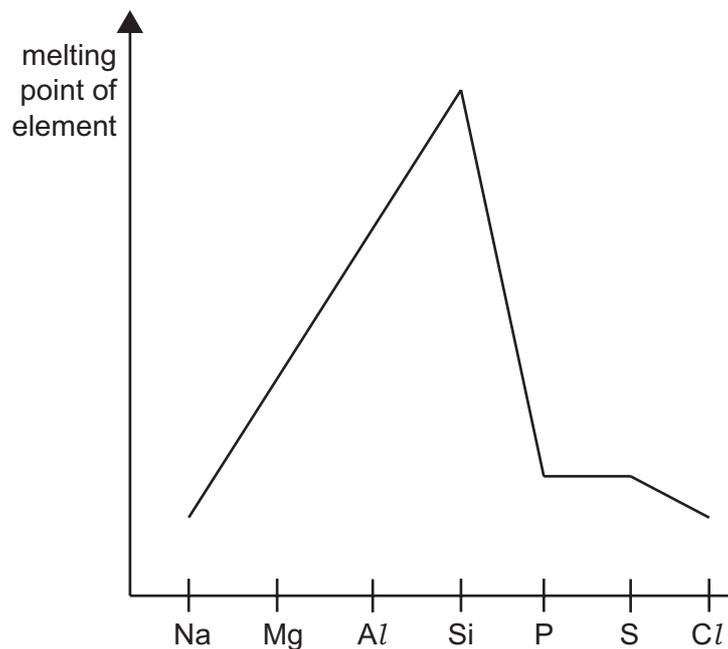general shape of curve (1)
for Na → Ar
nuclear charge increases (1)
electrons are added to same shell (1)   [3]

(b)

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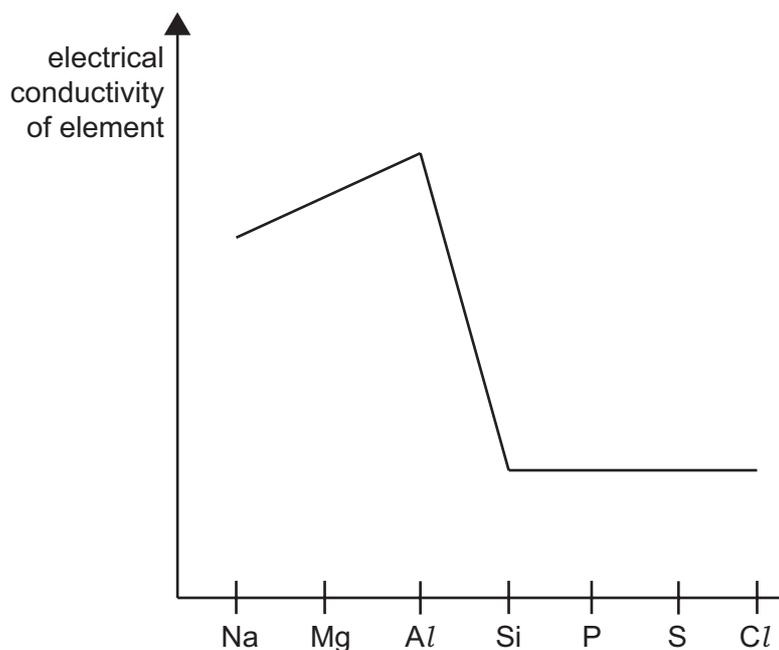Na, Mg and A*l* have metallic bonding (1)
Si is giant molecular (1)
P, S, and C*l* are simple molecular (1)   [4]

(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$_2$O   ionic   (1)

          SiO$_2$ covalent   (1)

          P$_4$O$_6$ 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** (1)
        the alcohol must be fully oxidised (1) [6]

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

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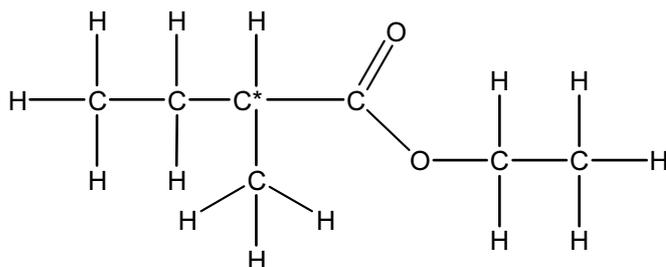
    correct structure (1)
    fully displayed $-CO_2C_2H_5$ group (allow ecf on wrong esters) (1)
    correct chiral C atom (allow ecf on wrong esters) (1) [3]

                                                    [Total: 14]