1 **(a) (i)** (particles) spread to fill total available volume / move from high concentration to low concentration / moves down a concentration gradient (1) [1]

(ii) mass or M_r (1) [1]

(b) helium atoms / molecules are lighter than molecules in air or N_2 **and** O_2
or helium is less dense than air or N_2 **and** O_2.
or helium diffuses (through the porous barrier) faster than air or N_2 **and** O_2. (1) [1]

(ii) faster rate of diffusion / molecules move faster (at high temperatures). (1) [1]

(c) (i) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ (1) [1]

(ii) would get a mixture of helium and carbon dioxide
or would get a mixture of gases
or waste of methane / natural gas / fossil fuel (1) [1]

(iii) <u>fractional</u> distillation (1) [1]

[Total: 7]

2 **(a** Any one of:
$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$
$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$
$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
for correct equation (2)
not balanced = (1) only

any four of:

coke burns to form carbon dioxide / $C + O_2 \rightarrow CO_2$

this reacts with more carbon to form carbon monoxide / $C + CO_2 \rightarrow 2CO$

calcium carbonate decomposes to form calcium oxide and carbon dioxide / $CaCO_3 \rightarrow CaO + CO_2$

calcium oxide / calcium carbonate reacts with silica / silicon oxide / silicon(IV) oxide (in ore) to form calcium silicate / slag / $CaO + SiO_2 \rightarrow CaSiO_3$ **or** $CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$

the reaction between carbon and oxygen is exothermic / produces heat / coke is used as a fuel / the slag floats on the (molten) iron / the slag and molten iron can be run off separately
[6]

(b) (i) greenhouse effect **/** CO_2 is a greenhouse gas [1]
global warming / ice caps melting / suitable example [1]

(ii) burning or combustion of charcoal produces carbon dioxide [1]
trees use carbon dioxide (in photosynthesis) [1]

(iii) cathode reaction $Fe^{3+} + 3e \rightarrow Fe$ [1]

anode reaction $2O^{2} \rightarrow O_2 + 4e$ [2]
not balanced = (1) only

[Total: 13]

3 **(a) (i)** $Cu(OH)_2 \rightarrow CuO + H_2O$ [1

(ii) Rb [1]

(b) (i) electron loss [1]

(ii) because they can accept electrons [1]

(c) (i) copper and mercury [1]

(ii) add copper / mercury / metal to (named) acid **and** no reaction / no bubbles / no hydrogen [1]

(d) (i) Mn [1]

(ii) (solution) becomes colourless / decolourises
NOT: clear [1]

[Total: 8]

4 **(a) (i)** Sb;

(ii) Xe / B;

(iii) Sr / Te / A / D;

(iv) Sn and I / E and F;

(v) Sr / A; [5]

(b) any two from:
physical
niobium is
harder; stronger; higher mp/bp; higher density [2]
note: there has to be a comparison

any two from:
chemical
niobium is less reactive; forms coloured compounds; forms complex ions; its compounds have catalytic properties; has more than one oxidation state; has more than one valency electron; [2]
note: the response has to refer to or compare properties of both elements

[Total: 9]

5 **(a)** Group II metals will lose 2e **[1]**
Group VI elements will gain 2e **[1]**

(b) SCl_2 **[1]**
COND 8e around both chlorine atoms **[1]**
8e around sulphur with 2nbp and 2bp **[1]**
If x and o reversed ignore if this is the only error

(c) Ions cannot move in solid **or** can move in liquid **[1]**

(ii) No ions in sulphur chloride **or** it is covalent **or** only molecules **or** only strontium chloride has ions **[1]**

TOTAL = 7

6 (a) (i) number of outer electrons increases [1]
or number of electrons more than complete energy level
or number of electrons to be lost
or accept clear examples
NOT just different groups or valencies

(ii) gain electrons [1]
number of electrons to be gained is less across period [1]

or number of outer electrons increases

(b) Al_2S_3 [1]
Si_3P_4 [1]

(c) (i) silicon [1]

(ii) sodium [1]

(iii) sulphur or chlorine [1]

(d) unreactive **or** inert or does not react [1]

(e) 3Na to 1P [1]
COND next two marks
correct charges [1]
8e around P [1]
If covalent then only one mark for 3Na to 1P

(f) (i) 11.5/23 = 0.5 [1]

(ii) 0.25 [1]
conseq to (i)

(iii) 0.25 x 32 = 8 g [1]
conseq

(iv) 2.0 g [1]
only **conseq** to (iii) if answer to (iii) is less than 10

NB If (ii) is 0.3(125), no excess is possible, (iv) **ZERO**

TOTAL = 16