1 **(a)** **(i)** *element*
cannot be broken into anything simpler [1]
by chemical means [1]
OR made up of one type of atom only [2]

(ii) *compound*
two **or** more different elements [1]
chemically bonded together [1]

(iii) *mixture*
two **or** more substances not chemically joined together [1]

(b) **(i)** mixture [1]

(ii) compound [1]

(iii) element [1]

(c) conductivity (of heat or electricity) [1]

[Total: 9]

2 **(a)** **(i)** positive **and** negative ions [1]
regular pattern / opposite charges closer than the same charge [1]

(ii) so that charges cancel / ions may not have the same charge [1]

(iii) Any **three** of:
high melting point or boiling point
hard
brittle
soluble in water / insoluble in organic solvents
conduct (electricity) in liquid state **or** in aqueous solution / non-conductors or poor conductor (when solid) [3]

(b) correct formula [1]
correct charges [1]
6x and 2o around oxygen [1]

[Total: 9]

3 **(a)** weak forces between layers or between (hexagonal) rings / weak bonds between layers or between (hexagonal) rings / Van der Waals forces between layers or between (hexagonal) rings; [1]
(layers/rings) slip/slide (over each other) / move over each other [1]

(b) strong bonds (between atoms) / covalent bonds (between atoms); [1]
all bonds are covalent/strong / each atom covalently bonded / carbon (atoms) is bonded to four others / bonds are directional / (atoms are arranged) tetrahedrally; [1]
accept: carbon has four bonds

(c) graphite has delocalised / mobile / free electrons; [1]
diamond (outer shell) electrons used / fixed / localised in bonding / no delocalised electrons / no mobile electrons / no free electrons; [1]

4 **(a) (i)** melting point is below 25°C; [1]
boiling point above 25°C; [1]
accept: argument based on actual values
note: 25°C is between mp and bp = [2]

(ii) strontium loses 2e; [1]
sulfur gains 2e; [1]

(iii) hydrogen chloride / hydrochloric acid; [1]
accept: sulfurous acid or sulfur dioxide

(iv) molten strontium chloride has ions / ionic compound; [1]
which can move; [1]
sulfur chloride has no ions / only molecules / molecular / covalent;

(b) strontium carbonate does not dissolve / no effervescence; [1]
note: not just reaction is complete

(ii) to remove excess / unreacted / undissolved strontium carbonate; [1]

(iii) water of crystallisation needed / $6H_2O$ in crystals / would get anhydrous salt / would not get hydrated salt / crystals dehydrate; [1]
not: just to obtain crystals

(c) number of moles of HCl used = 0.05 × 2 = 0.1 [1]
number of moles of $SrCl_2.6H_2O$ which could be formed. = 0.05 [1]
mass of one mole of $SrCl_2.6H_2O$ is 267 g
theoretical yield of $SrCl_2.6H_2O$ = 0.05 × 267 = 13.35 g [1
percentage yield = 6.4 / 13.35 × 100 = 47.9% [1]
accept: 48%
allow: ecf

[Total: 15]

5 **(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]

6 **(a** **(i)** $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ [2]
not balanced = [1]

(ii) 3 bps and 1 nbp around As; [1]
1 bp each hydrogen atom; [1]

(b) (97.4 / 75 =) 1.3 **and** (2.6 / 1 =) 2.6; [1]
empirical formula AsH_2; [1
note: correct formula with no working = [1]

(ii) As_2H_4; [1]

(iii) $H_2As–AsH_2$ / $AsH_2–AsH_2$; [1

(c) **(** amide / peptide; [1]

(ii) named strong acid / alkali; [1]
allow: HCl / enzymes

(iii) amino acid; [1]
allow: peptides

(d) **(** Cu and As have more than one oxidation state / valency; [1]

(ii) $3Cu^{2+} + 2AsO_4^{3} \rightarrow Cu_3(AsO_4)_2$ [2]
either side correct = [1]

[Total: 14]

7 **(a** $C + O_2 \rightarrow CO_2$ [1]

(b) (i) CO_2 already formed (from C burning or from $CaCO_3$); [
then carbon reacts with carbon dioxide; [1]
or
$C + CO_2 \rightarrow 2CO$ = [2] If equation not balanced = [1]

(ii) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ [2]
not balanced = [1]
not: reduction by carbon

(c) to remove / neutralise silica / silicon dioxide / silicon(IV) oxide / sand; [1]
reacts with limestone to form slag / calcium silicate; [1]
$CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$ [1]
or $CaO + SiO_2 \rightarrow CaSiO_3$
or $CaCO_3 \rightarrow CaO + CO_2$

(d) galvanising / galvanisation / sacrificial protection; [1]

(ii) sacrificial protection / zinc is sacrificed;
zinc corrodes rather than iron;
zinc is oxidised in preference to iron;
zinc reacts with oxygen and / water in preference to iron;
zinc more reactive / electropositive than iron;
zinc loses electrons more readily than iron;
electrons move on to iron
any **three** [3]

[Total: 12]