

Equations in Physics 2

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

An iron has a power of 2300W and operates on a mains voltage of 230V. Find the size of the current that flows through it at this voltage and hence select the appropriate fuse size to use in the plug from 3a, 5A and 13A.

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.

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

2) Which amounts to use? Look for the numbers and their units given, power=2300W, voltage=230V. Now put these numbers in place of the words and solve the equation

$$\text{Current} = \frac{2300}{230} = 10$$

3) Which unit for the answer? There is no easy way round this **YOU HAVE TO LEARN THE UNITS**

The unit for current is the amp or A so after the number write A.

Current = 10 A

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.

Start with the equation above, if you are asked to find the power then you need to take the voltage to the left side of the equals sign. It is underneath power on the right side of the equals sign, so when it goes to the left side it will go to the top and become multiply by. In other words instead of dividing into, it multiplies (it does the opposite).

Current= $\frac{\text{Power}}{\text{Voltage}}$ **becomes** Voltage x Current = Power

To find the voltage in the equation **voltage x current =power** you now need to take current to the other side (right side). When it goes to the other side of the equals sign it does the opposite so if it was multiplying it becomes dividing into so:

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

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) Resistance = $\frac{\text{voltage}}{\text{Current}}$

Voltage =

Current =

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

Distance =

Time =

iii) Force = mass x acceleration

Mass =

Acceleration =

iv) Work = force x distance

Force =

Distance =

HIGHER ONLY

v) Kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$

Speed =

Answers

i) Voltage = resistance x current
Current = $\frac{\text{voltage}}{\text{Resistance}}$

ii) Distance = speed x time
Time = $\frac{\text{distance}}{\text{Speed}}$

iii) Mass = $\frac{\text{force}}{\text{Acceleration}}$
Acceleration = $\frac{\text{force}}{\text{Mass}}$

iv) Force = $\frac{\text{work}}{\text{Distance}}$
Distance = $\frac{\text{work}}{\text{Force}}$

v) Kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$

$$2 \times \text{kinetic energy} = \text{mass} \times \text{speed}^2$$

$$\frac{2 \times \text{kinetic energy}}{\text{mass}} = \text{speed}^2$$

$$\frac{2 \times \text{kinetic energy}}{\text{mass}} = \text{speed}$$

c) Scary numbers

Some of the numbers used can be scary eg., 3.56901 or 0.0067 or 15×10^7 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 15×10^7 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

- i) $2.5 \times 10 =$
- ii) $4.1 \times 3 =$
- iii) $4.1 \times 3.5 =$
- iv) $0.5 \times 10 =$
- v) $0.05 \times 10 =$
- vi) $0.3 \times 10 =$
- vii) $0.3 \times 2 =$
- viii) $0.3 \times 3 =$
- ix) $0.3 \times 2.5 =$
- x) $0.01 \times 0.25 =$
- 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) $2 \times 10^4 \times 4 \times 10^3 =$
- xxii) $12 \times 10^2 \times 2 \times 10^2 =$
- xxiii) $3 \times 10^8 / 1 \times 10^{-5} =$
- xxiv) $3 \times 10^8 / 1 \times 10^{-1} =$
- xxv) $3 \times 10^8 / 2.5 \times 10^{-5} =$

Answers at bottom of page 6

Answers to page 7

- 1.i) 4Ω ii) 100V iii) 4A 2.i) 24m/s ii) 10m iii) 3s
3.i) 37.5N ii) 6kg iii) 30m/s^2 4.i) 3m/s^2 ii) 9s iii) 35m/s

Using equations practise

Select from the list below

1. Resistance = $\frac{\text{voltage}}{\text{Current}}$

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

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

4. Acceleration = $\frac{\text{change in speed}}{\text{Time}}$

5. force = mass x acceleration

6. work = force x distance

7. HIGHER ONLY

8. Kinetic energy = $\text{mass} \times \text{speed}^2$

2

9. potential energy = mass x gravitational field x change in height strength

Answers to page 5

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) resistance if voltage across a heating element is 24v and the current through it 6A
- ii) voltage if the resistance of a bulb is 50Ω and the current through it is 2A
- iii) current if the resistance is 50Ω and the voltage across it is 200V.

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) force if the mass is 12.5kg and the acceleration is 3m/s^2
- ii) mass if the force is 9N and the acceleration is 1.5m/s^2
- iii) acceleration if the force is 630N and the mass is 21kg

4. find the following

- i) acceleration if the change in speed is 45m/s and the time is 15s
- ii) time if the change in speed is 45m/s and the acceleration is 5m/s^2
- iii) change in speed if the acceleration is 7m/s^2 and the time 5s

Answers at bottom of page 5