

- 1 (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]

- 2 (a) any four max 4
- carbon forms carbon dioxide / carbon monoxide [1]
  - this is a gas it escapes / blown out / diffuses [1]
  - silicon forms silicon(IV) oxide / silica [1]
  - / silicon(IV) oxide present in impure iron
  - silicon(IV) oxide reacts with calcium oxide to form slag **or** calcium silicate [1]
  - slag removed from surface [1]
  - accept** skimmed, syphoned, poured off
  - not** tapped max [4]
  - accept** correct formula or equations
  - not** calcium oxide reacts with silicon
- (b) (i) any sensible suggestion – harder/stronger/can be tailored for a specific use/more resistant to corrosion [1]
- not** steel does not rust
- (ii) mild steel – cars or any vehicle/bicycles/white goods/screws or nails/roof/bridges/tools/buildings/ships/pipes/machinery etc. [1]
- stainless steel – chemical plants/cooking utensils/jewellery/cutlery/surgical equipment/kitchen sinks/pipes/etc. [1]
- (c) (i) strong attractive forces / strong bonds / bonds hard to break / requires a lot of energy to break bonds [1]
- not** between ions, **not** between positive and negative ions,  
**not** between electrons
- between positive ions and (negative) electrons / opposite charges attract [1]
- (ii) because the layers, lattice or rows of ions/cations [1]
- accept** sheets of ions  
**not** atoms / molecules / protons / nuclei
- can move / slip / slide past each other [1]

3 (b) metal A is magnesium [1]

**cond** most reactive or fastest reaction [1]

metal B is aluminium [1]

**cond** faster reaction after removal of oxide layer / it would give more hydrogen / aluminium more reactive than zinc [1]

metal C is zinc [1]

zinc least reactive [1]

**NOTE MAX** [5]

If you encounter different reasoning which is correct, please award the appropriate marks.

(b) for magnesium and zinc same volume of hydrogen [1]

because both have valency of 2 / 1 mole of metal gives 1 mole of hydrogen / 1 mole of metal reacts with 2 moles of acid [1]

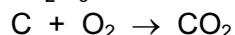
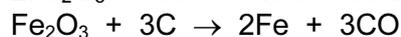
bigger volume for aluminium because its valency is 3 / 1 mole of metal gives 1.5 moles of hydrogen / 1 mole of metal reacts with 3 moles of acid [1]

If you encounter different reasoning which is correct, please award the appropriate marks.

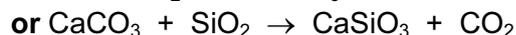
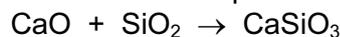
**accept** balanced equations

**accept** ionic charges as alternative to valency

4 **One** redox equation [1]



**one** acid/base equation [1]



**three** more equations or comments [3]

carbon burns to form carbon dioxide

this reaction is exothermic or produces heat

carbon dioxide is reduced to carbon monoxide

carbon monoxide reduces hematite to iron

carbon reduces hematite to iron

limestone removes silica which is an impurity

to form slag which is a waste product

limestone decomposes or symbol/word equation

- 5 (a) alloy / mixture [1]  
 iron and carbon / another metal or element etc. [1]
- (ii) electron loss [1]
- (b) electrons move from / lost from Mg [1]  
 to steel / iron [1]
- (c) (i)  $2\text{H}^+ + 2\text{e} \rightarrow \text{H}_2$  [2]  
 not balanced = 1
- (ii) sacrificial protection – is a cell [1]  
 cathodic protection – is electrolysis NOT electrical cell [1]  
**or:**  
 sacrificial protection – electrons from more reactive metal [1]  
 cathodic protection – electrons from battery etc. [1]  
**or:**  
 sacrificial protection – does not need or use power / battery / electricity / electrical cell [1]  
 cathodic protection – does [1]  
**or:**  
 sacrificial protection uses up / needs a sacrificial / more reactive metal [1]  
 cathodic protection doesn't [1]

- 6 (a) (i) harder / stronger / any sensible suggestion which relates to better properties for purpose  
e.g. stays sharp longer / cuts better / more corrosion resista [1]
- (ii) zinc [1]
- (b) lattice [1]
- (ii) regular pattern of one type of atom [1]  
with different atom interspersed [1]  
can show the difference – size, shading, label etc.
- (iii) can change its shape by force / plastically deform / can be hammered into sheets / can  
bend etc. [1]
- (iv) particles / ions / atoms / layers [1]  
**cond** can slide past each other [1]  
**or** metallic bond is non-directional [1]  
particles can move past each other [1]
- (c) tin(IV) oxide + carbon → tin + carbon dioxide [1]  
**not** carbon monoxide as a reductant  
**accept** carbon monoxide as a product  
**not** tin(IV)  
**accept** correct symbol equation
- (ii) water [1]  
carbon dioxide [1]
- (iii) correct labels for  
(pure) copper cathode [1]  
impure copper anode [1]  
electrolyte copper(II) sulfate / any soluble copper(II) salt / Cu<sup>2+</sup> [1]  
if labels on electrodes reversed [0]
- (iv) wires / pipes / jewellery / nails / roofing / ammunition / coins / cookware / catalyst /  
sculpture [1]

[Total: 15]

- 7 (a) (i) heat / roast / combustion / high temperature [1]  
**accept** burn [1]  
 in air / oxygen [1]  
 any incorrect Chemistry MAX [1]
- (ii)  $\text{ZnO} + \text{C} \rightarrow \text{Zn} + \text{CO}$  [1]  
**OR**  $2\text{ZnO} + \text{C} \rightarrow 2\text{Zn} + \text{CO}_2$   
 the equation must balance, if not [0]  
**not** carbon monoxide as a reactant /
- (iii) fractional [1]  
 distillation [1]
- (b) making alloys / brass / named alloy which contains zinc [1]  
 galvanising / sacrificial protection / electroplating [1]  
 accept galvanising / one specific use which depends on galvanising  
 zinc coated screws / roofing / buckets / sinks  
**not** just plating other metals
- (ii) positive ions / cations [1]  
**not** nuclei / atoms
- delocalised / free / mobile or sea of electrons [1]  
 bond is attraction between (positive) ions and delocalised electrons [1]  
 it is a good conductor because there are delocalised / free / mobile electrons [1]  
**Note** must be clear that electrons are moving / carry charge / reason why it is a  
 good conductor

[Total: 11]