Sulfur – 2019 June

1. 0620/31/M/J/19/No.8

(a) Sulfur dioxide is a pollutant in the air.

(i) State **one** source of sulfur dioxide in the air.

..... [1]

(ii) Sulfur dioxide is oxidised to sulfur trioxide in the air.
Oxides of nitrogen act as catalysts for this reaction.

What is meant by the term *catalyst*?

.....

..... [1]

(iii) Sulfur trioxide dissolves in rainwater to form acid rain.

Which **one** of the following pH values could be the pH of acid rain?
Draw a circle around the correct answer.

pH 4 pH 7 pH 9 pH 13

[1]

(iv) State **one** adverse effect of acid rain on buildings.

..... [1]

(b) Sulfur dioxide melts at –73 °C and boils at –10 °C.

What is the physical state of sulfur dioxide at –20 °C?
Explain your answer.

.....

..... [2]

(c) Excess sulfuric acid reacts with ammonia to make a salt which can be used as a fertiliser.

State the name of the salt formed when excess sulfuric acid reacts with ammonia.

..... [1]

(d) The table shows some observations about the reactivity of four metals with dilute sulfuric acid.

metal	reaction with sulfuric acid
iron	a slow stream of bubbles is seen
magnesium	a rapid stream of bubbles is seen
nickel	a few bubbles slowly form
tungsten	no bubbles are seen

Use the information in the table to put the four metals in order of their reactivity.
Put the least reactive metal first.

least reactive → most reactive

[2]

[Total: 9]

2. 0620/32/F/M/19/No.3

This question is about sulfur, sulfur compounds and the water from a sulfur spring. A sulfur spring is a natural source of water containing sulfur.

(a) The table shows the mass of ions present in a 1000 cm^3 sample of water from a sulfur spring.

ion present	formula of ion	mass present in the 1000 cm^3 sample / mg
	Br^-	4
calcium	Ca^{2+}	44
chloride	Cl^-	14
fluoride	F^-	6
iron(III)	Fe^{3+}	2
magnesium	Mg^{2+}	10
	K^+	8
sodium	Na^+	88
sulfate	SO_4^{2-}	92

Answer these questions using only information from the table.

(i) Which negative ion is present in the lowest concentration?

..... [1]

(ii) Give the name of the compound formed from only K^+ and Br^- ions.

..... [1]

(iii) Calculate the mass of calcium ions present in a 250 cm^3 sample of this water.

mass of calcium ions = ... mg [1]

(iv) Complete the equation to show the formation of a fluoride ion from a fluorine atom.

$$F + \text{.....} \rightarrow F^-$$

[1]

(b) Describe a test for sulfate ions.

test .....

observations .....

[2]

(c) Solid sulfur is found around the edge of sulfur springs.

(i) When heated, sulfur undergoes sublimation.

What is meant by the term *sublimation*?

.....

..... [1]

(ii) Sulfur reacts with hot concentrated sulfuric acid.

Complete the chemical equation for this reaction.

$$S + ... H_2SO_4 \rightarrow 2H_2O + ... SO_2$$ [2]

(iii) The table shows the solubility of sulfur and zinc in an organic solvent and in water. The organic solvent boils at 46 °C.

element	solubility in organic solvent	solubility in water
sulfur	soluble	insoluble
zinc	insoluble	insoluble

Use the information in the table to suggest how to obtain pure, dry samples of both sulfur and zinc from a mixture of sulfur powder and zinc powder.

.....

.....

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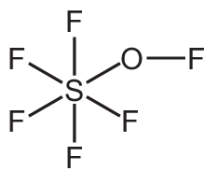
.....

.....

[4]

(d) The structure of a sulfur compound is shown.



Deduce the molecular formula of this compound showing the number of sulfur, fluorine and oxygen atoms.

..... [1]

[Total: 14]