Oxford Cambridge and RSA

GCSE Chemistry B (Twenty First Century Science)

J258/03 Breadth in chemistry (Higher Tier)

Question Set 33

1 Ammonia is used to make synthetic fertilisers.

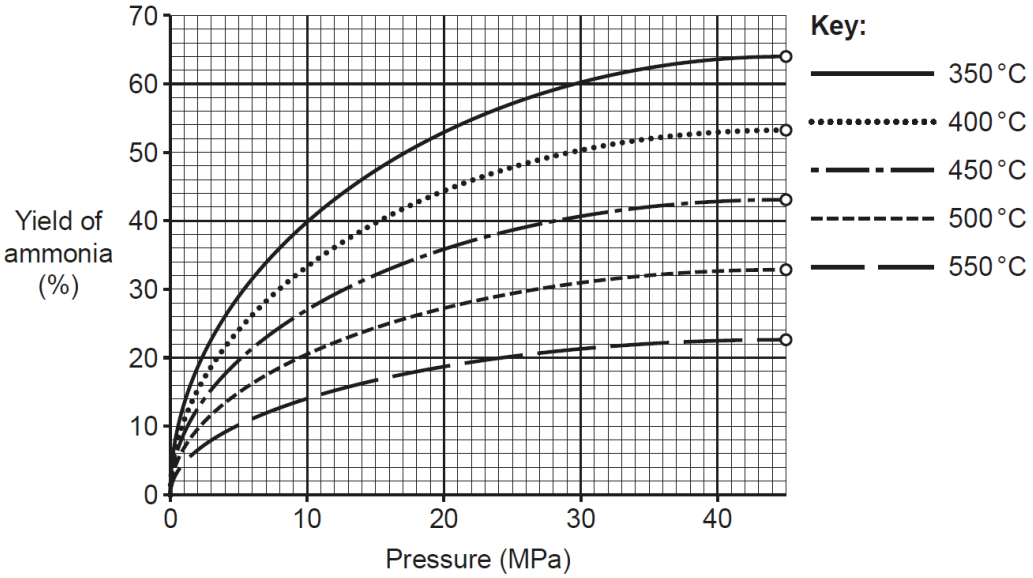
Ammonia is made by the Haber process.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

(a) The reaction in the Haber process reaches equilibrium.

Describe the rates of the forward and reverse reactions at equilibrium. **[1]**

(b) The graph shows the effect of temperature and pressure on the yield of ammonia in the Haber process:



(i) State the **lowest** temperature and pressure necessary to get a yield of ammonia of 15%.

Temperature = ...°C

Pressure = ... MPa

[1]

(ii) Suggest **one** disadvantage of using a temperature of 350 °C rather than 450 °C in the Haber process. **[1]**

(iii) A reactor starts with 12.0 tonnes of hydrogen and excess nitrogen.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

How many **tonnes of ammonia** would be produced from 6×10^6 moles of hydrogen, H_2?

1 tonne = 1×10^6 g

Use the equation: number of moles = $\dfrac{\text{mass of substance}}{\text{relative formula mass (g)}}$

Mass of ammonia = ... tonnes **[3]**

(c) Sarah makes ammonium sulfate from ammonia in a laboratory. This is her method:

- Add excess ammonia to dilute sulfuric acid in an evaporating basin.
- Boil the solution until it does not smell of ammonia.
- Cool the basin until crystals form in the solution.

The crystals that form in the solution are **impure**.

Describe what Sarah can do to get pure ammonium sulfate crystals.

[2]

(d) Ammonium sulfate can be mixed with other substances to make compound fertilisers.

Suggest why compound fertilisers are better for farmers than pure ammonium sulfate.

[1]

Total Marks for Question Set 33 : 9

Resource Materials

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		