Oxford Cambridge and RSA

A Level Chemistry B (Salters)

H433/02 Scientific literacy in chemistry

Question Set 12

1 Strontium carbonate is used in fireworks to colour the flames red.

(a) The red colour comes from lines of specific frequency in the atomic emission spectrum of strontium.

Explain how these lines are formed. **[3]**

(b) (i) Strontium carbonate decomposes to give strontium oxide when heated.

$$SrCO_3 \rightarrow SrO + CO_2$$

12.0 g of $SrCO_3$ are heated.

Calculate the volume of CO_2 (in cm^3) that would be collected at 290 K and 155 kPa.

Give your answer to an **appropriate** number of significant figures.

Volume of CO_2 =…..……...cm^3 **[4]**

(ii) A student says 'Strontium ions are larger than calcium ions, so the attraction to carbonate ions is weaker. This means that strontium carbonate has a lower thermal stability than calcium carbonate.'

Discuss the student's statement, giving the correct chemistry where necessary. **[4]**

(c) **(i)** A sample of strontium metal has the isotopic composition shown in the table.

Mass number	84	86	87	88
Abundance / %	0.56	9.86	7.00	82.58

How many neutrons are there in an atom of ^{84}Sr?

number of neutrons =…… **[1]**

(ii) Use the data to calculate the relative atomic mass of the strontium sample.

Give your answer to **2** decimal places.

relative atomic mass =…… **[2]**

(d)* Strontium oxide reacts with water to form strontium hydroxide, $Sr(OH)_2$.

The solubility of strontium hydroxide in water at room temperature is around $10\,g\,dm^{-3}$.

A student is given a saturated solution of strontium hydroxide, normal titration equipment and a variety of different concentrations of hydrochloric acid.

The student wishes to find an accurate value for the concentration of the solution in $mol\,dm^{-3}$.

Describe in full a suitable procedure and indicate how the result would be calculated. **[6]**

(e) **(i)** Write the equation for the equilibrium that occurs between solid strontium hydroxide and its ions in solution.

Use your equation to write the expression for the solubility product of strontium hydroxide.

Equation with state symbols:

K_{sp} =

[2]

(ii) At 0 °C, the solubility of strontium hydroxide in water is 3.4×10^{-2} mol dm^{-3}.

Calculate the solubility product of strontium hydroxide at this temperature.

Give the units in your answer.

solubility product = ... units …… **[3]**

(iii) Explain how the solubility of strontium hydroxide in aqueous NaOH at 0 °C compares with 3.4×10^{-2} mol dm^{-3}.

Use the idea of solubility product in your answer. **[2]**

(f) **(i)** The melting point of strontium is higher than the melting point of rubidium.

To which block of the Periodic Table do these elements belong? **[1]**

(ii) Explain the difference in melting point. **[2]**

Total Marks for Question Set 12: 30

The Periodic Table of the Elements

(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 H hydrogen 1.0	2	Key: atomic number, Symbol, name, relative atomic mass										13	14	15	16	17	2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	• 57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	• 89–103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium		114 Fl flerovium		116 Lv livermorium		

• 57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium 144.9	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.2	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.0	71 Lu lutetium 175.0
• 89 Ac actinium	90 Th thorium 232.0	91 Pa protactinium	92 U uranium 238.1	93 Np neptunium	94 Pu plutonium	95 Am americium	96 Cm curium	97 Bk berkelium	98 Cf californium	99 Es einsteinium	100 Fm fermium	101 Md mendelevium	102 No nobelium	103 Lr lawrencium

General Information

Molar gas volume = $24.0\,dm^3\,mol^{-1}$ at RTP

Avogadro constant, $N_A = 6.02 \times 10^{23}\,mol^{-1}$

Specific heat capacity of water, $c = 4.18\,J\,g^{-1}\,K^{-1}$

Planck constant, $h = 6.63 \times 10^{-34}\,J\,Hz^{-1}$

Speed of light in a vacuum, $c = 3.00 \times 10^8\,m\,s^{-1}$

Ionic product of water, $K_w = 1.00 \times 10^{-14}\,mol^2\,dm^{-6}$ at 298 K

1 tonne = 10^6 g

Arrhenius equation: $k = Ae^{-E_a/RT}$ or $\ln k = -E_a/RT + \ln A$

Gas constant, $R = 8.314\,J\,mol^{-1}\,K^{-1}$