

GCSE CHEMISTRY METALS & THE REACTIVITY SERIES
ANSWERS AND MARK SCHEMES

QUESTIONSHEET 1

- | | | |
|-----|--|-------------|
| (a) | voltmeter | 1 |
| (b) | greater difference between the reactivity of the metals
the greater the voltage
references between more reactive metal & greater voltage | 1
1
1 |
| (c) | accept any value between 0.6 and 1.6 volts | 1 |
| (d) | stays at 1.6 volts | 1 |
| (e) | silver is slightly less reactive than copper | 1 |
| (f) | liquid will spill out of the container / not portable | 1 |

TOTAL 8

QUESTIONSHEET 2

- | | | |
|-----|--|--------|
| (a) | D
A
B
C
(2 for all correct, 1 for one mistake) | 2 |
| (b) | A = magnesium
B = iron
C = platinum
D = calcium
(4 correct – 3 marks, 3 correct – 2 marks
2 correct – 1 mark) | 3 |
| (c) | (i) 2 HCl | 1 |
| | (ii) MgCl ₂ contains Mg ²⁺
formula is MgSO ₄ | 1
1 |
| | (iii) magnesium nitrate | 1 |

TOTAL 9

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QUESTIONSHEET 3

- (a) (i) reaction → zinc sulphate + copper 1
1
- (ii) no reaction 1
- (iii) reaction → magnesium sulphate + zinc 1
1
- (b) (i) loss of oxygen/gain of hydrogen/gain of electrons 1
- (ii) magnesium + copper oxide → magnesium oxide + copper 1
- (iii) magnesium circled 1
- (iv) the minimum energy required for a reaction to happen 1
1
- (c) (i) lead oxide/copper oxide 1
- (ii) calcium oxide/potassium oxide 1

TOTAL 12

QUESTIONSHEET 4

- (a) lithium
barium
magnesium
aluminium
all correct – 2 marks, 2 correct – 1 mark 2

(b)

solution	aluminium	barium	lithium	magnesium
aluminium nitrate			✓	
barium nitrate	*			
lithium nitrate		*		*
magnesium nitrate				

4 correct - 3 marks
3 correct - 2 marks
2 correct – one mark

3

- (c) aluminium reacts with oxygen/air 1
forms layer of aluminium oxide 1
coating prevents aluminium from reacting 1

TOTAL 8

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QUESTIONSHEET 5

- (a) (i) bauxite 1
- (ii) lowers melting point of aluminium oxide 1
process uses less energy/cheaper 1
- (iii) anode 1
 $2\text{O}^{2-} \rightarrow \text{O}_2 + 4\text{e}^-$
- cathode 1
 $\text{Al}^{3+} + 3\text{e}^- \rightarrow \text{Al}$
- (b) (i) haematite 1
- (ii) loss of oxygen/gain of hydrogen/gain of electrons 1
- (iii) $3\text{CO} + \text{Fe}_2\text{O}_3 \rightarrow 3\text{CO}_2 + 2\text{Fe}$ 2
- (iv) road building/fertiliser 1
- (c) aluminium higher than carbon in series 1
carbon not reactive enough to reduce aluminium oxide 1

TOTAL 12

QUESTIONSHEET 6

- (a) TEST - use of a named indicator 1
eg. Universal or pH indicator
RESULT - correct colour for the indicator used 1
eg. turns blue/purple
- (b) M_2O 1
- (c) GROUP – 1 1
REASON - forms compounds with similar formula to group 1 metals/
(accept named metal)/forms single positive ions 1
NOT - reacts violently with water
(this could be a group 2 metal)
- (d) REACTIVITY SERIES - correct order, placing manganese at the top 1
REASON - group 1 metals appear at the top of the reactivity series 1
- (e) copper + manganese sulphate 1
- (f) (i) manganese sulphate 1
- (ii) $2\text{MOH} + \text{H}_2\text{SO}_4 \rightarrow \text{M}_2\text{SO}_4 + 2\text{H}_2\text{O}$ 2
(1 mark for correct formulae for products)
(1 mark for balancing)

TOTAL 11

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QUESTIONSHEET 7

(a)	(i)	iron + aluminium oxide	1
	(ii)	2 Al and 2 Fe BOTH REQUIRED	1
(b)		aluminium is more reactive / higher in reactivity series than iron metals will therefore swap places / displacement occurs	1 1
(c)		gives a larger surface area therefore gives a higher rate of reaction / reacts more quickly	1 1
(d)	(i)	copper is less reactive than iron / is lower in the reactivity series therefore no reaction will take place	1 1
	(ii)	magnesium / zinc	1
			TOTAL 9

QUESTIONSHEET 8

(a)		measuring cylinder / burette/ pipette	1
(b)		chemical balance / balance NOT weighing machine or scales	1 1
(c)		temperature would rise brown / pink solid formed solution becomes colourless / blue colour of solution fades	1 1 1
(d)		$\text{Cu} + \text{ZnSO}_4$ BOTH REQUIRED	1
(e)		some zinc will be left over / unreacted at the end of the reaction / more than enough zinc to react with the copper sulphate	1
(f)	(i)	no reaction would take place	1
	(ii)	zinc is less reactive than magnesium / magnesium is more reactive than zinc zinc will not be able to displace magnesium	1 1
			TOTAL 10

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QUESTIONSHEET 9

- (a) ONE FROM:
metal A - reaction with air - colour change
metal B - reaction with air - colour change
metal B - reaction with water - fizzing/bubbles/effervesces
metal D - reaction with air - colour change
metal D - reaction with water - fizzing/bubbles/effervesces 1
- (b) MOST REACTIVE D
B
A
LEAST REACTIVE C 2
(1 mark for C being placed as least reactive)
- (c) D 1
REASON - reacts vigorously with water/ most reactive metal 1
- (d) C 1
- (e) copper + oxygen \rightarrow copper oxide 2
(1 mark for identifying oxygen as a reactant)
(1 mark for identifying the oxide as the sole product)
- (f) metal D is very reactive with water 1
metals react more vigorously with acid than with water 1
(references to 'too dangerous' scores 1 mark)

TOTAL 10

QUESTIONSHEET 10

- (a)
- | | |
|-----------|---------------------------------|
| copper | reacts with steam |
| iron | vigorous reaction in cold water |
| magnesium | no reaction with steam or water |
| potassium | reacts reversibly with steam |
- one per connection 3
- (b) (i) potassium 1
- (ii) magnesium/ iron 1
- (c) (i) hydrogen 1
- (ii) lighted splint
pops/explodes 1

TOTAL 8**QUESTIONSHEET 11**

- (a) aluminium
zinc
iron
lead
(4 correct – 2 marks, 2 correct – 1 mark) 2
- (b) (i) $\text{MgSO}_4(\text{aq}) + \text{Cu}(\text{s}) \rightarrow \text{Mg}(\text{s}) + \text{CuSO}_4(\text{aq})$ 2
- (ii) Any two from:
magnesium dissolves
brownish copper metal precipitated
blue colour of solution fades 2
- (iii) copper – last/bottom 1
magnesium – first/top 1
- (c) (i) no reaction 1
- (ii) reaction
 \rightarrow aluminium sulphate + iron 1

TOTAL 10

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QUESTIONSHEET 12

- (a) (i) Any two from:
sodium melts/becomes molten ball
moves across water quickly
increased amount of fizzing 2
- (ii) $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$ 1
- (iii) purple/dark blue 1
pH 12 – 14 1
- (b) Any two from:
potassium moves across water at increased speed
burns with lilac flame
sparks/explodes 2
- (c) (i) alkali metals 1
- (ii) have one electron in outer shell 1
- (iii) reactivity increases down group 1
outer electron becomes further from nucleus 1
nucleus has less force of attraction on outer electron/ increased shielding 1
outer electron is lost more easily 1

TOTAL 13

QUESTIONSHEET 13

- (a) oxygen and water BOTH REQUIRED 1
- (b) zinc corrodes instead of the iron
NOT forms a protective barrier 1
- (c) zinc is more reactive than iron/ zinc is higher in the reactivity series. 1
- (d) sea water is needed to complete the circuit 1
- (e) arrow points away from the zinc block 1
- (f) PREDICTION : iron would rust faster 1
REASON : iron is more reactive than copper and so will corrode first 1
- (g) nails placed in salt water and in deionised water 1
some form of observation or measurement of rusting after a period of time 1
use of 'fair' test or comparison between the two results 1

TOTAL 10

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QUESTIONSHEET 14

- (a) the less reactive metals were discovered first or earlier 1
- (b) (i) TWO FROM :
brown solid formed
blue solution will fade/become colourless
zinc dissolves 2
- (ii) copper + zinc sulphate BOTH REQUIRED 1
- (c) (i) 13°C 1
- (ii) exothermic 1
- (iii) TWO FROM:
add greater mass of zinc
use a more concentrated solution of copper sulphate
use a more reactive metal than zinc/accept a named metal 2
- TOTAL 8**

QUESTIONSHEET 15

- (a) brown solid is copper metal 1
magnesium is more reactive than copper 1
- (b) no reaction takes place 1
copper is less reactive than zinc 1
- (c) THREE FROM :
carbon is more reactive than iron
carbon will displace iron from its oxide forming iron metal
carbon is less reactive than aluminium
carbon and aluminium oxide will therefore not react 3
- (d) zinc is more reactive than hydrogen 1
zinc will displace hydrogen from an acid to form hydrogen gas 1
copper is less reactive than hydrogen 1
- (e) stability of carbonates is linked to the position of metals in the reactivity series 1
carbonates of metals that are lower decompose more easily 1
- TOTAL 12**

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QUESTIONSHEET 16

- (a) bubbles of gas / fizzing / effervescence/ iron dissolves 1
- (b) aluminium metal has a layer of oxide present 1
this makes it resistant to attack / is a protective layer /prevents reaction 1
- (c) students were investigating the effects of acid rain 1
this contains sulphuric acid / formed from sulphur dioxide 1
- (d) (i) lead and copper nitrate (ANY ORDER - 1 mark each) 2
- (ii) brown / pink solid or deposit 1
- (iii) lead + copper nitrate → copper + lead nitrate 1
- (iv) lead has displaced the copper in the compound 1
(accept replaced or changed places with)

TOTAL 10

QUESTIONSHEET 17

- (a) silver 1
- (b) sodium 1
- (c) mercury 1
- (d) sodium 1
- (e) magnesium 1
- (f) iron 1
- (g) zinc 1
- (h) sodium 1
- (i) calcium 1

TOTAL 9

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QUESTIONSHEET 18

- (a) iron 1
aluminium oxide 1
- (b) energy is given out in the reaction / reaction is exothermic 1
temperature rises above 1500°C to melt the iron 1
- (c) increases the surface area 1
reaction rate is increased / reaction happens faster 1
- (d) to allow the molten iron to run into the gap between the rails 1
- (e) clay is able to withstand the high temperatures reached 1
- (f) aluminium is more reactive than iron 1
copper is less reactive than iron 1
displacement only occurs when the metal is more reactive 1

TOTAL 11

QUESTIONSHEET 19

- (a) magnesium
copper
silver 1
- (b) (i) gain oxygen/lose hydrogen/lose electrons 1
- (ii) magnesium + oxygen → magnesium oxide
OR
copper + oxygen → copper oxide 1
- (c) (i) copper becomes black/coated in silver 1
- (ii) copper more reactive than silver 1
displaced silver from solution 1
- (d) (i) no visible reaction 1
- (ii) copper is less reactive than magnesium 1
cannot displace magnesium 1

TOTAL 9

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QUESTIONSHEET 20

- | | | | |
|-----|-------|--|---|
| (a) | (i) | hydrogen | 1 |
| | (ii) | magnesium hydroxide (allow oxide) | 1 |
| (b) | (i) | hydrogen | 1 |
| | (ii) | Two from:
calcium, zinc, iron, lead, nickel | 2 |
| | (iii) | copper/silver/gold/platinum | 1 |
| (c) | | gold & silver are unreactive | 1 |
| | | do not tarnish easily/retain shine | 1 |
| | | iron would rust/corrode | 1 |

TOTAL 9

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