

NPK Fertilisers

Mark Scheme



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1. NPK fertilisers are formulations containing compounds of nitrogen (N), phosphorus (P), and potassium (K), which are the three essential elements for plant growth."

Circle the letter of the correct answer for each of the following questions.

- a) A farmer adds calcium hydroxide to a field to neutralise acidic soil. He then immediately adds an ammonium based fertiliser. The two chemicals react, and a strong smell is noticed.

Why does this reaction reduce the effectiveness of the fertiliser?

A – is the only correct answer.	1 mark
	Total: 1 mark

- b) Which substance contains **two** elements that are found in NPK fertilisers?

C – is the only correct answer.	1 mark
	Total: 1 mark

- c) Plants require several essential elements to grow healthily.

Which of the following elements is not a primary component of a standard NPK fertiliser?

C – is the only correct answer.	1 mark
	Total: 1 mark

- d) A specific crop requires a fertiliser that is high in Potassium but low in Nitrogen.

The table below shows the NPK values for four different fertiliser bags.

Which fertiliser is most suitable for this crop?

B – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 4 marks)

2. Ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$, is a salt used as a fertiliser to improve crop yields.
It is made by reacting ammonia solution with sulfuric acid.

a) State the names of the three elements found in most fertilisers.

Any three from:	
• Phosphorus / P • Potassium / K • Nitrogen / N • Magnesium / Mg	
	Total: 3 marks

b) Suggest why farmers use fertilisers on their fields.

To improve crop growth / yield.	1 mark
Allow: to make plants grow faster / bigger.	
Allow: to replace nutrients in the soil.	
	Total: 1 mark

c) Write a **balanced** symbol equation for the reaction between ammonia and sulfuric acid to produce ammonium sulfate.

$2\text{NH}_3 + \text{H}_2\text{SO}_4 \rightarrow (\text{NH}_4)_2\text{SO}_4$	
Allow correct multiples.	
Award 1 mark for the correct reactants and products.	1 mark
Award 1 mark for the correct balancing.	1 mark
	Total: 2 marks

d) Calculate the percentage by mass (%) of Nitrogen in ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$.

Relative atomic masses (A_r): H = 1, N = 14, O = 16, S = 32.

Mr of $(\text{NH}_4)_2\text{SO}_4 = 132$	1 mark
Mass of N = 28	1 mark
$(28 \div 132) \times 100 = 21.2 \%$	1 mark
	Total: 3 marks

(Total for Question 2 is 9 marks)

3. A farmer tests the soil in a field.

The results show:

- Low levels of nitrogen and potassium.
- High levels of phosphorus.

Fertiliser	Formula	Name	Percentage of N, P & K	Cost per Kg
A	KCl	Potassium chloride	K: 52%	£0.24
B	NH ₄ NO ₃	Ammonium nitrate	N: 35%	£0.23
C	(NH ₄) ₂ HPO ₄	Ammonium hydrogen phosphate	N: 21% P: 23%	£0.35

Evaluate which compounds the farmer should use on this field.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Simple statements about which elements are in which fertiliser. May suggest a mix without full justification or cost analysis.
Level 2	3 - 4	A logical evaluation is given that identifies the missing nutrients in the soil, selects the correct fertilisers to replace them, and considers the cost efficiency to reach a valid conclusion.

Indicative content:	
Analysis of soil needs: • The soil has low levels of nitrogen and potassium. • The soil has high levels of phosphorus, so no extra phosphorus is needed. Evaluation of fertilisers: • Fertiliser A (KCl): contains potassium (52%) but no nitrogen. It is very cheap (£0.24 per kg). • Fertiliser B (NH₄NO₃): contains nitrogen (35%) but no potassium. It is the cheapest option (£0.23 per kg). • Fertiliser C ((NH₄)₂HPO₄): contains nitrogen (21%) and phosphorus (23%). It contains phosphorus which is not needed and is the most expensive option (£0.35 per kg). Conclusion: • Compound C should not be used because it provides unnecessary phosphorus and is the most expensive per kg. • Compounds A and B should be mixed together. • Reason: Mixing A and B provides the missing nitrogen and potassium without adding unnecessary phosphorus, and it is the most cost-effective solution.	
	Total: 4 marks

(Total for Question 3 is 4 marks)

4. Potassium chloride and potassium sulfate are used as fertilisers.

a) State the source of these **two** compounds.

Mined (from the ground / Earth).	1 mark
Allow: from rocks / ores / the Earth's crust.	
	Total: 1 mark

b) Phosphate rock is obtained from mining.

Explain why phosphate rock cannot be used directly as a fertiliser.

An explanation to include:	
Phosphate rock is insoluble (in water).	1 mark
Allow: plants cannot absorb it.	
So, it must be treated with acid to produce soluble salts.	1 mark
Allow: to make superphosphate / calcium phosphate.	
	Total: 2 marks

c) To make phosphate rock useful, it is treated with acid to produce soluble salts.

Complete the table below by naming the salts produced when phosphate rock reacts with different acids.

Row 1: Phosphoric acid	1 mark
Row 2: Calcium phosphate	1 mark
Row 3: Calcium phosphate	1 mark
	Total: 3 marks

d) Fertilisers like ammonium sulfate can be made in a school laboratory or in a large industrial factory.

Give **two** differences between the laboratory method and the industrial method of production.

Industrial: - Large scale / continuous process / faster. - High concentration / High temperature.	1 mark
Laboratory: - Small scale / batch process / slower. - Lower concentration / room temperature / crystallisation needed.	1 mark
	Total: 2 marks

(Total for Question 4 is 8 marks)