Equations in Physics 1

Okay this is the part that lots of us don't feel too confident about. Equations usually ask you to do one of two things: multiply 2 numbers, or divide 2 numbers. And if you think about it you have been multiplying and dividing numbers for years without too much trouble up till now so this can't be too difficult.

a) Looking for clues

Each word in the equation represents the property of something eg current is the amount of charges (electrons) flowing through a wire. Each word has a unit, the current's unit is the amp or A.

All you have to do is look for the clues in the question to help you find out 1) which equation to choose, 2) which amount to use, 3) which unit the answer has.

Example

A steam iron operates on a mains voltage of 230V and has a current of 4A flowing through it. What is the power of the steam iron?

What are the clues?

1) Which equation? Properties given are power, voltage and current. Find an equation in the list with just these 3 in it and write it down.

Power = Voltage x Current

2) What amounts to use? Look for the numbers and their units given, voltage=230V and current 4A. Now put these numbers in place of the words and solve the equation

Power = 230 x 4 = 920

3) Which unit for the answer? There is no easy way round this YOU HAVE TO LEARN THE UNITS which for power is Watts or W

b) Re arranging the equation

This is a skill that pass grade candidates need to master and is not difficult if you remember these rules.

To find the voltage:

Power = Voltage x Current

- *to get voltage on its own take current to the other side of the equals sign*
- *on the other side current goes under power - the opposite of multiply*

$$\frac{\text{Power}}{\text{Current}} = \text{Voltage}$$

- *to get back to power on its own take the current to the other side but this time it is multiplying – the opposite of divide*

Power = Voltage x Current

To summarise equations that are multiplying or dividing;

when you take the word from the bottom (÷ into) on one side it goes to the top on the other (and becomes x by)
when you take a word from the top to the other side it goes to the bottom.

Practise questions

Re arrange the following equations

i) Energy transfer = power x time

power =

time =

ii) Speed = $\frac{\text{distance}}{\text{Time}}$

Distance =

Time =

iii) Wave speed = wavelength x frequency

frequency =

wavelength =

iv) Efficiency = $\frac{\text{useful energy transfer}}{\text{Total energy input}} \times 100\%$

useful energy transfer=

total energy input =

Answers

i) Power = $\frac{\text{energy transfer}}{\text{time}}$

time = $\frac{\text{energy transfer}}{\text{power}}$

ii) Distance =speed x time

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

iii) Frequency = $\frac{\text{wave speed}}{\text{wavelength}}$

wavelength = $\frac{\text{wave speed}}{\text{Frequency}}$

iv) Useful energy transfer = $\frac{\text{efficiency x total energy input}}{100\%}$

total energy input = $\frac{\text{useful energy transfer}}{\text{efficiency}} \times 100\%$

c) Scary numbers

Some of the numbers used can be scary eg., 3.56901 or 0.0067 or 15 x 10^7 or sometimes you are asked to divide a small number by a larger one eg., $\frac{13}{347}$

So what to do? **1) HAVE FAITH, just put the numbers as you see them into your calculator – yes you will need one of these! For $15x10^7$ put 15 in then press EXP then 7.**

2) If the number below is bigger than the one on top like 13/347 then remember your answer will be less than one.

Some practise questions

i) 2.5 x 10 =
ii) 4.1 x 3 =
iii) 4.1 x 3.5 =
iv) 0.5 x 10 =
v) 0.05 x 10 =
vi) 0.3 x 10 =
vii) 0.3 x 2 =
viii) 0.3 x 3 =
ix) 0.3 x 2.5 =
x) 0.01 x 0.25 =
xi) 5/10 =
xii) 8/16 =
xiii) 4/16 =
xiv) 2/16 =
xv) 0.2/16 =
xvi) 1/10 =
xvii) 1/100 =
xviii) 3/12.5 =
xix) 3.6/4.3 =
xx) 7.94/ 10.04 =
xxi) $2x10^4$ x $4x10^3$ =
xxii) $12x10^2$ x $2x10^2$ =
xxiii) $3x10^8$ / $1x10^{-5}$ =
xxiv) $3x10^8$ / $1x10^{-1}$ =
xxv) $3x10^8$ / $2.5x10^{-5}$ =

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1.i) 96W ii) 230V iii) 0.5A 2.i) 24m/s ii) 10m iii) 3s
3.i) 300 000 000 m/s ii) 6000 m iii) 1 200 000 Hz
4.i) 33% ii) 17J iii) 150J

Using equations practise

Select from the list below

1. Power = Voltage x Current

2. Energy transfer = power x time

3. Speed = $\frac{\text{distance}}{\text{Time}}$

4. Wave speed = wavelength x frequency

5. Efficiency = $\frac{\text{useful energy transfer}}{\text{Total energy input}} \times 100\%$

6. units used = power x time

7. cost = units used x cost per unit

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i)25 ii) 12.3 iii) 14.35 iv) 5 v) 0.5 vi) 3 vii) 0.6 viii) 0.9 ix) 0.75 x) 0.0025 xi) 0.5 xii) 0.5 xiii) 0.25 xiv) 0.125 xv) 0.0125 xvi) 0.1 xvii)0.01 xviii) 0.24 xix) 0.84 xx) 0.7908 xxi) 8×10^{7} xxii) 2.4×10^{5} or 24×10^{4} xxiii)3×10^{13} xxiv) 3×10^{9} xxv) 1.2×10^{13}

Practise questions

1. find the following:

i) power if voltage across a heating element is 24v and the current through it 4A

ii) voltage if the power of a bulb is 460W and the current through it is 2A

iii) current if the power is 115W and the voltage across it is 230V.

2. find the following

i) speed if the distance travelled is 120m and the time taken is 5s

ii) distance if the speed is 4m/s and the time is 2.5s

iii) time if the speed is 4m/s and the distance is 12m

3. find the following

i) wave speed if the wavelength is 150m and the frequency is 2 000 000 Hz

ii) wavelength if the wave speed is 300 000 000 m/s and the frequency is 50 000 Hz

iii) frequency if the wave speed is 300 000 000 m/s and the wavelength is 250 m

4. find the following

i) efficiency if the useful energy transfer is 17J and the total energy input is 51J

ii) useful energy transfer if the efficiency is 20% and the total energy input is 85J

iii) total energy input if the efficiency is 30% and the useful energy transfer is 45J

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