**- Mark Scheme /**

**Question Answer Marks AO Element Notes Guidance**

1(a) 22 s **1**

1(b) P (1) **2**

the gradient / slope of the graphis steep(est) (1)

1(c) 0.9 (g) **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1(d)(i) |  | (increasing temperature)increases / faster (1) |  | **1** |
|  | 1(d)(ii) |  | (larger pieces of carbonate)decreases / slower (1) |  | **1** |
|  | 2(a) |  | speeds up rate of reaction /makes reaction faster |  | **1** |
|  | 2(b) |  | any suitable source, e.g. fromcar engines / lightning / hightemperature furnaces |  | **1** |
|  | 2(c) |  | irritates eyes / nose / mouth /skin / airways / lungs |  | **1** |

3(a) 179.3 (g) **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 3(b) |  | A (1)the gradient / slope is thesteep(est) (1) |  | **2** |

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 3(c) |  | 360 (cm 3)3) |  | **1** |
|  | 3(d)(i) |  | decreases rate / reaction slower(1) |  | **1** |
|  | 3(d)(ii) |  | increases rate / reaction faster(1) |  | **1** |
|  | 4(a) |  | measuring volume ofcarbon dioxide (1) |  | **3** |

use of gas measuring apparatuse.g. syringe / inverted measuringcylinder full of water (1)

(measure gas volume) at timeintervals (1)

4(b) 31.25 (g) **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 4(c)(i) |  | decreases (rate) / slower (rate)(1) |  | **1** |
|  | 4(c)(ii) |  | increases (rate) / faster (rate)(1) |  | **1** |

5(a) thermal decomposition **1**

5(b) **M1** basic (oxide ) **2**

**M2** calcium is a metal (oxide)

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 6 |  | removal of oxygen / addition ofhydrogen / gain of electrons /decrease in oxidation number |  | **1** |
|  | 7 |  | carbon gains oxygen (from Fe2O3) / oxygen (from Fe2O3)combines with carbon |  | **1** |
|  | 8(a) |  | (zinc is) more reactive thaniron |  | **1** |
|  | 8(b) |  | 3+ (1)Fe |  | **2** |

accept / take / gain electrons(1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 9 |  | speeds up a (chemical) reaction(1) |  | **2** |

not used up or unchanged (atend) (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 10 |  |  fewer **OR** less molecules **OR** moles + on right **OR** in product(1) **ORA** |  | **2** |

equilibrium shifts to the right(1)

11(a) iron(II) hydroxide **1**

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 11(b) |  | any **two** from:• it (iron(II) hydroxide) isoxidised |  | **2** |

• to form iron(III) (hydroxide)/(oxide)

• by (iron(II) hydroxide reacting with) air / oxygen

11(c) (green ppt) remains **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 12(a) |  | any value between and including92–102 s |  | **1** |
|  | 12(b) |  | 34 (cm 3)3) |  | **1** |
|  | 12(c) |  | line steeper than original andstarting from 0 (1) |  | **2** |

line ends up at same finalvolume **AND** levels off at or before 90s (1)

12(d) increases rate / goes faster **1**

12(e) decreases rate / goes slower **1**

13(a) carbon dioxide **1**

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 13(b) |  | anhydrous copper(II)sulfate / white copper(II) sulfate (1) |  | **2** |

turns blue (1)

**OR**

 anhydrous cobalt(II) chloride / blue cobalt(II) chloride(1)

turns pink / red (1)

14(a) 2 (Fe) (1) **2**

3 (C*l* 2) (1)

14(b) reversible reaction **1**

15(a) hematite **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 15(b) |  | iron oxide loses oxygen / oxygentransferred from iron oxide tocarbon / carbon takes oxygenaway from iron oxide |  | **1** |

16(a) **1**

decomposition

16(b) 31.7 (g) **1**

17(a) water / H2O

**1**

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 17(b) |  | speeds up reaction / increasesthe rate of reaction |  | **1** |

17(c) **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 18(a) |  | gas released / gas escapes / gaslost |  | **1** |

18(b) 0.7 (g) **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 18(c) |  | line steeper than original andstarting from 0 and 200.0 g (1) |  | **2** |

line ends up at same final mass**AND** levels off at or before 104 s(1)

18(d) 0.22 (g) **1**

18(e) large pieces → 0.005 **1**

small pieces → 0.030

powder → 0.100

19(a) reversible reaction **1**

19(b) heat / warm **1**

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 20(a) |  | burning fossilfuels / volcanoes / heating(sulfide) ores |  | **1** |
|  | 20(b) |  | substance which speeds up areaction / substance whichincreases the rate of reaction |  | **1** |

20(c) pH 4 **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 20(d) |  | erodes buildings (made ofcarbonate rocks) / wears awaybuildings (made of carbonaterocks) / reacts withmortar / corrodes ironwork / corrodes metal |  | **1** |

21(a) any **two** from: **2**

• faster rate of fizzing

• solid dissolves quicker / disappears

quicker / gets smaller quicker

• fizzing stops quicker

• dissolving stops quicker

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**Question Answer Marks AO Element Notes Guidance**

21(b) any **three** from: **3**

• temperature

• volume (of acid)

• concentration (of acid)

• mass / amount (of CaCO3)

• particle size / surface area (ofCaCO3)

22(a) **M1** less ester **2**

 **M2** equilibrium moves left **AND**because forward reaction isexothermic

22(b) **M1** more ester **2**

**M2** (equilibrium moves right) to replace water

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 23 |  | **M1** (a substance which)increases the rate of areaction |  | **2** |

**M2** without being used up (at theend) **OR** unchanged (chemically) at the end **OR** without changing mass

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 24 |  | **M1** particles/molecules inexplanation |  | **4** |

**M2** (particles) move faster / more energy

**M3** more collisions per second**OR** greater collision rate

**M4** more of the (colliding)molecules/particles havesufficient energy (activationenergy) to react / more of thecollisions have sufficient energy(activation energy) to react

25(a)(i) **M1** Ni / Nickel **2**

**M2** (it) loses or donates electrons

25(a)(ii) redox **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 25(b) |  | 2+ + 2e(–)**M1** Pb → Pb+ + e(–) → Ag**M2** Ag |  | **2** |
|  | 25(c) |  | most reactive: nickel / Nilead / Pbleast reactive: silver / Ag |  | **1** |

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 26(a) |  | chromium(III) oxide losesoxygen / it losesoxygen / oxidation number ofchromium decreases |  | **1** |
|  | 26(b) |  | energy of reactants greater thanenergy of products **ORA** |  | **1** |

27 3 (H2) (1)

**3**

⇌ (1)

2 (UH3) (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 28(a) |  | 54 (cm 3)3) |  | **1** |
|  | 28(b) |  | **S** on any portion of the graphabove 2.0 min and below 3.8min |  | **1** |
|  | 28(c) |  | steeper gradient starting at 0,0(1) |  | **1** |

ends up at same volume (70 cm

3) (1)

28(d) decreases rate / goes slower **1**

28(e) increases rate / goes faster **1**

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**Question Answer Marks AO Element Notes Guidance**

29 **M1** increases

**4**

**M2** increases **M3** decreases

**M4** decreases

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 30 |  | colourless liquidcollects / condenses at top of thetube (1) |  | **2** |

copper(II) sulfate turns white (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 31 |  | line in shape of upward curve(1) |  | **2** |

line below the curve for alltemperatures (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 32 |  | loss of oxygen / gain ofelectrons / decrease in oxidationnumber |  | **1** |

33(a) (symbol for reversible reaction) **1**

⇌

33(b) add water **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 34(a) |  | carbon dioxide released / gasreleased |  | **1** |

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**Question Answer Marks AO Element Notes Guidance**

34(b) 2.2 (g) **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 34(c) |  | initial gradient of line steeperand starts at 250–0 (1) |  | **2** |

levels out at 247.8g (1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 34(d) |  | 20 °C → 0.1640 °C → 0.6430 °C → 0.32 |  | **1** |
|  | 35 |  | oxygen removed from the zincoxide / zinc oxide losesoxygen / it loses oxygen |  | **1** |
|  | 36(a)(i) |  | any value between 5.0 and5.5 min (inclusive) |  | **1** |
|  | 36(a)(ii) |  | 396 cm |  | **1** |
|  | 36(b) |  | initial gradient of line less steepand starting at 0–0 (1) |  | **2** |

levelling off at a lower volume(1)

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**Question Answer Marks AO Element Notes Guidance**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 37 |  | gas syringe drawn / measuringvessel dipping into trough ofwater drawn (1) |  | **3** |

gas syringe or measuring cylinder correctly labelled (1)

workable apparatus e.g. airtight(1)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 38 |  | 11.5 (cm 3 / min)3 / min) |  | **1** |
|  | 39 |  | oxygen removed from thecopper oxide / copper oxideloses oxygen / it loses oxygen |  | **1** |

40(a) gradient gets less **1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 40(b) |  | concentration of HC*l* isdecreasing |  | **1** |

40(c) 120 (s) **1**

[Total: 128]