AQA GCSE Maths: Higher

Your notes

Standard & Compound Units

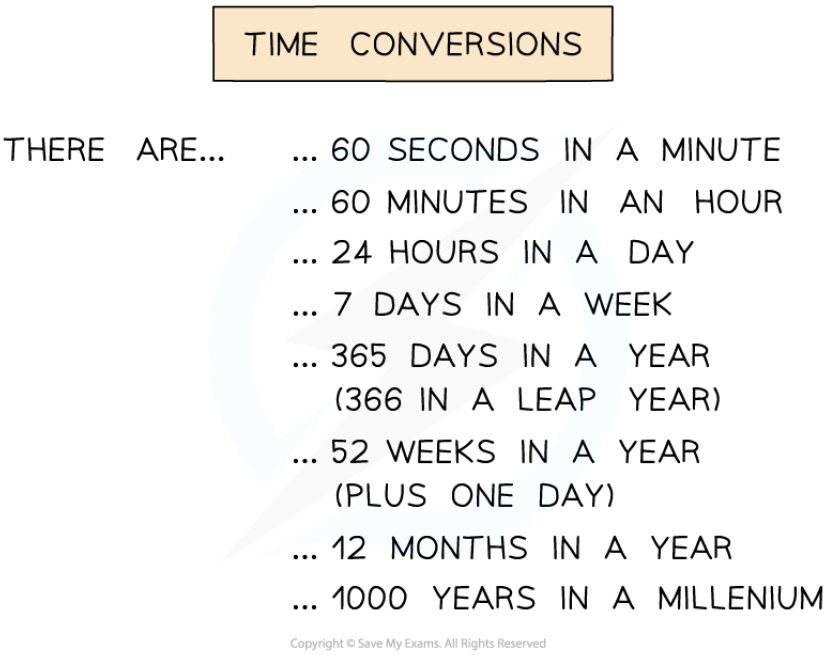
Contents

Your notes

Time

How do I convert between different units of time?

- **Time** has a **number of different conversions** and does not use the decimal number system (based on 10s, 100s, etc)
  - You need to know the follow time conversions



- You should also know the **number of days** in each **calendar month**

Your notes

DO LEARN THESE – AND HOW MANY DAYS ARE IN EACH MONTH...

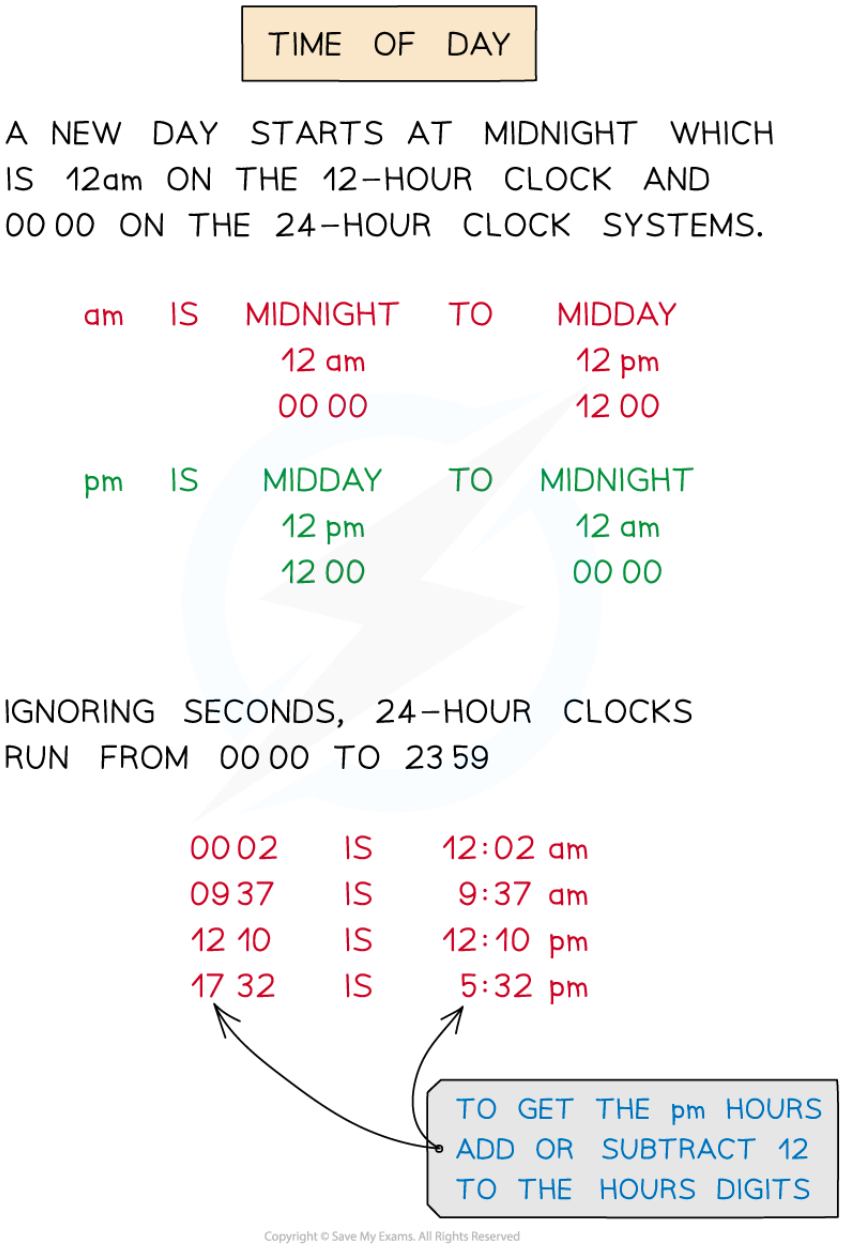
THIRTY DAYS HATH SEPTEMBER, APRIL, JUNE AND NOVEMBER,
ALL THE REST HAVE THIRTY-ONE.
EXCEPTING FEBRUARY ALONE.
AND THAT HAS TWENTY-EIGHT DAYS CLEAR,
AND TWENTY-NINE IN EACH LEAP YEAR.

JANUARY	31 DAYS
FEBRUARY	28
	(29 IN A LEAP YEAR)
MARCH	31
APRIL	30
MAY	31
JUNE	30
JULY	31
AUGUST	31
SEPTEMBER	30
OCTOBER	31
NOVEMBER	30
DECEMBER	31

What is the difference between a 12-hour clock and a 24-hour clock?

- A **12-hour clock** goes around once for AM and once for PM in **one complete day**
  - AM is between midnight (12 am) and midday (12 pm)
  - PM is between midday (12 pm) and midnight (12 am)
- A **24-hour clock** goes around once for **one complete day**
  - The display uses four digits, two for the hour, two for the minutes
  - The day starts at midnight which is 00 00 (12 am) and goes up to 23 59 (11.59 pm)
- You need to be able to **read the time** from both a **12-hour clock** and a **24-hour clock**

Your notes

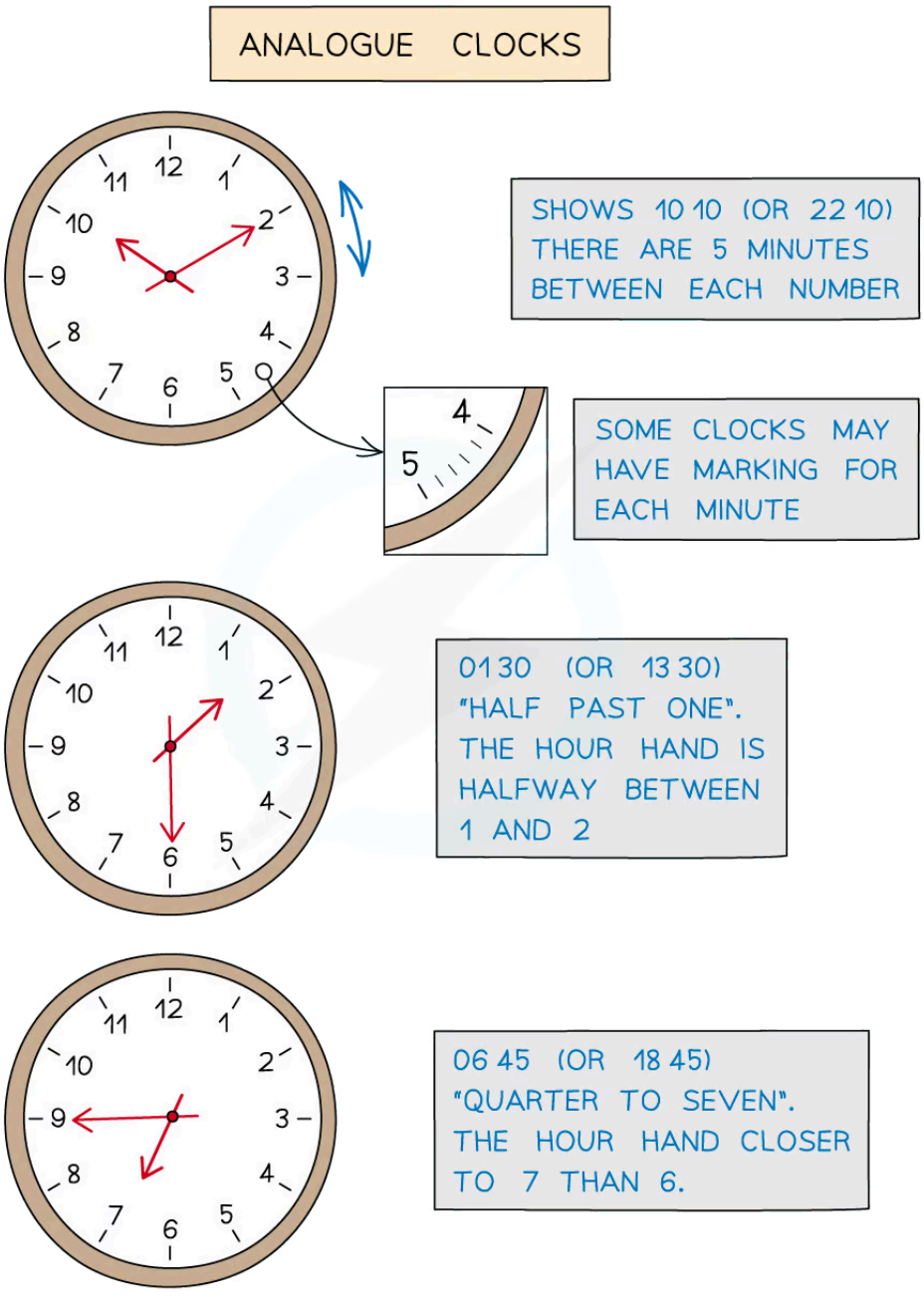


How do I read the time from an analogue clock?

- An **analogue** clock works in **12-hour** time
  - The **long hand** is the **hour hand**
    - Each number on the clock represents **one hour** for the hour hand

- The **short hand** is the **minute hand**
  - Each number on the clock represents **five minutes** for the minute hand
  - Some clocks will have markings for individual minutes

Your notes

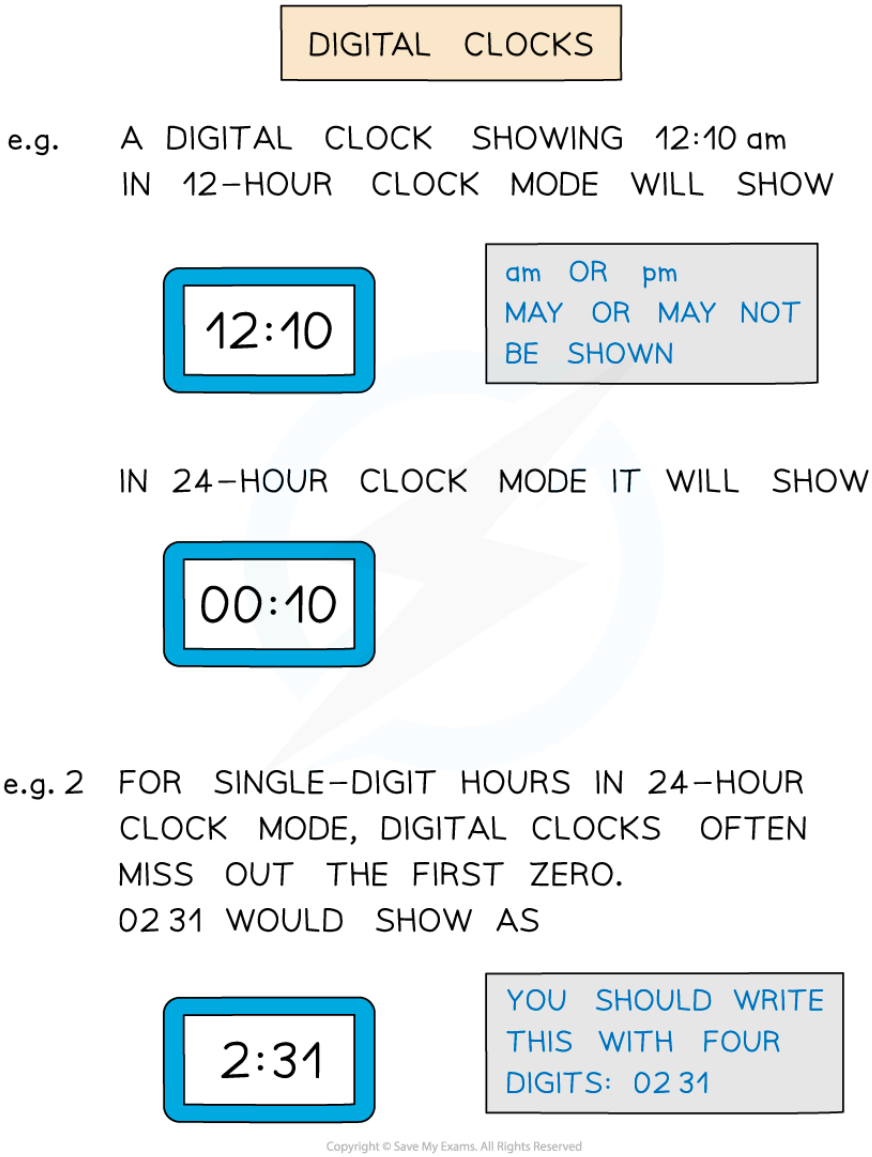


How do I read the time from a digital clock?


Your notes

- A **digital** clock can use either **24 hour** time or **12-hour** time
  - A colon ':' is often displayed between the hours and minutes
    - E.g., 1245 would be displayed as 12:45
  - AM or PM does **not** need to be specified with 24-hour time
    - it may or may not be shown on a 12-hour time digital clock
  - For **single-digit** hours, clocks often miss out the first zero
    - e.g. 09:23 would be displayed as 9:23

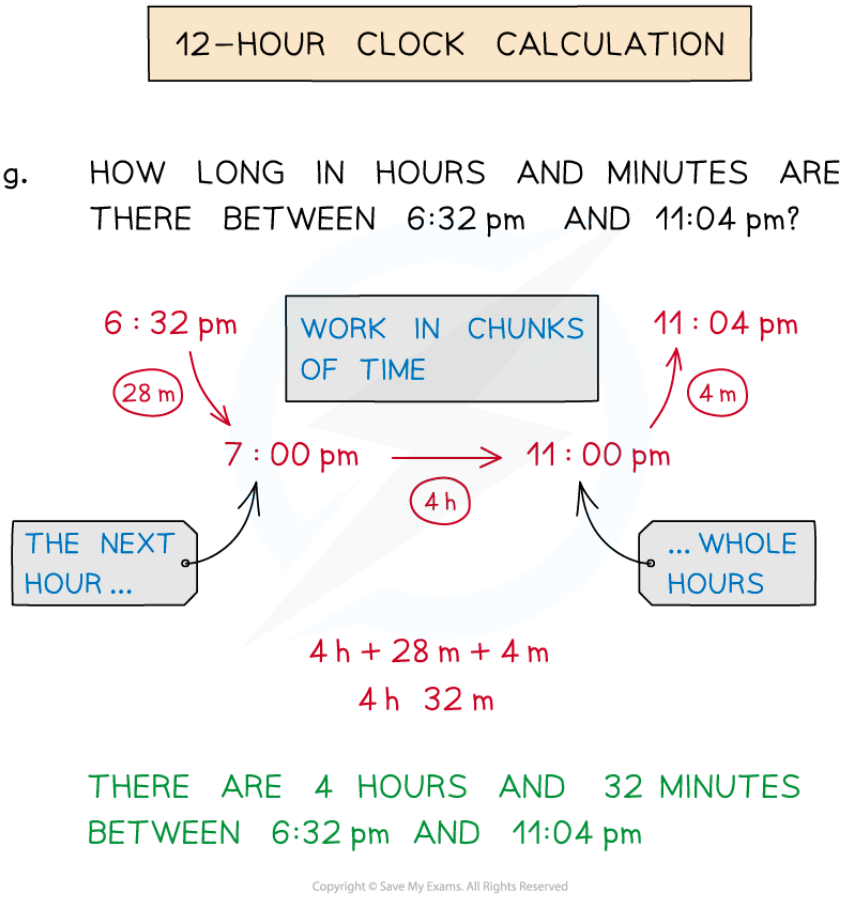
Your notes



How do I calculate with time using the 12-hour clock?

- Work in **chunks** of time
  - Calculate the **minutes until the next hour**, then **whole hours**, then **minutes until a final time**
- Ensure you know when the 12-hour clock **switches** from **AM to PM** and vice versa

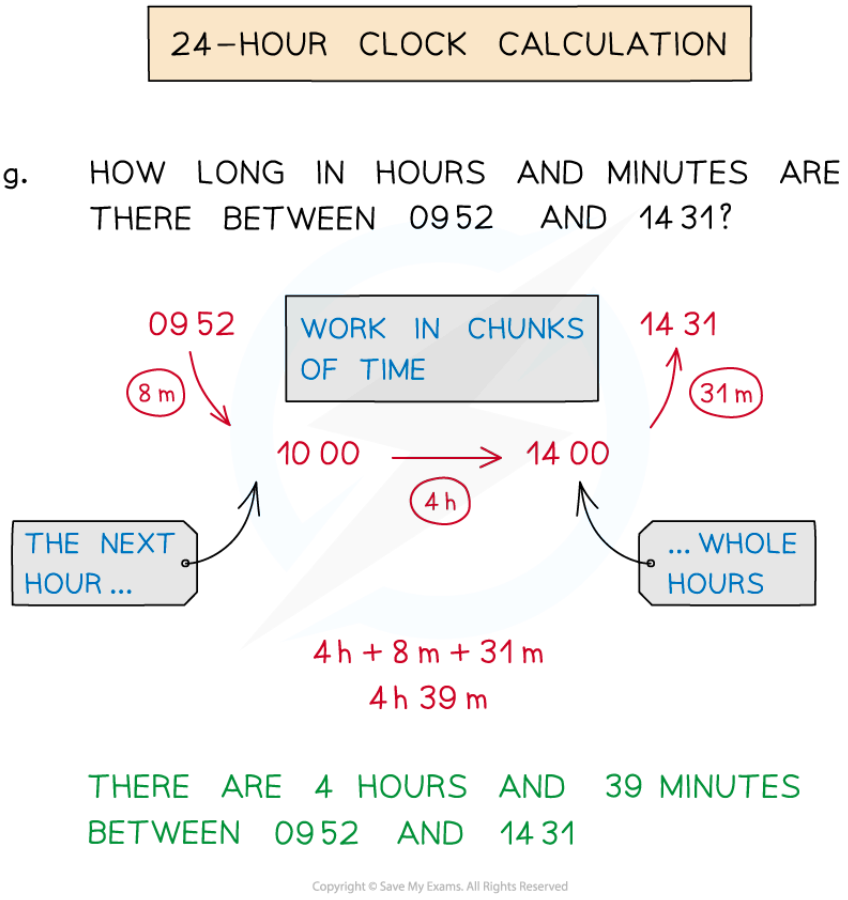
Your notes



How do I calculate with time using the 24-hour clock?

- Work in **chunks** of time just like the 12-hour clock calculations
  - Calculate the **minutes until the next hour**, then **whole hours**, then **minutes until a final time**
- If the hour is greater than 12, subtract 12 from it to find the 12-hour **PM** hour

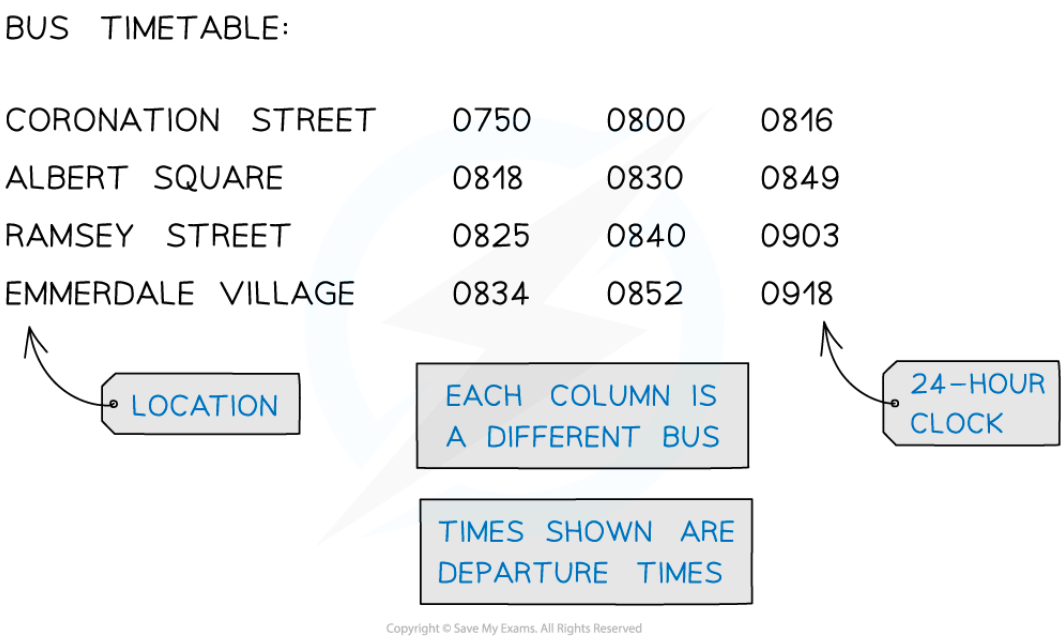
Your notes



How do I use bus and train timetables?

- Bus and train **timetables** tend to use the **24-hour** clock system
  - Each **column** represents a **different bus or train**
  - **Times** are listed as **four digits** without the colon ':'
  - The time in each cell usually indicates the **departure time** (when the bus/train leaves that stop/station)
  - The **last location** on the list usually shows the **arrival time**

Your notes



How do I convert time between time zones?

- Different countries are in different **time zones**, depending on where they are on the planet
- For example when it is 11:36 in London in the UK, it may be 06:36 in New York in the USA
  - So New York is 5 hours **behind** London
  - London is 5 hours **ahead** of New York
- You must consider:
  - What is the **time difference** between the two locations (**in hours**)?
  - Which time zone is **ahead**, and which one is **behind**?
- For example, Buenos Aires (Argentina) is 6 hours behind Helsinki (Finland)
  - When it is 7 am in Helsinki
    - 7 am - 6 hours = 1 am in Buenos Aires
  - When it is 5 pm in Buenos Aires
    - 5 pm + 6 hours = 11 pm in Helsinki

Your notes

Examiner Tips and Tricks

- Be careful when using a calculator, as they can often cause problems in time-based questions!
  - Remember that 1 hour 30 mins of time would be 1.5 hours on a calculator
- You can use the **degrees, minutes and seconds function** $\boxed{°\,'\,''}$ to enter time on your calculator
  - E.g. 3 minutes 45 seconds would be entered as $0°3'45''$
  - You can convert between an answer on the calculator, given in either format of time, by pressing this button

Worked Example

(a) A film starts at 15 35 and lasts for 1 hour 45 minutes.

Find the time at which the film ends.

Work in chunks of time
Add the hour on

15 35 + 1 hour = 16 35

Add on the number of minutes until the next hour
There are 60 minutes in an hour
Add on 25 minutes of the remaining 45 minutes to get to the next hour

16 35 + 25 minutes = 17 00

There are 45 - 25 = 20 minutes left of the film to add
Write your final answer using the type of clock used in the question (24–hour) unless otherwise stated

17 20

(b) It is due to start raining at 02 35 and not stop until 08 14.

Find the time, in hours and minutes, it is expected to rain for.

Work in chunks of time
Find the number of minutes until the next hour

02 35 + 25 minutes = 03 00

Find the number of hours until the hour in the stopping time

Your notes

03 00 + 5 hours = 08 00

Find the remaining minutes until the rain stops

08 00 + 14 minutes = 08 14

Add together the hours and minutes

25 minutes + 5 hours + 14 minutes

5 hours 39 minutes

(c) A train journey started at 11.23 am and finished at 2.27 pm.

How long, in hours and minutes, was the train journey?

Work in chunks of time
Find the number of minutes until the next hour
Be careful about the AM/PM boundary

11.23 am + 37 minutes = 12.00 pm

Add on the number of hours until the hour in the arrival time

12.00 pm + 2 hours = 2.00 pm

Add on the remaining minutes until the arrival time

2.00 + 27 minutes = 2.27 pm

Add up the hours and minutes to find the total length of the train journey

37 minutes + 2 hours + 27 minutes

37 minutes + 27 minutes add up to 1 hour and 4 minutes

3 hours 4 minutes

(d) The table below shows part of a bus timetable.

Coronation Street	0750	0800	0816
Albert Square	0818	0830	0849
Ramsey Street	0825	0840	0903
Emmerdale Village	0834	0852	0918

How long should the journey between Coronation Street and Ramsey street take on the 0800 bus?

The 08 00 bus is the middle column

Find the time between the departure times at Coronation Street and Ramsey street for the middle column

08 40 - 08 00

40 minutes

Worked Example

The time in Madrid is 7 hours ahead of the time in Chicago.

Mark takes a flight from Madrid to Chicago which lasts 9 hours and 45 minutes.

The flight leaves at 7:30 am Madrid time.

What will the local time be in Chicago when he arrives?

Work in Madrid time, and then change at the end

Add 9 hours 45 minutes on to 7:30 am to find the time Mark arrives in Chicago (in Madrid time)

07:30 + 9 h 45m = 16:30 + 45m = 17:15

17:15 is the time in Madrid, so find the time in Chicago

Madrid is 7 hours ahead of Chicago

Subtract 7 hours

17:15 - 7 hours = 10:15

10:15 am

Your notes

Converting between Units


Your notes

Converting Units

How do I convert units of lengths?

- For **metric units**, conversion can be done by simply **multiplying or dividing** by **powers of 10**
- You need to know the **basic conversions** for **length**
  - 1 cm = 10 mm
  - 1 m = 100 cm
  - 1 km = 1000 m
- You need to decide whether to **multiply or divide** by the conversion factor
  - Ask, **does the number of units increase or decrease?**
    - The number of mm is 10 times **bigger than** the number of cm so **mm = cm × 10**
- You can do the conversion in **stages**
  - First convert kilometres into metres then metres into centimetres

How do I convert units of mass?

- For **metric units**, conversion can be done by simply **multiplying or dividing** by **powers of 10**
- You need to know the **basic conversions** for **mass**
  - 1 g = 1000 mg
  - 1 kg = 1000 g
  - 1 tonne = 1000 kg

How do I convert units of volume/capacity?

- For **metric units**, conversion can be done by simply **multiplying or dividing** by **powers of 10**
- You need to know the **basic conversions** for **capacity**
  - 1 litre = 100 cl = 1000 ml
    - 1 cl = 10 ml
- You must know the **basic conversion** between **volume** and **capacity**

- 1 ml = 1 cm^3
- 1 litre = 1000 ml = 1000 cm^3
- 1 m^3 = 1000 litres

Your notes

Worked Example

Convert

(a) 54 cm to mm

1 cm = 10 mm

54 cm = (54 × 10) mm = 540 mm

540 mm

(b) 12 300 cm to km

First convert from cm to m
100 cm = 1 m

12 300 cm = (12 300 ÷ 100) m = 123 m

Now convert from m to km
1000 m = 1 km

123 m = (123 ÷ 1000) km = 0.123 km

0.123 km

(c) 485 g to kg

1000 g = 1 kg

485 g = (485 ÷ 1000) kg

0.485 kg


Your notes

Squared & Cubic Units

How do I convert between squared units (areas)?

- You need to **square** the **unit conversion** rates
  - E.g., 1 cm^2 = 10^2 mm^2 = 100 mm^2
  - This is because area is 2D
  - The fact the units have a 'squared' on them will help you remember
- It can help to **imagine a square**
  - E.g. 1 m^2 is a square measuring 1 m × 1 m
  - In cm this would be 100 cm × 100 cm
  - So 1 m^2 is equivalent to 10 000 cm^2
- The **basic conversions** for **area** are
  - 1 cm^2 = 100 mm^2
  - 1 m^2 = 10 000 cm^2
  - 1 km^2 = 1 000 000 m^2
- You may be told conversions for other units in a question, such as
  - 1 hectare (ha) = 10 000 m^2

How do I convert between cubed units (volume)?

- You need to **cube** the **unit conversion** rates
  - E.g. 1 cm^3 = 10^3 mm^3 = 1000 mm^3
  - This is because volume is 3D
  - The fact the units have a “cubed” on them will help you remember
- It can help to **imagine a cube**
  - E.g. 1 m^3 is a cube measuring 1 m × 1 m × 1 m
  - In cm this would be 100 cm × 100 cm × 100 cm

- So 1 m^3 is equivalent to 1 000 000 cm^3

- The **basic conversions** for volume are
  - 1 cm^3 = 1000 mm^3
  - 1 m^3 = 1 000 000 cm^3
  - 1 km^3 = 1 000 000 000 m^3

Worked Example

Convert

(a) 8254 mm^2 to cm^2

1 cm = 10 mm

1 cm^2 = 10^2 mm^2 = 100 mm^2

$$8254 \text{ mm}^2 = (8254 \div 100) \text{ cm}^2 = 82.54 \text{ cm}^2$$

82.54 cm^2

(b) 2.54 m^3 to cm^3

1 m = 100 cm
1 m^3 = 100^3 cm^3 = 1 000 000 cm^3

$$2.54 \text{ m}^3 = (2.54 \times 1\,000\,000) \text{ cm}^3 = 2\,540\,000 \text{ cm}^3$$

2 540 000 cm^3


Your notes

Your notes

Compound Measures

What is a compound measure?

- **A compound measure** is something that is calculated by using **more than one** measurement
- Compound measures can be used to **measure rates**
  - This measures how much one quantity changes when the other is increased by 1
  - Examples include:
    - **Speed** – how much the distance changes for each unit of time
    - **Flow rate** – how much the volume changes for each unit of time
    - **Population density** – how many people there are for each unit of area
    - **Fuel consumption** - volume of fuel used for each unit of distance travelled

How do I find the units for a compound measure?

- You can use the **formula** for a compound measure to **derive its units**
  - Use the **units** for the **quantities** in the formula to derive the units of the compound measure
  - Write a **division** as **a/b** or **ab^{-1}** and pronounce it as "a per b"
- Examples include:
  - $\text{Speed} = \dfrac{\text{Distance}}{\text{Time}}$
    - If the distance is measured in **km** and the time is measured in **minutes** then the speed is measured in **km/min** or **$km\ min^{-1}$**
  - $\text{Flow rate} = \dfrac{\text{Volume}}{\text{Time}}$
    - If the volume is measured in **m^3** and the time is measured in **minutes** then the flow rate is measured in **m^3/min** or **$m^3 min^{-1}$**

How do I find the formula for a compound measure?

- You can use the **units** for a compound measure to help remember its **formula**

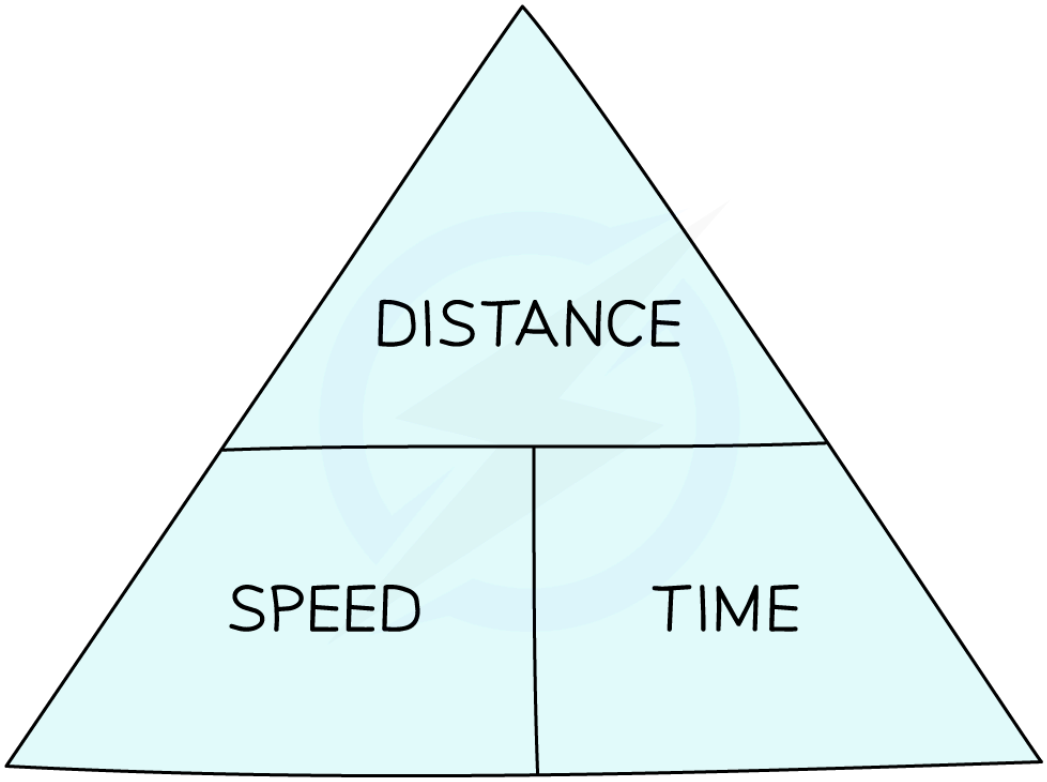
- You just need to remember what each unit **measures**
- If the unit is **a/b** then the formula will be the quantity that **a** measures **divided** by the quantity that **b** measures

- Examples include:
  - **Density** can be measured in **kg/cm^3**
  - kg is a measure of **mass** and cm^3 is a measure of **volume**
  - Therefore $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$

Your notes

What is a formula triangle?

- A **formula triangle** shows the **relationship** between the **different measures** in a **compound formula**
  - E.g. for Speed, Distance and Time



- If you are calculating a variable on the **top of the triangle**, multiply the two variables on the bottom
  - For example, $\text{Distance} = \text{Speed} \times \text{Time}$
- If you are calculating a variable on the **bottom of the triangle**, divide the top by the other variable on the bottom
  - For example, $\text{Speed} = \text{Distance} \div \text{Time}$ and $\text{Time} = \text{Distance} \div \text{Speed}$

Your notes

Examiner Tips and Tricks

- Check in the exam to see if the answer needs to be in different units
  - For example, the question may use metres and seconds but want the answer in km/h
- You need to remember the relationship between **speed**, **distance** and **time**

Worked Example

A high-speed racing car has an average fuel consumption of 3 km per litre during a race.

1 lap of the racing circuit is 5.9 km in length.

(a) Calculate the volume of fuel used, in litres, to complete 15 laps of the circuit.

The units for the fuel consumption are km per litre, which suggests the formula is

$$\text{fuel consumption} = \frac{\text{distance}}{\text{volume}}$$

Calculate the total distance covered for the 15 laps

$$15 \times 5.9 \text{ km} = 88.5 \text{ km}$$

Use the above formula to find the volume of fuel, V litres, used

$$\text{fuel consumption} = \frac{\text{distance}}{\text{volume}}$$

$$3 \text{ km per litre} = \frac{88.5 \text{ km}}{V \text{ litres}}$$

Rearrange the equation by multiplying both sides by V, and dividing both sides by 3

$$3V = 88.5$$

$$V = \frac{88.5}{3} = 29.5$$

29.5 litres of fuel

The race car then requires a pit-stop to refuel to complete the final laps of the race.

The flow rate of the fuel pump is 720 litres per minute, and fuel is pumped into the car for 3.1 seconds.

(b) Calculate the volume of fuel, in litres, pumped into the car in this time.

The flow rate is 720 litres per minute which suggests the formula is $\text{flow rate} = \frac{\text{volume}}{\text{time}}$

Before we can use the formula, we need to change the units of time to both be the same

Change 720 litres per minute, into litres per second (to match the time fuel is pumped for, which is in seconds)

If 720 litres are pumped in 1 minute, 60 times less will be pumped in 1 second

$$720 \div 60 = 12 \text{ litres per second}$$

Substitute these values into the formula

$$12 \text{ litres per second} = \frac{\text{volume in litres}}{3.1 \text{ seconds}}$$

Multiply both sides by 3.1

$$\text{volume in litres} = 12 \times 3.1 = 37.2$$

37.2 litres

Your notes

Your notes

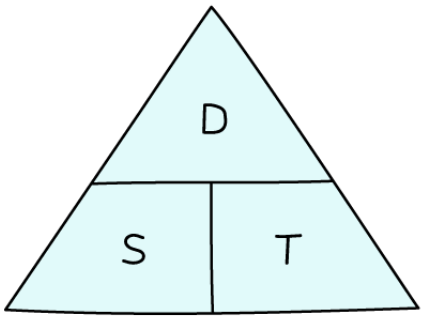
Speed, Density & Pressure

What are speed, density and pressure?

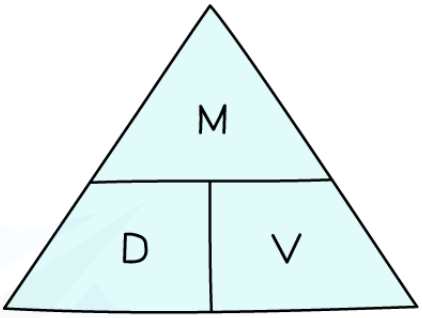
- **Speed**, **density** and **pressure** are frequently used **compound measures**
  - **Speed** is equal to **distance** divided by **time**
  - **Density** is equal to **mass** divided by **volume**
  - **Pressure** is equal to **force** divided by **area**

Your notes

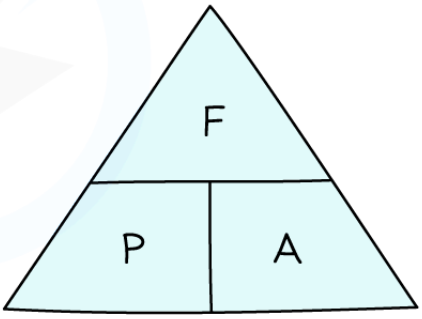
SPEED, DISTANCE, TIME



DENSITY, MASS, VOLUME

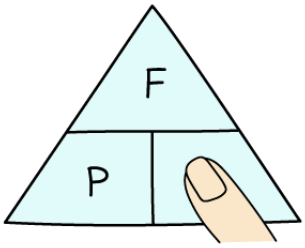


PRESSURE, FORCE, AREA



BLUE TRIANGLES WORK BY COVERING UP THE MEASURE YOU ARE TRYING TO FIND

e.g. FOR FINDING AREA...



$$\text{AREA} = \frac{\text{FORCE}}{\text{PRESSURE}}$$

Your notes

What should I know about speed, distance and time?

- **Speed** is commonly measured in **metres per second** (**m/s**) or **kilometres per hour** (**km/h**)
  - The units indicate **speed** is **distance per time**

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

- '**Speed**' (in this formula) means '**average speed**'
- In harder problems there are often **two journeys** or **two parts to one longer journey**

What should I know about density, mass and volume?

- Density is usually measured in **grams per centimetre cubed** (**g/cm^3**) or **kilograms per metre cubed** (**kg/m^3**)
  - The units indicate that **density** is **mass per volume**

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

- You may need to use a **volume formula** to find the volume of an object first

What should I know about pressure, force and area?

- Pressure is usually measured in Newtons per square metre (**N/m^2**)
  - The units of pressure are often called **Pascals** (**Pa**) rather than **N/m^2**
  - The units indicate that **pressure** is **force per area**

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

- Remember that **weight** is a **force**
  - It is different to **mass**

Examiner Tips and Tricks

- Look out for a mixture of units
  - **Time** can be given as **minutes** but common phrases like '**half an hour**' (30 minutes) could also be used in the same question

- Any mixed units should be those in common use and easy to convert, e.g., **g** to **kg** or **m** to **km** etc

Your notes

Worked Example

A box exerts a force of 140 newtons on a table.
The pressure on the table is 35 newtons/m^2.

$$p = \frac{F}{A} \quad \begin{matrix} p = \text{pressure} \\ F = \text{force} \\ A = \text{area} \end{matrix}$$

Calculate the area of the box that is in contact with the table.

Method 1

Substitute the numbers you know into the formula

$$35 = \frac{140}{A}$$

Solve the equation for A
First multiply both sides by A to get A out of the denominator

$$35A = 140$$

Then divide by 35 to find the value of A

$$A = \frac{140}{35}$$

The units will be m^2, matching the units seen in newtons/m^2

4 m^2

Method 2

Use the given formula to create a formula triangle for pressure, force and area

$$\begin{matrix} & F & \\ p & & A \end{matrix}$$

A is on the bottom of the triangle, so this tells us to divide F by P

$$A = \frac{F}{p} = \frac{140}{35} = 4$$

$4\ m^2$

Your notes

Worked Example

The density of pure gold is 19.3 g/cm^3.

What is the volume of a gold bar that has a mass of 0.454 kg?

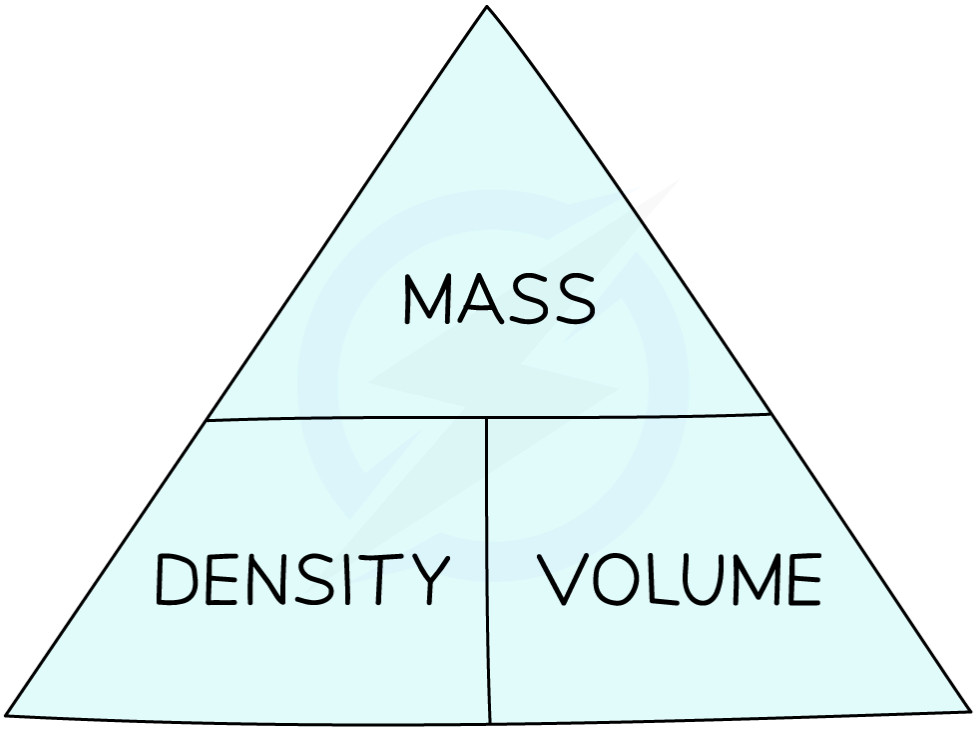
Begin by checking that all of the units are consistent
Density is given in g/cm^3
Convert the volume of the gold bar into grams to match the units

$$0.454\ kg = (0.454 \times 1000)\ g = 454\ g$$

The units of density are g/cm^3, so divide the mass (g) by the volume (cm^3)

Or, write out the formula triangle

Your notes



Write out the formula that you will need

$$\text{Volume} = \frac{\text{mass}}{\text{density}}$$

Substitute the given values for the mass and the density

$$\text{Volume} = \frac{454}{19.3} = 23.5233...$$

Make sure you give the correct units with your final answer
The density is given in g/cm^3, so the volume should be cm^3

Volume = 23.5 cm^3 (1 d.p.)