AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.4.2 REACTIONS OF ACIDS (PACK 3)

SCORE	PERCENTAGE
/247	%

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Q1.

(a) positive

accept + ***or*** *+ve* ***or*** *plus*

1

(b) chlorine

1

(c) (i) hydroxide

Any indication of hydro…

1

(ii) destroys / damages / dissolves (owtte) the hair / follicle / root

allow burns / reacts with the hair

ignore incorrect name of compound

1

[4]

Q2.

(a) water / H_2O / hydrogen oxide

1

(b) eg H (atom) loses an electron to form H^+
or <u>only</u> a proton left

1

(c) is partially ionised in water

1

(d) (i) eg same concentration / quantity of Mg

accept: volume of acid / ribbon for both / same time

accept: volume of gas measured under the same conditions

1

(ii) C A D B

1

(e) (i) OH^-

1

(ii) acidic

1

[7]

Q3.

(a) hydrogen / H^+ /$2H^+$ / H_3O^+

allow H / 2H

do ***not*** *accept* H_2

apply list principle

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1

(b) (i) 143

*correct answer with or without working = **2** marks*

ignore units

if answer is not correct
*40 + (2 × 35.5) + (2 × 16) gains **1** mark*

2

(ii) 49.7% (49.6 to 50)

*correct answer with or without working = **2** marks*

*answer 49 gains **1** mark*

if answer is not correct:
*(71 ÷ 143) × 100 gains **1** mark*

allow error carried forward from part (b)(i)

*ie. (71 or their (2 × 35.5) ÷ answer to (b)(i)) × 100 gains **2** marks if calculated correctly and **1** mark if not calculated correctly.*

***Special case** 35.5 ÷ 143 × 100 = 24.8*
*to 25% **or** 35.5 ÷ answer to (b)(i) × 100 correctly calculated for **1** mark*

2

(iii) 9.9 to 10g

allow ecf from (b)(i) or (b)(ii)

1

(c) (i) an alkali

apply list principle

accept named alkali

accept hydroxide

accept soluble base

ignore base

1

(ii) a solid / insoluble substance (owtte)

1

(iii) filter / filtration

allow decant / centrifuge

*accept filtration followed by evaporation **or** filtration and evaporation*

*do **not** accept filtration or evaporation*

*do **not** accept evaporation and filtration*

1

[9]

Q4.

(a) (i) any **one** from:

- they are positive / cations
- they are H^+

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- opposite charges attract

  ignore atom

1

(ii) potassium is more reactive (or reverse)

assume 'it' refers to hydrogen

allow potassium reacts <u>with</u> water

*allow potassium is very reactive **or** most reactive metal / element*

allow hydrogen gains electrons more easily / is reduced more easily

accept potassium is higher up the reactivity series

1

(b) 6 **and** 2

accept correct multiples and fractions

1

(c) (i) the reaction / it is reversible **or** a description of a reversible reaction

allow 'it is an equilibrium'

allow reversible symbol drawn correctly

allow 'the reverse / back reaction'

1

(ii) **lithium nitride**

assume that 'it' or if they do not specify means lithium nitride

assume lithium / lithium nitrate refers to lithium nitride

- hydrogen is bonded / held / absorbed / has formed a compound / reacted with lithium nitride

1

plus **one** of:

- does not explode / cause a fire
- is not free / less hydrogen
- is not under pressure
- does not leak
- is only released slowly

1

- compound of hydrogen with lithium nitride / product is (more) stable / less reactive / less chance of a reaction

  accept converse for hydrogen as below

  assume that gas / hydrogen means gas in the cylinder

  - *hydrogen (in cylinder) / gas is not bonded / held absorbed / in a compound / reacted with lithium nitride*

1

*plus **one** of:*

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- *can explode / cause a fire*
- *is free*
- *is under pressure*
- *can leak*
- *releases quickly*

1

(d) (i) loss of an electron **or** loses electrons

do not accept any ref. to oxygen

1

(ii) full outer shell of 8 electrons on circle

need not be paired

can be ×, dot or e

*do **not** accept if extra electrons added to inner shell*

1

[10]

Q5.

(a) (i) hydroxide

1

(ii) blue

1

(b) (i) pipette

1

(ii) burette

1

(iii) changes colour

1

(c) repeat

allow check results with another group or student

1

[6]

Q6.

(a) gives out (heat)

1

(b) D

1

(c) L

1

(d) magnesium chloride

1

[4]

Q7.

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(a) sensible line of best fit which goes through or close to all the points **except** the anomalous point

allow wobbly / short double lines

± ½ square

1

(b) loss of gas / loss of CO_2

idea of gas produced / formed

1

(c) 7

1

(d) (i) steeper line from around the same starting point and left of the points

*allow crosses if they are fully correct for **1** mark*

1

levelling off at 99

accept short level line at 99

± ½ square

1

(ii) any **three** from:

- particles / molecules / atoms/ ions have more energy

  allow given / gain / get energy

- move faster

  ignore move about more

  ignore vibrate more / faster

- collide more often

  or more chance of collisions

  or bump into each other more

  ignore collide quicker / faster

- collide with more force / energy

  or more particles have the activation energy

  or more collisions result in reaction

  or more collisions are successful

3

Q8.

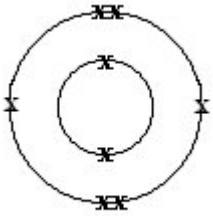
(a) $2Mg + O_2 \rightarrow 2MgO$

accept correct multiples / fractions

1

(b)

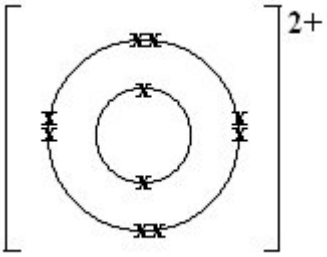
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electrons do not need to be paired
accept dots / circles / e instead of crosses
*do **not** allow 2.6 without diagram*

1

(c)



electrons do not need to be paired
allow without bracket s/ must have the charge
accept dots / circles / e instead of crosses
ignore extra empty outer shells
ignore nucleus
*do **not** allow $[2.8]^{2+}$ without diagram*

1

(d) oppositely charged (ions / atoms)

allow positive and negative(ions / atoms)

1

(they) attract

must be in correct context
accept held by electrostatic forces
ignore ionic bonding
***maximum 1** if they refer to intermolecular forces / attractions / covalent bonds*

1

(e) magnesium chloride

accept $MgCl_2$ (if correctly written)

1

[6]

Q9.

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(a) (i) burette

1

(ii) conical flask

accept conical / flask

1

(b) (i) an indicator

1

(ii) changed colour

1

(iii) titration

1

(c) 3

*correct answer = **2** marks*

*(1 × 3) or (1 × 750/250) = **1** mark*

1

(d) (i) hydrogen

2

(ii) is partially ionised

1

[9]

Q10.

(a) (i) (phosphoric) acid

allow phosphoric acid

1

(ii) hydrogen

1

(b) (i) faster / quicker / speeds it up (owtte)

allow answers based on activation energy

ignore helps it to react

1

(ii) most of the starting materials end up as useful products

1

(iii) H_2O

*allow HOH **or** OH_2*

1

[5]

Q11.

(a) (i) sulfuric

accept H_2SO_4

accept sulphuric

allow phonetic spellings

1

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(ii) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$

1 mark for reactants
1 mark for products
ignore state symbols
max 1 mark for incorrect balancing

2

(b) any **two** from:

- particles gain energy **or** particles have more energy
  allow have more activation energy
- particles move faster
  allow they collide faster / quicker
  ignore move / vibrate more
- collide more often
  allow more collisions
- collide more energetically
- more of the collisions are successful
  or more particles have the activation energy
  NB more successful collisions alone = 1 mark
  if particles are identified as electrons = max 1 mark

2

[5]

Q12.

(i) potassium hydroxide

accept correct formulae

1

water

1

(ii) fertiliser

1

(iii) H^+

*accept hydrogen but **not** H*

1

[4]

Q13.

(a) $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ **or**

$H_3O^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

mark for correct equation
mark for state symbols
any other symbols = 0 marks
accept correct spectator ions e.g.
$Na^+(aq) + OH^-(aq) + H^+(aq) + Cl^-(aq) \rightarrow Na^+(aq) + Cl^-(aq)$

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+ $H_2O(l)$

2

(b) (i) nitric acid **and** ammonia (solution)
HNO_3 NH_3 / NH_4OH

mark for both
accept ammonium hydroxide / NH_4OH instead of ammonia
*do **not** accept ammonia hydroxide*
*do **not** accept hydrogen nitrate solution*
accept correct formulae

1

(ii) provides oxygen or oxidising (agent) **or** oxidant

*do **not** accept it contains oxygen alone*
***or** rich in oxygen*

1

[4]

Q14.

nitric acid

1

potassium hydroxide

1

water

1

[3]

Q15.

(a) hydrogen

accept H_2
*do **not** accept H*

1

(b) litmus paper / Universal Indicator paper / pH paper

allow any suitable named indicator

1

bleached / turns white **or** loses its colour

*do **not** accept bleached cloth / leaves etc.*
allow second mark unless incorrect indicator given
allow starch iodide paper (1)
goes black / blue black (1)
allow potassium iodide solution (1) goes brown / orange / black precipitate (1)

1

(c) because they have a negative charge **or** opposite charges attract

accept (because) it is Cl^-
*accept chlorine, Cl **or** chlorine ions has a negative charge*
*do **not** accept Cl^- on its own*
*do **not** accept Cl_2 o.e. has negative charge*

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1

(d) kill bacteria / germs, etc. **or** sterilise / disinfect

accept destroys bacteria etc.
ignore clean / purify water (owtte)
*do **not** accept just gets rid of bacteria*

1

(e) hydroxide (ion)

accept OH^-

1

[6]

Q16.

(a) 100

ignore units
*40 + 12 + (3 × 16) for **1** mark*

1

(b) 40

*(**ecf** from part (a) can get **2** marks)*

$\frac{40}{\text{their (a)}} \times 100$ *for **1** mark*

1

(c) 0.5

*(**ecf** from part (b) can get **2** marks)*

$1.25 \times \left(\frac{\text{their (b)}}{100}\right)$ ***or** other correct working for **1** mark*

2

(d) gas produced **or** carbon dioxide / CO_2 produced

1

[7]

Q17.

(a) M_r (SiO_2) = 60

if M_r incorrect ecf for max 2

1

60 g SiO_2 → 28 g Si

*correct answer for **3** marks*

1

2.14 g SiO_2 → 1 g Si

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2
a unit is not required but an incorrect unit loses the third mark

OR M_r (SiO_2) = 60 (1)

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moles if silicon needed = $\frac{1}{28}$ = 0.0357

mass of SiO_2 needed = 0.0357 × 60 (1)

= 2.14 g (1)

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

OR M_r (SiO_2) = 60 (1)

mass SiO_2 = 1 × $\left(\frac{60}{28}\right)$ (1)

= 2.14 g (1)

allow 2, 2.1, 2.4 (or anything rounding to 2.14), 2.16 or 2.2

3

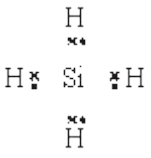
(b) (i) $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$

*penalise incorrect symbols correctly balanced equation for **1** mark state symbols for **1** mark*

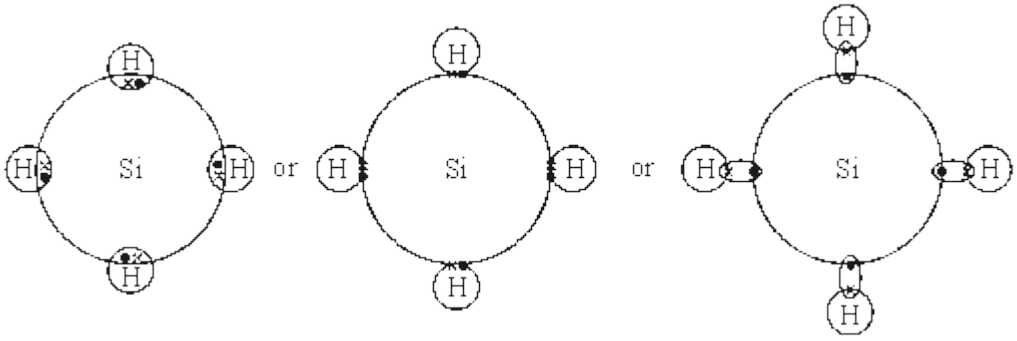
allow correct multiples / fractions

2

(ii)



or



ignore inner shell electrons of silicon
allow correct drawings without symbols
must clearly indicate four shared pairs of electrons with one electron from each atom

(iii)

Si	**H**
$\frac{1.4}{28}$	$\frac{0.15}{1}$

1

= 0.05	= 0.15

1

1	3

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for whole number ratio can be implied

1

$Si\ H_3$

*accept $H_3\ Si$ **or** any correct formula with 1:3 ratio*
if in step 1 they get either of ratios incorrect they lose first 2 marks but can be ecf for 3rd and 4th mark
*evidence of mass / A_r **1** mark*
*proportions of each **1** mark*
*whole number ratio **1** mark*
*correct formula **1** mark*

1

(iv) **C**

accept c

1

(c) any **four** from:

- giant structure / macromolecule / lattice / giant molecule
  allow giant molecular / giant atomic structure
- each silicon atom joined to four other atoms
  (or diagram)
- covalent bonds
- bonds are strong **or** large amount of energy needed to break bonds
  accept hard to break bonds
- large number of bonds to be broken
  *mention of giant **ionic** structure **or** intermolecular forces **or** intermolecular bonds max **1** mark*
  *diamond **or** carbon discussion max **3** marks unless clearly linked to silicon*

4

[15]

Q18.

(a)

***must** be a description of a titration no titration = **0** marks*

Quality of written communication

*for correct sequencing of 2 of first 3 bullet points i.e. 1 + 2 **or** 2 + 3 **or** 1 + 3*

1

any **three** from:

- nitric acid in burette
  *do **not** accept biuret*
  can be inferred from 3rd point
- add nitric acid until indicator changes (colour)

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can be named acid-base indicator
colour change does not have to be correct

- note (burette) volume used **or** final reading
- accuracy: e.g. repeat

  *accept white tile **or** dropwise near end **or** white background **or** swirling the flask **or** read meniscus at eye level*

3

(b) e.g. formula method:

$25 \times M_{NH3} = 0.25 \times 20$

1

$M_{NH3} = 0.2$

*correct answer alone = **2***

OR

moles NH_3 = moles HNO_3

$= \frac{20}{1000} \times 0.25 = 0.005$ moles (1)

concentration NH3

$= \frac{0.005 \times 1000}{25} = 0.2$ (1)

1

(c) sodium hydroxide **or** potassium hydroxide **or** lithium hydroxide **or** calcium hydroxide

ignore mention of alkali

1

ammonia produced

*accept gas produced turns (damp) (red) litmus blue (not blue litmus) **or** <u>alkaline</u> gas produced*

any suitable named indicator e.g. UI with consequential marking white fumes / smoke with (concentrated) HCl

*do **not** accept white gas wrong test = **0** marks*

1

[8]

Q19.

(a) (i) water

accept H_2O
accept correct ringed answer in box

1

(ii) neutralisation

accept underlining or any indication, eg tick

1

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(b) sodium hydroxide

1

sulphuric acid

apply list principletotal

1

[4]

Q20.

hydrogen ions (from acid) or protons / H^+

1

react with hydroxide ions (from alkali) / OH^-

1

to produce water

*$H^+ + OH^- \longrightarrow H_2O$ gains all **3** marks*
ignore state symbols
*molecules of hydrogen ions and molecules of hydroxide ions produce water = **2** marks*
*if they fail to get any of the above marks they can get **1** mark for neutralisation / product neutral*

1

[3]

Q21.

(a) (i) to remove or separate copper oxide

accept to remove or separate unreacted or excess base
accept to remove or separate insoluble solids

1

(ii) heat (the solution)

accept heat the water
accept evaporate the water
***rapid** cooling/cool to lower temperature*
accept boil the water or solution
***not** increase surface area, put in draught*
***not** increase the temperature*

1

(iii) aqueous

accept in water
accept solution
***not** soluble in water*

1

(b) add water/liquid/solution

1

colour changes to blue

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1

[5]

Q22.

(a) (i) ***must*** *be chemical symbol*

Ca

1

C

$CaCO_3$= 2 marks

1

O not O_2

1

(ii) carbon dioxide

must *be name*

1

(b) (i) *points all correct 2 marks*
one point incorrect 1 mark
two points incorrect 0 marks

2

suitable line -narrow neat single curve

not dot to dot

1

(ii) reaction with X forms less gas

must *include X or Y*

do ***not*** *penalise for H_2/O_2 if (a) (ii) already penalised*

do ***not*** *accept is finished in less time* ***or*** *slower/faster reaction* ***or*** *lower on graph*

1

(iii) any two from:

- concentration (of acid) decreases/less reacting particles/molecules
  not *acid/$CaCO_3$ runs out/is used up*
- surface area of calcium carbonate decreases
  not *strength of acid decreases*
- less collisions between reacting particles
  not *smaller (amount of) $CaCO_3$*

2

[10]

Q23.

(a) (i)

calcium → calcium + carbon

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carbonate oxide dioxide

accept $CaO_3 \rightarrow CaO + CO_2$

1

(ii) (thermal) decomposition

accept endothermic

accept reversible

1

(b) (i) neutralisation

accept exothermic

1

(ii) sulphuric (acid) H_2SO_4

2

(c) (i) to speed up the reaction

*accept to increase the rate of reaction **or** to increase the number **or** rate of collisions*

*do **not** accept "dissolves" copper oxide faster*

1

(ii) all acid reacts

*accept there will be no acid left **or** acid used up*

1

acid is neutralised (for **2** marks)

*do **not** accept to form a concentrated **or** saturated solution*

1

(excess) copper oxide collects in filter paper

accept larger particles (of copper oxide) cannot pass through filter paper

1

copper sulphate solution passes through the filter paper

*accept dissolved copper sulphate passes through filter paper **or** smaller particles (of copper sulphate) in solution (liquid) pass through filter paper*

*accept (black) solid collects in filter paper and filtrate **or** soluble solid **or** (blue) solution (liquid) passes through filter paper for 1 mark only*

1

[10]

Q24.

(a) 0 – 6

1

(b) more accurate

1

(c) burette

1

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(d) sodium hydroxide / potassium hydroxide / ammonia / any other soluble Group I or II hydroxide

1

(e) (i) named indicator / litmus / U.I. / methyl orange / methyl red / phenolphthalein

1

(iii) colour at end point

1

[6]

Q25.

(i) electrolysis

1

(ii) oxidation

1

(iii) hydroxide ions **or** OH^-

*accept sodium hydroxide **or** hydroxide **or** OH for one mark only*

2

(iv) $H^+ + e^-$

1

H_2

ignore any state symbols

1

$2H^+ + 2e^- \rightarrow H_2$

*accept $H^+ + e^- \rightarrow H$ for **one** mark only*

1

[7]

Q26.

(a) any four from:

- sulphuric acid measure by pipette
  ***or** diagram*
- potassium hydroxide in burette
  ***or** diagram*
- if solutions reversed, award
- note initial reading
- use of indicator
- note final reading **or** amount used

4

(b) $\frac{34 \times 2}{1000}$

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1

= 0.068

1

(c) ½ or 0.5 moles H_2SO_4 react with 1 mole KOH

1

moles H_2SO_4 in 25.0 cm^3 = 0.068 × 0.5

1

$\therefore$ moles H_2SO_4 in 1 dm^3 = $\frac{0.068 \times 0.5 \times 1000}{25}$ = 1.36 mol/dm^3

1

[9]

Q27.

(i) Mg + (H_2SO_4) →

1

MgSO4 +

1

H_2

*deduct **1** mark if not balanced only if all three correct*
*accept alternative metal of similar reactivity for example Zn **or** Fe candidate would not then be awarded first mark for Mg then error carried forward*
*deduct **1** mark if not balanced only if all three correct*

1

(ii) to remove the (excess) magnesium

accept separate
*accept insoluble substances **or** solids **or** residue*
*do **not** accept unreactive substances **or** impurities **or** remove magnesium from sulphuric acid*

1

(iii) to <u>evaporate</u> (some of the water **or** solution)

1

to form crystals **or** crystallise

*accept to form a saturated solution **or** concentrated solution*
*do **not** accept to leave $MgSO_4$*

1

[6]

Q28.

(a) (i) test: limewater

accept calcium hydroxide solution

1

result: 'goes' cloudy

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*accept white **or** milky*

*do **not** accept misty **or** chalky test must be correct before result mark can be considered*

1

(ii) $2\ NaHCO_3 + H_2SO_4 \rightarrow$

$Na_2SO_4 + (2)\ H_2O + (2)\ CO_2$

1

correctly balanced

1

(b) (i) $H^+ + OH^-$

1

$\rightarrow H_2O$

deduct **one** mark if incorrectly balanced

accept H_3O^+ instead of H^+ then $2H_2O$ needed for balance

1

(ii) pH increases

accept numerical indication

1

(c) addition of sulphuric acid

1

correct use of an indicator

accept idea of forming a neutral solution

1

crystallisation (of neutral solution)

accept description using evaporation

1

[10]

Q29.

(a) (i) H_2SO_4 **or** red (acidic) pH < 7

accept names of compounds

accept correct use of acidic

1

NaOH **or** purple (alkaline) pH > 7

*alkaline and neutral without any mention of pH for **1** mark only*

1

NaCl **or** green (neutral) pH 7

*ignore high **or** low pH*

1

(ii) hydrogen (ion)

accept proton

accept hydroxonium ion

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1

H^+

accept H_3O^+ for hydroxonium ion

1

(b) (i) neutralisation

1

(ii) NaOH + HCl

ignore state symbols

1

$NaCl + H_2O$

ignore state symbols

*maximum of **1** mark if incorrectly balanced*

1

(c) (i) sodium – 2 . 8 . 1

accept 2.8.1 written

1

chlorine – 2 . 8 . 7

accept 2.8.7 written

1

(ii) ion(s)

1

(iii) attraction between oppositely charged particles (ions)

accept attraction between + and – particles (ions)

accept electrostatic attraction

1

(d) chloride ions lose electrons to form chlorine

$Cl^- - e^- \rightarrow Cl$

1

hydrogen ions gain electrons to form hydrogen

$H^+ + e^- \rightarrow H$

1

sodium hydroxide remains in solution

Na + and OH^- remain in solution to form sodium hydroxide

1

[15]

Q30.

(a) hydrochloric acid in burette

1

indicator

1

note volume at end / neutralisation point

titre must be HC1

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1

(b) 1 mole HCl = 36.5g /36.5

1

$\therefore \frac{73}{36.5}$ = 2 moles / dm^3

2 for correct answer

1

(c) (i) $\frac{10 \times 2}{1000}$

allow e.c.f. ie their (b) × $\frac{10}{1000}$

2 for correct answer

1

= 0.02 moles

1

(ii) 0.02 × $\frac{1000}{25}$ = 0.8 mol / dm^3

1

allow e.c.f. ie their (c)(i) × $\frac{1000}{25}$

1

[9]

Q31.

(a) (i) (s) (aq) (1) (g)

*2 **or** 3 correct **1** mark*
*1 correct **0** marks*

2

(ii) calcium chloride

1

(b) (i) points

*deduct **1** mark for each error to a maximum of **2** marks*

2

line

accept a single line 'best fit' curve
accept reasonable attempt at curve

1

(ii) increase temperature **or** heat

*accept increase surface area **or** increase concentration **or** description*

1

(iii) 75% or ¾

not pure 1 mark

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only 60 cm³ (instead of 80 cm³ of gas)

$\frac{60}{80}$ ***or*** *× 100* ***1*** *mark*

3

[10]

Q32.

(a) (i) iron **must** be <u>named</u>

*do **not** accept Fe*

1

(ii) hydrogen

1

and oxygen mixtures

1

burn <u>rapidly</u>

1

(b) (i) lowers concentration

accept dilutes the acid

*do **not** accept cooling*

1

less collisions (between particles)

1

(ii) H^+ (aq)

accept H_3O^+ only if 2 in front of H_2O

1

OH^- (aq)

*if spectator ions correctly included on both sides, maximum = **1** mark*

1

(iii) $Ca(OH_2)$ weak alkali

accept NaOH strong alkali

1

$Ca(OH)_2$ causes no problems

accept NaOH causes named problem
*(eg caustic **or** exothermic **or** burns **or** corrosive)*

1

[10]

Q33.

(a) pipette / burette

1

(b) named indicator eg methyl orange / phenolphthalein

***not** universal*

*accept litmus but **not** litmus paper*

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1

(c) $\frac{25 \times 0.4}{1000}$

2 for correct answer

1

= 0.01

1

(d) 1KOH ≡ 1 HCl

∴ 0.01 moles HCl in 35 cm^3

1

∴ $\frac{0.01 \times 1000}{35}$ = 0.29

2 for correct answer
0.3 = (1) (with correct working = (2))

1

[6]

Q34.

(a) (i) fertilisers

for 1 mark

1

(ii) 7

for 1 mark

1

(iii) 5

for 1 mark
(ignore other units)

1

(b) (i) both nitrogen and hydrogen

for 1 mark

1

(ii) two of:
nitrogen;
hydrogen/methane/natural gas;
oxygen/air;
water;
any fuel
(allow symbols, do not allow nitrogen oxides)

any two for 1 mark each

2

(c) (i) alkali/alkaline/base/basic

for 1 mark

1

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(ii) must be nitrate

for 1 mark

1

(iii) thermometer or any other temperature measuring device

for 1 mark

1

[9]

Q35.

(a) sodium

1

(b) neutralisation

1

(c) increase/inc. number

1

(d) H^+

1

(e) OH^-

1

(f) $H^+ + OH^- \rightarrow H_2O$

1

[6]

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