1 (a) **(i)** Cs / Fr [1]

(ii) Br [1]

(iii) U / Pu / Th [1]

(iv) I or At [1]

(v) As [1]

(vi) He / Ne / Ar / Kr / Xe [1]

(b) **(i)** GeO_2 / GeO [1]

(ii) $TeBr_2$ / $TeBr_4$ [1]

(c) **(i)** Sr^{2+} [1]

(ii) F^- [1]

2 **(a** any **three** from:
barium more reactive / forms ions more readily
barium reacts with (cold) water, nickel does not
barium more vigorous with acids
nickel compounds coloured, barium compounds white
nickel has more than one oxidation state, barium has one
nickel / nickel compounds catalysts, barium / barium compounds not catalysts
nickel forms complex ions, barium does not [3]

(b) (i) forward reaction favoured by low temperatures / reverse reaction favoured by high temperatures / heat [1]
exothermic [1]

(ii) products / RHS [1]
has fewer moles / molecules / smaller volume / ORA [1]

(iii) do not react or left behind / left at 60 °C [1

(iv) electrolysis [1]
cathode (pure) nickel [1]
anode impure nickel [1]
electrolyte is a soluble nickel salt [1]

3 **(i** sulfur [1]

(ii) iodine [1]

(iii) copper **ignore** (II) [1]

(iv) calcium [1]

(v) helium [1]
not name of a compound
accept correct symbols

4 **(a** a transition element has more than one oxidation state or valency [1]
accept different oxidation states

(b) by removing oxygen concentration of O_2 decreases [1]
prevents the back reaction / equilibrium shifts to right [1]

(c) oxidation number reduced (from (+) 4 to 0) [1]
accept accepts electrons **or** accepts four electrons
if number given must be 4

(d) low density / lightweight / light [1]
propellers / fittings on ships / inert anodes in electrolysis / hip replacements /
ship building / chemical plants / cathodic protection / diving equipment [1]

(e) **(i)** percentage of oxygen = 31.6 % [1

(ii) calculate the number of moles of atoms for each element

number of moles of Ti = 31.6/48 = 0.66

number of moles of O = 31.6/16 = 1.98 **accept** 2 [1]
both correct for one mark

(iii) the simplest <u>whole number ratio</u> for moles of atoms:

Fe	:	Ti	:	O
1		1		3

[1]

(iv) formula is $FeTiO_3$ **accept** $TiFeO_3$ [1]
must be whole numbers from **(iii)** or cancelled numbers from **(iii)**
mark **ecf** throughout

5 **(a) (i)** same molecular formula / same number of C and H atoms [1]
different structural formula or structure [1]
same compound = [1]

(ii) correct **formula** of but-2-ene / methylpropene / methyl cyclopropane [1]

(iii) bromine / bromine water / aqueous bromine [1]
brown to colourless **not** clear [1]
stays brown [1]
brom**ide** loses the first mark only

OR alkaline potassium manganate(VII) [1
from purple/pink to green/brown [1]
stays purple [1]

OR acidic potassium manganate(VII) [1
from purple/pink to colourless **not** clear [1]
stays purple [1]

(b) heat / high temperature (temperature need not be stated, but if it is stated it must be 500ºC or above) [1]

catalyst (need not be named, but if they are named accept any metal oxide or zeolite / aluminosillicates / silicon dioxide) [1]
not nickel/platinum

(c) (1,2)dibromobutane
if numbers given must be correct
butane [1]
butanol [1]
accept butan-1-ol or butan-2-ol **not** but-1-ol / but-1-anol / buthanol

6 **(a) (i)** strong
hard
light **or** low density
high melting point **or** high fixed points
Accept high strength to weight ratio for [2]
it includes marks 1 and 3
any **THREE** [3]

(ii) silicon [1]
four [1]

(b) diagram to include:
each germanium atom bonded 4 oxygen atoms [1]
each oxygen to 2 germanium atoms [1]
looks **or** stated to be tetrahedral [1]
"tetrahedral" scores mark even if diagram does not look tetrahedral
independent marking of three points

(c) (i) structural formula of Ge_4H_{10} all bonds shown [1]

(ii) germanium(IV) oxide [1]
water [1]

[Total: 11]

7 An incorrectly written symbol, e.g. NA or CL, should be penalised once in a question.

(a) bromine [1]

(b) germanium [1]

(c) potassium **or** calcium [1]

(d) krypton [1]

(e) iron **or** cobalt [1]

(f) bromine [1]

(g) vanadium [1]

ACCEPT name or symbol

[Total: 7]