CAMBRIDGE
INTERNATIONAL EXAMINATIONS

JUNE 2003

GCE A AND AS LEVEL

MARK SCHEME

MAXIMUM MARK: 60

SYLLABUS/COMPONENT: 9701/02

CHEMISTRY
Theory 1 (Structured Questions)

1 (a) Atoms which have the same number of protons (or same element) but different numbers of neutrons (1) **[1]**

(b) (i) ^{35}Cl (1)

(ii) $H^{37}Cl$ (1) **[2]**

(c) H Cl line at 36 has rel. abundance of 90 } (1)
38 30 }

These show ^{35}Cl and ^{37}Cl in ratio 3:1 (1)
[or use of 35 and 37] **[2]**

(d) Mean of the two isotopes $\frac{3 \times 35 + 1 \times 37}{4} = 35.5$ (1) **[1]**

[Total: 6]

2 (a) (i) That the volume of the gas molecules is negligible compared to the volume of gas (1)

(ii) That there are no intermolecular forces
OR collisions of the molecules are perfectly elastic
Particles are in constant motion, losing no energy on collision (1) any two **[2]**

(b) 6.02×10^{23} (1) **[1]**

(c) (i) r = 0.192 nm (1) Assume most candidates will work in dm^3
$v = \frac{4}{3} \times 3.14 \times (1.92 \times 10^{-9})^3 = 2.96 \times 10^{-26}$ dm^3 (2.96×10^{-29} m^3) (1)

(ii) $2.96 \times 10^{-26} \times \frac{6.02 \times 10^{23}}{}$ (1) = 1.78×10^{-2} dm^3 (1.78×10^{-5} m^3) (1)

(iii) 24 dm^3 (0.024 m^3) (1)

(iv) $\frac{1.78 \times 10^{-2} \times 10^2}{24} = 0.074\%$ (1)

(v) Some statement which connects with **(a) (i)** above (1) **max [5]**

(d)
- hot metals will react with oxygen in air (or nitrogen)
- to form oxides/will burn out/to a powder
- argon will not react
- at high temperatures O_2 and N_2 in air will react to give NO_x

NOT expansion of gases on heating any two **[2]**

[Total: 10]

3 (a) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (1) exothermic (1) **[2]**

(b) Pr. 5O atm upwards; Temp 400-600ºC; catalyst of iron
(1 each, conditions stated) **[3]**

(c) Too high a temp and equilibrium favours LHS, less ammonia at equilibrium (1)
Too low a temp, rate too slow/not enough molecules have E_{act} (1) **[2]**

(d) (i) $K_p = \dfrac{PNH_3^2}{PN_2 \times PH_2^3}$ (1)

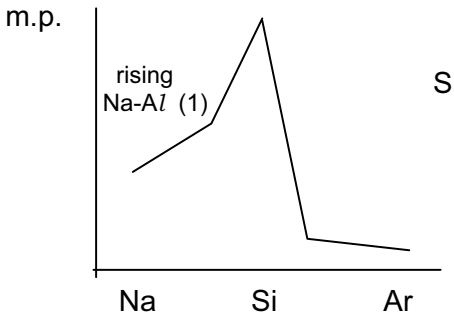
(ii) $K_p = \dfrac{37.2^2}{44.8 \times 105.6^3}$ (1)

$= 2.62 \times 10^{-5}$ atm^{-2} (1) calculation and units **[3]**

(e) Excess (hence uncontrolled) nitrates leach out of fields into streams, seas (1)
Bacteria or algae grow fast/use oxygen/clog up water (1)
Balance destroyed/fish unable to live (1)
Process called eutrification (1) any 3 **[3]**

[Total: 13]

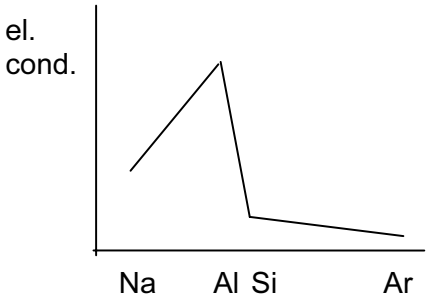
4 (a) (i)



Si to Ar (1)

[2]

(ii)

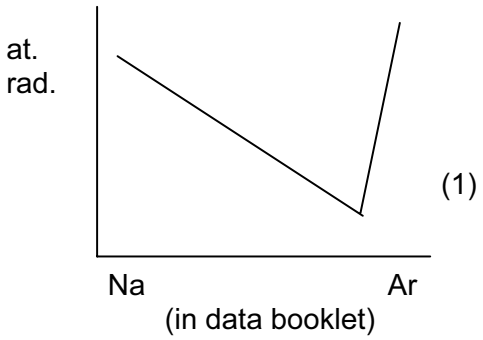


rising
Na-Al (1)

P – Ar (below Na) (1)

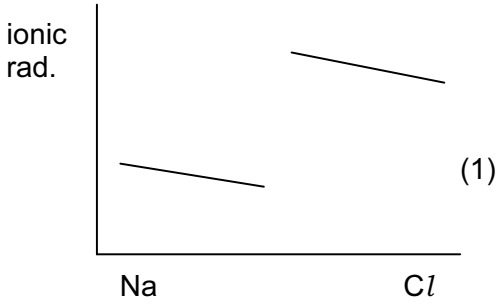
[2]

(iii)



(1) **[1]**

(iv)



(1) **[1]**

[6]

(c) (i) Na_2O MgO Al_2O_3 P_2O_5 (or P_4O_{10} or P_2O_3) SO_2 or SO_3 (1)

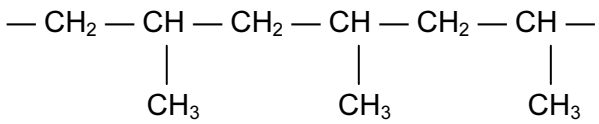
(ii) $Na_2O + H_2O \rightarrow 2NaOH$ (1)

(iii) $2NaOH + SO_2 \rightarrow Na_2SO_3 + H_2O$ (1) or $NaHSO_3$

<u>OR</u> $2NaOH + SO_3 \rightarrow Na_2SO_4 + H_2O$ (1) $NaHSO_4$ **[3]**

[Total: 9]

5 (a)



(1) **[1]**

(b) Alkane (1) **[1]**

(c) (i) Not biodegradable/does not decompose/unreactive
Not affected by enzymes
Not attacked by aqueous or polar reagents found in tissues
Insoluble/does not absorb water/cotton absorbs water
NOT is stronger than cotton
[equivalent worthy points; they may overlap - but allow - max 2] **[2]**

(ii) Alkanes react with oxygen (combustion)
Not possible in muscle (1)
also react with halogens/in U.V. light
muscle is internal and no halogens (1)
[ecf for alkene answers in **(b)**] **[2]**

[Total: 6]

6 (a)

$$\frac{66.7}{12} \qquad \frac{11.1}{1} \qquad \frac{22.2}{16}$$

= 5.5 = 11.1 = 1.3875

Divide by 1.3875

C_4H_8O (1) 48 + 8 + 16 = 72 hence C_4H_8O (1) **[2]**

(b) (i) orange ppt (1) red to yellow/crystals or solid

(ii) ketone (1)

(iii) $CH_3CH_2COCH_3$ or butanone (1) **[3]**

(c) (i) $NaBH_4$ allow $NaAlH_4$ (Li Al H_4) (1) H_2/Ni or Pt

(ii) secondary alcohol (1)

(iii) $CH_3CH_2CHOHCH_3$ (1)
[Allow ecf marks if **(b) (iii)** is butanal] **[3]**

[Total: 8]

7 (a) (i) e.g.
$CH_3CO_2C_3H_7$ $CH_3CO_2CH(CH_3)_2$ $CH_3CH_2CO_2C_2H_5$ $H\text{-}CO_2C_4H_9$
$C_3H_7CO_2CH_3$ + branches any three **[3]**

(ii) RCO_2R' + NaOH → RCO_2Na (1) + R'OH (1)
→ RCO_2H + R'OH (1) only **[2]**

(b) (i) and (ii) * volatile, or liquids (1) immiscible, with water (1) smell (1) any two **[2]**

(c) (i) solvents, perfumes, flavourings, lotions, olive or palm oils any two

and (ii) To make soap, to make Terylene **[2]**
NOT polyesters

[Maximum Total: 8]