2815/05 Gases, Liquids and Solids

June 2003

Mark Scheme

The following annotations may be used when marking:

X	=	incorrect response (errors may also be underlined)
^	=	omission mark
bod	=	benefit of the doubt (where professional judgement has been used)
ecf	=	error carried forward (in consequential marking)
con	=	contradiction (in cases where candidates contradict themselves in the same response)
sf	=	error in the number of significant figures

Abbreviations, annotations and conventions used in the Mark Scheme:

/	=	alternative and acceptable answers for the same marking point
;	=	separates marking points
NOT	=	answers not worthy of credit
( )	=	words which are not essential to gain credit
___ (underlining)	=	key words which must be used
ecf	=	allow error carried forward in consequential marking
AW	=	alternative wording
ora	=	or reverse argument

1	(a)	Low temperatures	1
		Particles move more slowly so intermolecular forces become significant.	1
		High pressures	1
		Particles are forced closer together increasing intermolecular forces / volume of particles becomes significant	1
	(b)		1
		Neon, nitrogen, carbon dioxide	1
		Neon is a noble gas, nitrogen a molecule / larger size, carbon dioxide significant dipoles.	
	(c)	Increasing energy makes particles vibrate more. (1) This breaks intermolecular forces. (1) This reduces the orderly structure / particles move past one another (1) As the temperature increases, more particles have enough energy to break free from the liquid. (1) Continues heating increases the average energy of the particles. (1) Eventually all particles have enough energy to become a gas. (1)	5 max
		QWC	1
	(d)		1
		Zones / domains / crystals of one component disrupt the 3D structure / lattice will be less regular.	1
		This prevents ‘slippage’ of layers of atoms.	Total : 14

2 (a) (i) Mass of a gas dissolving in a given volume of solvent / concentration of gas at a particular temperature is proportional to its pressure. 2 x 1

(ii) Any 2 of : concentrated solutions; where there is a reaction between gas and solvent; a polar gas and a polar solvent. 2 x 1

(iii) Increase in temp. increases average energy of particles 1
Dissolving gas is an exothermic process. 1

(b) (i) $\frac{[CO_2]}{pCO_2} = 3.4 \times 10^{-4}$ mol dm^{-3} kPa^{-1}

Hence $[CO_2] = 3.4 \times 10^{-4} \times 5 = 1.7 \times 10^{-3}$ mol dm^{-3} 1

(ii) Volume of $CO_2 = \frac{nRT}{pV} = \frac{1.7 \times 10^{-3} \times 8.31 \times 298}{5 \times 10^3}$ 1

$= 8.4 \times 10^{-4}$ m^3 1

(iii) Carbon dioxide reacts with water (0r equation) 1

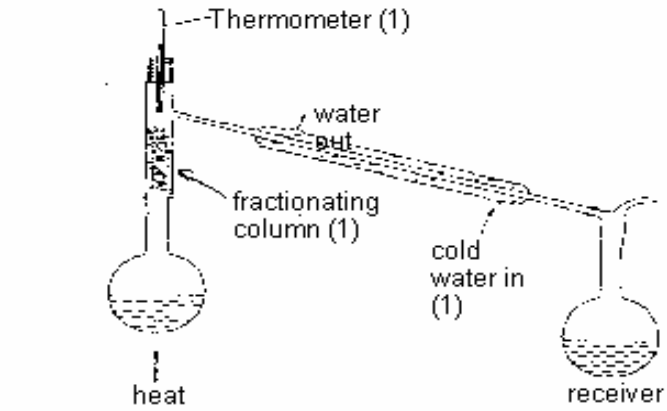
This produces H^+ ions 1

Total : 11

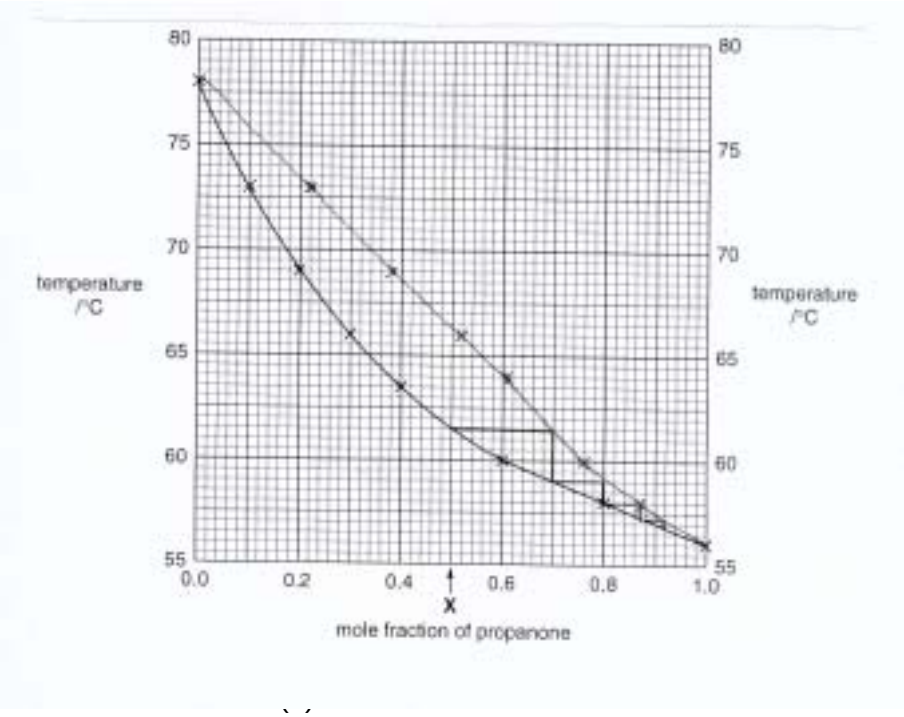
3 (a) (i)	Correct curve	1
(ii)	Phase boundary between solid NaC*l* and saturated solution of NaC*l* (or solubility curve of NaC*l*) or equivalent	1
(b) (i)	**A** – ice separates **B** – mixture freezes	1 1
(ii)	**X** - -10°C **Y** - -23**°C**	1 1
(c)	Any 2 of : Temperatures in winter in the UK are higher than those in Sweden. Temperatures in the UK never get so low that the NaC*l* solution freezes. In Sweden temperatures drop to below the freezing point of the eutectic.	2 x 1

Total : 8

4 (a)



(b) (i)



3

1

(ii) At least two plates shown (1) 2 x 1

(iii) 3-4 plates 1

(c) TWO of : It has a constant boiling point.
Composition of the vapour is the same as that of the liquid.
Cannot be separated by distillation 2 x 1

(d) (i) Any suitable example, e.g. perfumes, flavourings, esters, natural products, substances which decompose close to their boiling points 1

(ii) The mixture boils when the total vapour pressure equals the sum of the vapour pressures of water and the other substance.
This has to be less than 100 °C 1

Total 12