Mark schemes

Q1.

(a) **Level 3:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

3-4

Level 2: Some logically linked reasons are given. There may also be a simple judgement.

1-2

No relevant content

0

Indicative content

reasons

- compound **A** (potassium chloride) only contains potassium
- compound **A** (potassium chloride) is the only source of potassium so is needed.

- compound **B** (ammonium nitrate) only contains nitrogen
- compound **B** (ammonium nitrate) contains more nitrogen than compound **C** (diammonium hydrogen phosphate) so is preferable
- compound **B** (ammonium nitrate) contains more nitrogen and is cheaper than compound **C** (diammonium hydrogen phosphate) and so is more cost effective

- compound **C** (diammonium hydrogen phosphate) contains phosphorus which is not needed

judgement

- none of the compounds contain both nitrogen and potassium so a mixture is needed
- (both) compound **A** (potassium chloride) and **B** (ammonium nitrate) should be used
- (both) compound **A** (potassium chloride) and **C** (diammonium phosphate) could be used

(b) mining

allow quarrying

1

(c) potassium sulfate

ignore potassium chloride

allow potassium nitrate

allow any other named potassium salt

1

(d) ammonia

allow water

1

(e) (phosphate rock is) insoluble (in water)

allow (phosphate rock) cannot be absorbed as a solid

1

(f) (sulfuric acid)
calcium sulfate

allow single superphosphate

allow calcium phosphate

1

(phosphoric acid)
calcium phosphate

allow triple superphosphate

1

[10]

Q2.

(a) (nitrogen) air

allow atmosphere

1

(hydrogen) natural gas

allow methane

allow water / steam

1

(b) there is only one product

1

(c) (mixture is) cooled

1

(so that only) ammonia liquefies

allow (so that only) ammonia condenses

1

(d) scale labelled at 100, 200, 300 and 400 (atm)

allow scale labelled at 50, 150, 250 and 350 (atm)

1

all five points plotted correctly

allow a tolerance of ± ½ a small square

*allow **1** mark for three / four points plotted correctly*

2

line of best fit

1

(e) **View with Figure 2**

extrapolation to 500 atmospheres

1

percentage value at 500 atmospheres

allow a tolerance of ± ½ a small square

1

(f) **Level 3**: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

rate
- higher temperature gives higher rate because of more frequent collisions
- higher temperature gives higher rate because more particles have the activation energy
- higher pressure gives higher rate because of more frequent collisions
- use of catalyst gives higher rate because the activation energy is lowered

equilibrium
- higher temperature shifts the position of equilibrium to the left because reaction is exothermic
- higher pressure shifts the position of equilibrium to the right because more molecules on left-hand side
- use of catalyst has no effect on the position of equilibrium

other factors
- higher temperature (than 450°C) uses more energy so increases costs
- higher pressure (than 200 atmospheres) uses more energy so increases costs
- higher pressure (than 200 atmospheres) requires stronger reaction vessels so increases costs
- use of a catalyst reduces energy costs

compromise
- the temperature chosen is a compromise between rate of reaction and position of equilibrium
- the temperature chosen is a compromise between rate and cost
- the pressure chosen is a compromise between yield / rate and cost

[17]