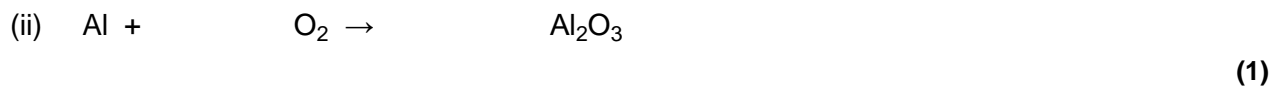
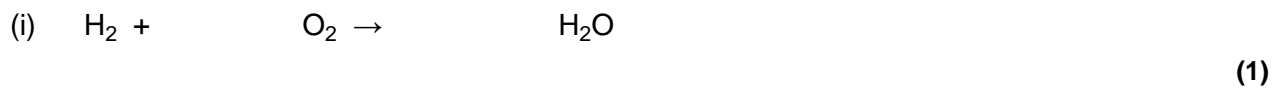


1

(a) Balance these chemical equations.



(b) Briefly explain why an unbalanced chemical equation cannot fully describe a reaction.

(2)

(Total 4 marks)

2

This question is about iron.

Iron reacts with dilute hydrochloric acid to produce iron chloride solution and one other product.

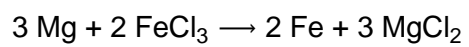
(a) Name the other product.

(1)

(b) Suggest how any unreacted iron can be separated from the mixture.

(1)

Magnesium reacts with iron chloride solution.



(c) 0.120 g of magnesium reacts with excess iron chloride solution.

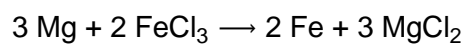
Relative atomic masses (A_r): Mg = 24 Fe = 56

Calculate the mass of iron produced, in mg

Mass of iron = _____ mg

(5)

(d) Explain which species is reduced in the reaction between magnesium and iron chloride.



Your answer should include the half equation for the reduction.

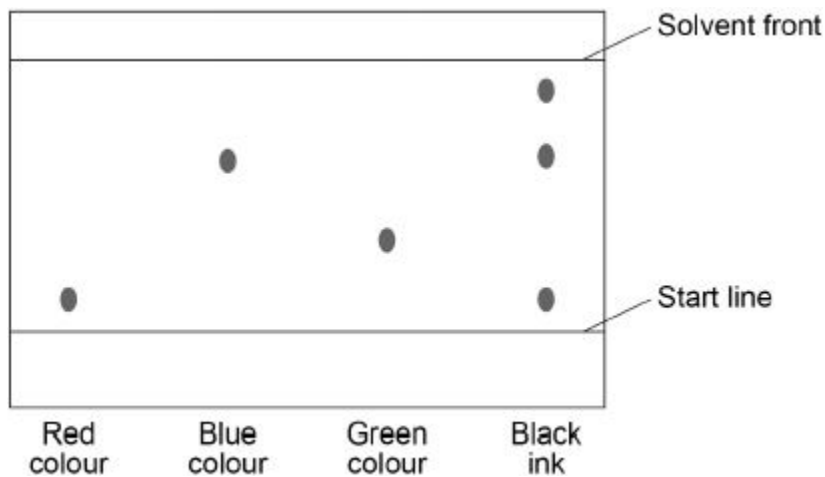
(3)

(Total 10 marks)

3

A student used paper chromatography to identify the colours in a black ink.

The diagram below shows the student's results.



(a) What colours are in the black ink?

(2)

(b) Suggest which colour is least soluble in the solvent.

Give a reason for your answer.

Colour _____

Reason _____

(2)

(c) Use the diagram above to complete the table below.

| | Distance in mm |
|--------------------------------|----------------|
| Distance moved by green colour | |
| Distance moved by solvent | |

Calculate the R_f value for the green colour.

Use the equation:

$$R_f = \frac{\text{distance moved by green colour}}{\text{distance moved by solvent}}$$

R_f value = _____

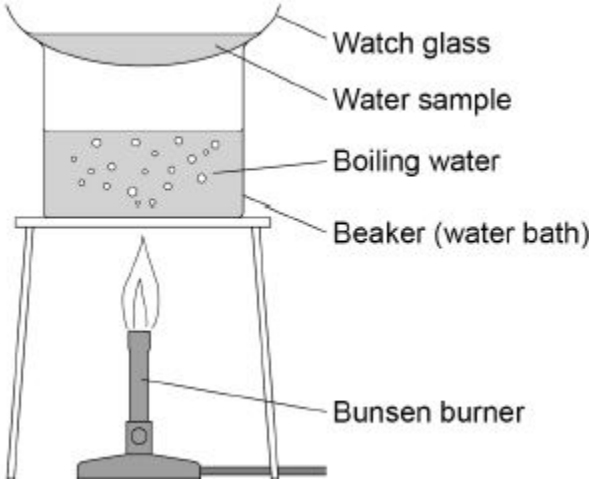
(4)

(Total 8 marks)

4

A student investigated the mass of dissolved solids in 5 cm³ samples of water.

The diagram below shows the apparatus.



The table below shows the student's results.

| Type of water | Mass in g | | | |
|---------------|-------------|----------------------------------|--|---|
| | Watch glass | Watch glass and dissolved solids | Dissolved solids in 5 cm ³ of water | Dissolved solids in 1000 cm ³ of water |
| Sea water | 9.34 | 9.48 | 0.14 | 28.00 |
| River water | 9.15 | 9.23 | 0.08 | X |
| Rainwater | 8.93 | 8.93 | 0.00 | 0.00 |

(a) Calculate mass **X** in the table above.

Mass **X** = _____ g

(1)

(b) 5 cm³ is a small volume of water for each experiment.

Give **one** advantage and **one** disadvantage of using a larger volume.

Advantage _____

Disadvantage _____

(2)

(c) Potable water is **not** pure water.

Describe the difference between potable water and pure water.

(1)

(d) Potable water is obtained from both groundwater **and** from sea water.

Describe how groundwater and sea water are treated to produce potable water.

(3)

(e) The percentage by mass of dissolved solids in a 6.50 g sample is 2.2%

Calculate the mass of the dissolved solids.

Mass of dissolved solids = _____ g

(2)

(Total 9 marks)

Mark schemes

- 1** (a) (i) $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$
for 1 mark 1
- (ii) $4\text{Al} + 3\text{O}_2 \rightarrow 2\text{Al}_2\text{O}_3$
for 1 mark 1
- (b) *idea that:*
must end up with the same number of atoms as at the start
any 2 each
- otherwise matter is shown to be lost/gained
for 1 mark
- won't show correct amount of each element/compound 2
- [4]**
- 2** (a) hydrogen **or** H_2
allow hydrogen gas
ignore H without the 2 subscript 1
- (b) filtration / filter
*allow magnet **or** decant*
ignore heating 1

(c) (Mg) $\frac{0.12}{24}$ or 0.005 (moles)

mark is for ÷ by 24

1

(Fe) $\frac{2}{3} \times 0.005 = 0.00333 \times 56$

mark is for $\times \frac{2}{3}$

1

(mass Fe) = 0.00333×56

mark is for $\times 56$

1

= 0.1866 (g)

1

= 187 (mg)

1

an answer of 280 (mg) scores 4 marks

an answer of 0.280 scores 3 marks (no ratio from equation)

184 scores 0 [= (3 × 24) + (2 × 56)]

OR

(Mg) = $\frac{0.12}{(3 \times 24 =) 72}$ (1)

= 0.00166 **or** $\frac{1}{600}$ (moles) (1)

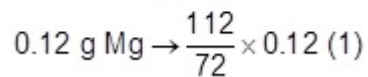
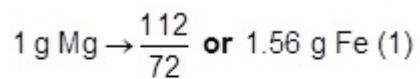
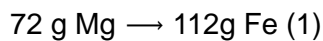
(mass of Fe) = 0.00166

or $\frac{1}{600} \times 112(2 \times 56)$ (1)

= 0.1866 (g) (1)

187 (mg) (1)

OR



$$= 0.1866 \text{ (g) (1)}$$

$$= 187 \text{ (mg) (1)}$$

an answer of 185–190 (mg) scores 5 marks

an answer of 0.185–0.19 scores 4 marks

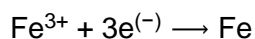
(d) Fe^{3+}

1

(because) reduction is gain of electrons

allow change in oxidation state / (+)3 to 0

1



1

[10]

3

(a) red **and** blue

1

unknown

1

both needed for the mark

(b) red

ignore black

1

travels least far

dependent on correct colour allow closest to the start line

1

(c) distance moved by green colour = 12 mm

allow 10 to 14 mm

1

distance moved by solvent = 36 mm

allow 35 to 36 mm

1

$$\frac{12}{36}$$

allow correct substitution of student's measurements

1

R_f value = 0.33

allow correct answer from student's measurements for 2 marks

1

[8]

4

(a) 16(.0)

1

(b) advantage: more accurate result

*do **not** accept reliable*

1

disadvantage: takes a long(er) time, more energy needed (to heat more water)

ignore expensive

1

(c) pure: no dissolved solids / impurities

or no (dissolved) chlorine

allow only water / H₂O

ignore safe to drink

and

potable: has dissolved solids / impurities

or has (dissolved) chlorine

ignore safe to drink

1

a clear comparative statement referring to solutes gains the mark

(d) groundwater:

- filtered

allow acceptable method of filtration

1

- sterilised

allow acceptable method of sterilisation

1

groundwater:

- distilled **or** reverse osmosis

allow desalination

ignore salt removed

ignore boiling alone

ignore filtering

*do **not** accept fractional distillation*

1

(e) $\frac{2.2}{100} \times 6.50$

1

(=) 0.143 (g)

1

an answer of 0.143 (g)

***or** 0.14 (g) scores **2** marks*

[9]