Essential Maths Skills

for AS/A-level

Chemistry

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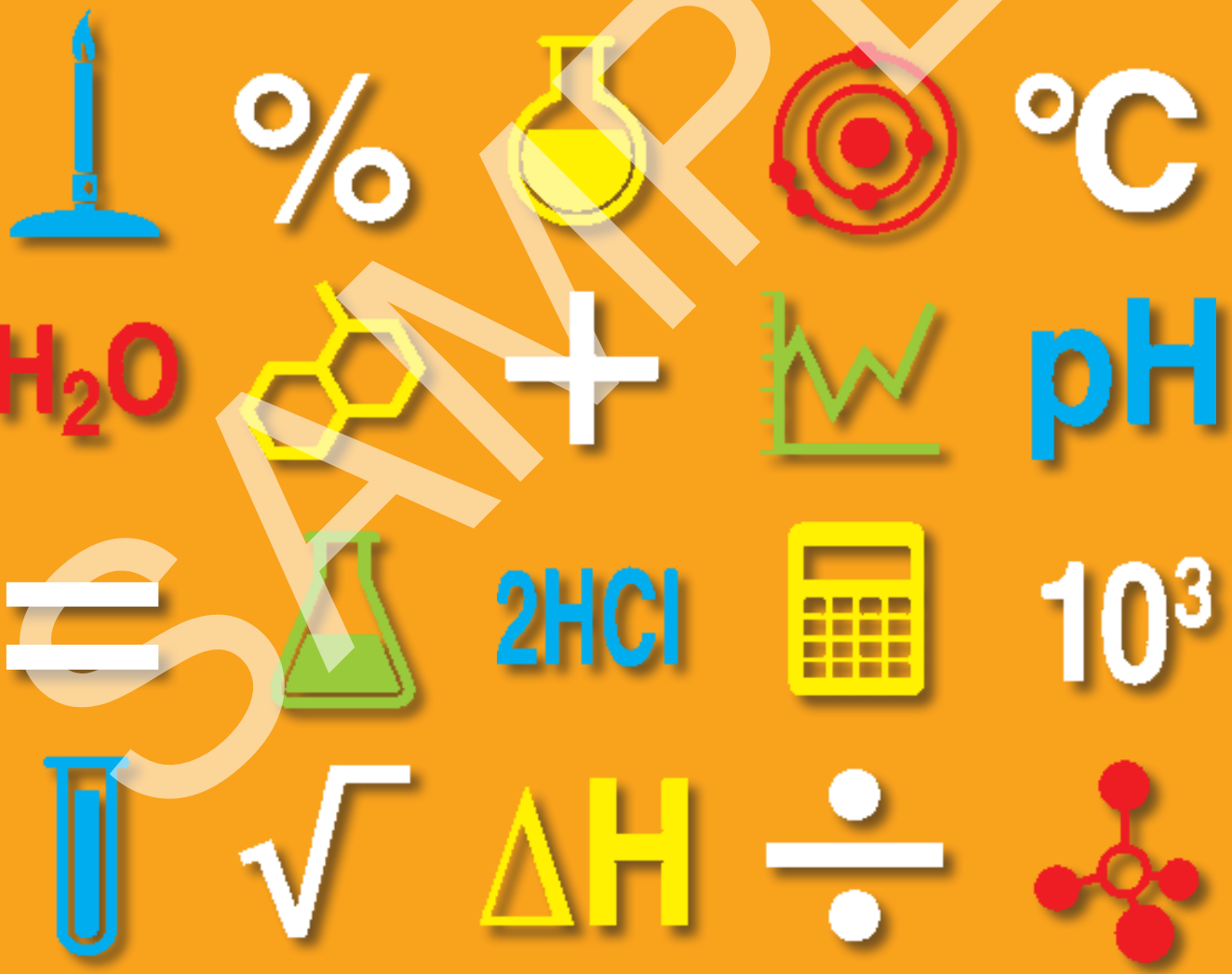

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Contents

The listed content is assessed by the awarding bodies AQA, OCR, Pearson Edexcel and WJEC at AS and A-level. **The content listed in bold is only specified to be assessed at A-level.**

5 Geometry and trigonometry

Understand the symmetry of 2D and 3D shapes

Exam-style questions

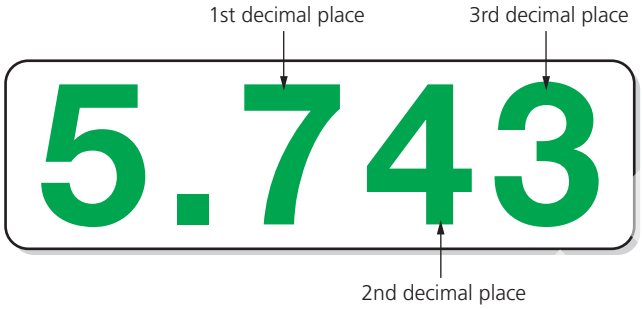
Appendix Cross referencing essential maths skills with exam boards

1 Arithmetic and numerical computation

Expressions in decimal and ordinary form

Decimal places

When adding or subtracting data, decimal places are used to indicate the precision of the answer. The term 'decimal place' refers to the numbers after the decimal point.



Sometimes in calculations you are asked to present your answer to one or two decimal places. To do this you need to round the number. For example:

- Rounding a number to one decimal place means there is only one digit after the decimal point.
- Rounding a number to two decimal places means there are two digits after the decimal point.

The rules for rounding are:

- If the next number is **5 or more**, round up.
- If the next number is **4 or less**, do not round up.

If you are rounding a number to two decimal places, for example, it is useful to underline all numbers up to two numbers after the decimal point. This then focusses your attention on the next number, which helps with rounding.

A Worked examples

a Round 2.262 g to two decimal places.

Step 1: underline all the numbers up to two numbers after the decimal point.

2.26<u>2</u>

Step 2: look at the number after the last underlined number. This number is 2 so you should follow the rule 'if the next number is 4 or less, do not round up'. This means the number 6 is unchanged.

The answer is 2.26 g (to 2 d.p.).

b Round 4.976 2 g to one decimal place.

Step 1: underline all the numbers up to one number after the decimal point.

4.9762

Step 2: look at the number after the last underlined number. This number is 7 so you should follow the rule 'if the next number is 5 or more, round up'. This means the number 9 is rounded up to 10.

The answer is 5.0 g (to 1 d.p.).

B Guided questions

Copy out the workings and complete the answers on a separate piece of paper.

1 Round 3.418 g to 2 decimal places.

Step 1: underline all the numbers up to two numbers after the decimal point.

3.418

Step 2: look at the number after the last underlined number and decide, using rounding rules, if you need to round up or not.

The answer is _____ (to 2 d.p.).

2 In an experiment to find the mass of water removed on heating a solid, a student recorded the following measurements:

Mass of hydrated solid + evaporating basin = 28.465 g

Mass of evaporating basin = 26.250 g

Mass of anhydrous solid + evaporating basin = 27.799 g

a Calculate the mass of the anhydrous solid to 2 decimal places.

Step 1: subtract the mass of the evaporating basin from the mass of the evaporating basin + anhydrous solid.

27.799 − 26.250 = 1.549

Step 2: underline the numbers up to 2 numbers after the decimal place.

1.549

Step 3: look at the number after the last underlined number and decide, using rounding rules, if you need to round up or not.

b Calculate the mass of water removed to two decimal places.

Step 1: subtract the combined mass of the anhydrous solid + evaporating basin from the combined mass of the hydrated solid + evaporating basin.

28.465 − 27.799 = _____

Step 2: underline the numbers up to two numbers after the decimal point.

Step 3: look at the number after the last underlined number and decide, using rounding rules, if you need to round up or not.

3 Calculate the pH of a 0.2 mol dm^{-3} solution of hydrochloric acid. Record your answer to 2 decimal places.

- To calculate the pH of a solution you need to use the following equation:

  pH = −log [H$^+$] where [H$^+$] is the acid concentration.

  In this case pH = −log 0.2.
- Remember that pH is −log [H$^+$] and the minus symbol means multiply by −1. Hence the answer for log [H$^+$] must be multiplied by −1. If log [H$^+$] gives a minus number this must be multiplied by −1 to give a positive pH value.
- If you are unsure how to use the log button on your calculator there are lots of examples on page XX.

Step 1: find the log of 0.2 and write down all the numbers from your calculator.

Step 2: underline the numbers up to 2 numbers after the decimal place.

Step 3: look at the number after the last underlined number and decide, using rounding rules, if you need to round up or not.

REMEMBER

− × − two negatives make a positive: + (−3) × (−2) = 6

− × + a negatives and a positive make a negative: − (−3) × 2 = −6

C Practice questions

4 In an experiment different solids were heated in evaporating basins. To determine the mass of solid after heating, the mass of the evaporating basin must be subtracted from the combined mass of solid and evaporating basin. Calculate the mass of solid to one decimal place by carrying out the following subtractions.

a 30.25 − 28.53

b 35.67 − 25.98

c 24.34 − 22.23

5 Complete the table below.

Table 2.1

Mass (g)	Mass recorded to two decimal places (g)
29.883	
0.046	
32.6789	
13.999	
0.0894	
19992.456	

6 Complete the following pH calculations and record the pH to one decimal place.
- a $pH = -\log 0.2$
- b $pH = -\log 0.05$
- c $pH = -\log 2.0$
- d $pH = -\log 0.005$
- e $pH = -\log 0.02$

Accuracy

When adding or subtracting measurements with different numbers of decimal places, **the accuracy of the final answer can be no greater than the least accurate measurement**. This means that when measurements are added or subtracted the answer should have the same number of decimal places as the smallest number of decimal places in any number involved in the calculation.

A Worked example

A student recorded the following masses of potassium chloride: 32.23 g, 2.1 g and 4.456 g. Calculate the total mass of potassium chloride. Give your answer to the appropriate precision.

Step 1: add the three masses.

32.23 + 2.1 + 4.456 = 38.786 g

Step 2: look at each of the masses and record the number of decimal places in each:

Table 2.2

Measurement	Number of decimal places
32.23 g	2
2.1 g	1
4.456 g	3

The number with least decimal places is 2.1. It has one decimal place, so the answer must be rounded to one decimal place.

Step 3: underline the numbers up to 1 number after the decimal place.

38.786

The number after the last underlined number is 8. This is greater than 5 so the answer must be rounded up.

The answer is 38.8 g.

B Guided question

Copy out the working and complete the answer on a separate piece of paper.

1 **A student recorded some different temperatures in an experiment, using thermometers with different accuracies. The results are shown in the table below. Calculate the average temperature and give your answer to the appropriate number of decimal places.**

Step 1: record the number of decimal places in each reading in the table.

Table 2.3

Temperature (°C)	Number of decimal places
10.2	
10	
10.3	
11	

Step 2: identify the number of decimal places in the temperature with least accuracy. This is the number of decimal places which should be in your answer.

Step 3: to calculate the average, add the four temperature readings and divide by the number of temperature readings (4). Record your answer to the correct number of decimal places.

C Practice questions

2 In an experiment different solids were heated in different evaporating basins. To determine the mass of solid after heating, the mass of the evaporating basin must be subtracted from the mass of solid and evaporating basin. Calculate the mass of solid used in each experiment to the appropriate number of decimal places, and complete the table below.

Table 2.4

Mass of evaporating basin (g)	Mass of evaporating basin and solid (g)	Mass of solid (to appropriate number of decimal places) (g)
34.567	23.4	
29.93	25.66	
25.49	22.1	
18.456	11.9	

3 A technician recorded the following masses of different chemicals.

a Calcium carbonate 43.2 g, 0.245 g, 10.222 g

b Copper(II) sulfate 0.245 g, 10.393 g, 2.49 g

c Copper(II) oxide 3.23 g, 0.3439 g, 3.97 g

Work out the total mass of each chemical, giving your answers to the appropriate accuracy.