T-LEVELS | Institute for Apprenticeships & Technical Education

Understanding and using formulae in your exam

T Level Technical Qualification in Health

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Contents

Introduction

Health professionals are expected to conduct a range of tasks, which require the application of maths to practice. This is sometimes done without having to think about the fact that maths is being applied to everyday working situations.

Examples of applying maths in a health care setting - which are commonly used, include: monitoring a patient's temperature, respiration rate, their blood pressure, heart rate, and carrying out a wound assessment, etc.

Working in a health care setting will require workers to be able to manoeuvre patients by safe lifting and handling. This means that workers will need to be able to choose the correct equipment according to the patient's size and weight, and requires the ability to correctly calculate a patient's body mass index to ensure safe working.

Whichever route you take into a health career, you would be required to demonstrate your maths knowledge, usually with a minimum of a grade 4 at GCSE. The ability to use formulae is a requirement at GCSE and level 2 Functional Skills maths.

For students considering progression into higher education, it is worth knowing that some universities have a maths assessment as an entry test for health degrees, while others carry out continuous maths assessments during the degree course.

There are formulas that are part of the science content of the Health Technical Qualification that may be assessed in the exam. You may need to substitute values into a formula or rearrange a formula first. This booklet covers the order of operations when solving a calculation, substituting into a formula, and rearranging formulas. There are activities that you can complete, with the worked answers given at the end of this booklet.

BIDMAS

When using formulae, we first need to know the **order of operations** (+, −, ×, ÷, brackets) in calculations. For example, if you use your calculator to work out;

$$20 + 10 \times 2$$

you get the answer 40 (check this out).

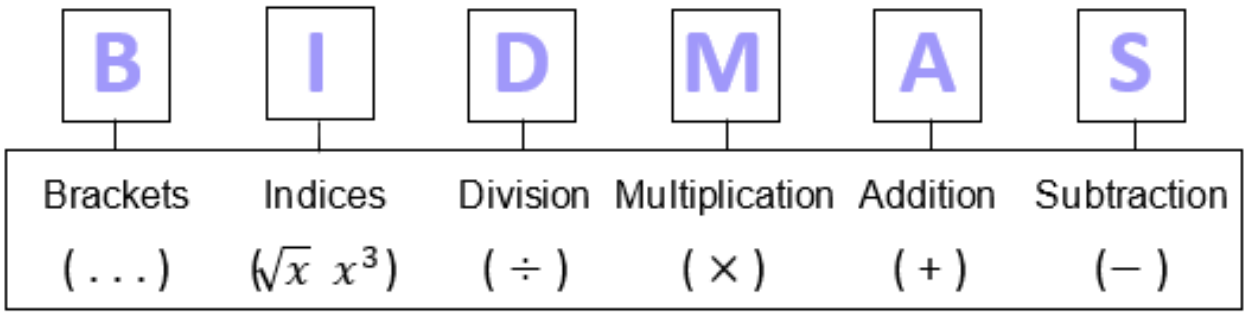
If you calculate it in your head, working from left to right, you get;

$$20 + 10 \times 2 = 30 \times 2 = 60$$

The order of the operations (that is, the addition and multiplication in this example) is important.

Your calculator is programmed to do the calculations in the correct order.

The convention (that is, the way in which this is usually done) can be illustrated by the acronym **BIDMAS** (also given, sometimes, as **BODMAS**, where the 'O' stands for 'orders').



Let's look at how this would be applied in a more complex formula:

$$5 + (6 \times 2^3 + 7)$$

Using **BIDMAS**, we first deal with the calculations **inside the brackets**:

$$6 \times 2^3 + 7$$

Next, we calculate 2^3 (**index –** $2^3 = 2\ X\ 2\ X\ 2$), which gives '8', and so we have:

$$6 \times 8 + 7$$

Now we calculate the **multiplication**, giving

$$48 + 7$$

and **addition**

$$55$$

We return to our original equation and the solution, using BIDMAS:

$$5 + (6 \times 2^3 + 7) = 5 + 55$$
$$= 60$$

BIDMAS calculations practice

Answers are in the BIDMAS calculations practice part of the answers section at the end.

Calculate, using the BIDMAS convention,

$16 \times 2 + 3^2 =$

$16 \times (2 + 3) =$

$3 \times 2^3 + 8 \div 4 =$

$42 \div 7 + 3 =$

$\frac{4+17}{7} - 2 =$

$17 + \frac{70 - 16}{3^2} =$

Substituting values into a formula

A formula that is commonly used in healthcare settings and in everyday life is the formula for calculating BMI.

$$BMI = \frac{mass(kg)}{[height\ (m)]^2}$$

As an example:

A person has a height of 1.65 m and their weight is 78 kg. What is their BMI?

The first step is to substitute the values into the formula:

$$BMI = \frac{78}{1.65^2}$$

Next, we use BIDMAS to decide which order to do the calculations. Indices come first, so we calculate 1.65^2 first and rewrite the formula:

$$BMI = \frac{78}{2.7225}$$

The next step is to complete the division 78 ÷ 2.7225

$$BMI = 28.65$$

To check this is the correct result you can use a BMI calculator and input the same information. You can then use this information to determine whether a patient needs to manage their weight.

Substituting values into a formula practice

Answers are in the Substituting values into a formula practice part of the answers section at the end.

1. Using the formula $BMI = \frac{mass}{height^2}$ Calculate the BMI of a patient with a height of 1.69 m and weight 92 kg.

2. Using the formula $Magnification = \frac{size\ of\ image}{size\ of\ object}$ calculate the magnification when the size of image is 2 mm and the size of the object is 0.005 mm.

3. Using the formula Q = I × t where Q = charge in Coulombs, I = current in amps and t = time in seconds, calculate the charge when I = 0.005 A and T = 30 s.

4. Using Ohm's law V = IR where V = Potential difference in volts, I = current in amps and R = resistance in Ohms, calculate the potential difference when the current is 0.001 A and the resistance is 15 Ω.

Rearranging a formula

Knowing how to rearrange a formula means that you only need to remember one version of any formula and if a question comes up that requires that formula, but with a different subject (the value on its own on one side of the equation), you can simply rearrange it.

We can easily calculate BMI if we are given a mass and height using the knowledge of substituting into a formula from the previous section, but what if we are given height and BMI and we want to calculate the ideal weight? We would need to rearrange the formula to make mass the subject.

When rearranging formula, it is important to remember that the balance of the formula must remain the same. E.g. if we wish to subtract a value from one side, then the same value must be subtracted from both sides.

As an example, we have a person whose height is 160cm and the top range of their ideal BMI is 24.9, so what would be the top range of their weight?

We use the same formula as before and rearrange to make mass the subject:

$$BMI = \frac{mass(kg)}{[height\ (m)]^2}$$

We want mass to be on one side of the equation on its own, in the current format of the equation, BMI is the subject and mass is divided by $[height\ (m)]^2$.

The opposite of division is multiplication, so we can multiply both sides of the equation by $[height\ (m)]^2$

BMI x $[height\ (m)]^2$ = mass (kg)

Now that we have mass as the subject of the equation, we can substitute in the given values to do the calculation:

24.9 x 1.6^2 = mass (kg)

Using BIDMAS we calculate the indices first:

24.9 x 2.56 = mass (kg)

63.744 = mass (kg)

Rearranging and using formula practice

Answers are in the Rearranging and using formula practice part of the answers section at the end.

1a) Rearrange the formula $Magnification = \frac{size\ of\ image}{size\ of\ object}$ to make "size of object" the subject

1b) Use your rearranged formula to calculate the size of an object when magnification is 800 and the size of an image is 2.4 mm

2a) Rearrange the formula Q = I × t to make t the subject.

2b) Use your rearranged formula to find the time in seconds for a charge of 0.25 C when the current is 0.004 A.

3a) Rearrange the formula Q = I × t to find current when the charge and time are known.

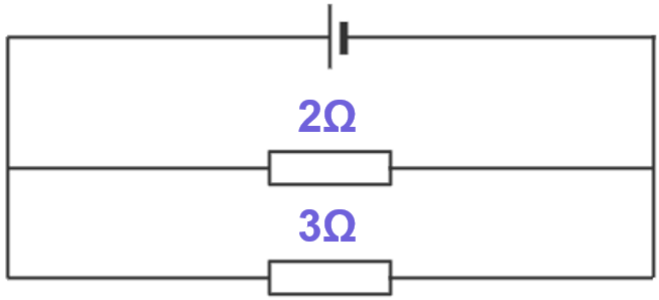
3b) Use your rearranged formula to calculate current when the charge is 0.09 C and the time is 20 s.

4a) Rearrange the formula V = IR to find the resistance when the current and potential difference are known.

4b) Rearrange Ohm's law to find the current when resistance and potential difference are known.

4c) Calculate the current when V = 9 V and R = 17 Ω

5. Using the formula for resistance in a parallel circuit $\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \cdots \frac{1}{Rn}$ calculate the total resistance in this circuit:



Answers

BIDMAS calculations practice

Calculate, using the BIDMAS convention,

$16 \times 2 + 3^2 =$

16 x 2 + 9

32 + 9

= 41

$16 \times (2 + 3) =$

16 x 5

= 80

$3 \times 2^3 + 8 \div 4 =$

3 x 8 + 8 ÷ 4

3 x 8 + 2

24 + 2 = 26

$42 \div 7 + 3 =$

6 + 3

= 9

$\frac{4+17}{7} - 2 =$

$\frac{21}{7} - 2$

3 – 2 = 1

$17 + \frac{70 - 16}{3^2} =$

$17 + \frac{54}{9}$

17 + 6 = 23

Substituting values into a formula practice

1. Using the formula $BMI = \frac{kg}{m^2}$ Calculate the BMI of a patient with a height of 1.69 m and weight 92 kg. Give your answer to 3 s.f. (s.f. stands for significant figures)

$BMI = \frac{92}{1.69^2}$ $BMI = \frac{92}{1.69^2}$ $BMI = \frac{92}{2.8561}$ $BMI = 32.2$

2. Using the formula $Magnification = \frac{size\ of\ image}{size\ of\ object}$ calculate the magnification when the size of image is 2 mm and the size of the object is 0.005 mm.

$Magnification = \frac{2}{0.005}$

$Magnification = 400$

3. Using the formula Q = I × t where Q = charge in Coulombs, I = current in amps and t = time in seconds, calculate the charge when I = 0.005A and T = 30s

Q = 0.005 x 30

Q = 0.15

0.15 C

4. Using Ohm's law V = IR where V = Potential difference in volts, I = current in amps and R = resistance in Ohms, calculate the potential difference when the current is 0.001A and the resistance is 15 Ω

V = 0.001 x 15

V = 0.015

0.015 V

Rearranging and using formula practice

1a) Rearrange the formula $Magnification = \frac{size\ of\ image}{size\ of\ object}$ to make "size of object" the subject

Magnification x size of object = size of image (multiply both sides by size of object)

$\text{size of object} = \frac{\text{size of image}}{\text{Magnification}}$ (Divide both sides by magnification)

1b) Use your rearranged formula to calculate the size of an object when magnification is 800 and the size of an image is 2.4 mm.

$\text{size of object} = \frac{2.4}{800}$

size of object = 0.003

0.003 mm

2a) Rearrange the formula Q = I × t to make t the subject

$\frac{Q}{I}$ = t (divide both sides by I)

2b) Use your rearranged formula to find the time in seconds for a charge of 0.25 C when the current is 0.004 A.

$\frac{0.25}{0.004}$ = t

62.5 = t

62.5 seconds

3a) Rearrange the formula Q = I × t to find current when the charge and time are known.

$\frac{Q}{t}$ = I (divide both sides by t)

3b) Use your rearranged formula to calculate current when the charge is 0.09 C and the time is 20 s.

$\frac{0.09}{20}$ = I

0.0045 = I

0.0045 A

4a) Rearrange the formula V = IR to find the resistance when the current and potential difference are known.

$\frac{V}{I}$ = R (Divide both sides by I)

4b) Rearrange Ohm's law to find the current when resistance and potential difference are known.

$\frac{V}{R}$ = I (divide both sides by R)

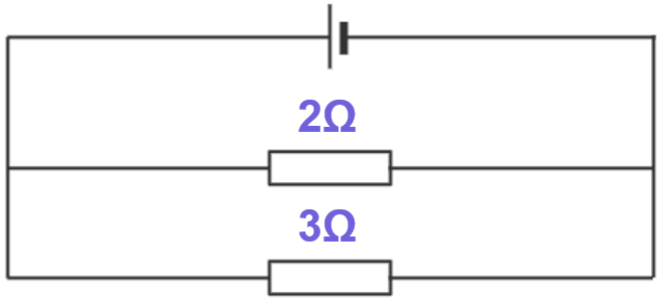
4c) Calculate the current when V = 9 V and R = 17 Ω. Give your answer to 3 s.f.

$\frac{9}{17}$ = I

0.529 = I

0.529 A

5. Using the formula for resistance in a parallel circuit $\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \cdots \frac{1}{Rn}$ calculate the total resistance in this circuit:



$\frac{1}{R} = \frac{1}{2} + \frac{1}{3}$ First substitute in the values

$\frac{1}{R} =$ 0.83 Now we need to make R the subject by rearranging

1 = 0.83 x R (Multiply both sides by R)

$\frac{1}{0.83} =$ R (Divide both sides by 0.83)

1.205 = R

1.2 Ω