M1. (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response.Examiners should also apply a best-fit approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)
There is a simple description of a laboratory procedure for obtaining potassium chloride.

Level 2 (3-4 marks)
There is a clear description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that does not necessarily allow the procedure to be completed successfully by another person. The answer must include the use of an indicator or a method of obtaining crystals.

Level 3 (5-6 marks)
There is a detailed description of a laboratory procedure for obtaining potassium chloride from potassium hydroxide solution and hydrochloric acid that can be followed by another person. The answer must include the use of an indicator and a method of obtaining crystals.

examples of the chemistry/social points made in the response:

- One reagent in beaker (or similar)
- Add (any named) indicator
- Add other reagent
- Swirl or mix
- Add dropwise near end point
- Stop addition at change of indicator colour
- Note volume of reagent added
- Repeat without indicator, adding same volume of reagent **or** remove indicator using charcoal
- Pour solution into basin / dish
- Heat (using Bunsen burner)
- Leave to crystallise / leave for water to evaporate / boil off water

Accept any answers based on titration

6

(b) nitric (acid)

allow HNO_3

ignore incorrect formula

1

(c) (i) because it is a fertiliser / helps plants grow

allow plant food

*do **not** accept pesticide / herbicide / neutralising soil*

1

(ii) tick by: 'Should farmers stop using ammonium nitrate on their land?'

1

any **two** from:

- cannot be done by experiment
  accept difficult to get / not enough evidence
- based on opinion / view
  allow must be done by survey
- ethical **or** economic issue
  *if top box ticked allow **1** mark for drinking water varies from place to place*

2

[11]

M2. (a) to speed up the reaction **or** it is a catalyst

allow higher level answers such as to reduce the activation energy

ignore cost or yield

1

(b) (i) reaction is exothermic

*accept reverse reaction is endothermic **or** high temperature causes decomposition of ammonia*

ignore reference to rate

1

(ii) more (gaseous) reactant molecules than (gaseous) product molecules

accept 4 volumes / moles of reactant and 2 volumes / moles of product

*accept lower volume of products **or** volume lower on right hand side*

accept 'favours the reaction which produces fewer molecules'

ignore incorrect number of moles

ignore reference to 'amount' of product / reactant

ignore references to rate

1

(c) (rate is) too slow / slower owtte

allow catalyst would not work

accept at higher temperature the rate is quicker

*accept at lower temperatures particles do not collide as often **or** fewer particles have the activation energy **or** particles do not have the activation energy*

ignore reaction would not work

ignore optimum / compromise type answers

1

(d) cooled

*allow ammonia / it is turned into a liquid **or** is condensed*

ignore references to boiling point

1

[5]

M3. (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.
$Na^+(aq) + OH^-(aq) + H^+(aq) + Cl^-(aq) \rightarrow Na^+(aq) + Cl^-(aq) + H_2O(l)$

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]

M4. (a) nitrogen

consider answers as a list

1

hydrogen

1

(b) speed up the reaction

accept increase rate of reaction

1

(c) fertiliser

*accept to replace **or** add nitrogen **or** nutrients*

*do **not** accept minerals or nitrates*

1

growth

*accept for protein **or** increased yield*

1

[5]

M5. (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

(ii) must be nitrate

for 1 mark

1

(iii) thermometer or any other temperature measuring device

for 1 mark

1

[9]

M6. (i) A = air
B = natural gas
for 1 mark each
2

(ii) nitrogen
both for 1 mark
1

(iii) catalyst / speed up reaction
for 1 mark
1

(iv) recycle unreacted gases / save money
for 1 mark
1
[5]

M7. (a)

*the answer yes **or** no does not gain a mark*

Yes – plants will grow faster

*do **not** accept grow better*

1

more food available, greater yield

1

OR

No – plants still grow without adding nitrates

*accept the idea that **small** amounts of nitrate could be used*

1

(nitrates) can 'kill' babies / causes brain damage

do not accept can stop respiration in babies

1

(b) (i) 2

accept two

1

(ii) $2 \times 14 + 4 \times 1 + 3 \times 16$

1

$= 80$

1

$\frac{28}{80} \times 100 = 35$ %

1

allow 1 mark for correct working for percentage 28/Y × 100, where Y is an incorrect formula mass
allow 2 marks for formula mass of 80 where no working
***or** correct working is shown*
allow 3 marks for 35 where no working
***or** correct working is shown*

[6]

M8. (a) as a catalyst

accept to speed up the reaction (equilibrium)

1

(b) nitrogen + hydrogen ⇌ ammonia

$N_2 + H_2 \rightleftharpoons NH_3$

accept mixed formula / word equations
ignore balancing

1

(c) (i) the reaction is reversible / an equilibrium

accept that ammonia can break down again into nitrogen and hydrogen
accept reaction goes both ways
*do **not** accept some nitrogen and hydrogen do not react*

1

(ii) (the gases are cooled)

no marks as given in the diagram
accept correct formulae NH_3, N_2 H_2

1

ammonia removed as a liquid

*accept ammonia liquefies **or** condenses*

nitrogen and hydrogen are recycled

accept nitrogen and hydrogen are put back through the converter
accept 'other gases' only if ammonia identified for first mark

1

[5]

M9. (a) ammonium nitrate

accept NH_4NO_3
*do **not** accept ammonia nitrate*

1

(b) different reactions need different catalysts

1

(c) they are used over and over again

accept they are reused
accept they are not used up
accept they are not changed
recycling is neutral

1

(d) any **two** from

they speed up reactions

they reduce energy requirements

accept allow reactions to take place at a lower temperature

they reduce costs

accept make process more economic

2

(e) (high pressure) increases the frequency of collisions

accept more collisions
move faster is neutral

1

this increases the rate of reaction

accept 'more successful collisions' for 2 marks

1

[7]