

Q1. (a) The formula for the chemical compound magnesium sulphate is MgSO_4 .

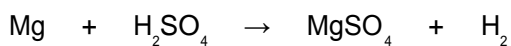
Calculate the relative formula mass (M_r) of this compound. (Show your working.)

.....
.....
.....
.....

(2)

(b) Magnesium sulphate can be made from magnesium and dilute sulphuric acid.

This is the equation for the reaction.



Calculate the mass of magnesium sulphate that would be obtained from 4g of magnesium.

(Show your working.)

.....
.....
.....
.....
.....
.....

Answer..... g

(2)

(Total 4 marks)

Q2. (a) The formula for ammonia is NH_3 . What does the formula tell you about each molecule of ammonia?

.....
.....
.....
.....

(3)

- (b) Ammonia is used to make nitric acid (HNO_3). Calculate the formula mass (M_r) for nitric acid. (Show your working).

.....

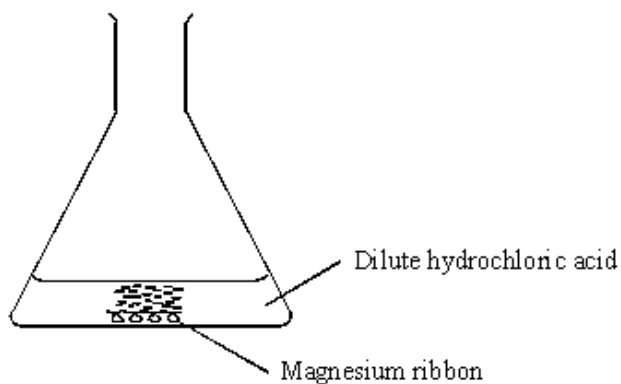
(3)
 (Total 6 marks)

##

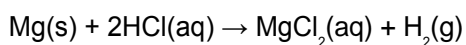
In this question you will need to use the following information:

Relative atomic masses: H 1; O 16; Mg 24.
 The volume of one mole of any gas is 24 dm^3 at room temperature and atmospheric pressure.

The diagram shows a chemical reaction taking place in a conical flask.



The balanced equation for this reaction is:



- (a) Write a balanced ionic equation for this reaction.

.....

(2)

- (b) Calculate the mass of magnesium required to produce 0.50 g of hydrogen. Show clearly how you work out your final answer and give the unit.

.....

Mass =

(2)

(c) (i) Draw a diagram to show how the electrons are arranged in a hydrogen molecule.

(1)

(ii) What is the name of the type of chemical bond between the hydrogen atoms in a hydrogen molecule?

.....

(1)

(d) The chemical formula for hydrogen peroxide is H_2O_2 .

Calculate, to the nearest whole number, the percentage, by mass, of hydrogen in hydrogen peroxide. Show clearly how you work out your answer.

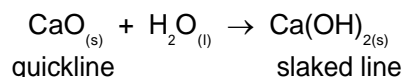
.....
.....

Percentage = %

(2)

(Total 8 marks)

Q4. Quicklime can be converted to slaked lime. The equation which represents this reaction is shown below.



(i) Why do farmers sometimes add slaked lime to acidic soil?

.....
.....

(1)

(ii) Use these relative atomic masses: H = 1; O = 16; Ca = 40
to calculate the relative formula mass (M_r) of

quicklime CaO

slaked lime Ca(OH)_2

(2)

(iii) Calculate the mass of slaked lime that could be made from 1000 kg of quicklime.

.....
.....
.....

Mass of slaked lime kg

(2)
(Total 5 marks)

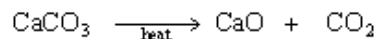
Q5. Use these relative atomic masses: H = 1; O = 16; Ca = 40
to calculate the relative formula mass (M_r) of

quicklime CaO

slaked lime Ca(OH)₂

(Total 2 marks)

Q6. Limestone (CaCO₃) is a raw material. On strong heating it is converted to calcium oxide which is a very useful substance.



(a) Calculate the formula mass (M_r) of calcium carbonate.

.....

M_r of calcium carbonate =

(2)

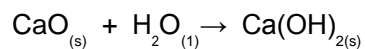
(b) About 60 million tonnes of calcium oxide is made in Britain each year.
Calculate the mass of calcium carbonate needed to make this amount of calcium oxide.

.....
.....
.....
.....
.....
.....

Mass of calcium carbonate needed = million tonnes

(4)

- (c) Water is added to some of the calcium oxide produced in a process known as 'slaking'. The product of this reaction is used to make plaster.



- (i) Give the chemical name of Ca(OH)_2 .

.....

(1)

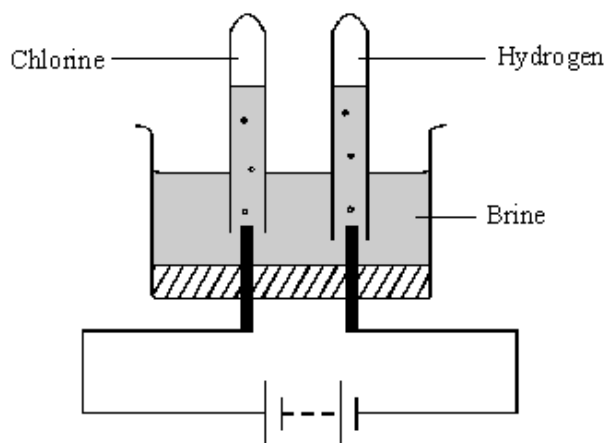
- (ii) What is the physical state of the Ca(OH)_2 formed in the reaction?

.....

(1)

(Total 8 marks)

- Q7.** Brine, a solution containing sodium chloride in water, can be used to manufacture chlorine, hydrogen and sodium hydroxide. A student sets up a simplified model of the industrial cell.



- (a) The electron arrangements of some atoms are shown here.

H 1

O 2.6

Na 2.8.1

Cl 2.8.7

(i) Use the relevant electron arrangements to describe the bonding in water.

.....
.....
.....
.....
.....
.....

(2)

(ii) Use the relevant electron arrangements to describe the bonding in sodium chloride.

.....
.....
.....
.....
.....
.....

(3)

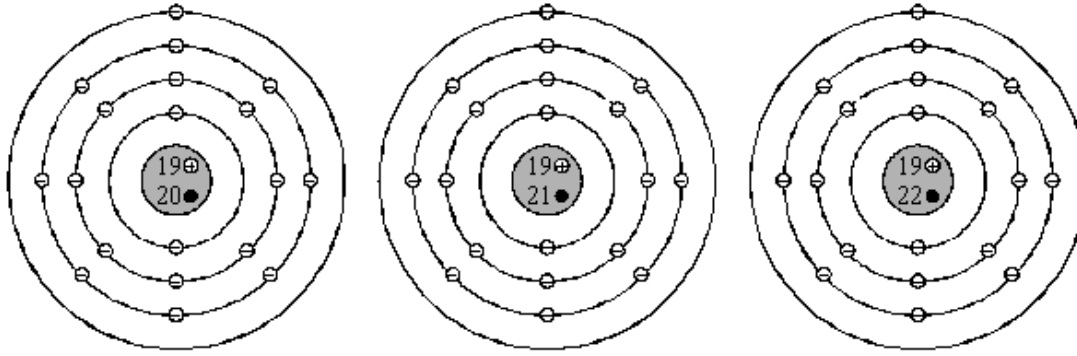
(b) Use the atomic structures of $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$ to explain the meaning of the term *isotopes*.

.....
.....
.....
.....
.....
.....

(3)

(Total 8 marks)

Q8. The diagrams show three *isotopes* of potassium.



Key		
⊕ Proton	● Neutron	⊖ Electron

(i) In what way does the atomic structure show you that they are all **atoms**?

.....
.....

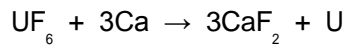
(1)

(ii) Explain why these three atoms are called *isotopes* of potassium.

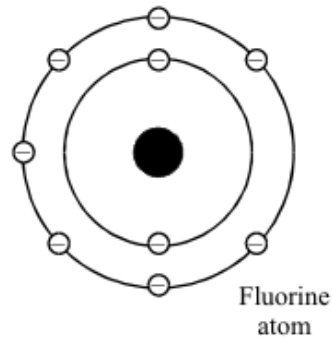
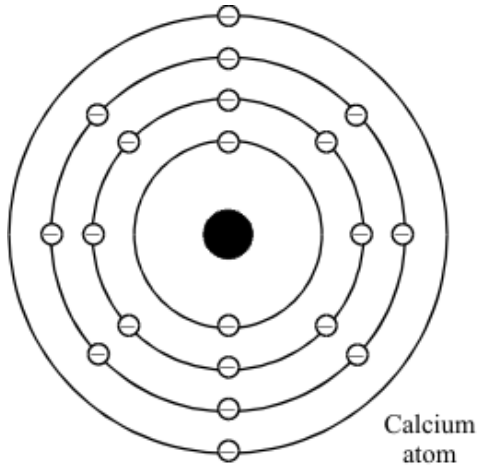
.....
.....
.....
.....
.....
.....

(3)
(Total 4 marks)

Q9. Uranium metal can be produced by reacting uranium hexafluoride with calcium.



- (a) Describe how calcium and fluorine bond together to form calcium fluoride. The electron arrangement of each atom is shown.



.....

.....

.....

.....

.....

(5)

- (b) Uranium has two main isotopes, ${}_{92}^{235}\text{U}$ and ${}_{92}^{238}\text{U}$. Use these as examples to explain what is meant by the word isotope.

.....

.....

.....

.....

.....

(4)

(c) At the start of a reaction there was 174.5 g of uranium hexafluoride, UF_6 .

Relative atomic masses: F 19; U 235

(i) Calculate the relative formula mass of uranium hexafluoride, UF_6 .

.....
.....
.....

Relative formula mass $UF_6 = \dots\dots\dots$ g

(1)

(ii) Calculate the mass of uranium that would be produced from 134.5 g of uranium hexafluoride.

.....
.....
.....
.....
.....

Mass of uranium = $\dots\dots\dots$ g

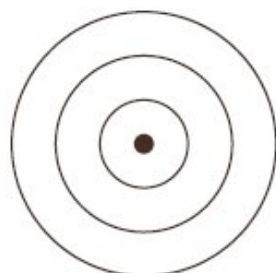
(2)

(Total 12 marks)

Q10. Aluminium is a useful metal.

(a) The atomic number (proton number) of aluminium is 13.

Complete the diagram to show the electronic structure of an aluminium atom.
Use crosses (x) to represent the electrons.



(1)

(b) Aluminium is used as the electrical conductor for overhead power cables.



Explain why metals are good conductors of electricity.

.....

.....

.....

.....

(2)
(Total 3 marks)

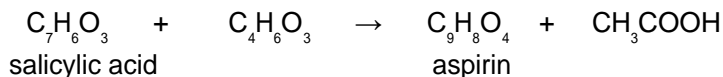
Q11. Aspirin tablets have important medical uses.



A student carried out an experiment to make aspirin. The method is given below.

1. Weigh 2.00 g of salicylic acid.
2. Add 4 cm³ of ethanoic anhydride (an excess).
3. Add 5 drops of concentrated sulfuric acid.
4. Warm the mixture for 15 minutes.
5. Add ice cold water to remove the excess ethanoic anhydride.
6. Cool the mixture until a precipitate of aspirin is formed.
7. Collect the precipitate and wash it with cold water.
8. The precipitate of aspirin is dried and weighed.

(a) The equation for this reaction is shown below.



Calculate the maximum mass of aspirin that could be made from 2.00 g of salicylic acid.

The relative formula mass (M_r) of salicylic acid, $\text{C}_7\text{H}_6\text{O}_3$, is 138

The relative formula mass (M_r) of aspirin, $\text{C}_9\text{H}_8\text{O}_4$, is 180

.....
.....
.....
.....

Maximum mass of aspirin = g

(2)

(b) The student made 1.10 g of aspirin from 2.00 g of salicylic acid.

Calculate the percentage yield of aspirin for this experiment.

(If you did not answer part (a), assume that the maximum mass of aspirin that can be made from 2.00 g of salicylic acid is 2.50 g. This is **not** the correct answer to part (a).)

.....
.....
.....
.....

Percentage yield of aspirin = %

(2)

(c) Suggest **one** possible reason why this method does **not** give the maximum amount of aspirin.

.....
.....

(1)

(d) Concentrated sulfuric acid is a catalyst in this reaction.

Suggest how the use of a catalyst might reduce costs in the industrial production of aspirin.

.....
.....

(1)
(Total 6 marks)

Q12. Spacecraft have been to the planets Venus and Mars. The spacecraft have sent back information about the atmosphere of each planet.



© Tristan3D/Shutterstock

(a) The main gas in the atmosphere of Mars is carbon dioxide.

Explain why, in terms of structure, carbon dioxide is a gas, even at low temperatures.

.....
.....
.....
.....
.....
.....
.....
.....
.....

(3)

(b) Gas chromatography linked to a mass spectrometer (GC-MS) is used to identify substances found on Mars.

(i) What is the purpose of gas chromatography?

.....
.....

(1)

(ii) What information do the molecular ion peaks from the mass spectrometer give about the substances?

.....

(1)

(c) The atmosphere on Venus contains droplets of sulfuric acid solution.

(i) Suggest a pH value for sulfuric acid solution.

pH =

(1)

(ii) Name the ion which makes sulfuric acid solution acidic.

.....

(1)

(d) The atmosphere of Venus contains the isotopes ${}^2_1\text{H}$ and ${}^1_1\text{H}$

Describe the similarities and the differences in the isotopes ${}^2_1\text{H}$ and ${}^1_1\text{H}$

You should refer to the sub-atomic particles in each isotope.

.....
.....
.....
.....
.....
.....
.....
.....

(3)

(Total 10 marks)

