

AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES SCHOOLS ENRICHMENT CENTRE (AIMSSEC)

AIMING HIGH

TEMPERATURE



In some countries temperature is measured in degrees Celsius (originally called degrees Centigrade) and in other countries it is measured in degrees Fahrenheit.

The freezing point of water is 0 degrees Celsius and 32 degrees Fahrenheit.

The boiling point of water is 100 degrees Celsius and 212 degrees Fahrenheit.

Use this information to write down an expression for converting Fahrenheit readings into Celsius.

Write down an expression for converting Celsius readings into Fahrenheit.

A temperature for the human body of between 97 and 99 degrees Fahrenheit is considered normal and a temperature of over 100 degrees Fahrenheit is said to be a fever. Find the equivalent temperatures in degrees Celsius.

What equation would you solve to find the temperature at which Celsius and Fahrenheit readings are the same

HELP

You must think how you will deduce information from the initial temperature facts given.

You could use a straight line graph to show the conversion of Fahrenheit to Celsius. With Celsius on the horizontal axis plot the points (0, 32) and (100, 212) to show the freezing point and the boiling point of water and join them with a straight line.

What is the gradient of the line? What is the equation of the line?

NEXT

Scientists often use the Kelvin scale of temperature, where the freezing point of water is $273.15 \circ K$ and the boiling point of water is $373.15 \circ K$.

Is there a temperature at which Kelvin and Fahrenheit readings are the same? Is there a temperature at which Kelvin and Celsius readings are the same?

Can you describe ways of converting Kelvin readings into Fahrenheit and Celsius readings?

NOTES FOR TEACHERS



Using the information given plot the points (0, 32) and (100, 212) and join the points with a straight line to

get a graph to convert between Celsius and Fahrenheit.

The range of 100°C corresponds to the range of 180°F so $1^{\circ}C = 1.8^{\circ}F$

The formula to convert Fahrenheit to Celsius is C = 5(F - 32)/9

The formula to convert Celsius to Fahrenheit is F = 9C/5 + 32

97°F is equivalent to 36.1°C and 99°F is equivalent to 37.2 to the nearest 0.1°.

1. Write the question on the board, say to the class:

 100° F is equivalent to 37.8° C to the nearest 0.1° C.

The equation for finding when the readings are the same is C = 9C/5 + 32 or F = 5(F - 32)/9. Solving these equations gives the temperature at which the readings are the same as -40° which is also shown by the graph.

"Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 fingers for D".

Diagnostic Assessment This should take about 5–10 minutes.

2.	Notice how the learners responded. Ask a learner who gave answer A to explain why he or she gave that answer and DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.						
3.	Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide						
	if their own answer was right or wrong.						
4.	Ask the class again to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a change						
	and who gave right and wrong answers. It is important for learners to explain the reason for their answer otherwise many learners will just make a guess.						
5.	5. If the concept is needed for the lesson to follow, explain the right answer or give a remedial task.						
Pat has a fever and her temperature is 38.10 C							
V	That is this temperature in degrees Fahrenheit	C. is the correct answer.					
to	o the nearest degree?	It is important for learners to explain the reason for					
		their answer otherwise many learners will just make a					
A	. 76ºF B. 100ºF C. 101ºF D. 99º	guess.					
		Common Misconceptions					
		A).Learners might just double 38.					
		B). This answer may be given because above 100°C is a					
		fever.					
		D). This may be a guess or may be given because the					
	https://diagnosticquestions.com	learner knows that 38.1°C and 99°F are above normal.					

Why do this activity?

This activity gives an opportunity to combine skills from mathematics and science. It can be solved numerically, algebraically or graphically, so the merits of different methods can be discussed. Conversion calculations are necessary in many situations in life (apart from within a metric system). This is also a real life application of mathematics, important to healthcare and also to understanding weather reports. Some countries use Fahrenheit, or may have switched to Celsius in recent years, so many people understand one system well and not the other.

Learning objectives

In doing this activity students will have an opportunity to:

- develop their understanding of algebraic expressions and how to do conversion calculations;
- develop their understanding of straight line graphs;
- appreciate the different representations of mathematical relationships.

Generic competences (some suggestions, select from list or write your own)

In doing this activity students will have an opportunity:

- to think mathematically and to apply knowledge to real life situations:
- to relate ideas that arise in different academic subjects (for example maths, science and medicine) and also in different contexts in human experience'

Suggestions for teaching

Start with the Diagnostic Quiz to find out what the learners know about measuring temperature. Some may have cared for a sick person and may be aware of the normal and fever temperatures for people, or they may have met this in Science.

Introduce the boiling and freezing point of water in Celsius and Fahrenheit.

"What other information can you deduce from these temperature facts?"

Give the class some time to discuss in pairs, then bring the class together to collect ideas on the board. Possible responses might be:

"50°C=122° F because it's halfway between."

"200°C=392°F because it's another 180°F."

"A temperature increase of $100^{\circ}C$ is the same as a temperature increase of $180^{\circ}F$."

Give the class plenty of time to work on this activity. Some learners are likely to use a **numerical approach**. If others use **algebraic** or **graphical methods**, ask them to share their approaches with the rest of the class.

If nobody uses algebra or graphs, ask the class to consider first how a graph might help: "Can you represent the original information graphically in a way that could help you to solve the problem?"

The graphical method can then lead on to a discussion of the algebraic representation of the straight line graph and hence algebraic methods of solution.

Take time to discuss the merits of the different methods and then challenge students to show how to use each solution method to solve problems such as:

"Is there a temperature where the reading in Celsius is the same as the reading in Fahrenheit?" "Is there a temperature at which the Fahrenheit reading is 20 degrees higher than the Celsius reading?"

"Is there a temperature at which the Celsius reading is 20 degrees higher than the Fahrenheit reading?"

Key questions

- Does every method give the same answer?
- Does every method give equally accurate answers?
- What are the merits of the different methods?

Follow up

How Hot? https://aiminghigh.aimssec.ac.za/years-5-to-8-how-hot/

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and up to Secondary 5 in East Africa. New material will be added for Secondary 6. The mathematics taught in Year 13 (UK) and Secondary 6 (East Africa) is beyond the school curriculum for Grade 12 SA. For resources for teaching A level mathematics see https://nrich.maths.org/12339

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	Lower Primary	Upper Primary	Lower Secondary	Upper Secondary		
	or Foundation Phase					
	Age 5 to 9	Age 9 to 11	Age 11 to 14	Age 15+		
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12		
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12		
UK	Reception and Years 1 to 3	Years 4 to 6	Years 7 to 9	Years 10 to 13		
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6		