

Open Ended Questions – Advice

The most important message is to write as much correct information as you can that relates to the question! Make sure you have answered the question!

Don't be put off by the model answers – they were written by someone who has been teaching a long time! Just do your best and try to write at least three points of correct information!

If the question is about elements:

Try to mention correct information about

- atomic number and mass number
- group in the periodic table, number of outer electrons
- elements in the same group have the same chemical properties
- as you go down a group the physical properties change
- whether they are solid, liquid or gas

If the question involves molecules, compounds:

Try to mention information about

- bonding and properties (revise here http://www.bbc.co.uk/schools/gcsebitesize/science/add_edexcel/periodic_table/metalsrev4.shtml)
- include conduction
- solubility, melting and boiling points (from the data book)

If the question involves electricity:

Try to mention information about

- the electrochemical series (from the data book)
- an explanation of oxidation (loss of electrons), reduction (gain of electrons)
- how electrons flow from metals higher in the electrochemical series to lower in the electrochemical series
- any advantages or disadvantages about the environment (pollution, recycling, lack of availability of metals from the Earth's crust)

If the question involves homologous series:

Try to mention information about

- functional groups (carbon to carbon double bonds C=C, hydroxyl OH, carboxyl COOH)
- formula – molecular, structural
- increasing the number of carbons increase the boiling point and viscosity, decrease the volatility
- any advantages or disadvantages about the environment (pollution, recycling, use as fuels etc)

If the question is about Fertilisers:

Try to mention information about

- N, P and K essential elements
- Solubility
- Pollution
- Haber / Ostwald
- Natural v Synthetic

If the question is about metals:

Try to mention information about

- Reactivity series
- Whether it is found combined (reactive element) or uncombined (silver, gold)
- Energy needed to extract the metal (cost)
- Pollution – CO₂ formed to produce that energy
- Availability of metals is low as they are finite
- Properties and uses

If the question involves acids and bases (alkalis are soluble bases):

Try to mention information about

- Neutralisation reactions
 - Acid + alkali → Salt + water
 - Acid + carbonate → salt + water + carbon dioxide
- Write balanced equations
- Names of salts
- pH
- H⁺ ions in acids, OH⁻ ions in alkalis

If the question is about fuels:

Try to mention information about

- Combustion products – usually CO₂ and H₂O
- Pollution – from sulphur (burns to make SO₂), soot (unburned hydrocarbons)
- E_h = cmΔT experiment
- CO₂ impact on Global Warming (this is not pollution)

Examples from Specimen paper book:

Specimen Paper 1 Q 2 (d)

In 1825 bromine had been isolated from sea water by Liebig who mistakenly thought it was a compound of iodine and chlorine.

Using your knowledge of chemistry, comment on why he might have made the mistake.

Points to note:

- Cl, Br and I are in the same group of the periodic table and will have similar chemical properties
- They are all diatomic (Cl_2 , Br_2 and I_2)
- They all have 7 outer electrons and a valency of 1
- The formula of iodine chloride would be ICl
- The gfm of ICl is 162.5 and the GFM of Br_2 is 160 – these values are very close
- All molecules are covalent so would not conduct electricity when solid, molten or in solution
- Could draw dot-cross bonding diagrams here for ICl and Br_2

When Liebig tests the bromine he would find that it would have similar chemical and physical properties to iodine chloride because iodine, bromine and chlorine are all diatomic (I_2 , Br_2 and Cl_2) and because iodine and chlorine have a valency of 1, iodine chloride would have the formula ICl. They would have similar GFM's (can show this), they are covalent molecules, they would not conduct electricity when solid, molten or in solution and because they are in the same column of the periodic table, they would have similar reactivity.

Specimen Paper 1 Q10

10. The essential elements for plant growth are nitrogen, phosphorus and potassium.

A student was asked to prepare a dry sample of a compound which contained two of these elements.

The student was given access to laboratory equipment and the following chemicals.

Chemical	Formula
ammonium hydroxide	NH_4OH
magnesium nitrate	$\text{Mg}(\text{NO}_3)_2$
nitric acid	HNO_3
phosphoric acid	H_3PO_4
potassium carbonate	K_2CO_3
potassium hydroxide	KOH
sodium hydroxide	NaOH
sulfuric acid	H_2SO_4
water	H_2O

Using your knowledge of chemistry, comment on how the student could prepare their dry sample.

You may wish to use the data booklet to help you.

Points to note:

- Fertilisers are soluble salts containing the essential nutrients N, P or K
- Two neutralisation reactions to form salts:
 - Acid + alkali → salt + water
 - Acid + carbonate → salt + water + carbon dioxide
 - Write and balance the equation if you are confident
- State that it requires neutralisation
- There are various options you could pick to make the salt but the salt must have N, P or K in it.
- If you pick the potassium carbonate, you can tell the end point of the reaction as there will be no more gas given off.
- Need to talk about evaporating the water off at the end – could draw a diagram here.

The student should pick the acid and base that will give N, P or K in the product of the reaction. For example, they could react:

Adding potassium carbonate and phosphoric acid will provide a neutral solution of the fertiliser potassium phosphate containing the essential elements K and P. During the reaction, pH paper can be used to test whether the solution is neutral – if the pH paper is dipped in and it turns green then the sample can be evaporated to remove the water. CO₂ gas will be formed and when it stops forming this is also an indication that the acid is fully neutralised.

The equation for the reaction is : $3K_2CO_3 + 2H_3PO_4 \rightarrow 2K_3PO_4 + 3H_2O + 3CO_2$

Adding potassium hydroxide and nitric acid will provide a neutral solution of the fertiliser potassium nitrate containing the essential elements K and N. During the reaction, pH paper can be used to test whether the solution is neutral – if the pH paper is dipped in and it turns green then the sample can be evaporated to remove the water.

The equation for the reaction is : $KOH + HNO_3 \rightarrow KNO_3 + H_2O$

I think it would be enough to select a pair of reactants, state why and comment that they have to be neutralised, how you would do this, then describe the evaporation.

Correct pairs of reactants:

Acids	Bases	Salt formed
Nitric	ammonium hydroxide	ammonium nitrate
Phosphoric	ammonium hydroxide	ammonium phosphate
Phosphoric	potassium hydroxide or potassium carbonate	potassium phosphate
Nitric	potassium hydroxide or potassium carbonate	potassium nitrate