A LEVEL PHYSICS

DAILY WORKOUT

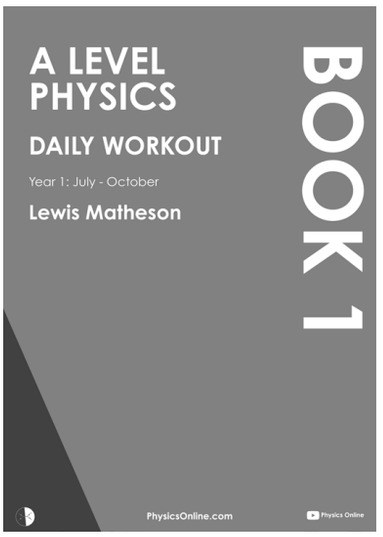
Year 1: July - October

Lewis Matheson

BOOK 1

This is a sample of Book 1, with questions and answers for July.

There is also an example of the type of worked solutions you can find on the website when you buy the book.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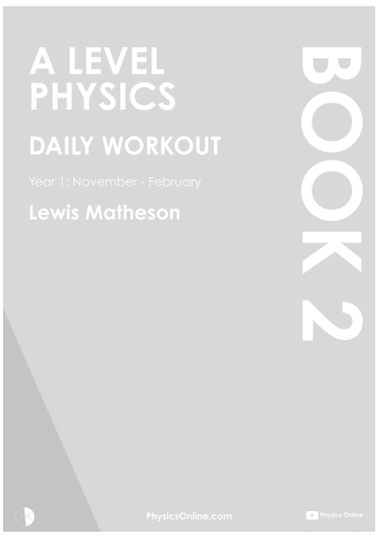
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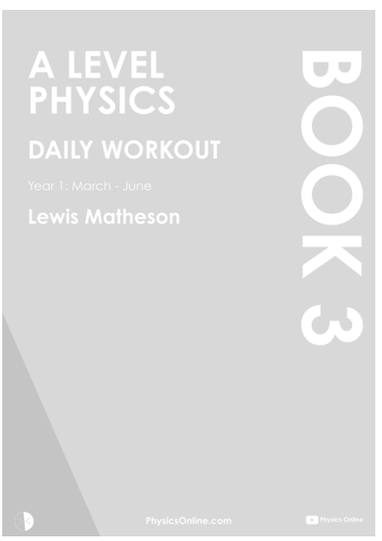
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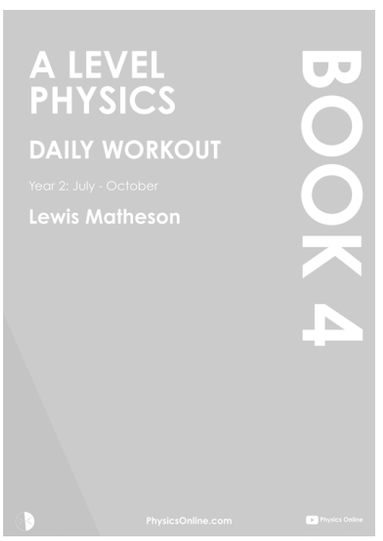
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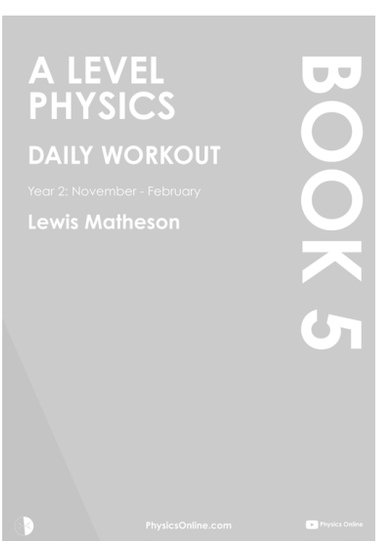
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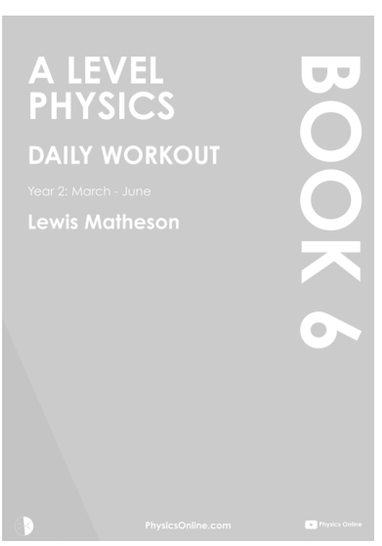
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JULY

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JULY

In July we're going to start covering some of the basics – a lot of which you will already have covered in your GCSE Science course and GCSE Maths.

This includes:

- Pythagoras and trigonometry with right-angled triangles
- Standard form
- Significant figures
- Rearranging formulas
- Simple calculations (based on your GCSE knowledge)

Many of the questions will be quick and straightforward, others may appear a little more tricky, but it's worth persevering. A Level Physics relies a lot more on mathematics than GCSE Physics - so you must be familiar with the techniques you practise this month.

There are answers in the back of the book for you to mark your work. For full worked solutions please visit the A Level Physics website.

Worked Examples

1. Calculate the **area**, in m^2, of a circle with a radius of:

   a. 1.25 m $A = \pi r^2 = \pi \times 1.25^2 = 4.91\ m^2$ (3 sf)

   b. 12.5 mm $A = \pi r^2 = \pi \times (12.5 \times 10^{-3})^2 = 4.91 \times 10^{-4}\ m^2$ (3 sf)

   c. 125 µm $A = \pi r^2 = \pi \times (125 \times 10^{-6})^2 = 4.91 \times 10^{-8}\ m^2$ (Standard form)

2. Calculate the **mass** of a robin flying at 8.9 m s^{-1} when it has a kinetic energy of 879 mJ.

   Equation: $E_k = \frac{1}{2}mv^2$

   Rearrange: $m = \frac{2E_k}{v^2}$

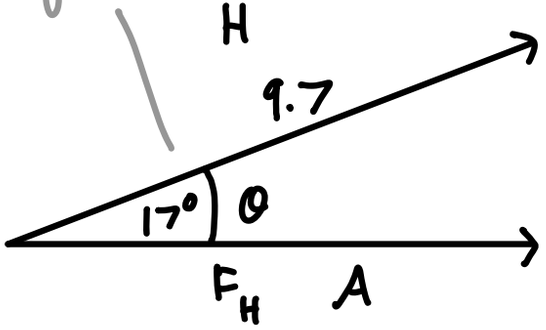
   Working out: $m = \frac{2 \times 879 \times 10^{-3}}{8.9^2}$

   $m = 0.02219$

   $m = 2.2 \times 10^{-2}\ kg$ (Units, 2 sf)

3. Calculate the **horizontal component** of a force of 9.7 N acting at 17° above the horizontal.

   Diagram:



   $\cos\theta = \frac{A}{H}$

   $A = H\cos\theta$

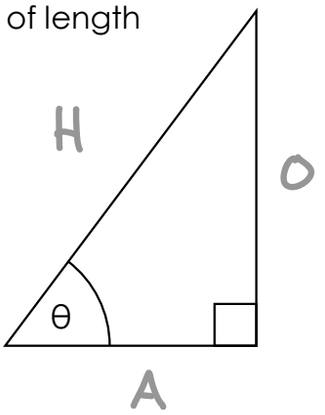
   $F_H = 9.7 \times \cos 17$

   $F_H = 9.276$

   $F_H = 9.3\ N$

1st July

1. Calculate the **angle**, θ, in the triangle with a hypotenuse of length 10.0 cm and an opposite side length of 8.00 cm.



2. Write down the **proportionality relationship** between kinetic energy and (non-relativistic) mass for a moving object.

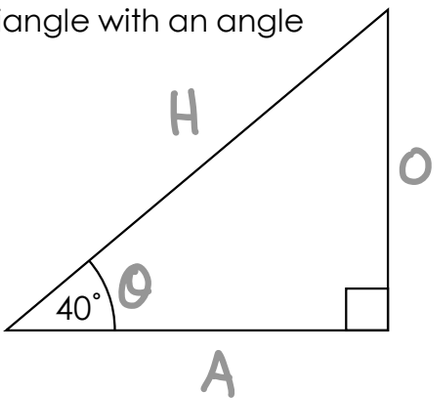
$$E_K = \frac{1}{2}mv^2$$

3. Calculate the **kinetic energy** and **momentum** of a car with a mass of 1200 kg and a velocity of 30 m s^{-1}.

$m = 1200\ kg$ $v = 30\ m\,s^{-1}$ $p = mv$ $E_K = \frac{1}{2}mv^2$

2nd July

1. Calculate the length of the **hypotenuse** in this triangle with an angle of 40˚ and an adjacent side length of 2.8 m.



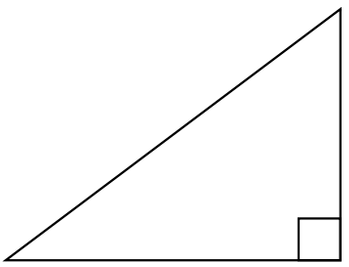
2. Write down the **proportionality relationship** between resultant force and acceleration.

3. Explain what a **vector** quantity is and identify which of these quantities are vectors:

Speed, velocity, force, mass, energy and weight

3rd July

1. State **Pythagoras'** Theorem.

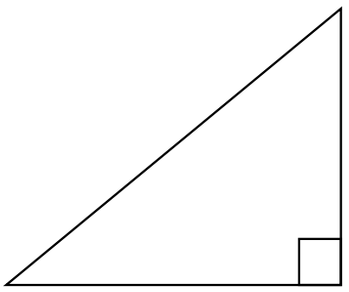


2. Write down the **proportionality relationship** between and frequency and time period for a wave.

3. Calculate the **frequency** of a sound wave that has a velocity of 330 m s^{-1} and a wavelength of 2.60 m.

4th July

1. Calculate the length of the **hypotenuse** of an orthogonal triangle with sides of length 3.3 cm and 4.0 cm.



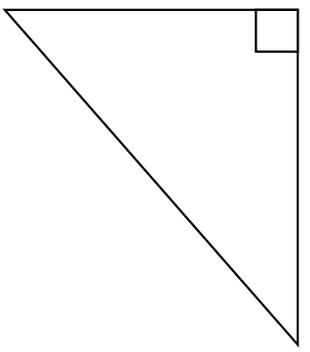
2. Write down the **proportionality relationship** between acceleration and mass, for a constant net force.

3. Calculate the **current** in a circuit if 50 C of charge is transferred in 20 s.

5th July

1 2 3

1. Calculate the length of the **side** of a right-angled triangle if the hypotenuse is 10 cm and the other side is 7.0 cm.

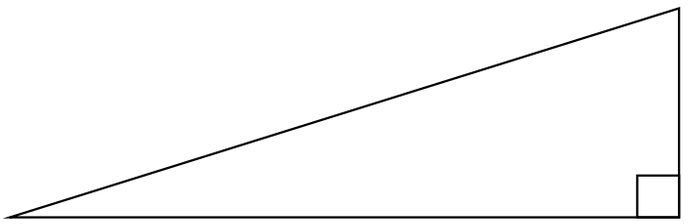


2. Write down the **proportionality relationship** between momentum and velocity.

3. Describe, in as much detail as you can, the structure of an **atom**.

6th July

1. Calculate the length of a **side** of a right-angled triangle if the hypotenuse is 42 m and the other side is 40 m.



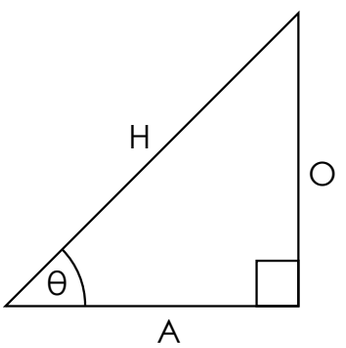
2. Write down the **proportionality relationship** between kinetic energy and velocity.

3. Describe, in a **DC circuit**, what electric current is and how **conventional current** is defined.

7th July

1. Write the following numbers in **standard form**:
   a. 8 990 000 000
   b. 299 790 000
   c. 96 485

2. For the following **triangle** where O = 10.00, H = 14.14 and θ = 45.0° calculate to 3 sf:
   a. The ratio of side O to H
   b. sinθ
   c. The ratio of side A to H
   d. cosθ

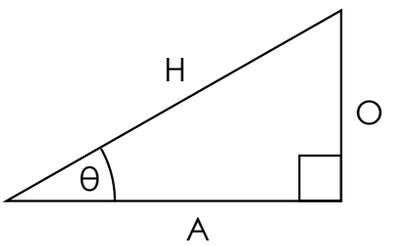


3. Calculate the **distance** travelled by an object that has a speed of 16 m s^{-1} in exactly one minute.

8th July

1. Write the following numbers in **standard form**:
   a. 0.002 898
   b. 0.000 000 000 000 000 000 000 000 000 000 910 94
   c. 0.000 000 056 70

2. For the following **triangle** where O = 2.20, H = 4.40 and θ = 30.0˚ calculate to 3 sf:
   a. The ratio of side O to H
   b. sinθ
   c. The ratio of side A to H
   d. cosθ



3. Calculate the **speed of light** if red light has a frequency 4.3×10^{14} Hz and a wavelength of 7.0×10^{-7} m.

9th July

1. Write down the charge, in **coulombs**, of:
   a. An electron
   b. A neutron
   c. A proton

2. Rearrange $v = u + at$ to make $\boldsymbol{u}$ the subject.

3. Calculate the **average acceleration** of a runner who starts at rest and reaches a velocity of 6.00 m s^{-1} in 9.00 s.

10th July

1. Calculate, **without** using a calculator:
   a. 2.0×10^4 multiplied by 4.0×10^7
   b. 4.0×10^4 multiplied by 2.0×10^7
   c. 3.0×10^4 multiplied by 3.0×10^7
   d. 3.0×10^4 multiplied by 4.0×10^7

2. Rearrange $v^2 = u^2 + 2as$ to make $\boldsymbol{u}$ the subject.

3. Calculate the **final** velocity of a rocket if it starts at rest and uniformly accelerates at 0.80 m s^{-2} over 20 km.

11th July

1. Calculate, **without** using a calculator:
   a. 4.0×10^4 divided by 2.0×10^7
   b. 2.0×10^4 divided by 4.0×10^7
   c. 2.0×10^7 divided by 4.0×10^7
   d. 2.0×10^7 divided by 4.0×10^4

2. Rearrange the following to make **d** the subject:
   a. $E = V / d$

   b. $n\lambda = d\sin\theta$

   c. $A = \pi d^2 / 4$

3. Calculate the **acceleration** of an object that slows down from 70 m s^{-1} to rest in 5.0 minutes.

12th July

1. Calculate, **without** a calculator:
   a. 2.0×10^4 plus 4.0×10^4
   b. 2.0×10^5 plus 4.0×10^4
   c. 2.0×10^4 plus 4.0×10^5
   d. 8.0×10^4 plus 4.0×10^5

2. Rearrange *the following* to make **Q** the subject.
   a. $r = p / BQ$

   b. $V = W / Q$

   c. $F = BQv$

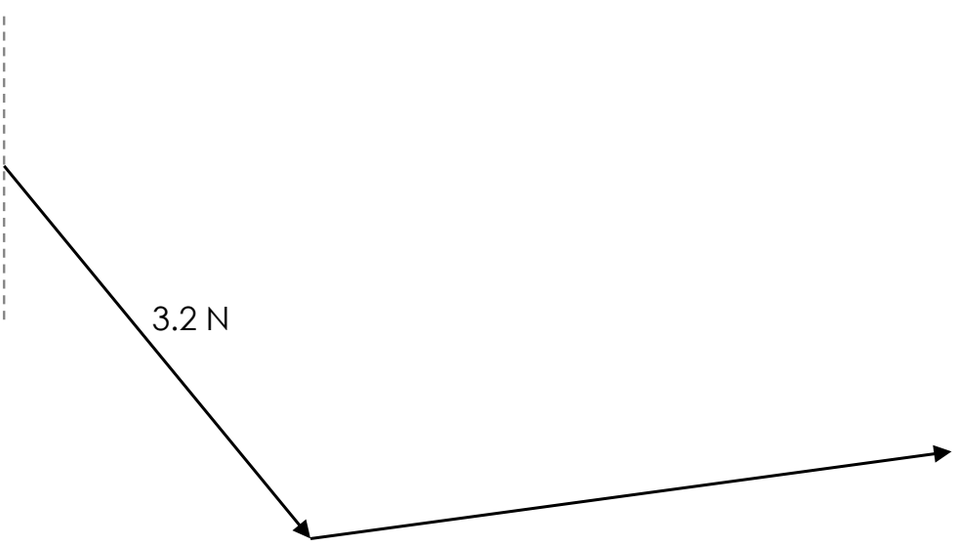
3. A wave travels at 5.00×10^4 m s^{-1}. Calculate its **wavelength** if its frequency is 7.00×10^2 Hz.

13th July

1. Calculate, **without** a calculator:
   a. 2.0×10^4 minus 4.0×10^4
   b. 2.0×10^5 minus 4.0×10^4
   c. 2.0×10^4 minus 4.0×10^5
   d. 8.0×10^4 minus 4.0×10^5

2. State **Newton's 1st Law** and provide a real-life example.

3. Complete the tip-to-tail vector diagram by drawing in the resultant vector, working out its **magnitude** and measuring the **angle** from the vertical.



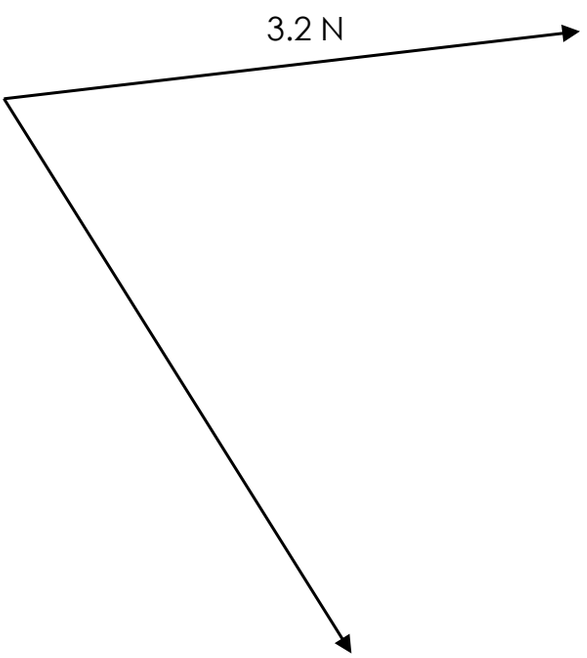
14th July

1. Calculate the **mean**, **mode** and **median** of the following set of numbers:

   2, 3, 3, 3, 6, 8, 10

2. State **Newton's 2nd Law** and describe a real-life example to illustrate it in action.

3. Complete the vector diagram using the **parallelogram** method. Draw in the resultant vector and work out its magnitude.



15th July

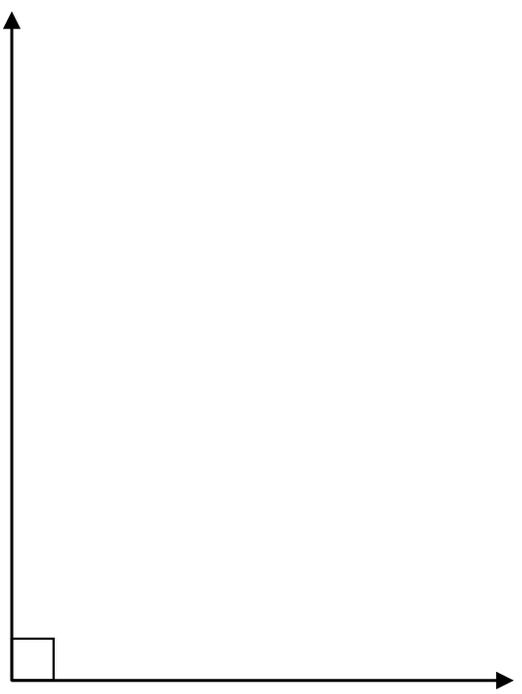
1 2 3

1. Calculate the **mean**, **mode** and **median** of the following set of numbers:

   45, 46, 39, 40, 50, 45, 51

2. State **Newton's 3rd Law** (between two objects A and B) and give a relevant example.

3. Calculate, using a **graphical** method, the size of the resultant force produced by these two perpendicular forces (where 1 cm = 1 N).

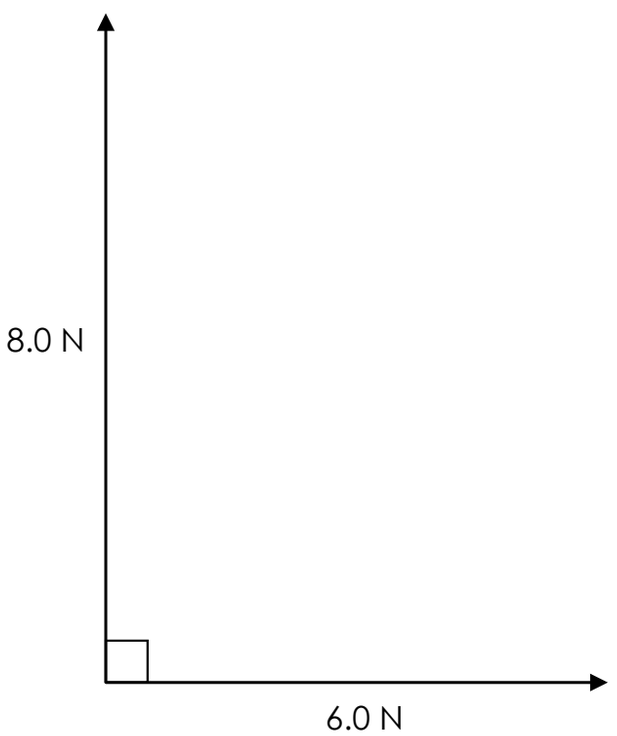


16th July

1. Write the following numbers in **standard form** to **3 significant** figures.
   a. 0.000 000 000 000 000 000 000 000 000 000 000 662 607
   b. 0.000 000 000 000 000 000 000 000 001 660 539
   c. 0.000 000 000 008 854 188

2. A car is travelling at a constant velocity of 30 m s^{-1}. Describe the **forces** acting on it and draw a diagram to illustrate your answer.

3. Calculate, using a **mathematical** method, the size of the resultant force produced by these two perpendicular forces and the angle through which it acts.



17th July

1. Write the following numbers in **standard form** to **3 significant** figures.
   a. 0.000 000 000 000 000 000 000 000 001 672 622
   b. 0.000 000 000 000 000 000 000 000 001 674 927
   c. 0.000 000 000 000 000 000 000 000 013 806
   d. 0.000 000 000 066 743

2. State the relative **masses**, relative **charges** and **ionisation** power of alpha, beta minus and gamma radiation.

3. Calculate the size and angle of the resultant force, using **scale drawing**, produced by a downwards vertical force of 40 N and a horizontal force to the right of 60 N.

18th July

1. Calculate the following to an **appropriate** number of significant figures:
   a. 32.1 x 49
   b. 32 x 49
   c. 32.1 x 48.9
   d. 32 x 48.927

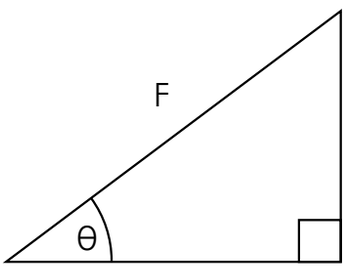
2. Calculate the **velocity** of a 600 g basketball ball when it has 67.5 J of kinetic energy.

3. Calculate the size of the resultant force, using a **mathematical** method, produced by a vertical force of 950 N down and a horizontal force of 390 N to the left.

19th July

1. Calculate the following to an **appropriate** number of significant figures:
   a. 30 + 50
   b. 30.1 ÷ 49.97
   c. 30.0 + 50.0
   d. 30 x 49.97

2. Calculate the **opposite** and **adjacent** sides of the triangle if F = 550 N and θ = 39˚.



3. Describe the changes to a nucleus's **proton** and **mass** numbers if it decays by emitting:
   a. Alpha radiation

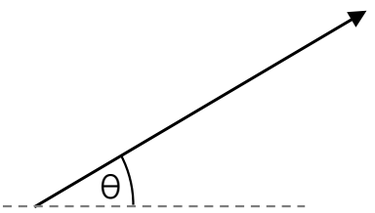
   b. Beta minus radiation

   c. Gamma radiation

20th July

1. Calculate the following to an **appropriate** number of significant figures:
   a. 9.2×10^{2} multiplied by 8.3×10^{-2}
   b. 9.21×10^{2} multiplied by 8.3×10^{-2}
   c. 9.2×10^{22} multiplied by 8.317×10^{-20}
   d. 9.210×10^{22} multiplied by 8.317×10^{-20}

2. Calculate the **horizontal** and **vertical** components of a resultant force of 100 N acting at 30˚ above the horizontal.

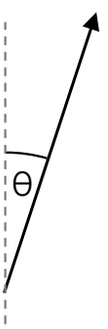


3. Calculate the **initial** velocity of a ball if its final velocity is 3.00 m s^{-1} after it accelerates at 24 m s^{-2} over 0.15 m.

21st July

1. Solve:
   a. $4x + 20 = 0$
   b. $15x - 30 > 0$
   c. $8x - 16 < 0$
   d. $x^2 - 4 = 0$

2. Calculate the **horizontal** and **vertical** components of a force of 24.0 kN acting at 19˚ from the vertical plane.



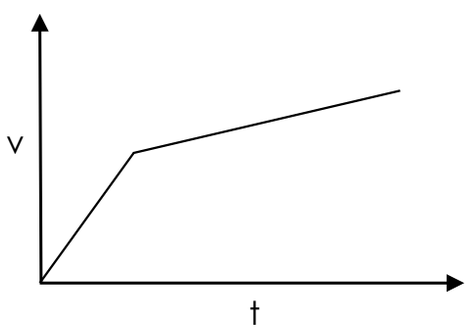
3. Calculate the **maximum** theoretical height a 300 g ball would reach if fired vertically upwards with an initial kinetic energy of 400 J.

   Assume negligible air resistance and use g = 9.81 N kg^{-1}

22nd July

1. Define the **joule**.

2. Describe what the **area** underneath a velocity-time graph represents.



3. Calculate the **energy transferred per second** in a resistor with 2.0 V across it and 0.30 A through it.

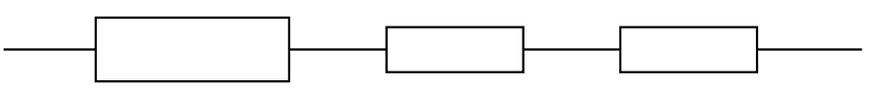
23rd July

1. Define the **frequency** of a wave.

2. Calculate the **area** under the graph of y = 3 between x = 0 and x = 3.

   Sketching the graph may help.

3. Calculate the **total resistance** when a 1.0 kΩ resistor is connected in series to two 400 Ω resistors.



24th July

1. Define **fission** and **fusion**.

2. Calculate the **area** under the graph of y = 2x between x = 0 and x = 4.

   Sketching the graph may help.

3. Calculate the **frequency** of a sound wave with a speed of 330 m s^{-1} and a wavelength of 30 cm.

25th July

1. $y = mx + c$ describes a graph with a straight line of gradient 'm' and y-intercept 'c'.
   Write down the **gradient** and **y-intercept** of the graphs with equation:
   a. $y = 2x + 3$
   b. $y = 3x + 2$
   c. $y = 6x + 3$
   d. $y = 6 + 3x$

2. Rearrange $F = BIL\sin\theta$ to make:
   a. **B** the subject
   b. **I** the subject
   c. **L** the subject
   d. **θ** the subject

3. Write down the number of **protons**, **neutrons** and **electrons** in the following atoms:

$^{56}_{26}Fe$ $^{54}_{26}Fe$ $^{59}_{27}Co$ $^{60}_{28}Ni$

26th July

1. Write down the **gradient** and **y-intercept** of the graphs with equation:
   a. $y = 3x + 5$
   b. $2y = 4x + 2$
   c. $x + 3 = y$
   d. $y - 4 = x / 2$

2. Rearrange $g = Gm / r^2$ to make **r** the subject.

3. Calculate the **acceleration** of a 1825 N boat when there is a thrust of 350 N from the engines and total drag forces of 185 N.

27th July

1. Calculate the **gradient** and **y-intercept** of the line with equation:
   a. $2y = 4x + 8$
   b. $4y - 6 = x/2$
   c. $0 = x + y$
   d. $x = 0.5y + 2$

2. Rearrange $V_g = Gm / r$ to make **m** the subject.

3. A ray of light at 25° to the surface of a plane mirror is reflected (with a specular reflection). Calculate the angle of **reflection** (a diagram will help).

28th July

1. Calculate the gradient and hence the **equation** of the straight-line graph that goes through the points (1, 2) and (5, 10).

2. Rearrange the following to make **p** the subject:

   a. $m = p / v$

   b. $pV = NkT$

   c. $E_k = p^2 / 2m$

3. Sketch the arrangement of particles in a **solid**, a **liquid** and a **gas**.

29th July

1. Calculate the **equation** of the straight-line graph that goes through the point (1, 2) and has a gradient of 3.

2. Use the symbol '≈' to describe the **small-angle approximation** involving sin θ, cos θ and tan θ.

3. A 2.1 kg wheel rolls down a slope, losing 0.62 kJ of gravitational potential energy.

   Calculate the **height** it rolls down.

30th July

1 2 3

1. **Sketch** the graphs of $y = 3x + 1$ and $y = x + 3$.

2. Write down **two** ways of defining radioactive **half-life**.

3. Calculate the **acceleration** of a car when it slows down from 10 m s^{-1} to 3.0 m s^{-1} in 2.5 s.

31st July

1. **Sketch** the graphs of $y = e^{x}$ and $y = e^{-x}$.

2. Define electrical **resistance**.

3. Complete the following **nuclear** equations:

$$^{238}_{92}U \rightarrow Th + He$$

$$^{234}Th \rightarrow Pa + {}^{}_{-1}\beta$$

$$^{234}Pa \rightarrow \quad + {}^{}_{-1}\beta$$

JULY REVIEW

Record your progress at the end of the month and have another go at any questions you may have missed.

A Level Physics Content	Red	Amber	Green
I can use **standard form**.			
I can give an answer to an appropriate number of **significant figures**.			
I can use **Pythagoras** to calculate the length of the third side of a triangle.			
I can identify the **opposite**, **adjacent** and **hypotenuse** of a right-angled triangle.			
I can resolve the **horizontal** and **vertical** components of a vector quantity.			
I can **rearrange** simple equations.			
I can recall **Newton's 3 Laws**.			
Any other comments:			

1st July

1. 53.1˚
2. $E_k \propto m$
3. E_k = 540 000 J p = 36 000 kg m s^{-1}

2nd July

1. 3.7 m
2. $F \propto a$
3. Magnitude and direction. Velocity, force and weight.

3rd July

1. The sum of the squares of the two side lengths of a right-angled triangle is equal to the square of the hypotenuse: $a^2 + b^2 = c^2$
2. $f \propto 1/T$
3. 127 Hz

4th July

1. 5.2 cm
2. $a \propto 1/m$
3. 2.5 A

5th July

1. 7.1 cm
2. $p \propto v$
3. Central dense nucleus containing positively charged protons and neutral neutrons. This is where most of the mass is. Orbiting the nucleus are negatively charged electrons in shells.

6th July

1. 13 m
2. $E_k \propto v^2$
3. Electric current is the flow of negatively charged electrons. Conventional current is from the positive terminal to the negative terminal in a DC circuit.

7th July

1. a. 8.99 x 10^9
   b. 2.9979 x 10^8
   c. 9.6485 x 10^4
2. a. 0.707 b. 0.707
   c. 0.707 d. 0.707
3. 960 m

8th July

1. a. 2.898 x 10^{-3}
   b. 9.1094 x 10^{-31}
   c. 5.670 x 10^{-8}
2. a. 0.500 b. 0.500
   c. 0.866 d. 0.866
3. 3.0 x 10^8 m s^{-1}

9th July

1. a. -1.60 x 10^{-19} C
   b. 0 C
   c. +1.60 x 10^{-19} C
2. $u = v - at$
3. 0.667 m s^{-2}

10th July

1. a. 8.0 x 10^{11}
   b. 8.0 x 10^{11}
   c. 9.0 x 10^{11}
   d. 1.2 x 10^{12}
2. $u = \sqrt{(v^2 - 2as)}$
3. 180 m s^{-1}

11th July

1. a. 2.0 x 10^{-3}
   b. 5.0 x 10^{-4}
   c. 0.50
   d. 5.0 x 10^{-2}

11th July - continued

2. a. $d = V / E$
   b. $d = n\lambda / \sin\theta$
   c. $d = \sqrt{(4A / \pi)}$
3. -0.23 m s^{-2}

12th July

1. a. 6.0 x 10^4
   b. 2.4 x 10^5
   c. 4.2 x 10^5
   d. 4.8 x 10^5
2. a. $Q = p / Br$
   b. $Q = W / V$
   c. $Q = F / Bv$
3. 71.4 m

13th July

1. a. -2.0 x 10^4
   b. 1.6 x 10^5
   c. -3.8 x 10^5
   d. -3.2 x 10^5
2. If the resultant force acting on an object is zero and the object is:
   - stationary, the object remains stationary
   - moving, the object continues to move at the same velocity

   A bird flying at 30 m s^{-1} in a straight line must have no resultant force acting on it.
3. About 6.6 N and 107˚

14th July

1. Mean = 5
   Mode = 3
   Median = 3

14th July - continued

2. The resultant force on an object is proportional to the rate of change of momentum.

   Double the force and you get double the acceleration.

3. About 5.8 N

15th July

1. Mean = 45.1

   Mode = 45

   Median = 45

2. The force of object A on object B is equal in magnitude, opposite in direction and of the same type as the force of object B on object A.

   The Earth pulls on you with a force due to gravity. You pull on the Earth with the exact same sized force in the opposite direction.

3. About 10.0 N

16th July

1. a. 6.63×10^{-34}

   b. 1.66×10^{-27}

   c. 8.85×10^{-12}

2. Driving force = drag

   Normal contact force = weight

   No resultant force.

3. 10 N at 37˚ from vertical

17th July

1. a. 1.67×10^{-27}

   b. 1.67×10^{-27}

   c. 1.38×10^{-23}

   d. 6.67×10^{-11}

2. α m = 4, Q = +2, high

   β m = 1/1830, Q = -1, medium

   γ m = 0, Q = 0, low

3. About 72 N at 56˚ from vertical

18th July

1. a. 1.6×10^{3}

   b. 1.6×10^{3}

   c. 1.57×10^{3}

   d. 1.6×10^{3}

2. 15 m s^{-1}

3. 1030 N

19th July

1. a. 80

   b. 0.602

   c. 80.0

   d. 1500

2. O = 350 N

   A = 430 N

3. a. Proton – 2 Mass - 4

   b. Proton +1 Mass 0

   c. Proton 0 Mass 0

20th July

1. a. 76

   b. 76

   c. 7.7×10^{3}

   d. 7.660×10^{3}

2. F_H = 87 N

   F_V = 50 N

3. 1.3 m s^{-1}

21st July

1. a. x = -5

   b. x > 2

   c. x < 2

   d. x = ±2

2. F_H = 7.81 kN

   F_V = 22.7 kN

3. 136 m

22nd July

1. One joule of work is done when a force of one newton causes a displacement of one metre.

2. Total displacement

3. 0.60 J s^{-1} (W)

23rd July

1. The frequency of a wave is the number of waves passing a point each second.

2. 9

3. 1800 Ω

24th July

1. Nuclear fission is the splitting of a large and unstable nucleus while nuclear fusion is the joining of two light nuclei to form a heavier nucleus.

2. 16

3. 1100 Hz

25th July

1. a. m = 2 c = 3

   b. m = 3 c = 2

   c. m = 6 c = 3

   d. m = 3 c = 6

2. a. B = F / ILsinθ

   b. I = F / BLsinθ

   c. L = F / BIsinθ

   d. θ = $\sin^{-1}$(F / BIL)

3. Fe-56 26p 30n 26e

   Fe-54 26p 28n 26e

   Co-59 27p 32n 27e

   Ni-60 28p 32n 28e

26th July

1. a. m = 3 c = 5

   b. m = 2 c = 1

   c. m = 1 c = 3

   d. m = 0.5 c = 4

26th July - continued

2. $r = \sqrt{(Gm / g)}$

3. 0.887 m s^{-2}

27th July

1. a. m = 2 c = 4

   b. m = 0.125 c = 1.5

   c. m = 1 c = 0

   d. m = 2 c = -4

2. $m = -V_g r / G$

3. 65°

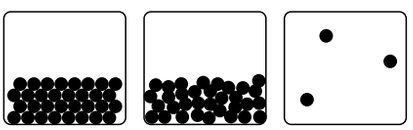
28th July

1. m = 2 y = 2x

2. a. $p = mv$

   b. $p = NkT / V$

   c. $p = \sqrt{(2mE_k)}$

3. 

29th July

1. y = 3x - 1

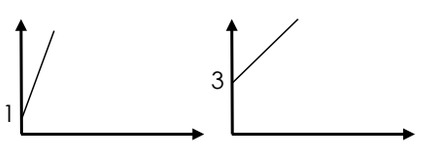
2. sin θ ≈ θ

   cos θ ≈ 1

   tan θ ≈ θ

3. 30 m

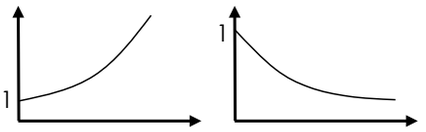
30th July

1. 

2. The half-life of a radioactive isotope is the time it takes for the number of nuclei of the isotope in a sample to halve or the time it takes for the count-rate, or activity, from a sample containing the radioactive isotope to fall to half its initial level.

3. -2.8 m s^{-2}

31st July

1. 

2. Resistance is defined as the ratio of the potential difference across a component to the current through it.

3. $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

   $^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}\beta$

   $^{234}_{91}Pa \rightarrow {}^{234}_{92}U + {}^{0}_{-1}\beta$

1st July

1. Calculate the **angle**, θ, in the triangle with a hypotenuse of length 10.0 cm and an opposite side length of 8.00 cm.

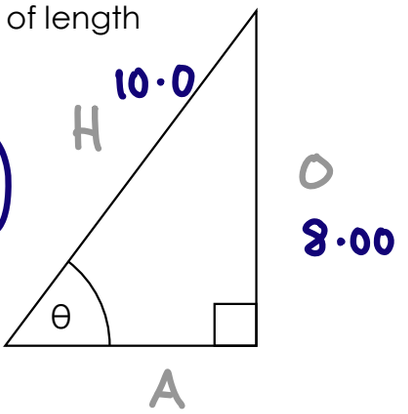
SOH CAH TOA

$\sin\theta = \frac{O}{H}$

$\theta = \sin^{-1}\left(\frac{O}{H}\right)$

$\theta = \sin^{-1}\left(\frac{8.00}{10.0}\right)$

$\theta = 53.1°$



2. Write down the **proportionality relationship** between kinetic energy and (non-relativistic) mass for a moving object.

$E_K = \frac{1}{2}mv^2$

$E_K \propto m$

3. Calculate the **kinetic energy** and **momentum** of a car with a mass of 1200 kg and a velocity of 30 m s^{-1}.

$m = 1200\ kg$ $v = 30\ m\,s^{-1}$ $p = mv$ $E_K = \frac{1}{2}mv^2$

$E_K = \frac{1}{2}mv^2 = \frac{1}{2} \times 1200 \times 30^2 = 540\,000\ J$

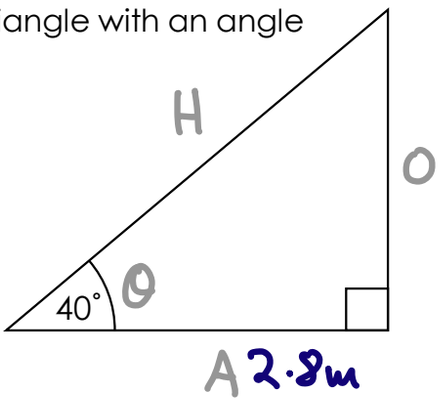
$p = mv = 1200 \times 30 = 36\,000\ kg\,m\,s^{-1}$

Note: At GCSE we use kg m/s but at A Level you should use kg $m\,s^{-1}$ etc

ANSWERS

2nd July

1. Calculate the length of the **hypotenuse** in this triangle with an angle of 40° and an adjacent side length of 2.8 m.



SOH CAH TOA

$\cos\theta = \frac{A}{H}$

$H = \frac{A}{\cos\theta}$

$H = \frac{2.8}{\cos\theta}$

$H = 3.7\text{m}$

2. Write down the **proportionality relationship** between resultant force and acceleration.

$F = ma$

$\therefore F \propto a$

$\therefore$ means 'therefore'

3. Explain what a **vector** quantity is and identify which of these quantities are vectors:

Speed, velocity, force, mass, energy and weight

A vector quantity has magnitude (size) and direction.

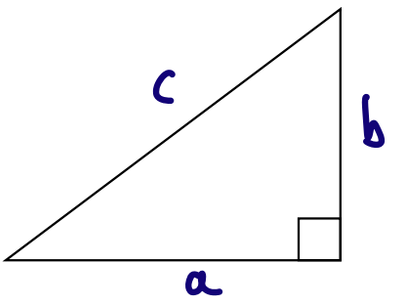
- Velocity
- Force
- Weight

ANSWERS

3rd July

1. State **Pythagoras'** Theorem.

$a^2 + b^2 = c^2$



2. Write down the **proportionality relationship** between and frequency and time period for a wave.

$f = \frac{1}{T}$

$\therefore f \propto \frac{1}{T}$

3. Calculate the **frequency** of a sound wave that has a velocity of 330 m s^{-1} and a wavelength of 2.60 m.

3sf 3sf

$v = f\lambda$

$f = \frac{v}{\lambda} = \frac{330}{2.60} = 126.9230769$

$= 127$ Hz

3sf

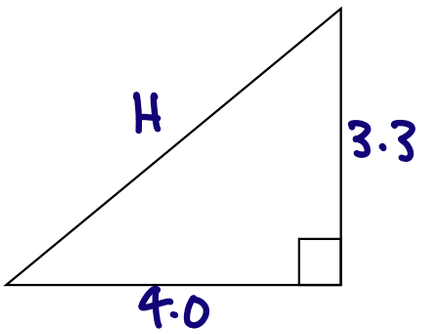
ANSWERS

4th July

ANSWERS

1. Calculate the length of the **hypotenuse** of an orthogonal triangle with sides of length 3.3 cm and 4.0 cm.

right-angled



$H = \sqrt{3.3^2 + 4.0^2}$

$H = 5.2\ cm$

2. Write down the **proportionality relationship** between acceleration and mass, for a constant net force.

$F = ma \qquad a = \frac{F}{m}$

$\therefore a \propto \frac{1}{m}$

3. Calculate the **current** in a circuit if 50 C of charge is transferred in 20 s.

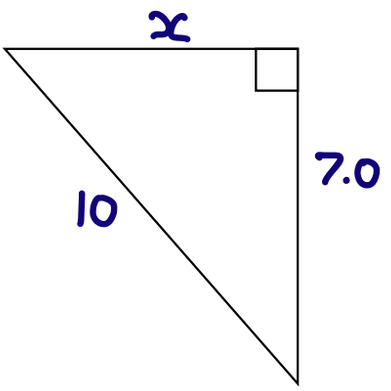
$Q = It$

$I = \frac{Q}{t} = \frac{50}{20} = 2.5\ A$

2sf

5th July

1. Calculate the length of the **side** of a right-angled triangle if the hypotenuse is 10 cm and the other side is 7.0 cm.



$10^2 = 7.0^2 + x$

$x = \sqrt{100 - 49}$

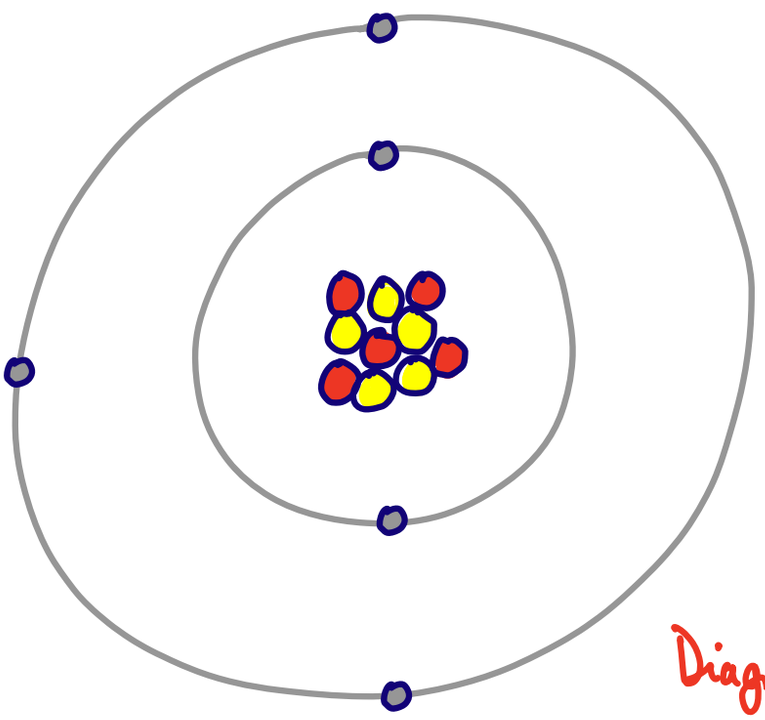
$x = 7.1\,cm$

2. Write down the **proportionality relationship** between momentum and velocity.

$p = mv$

$p \propto v$

3. Describe, in as much detail as you can, the structure of an **atom**.



e⁻ Small electrons orbiting in shells

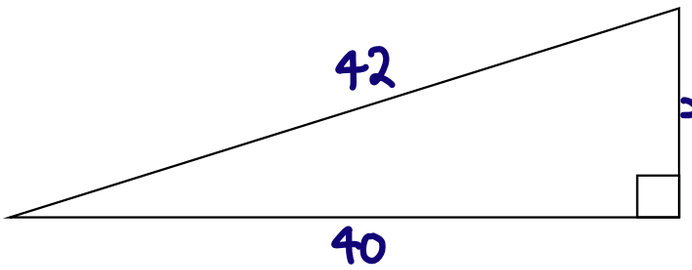
p Positive protons and

n neutral neutrons tightly packed in a dense nucleus

Diagrams are really useful in your answers.

6th July

1. Calculate the length of a **side** of a right-angled triangle if the hypotenuse is 42 m and the other side is 40 m.



$x = \sqrt{42^2 - 40^2}$

$x = 12.8$

$x = 13\,m$

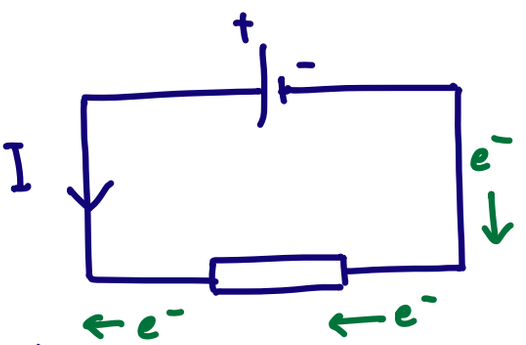
2. Write down the **proportionality relationship** between kinetic energy and velocity.

$E_K = \frac{1}{2}mv^2$

$\therefore E_K \propto v^2$

(E_K or KE can be used)

3. Describe, in a **DC circuit**, what electric current is and how **conventional current** is defined.



Conventional current is from +ve to -ve.

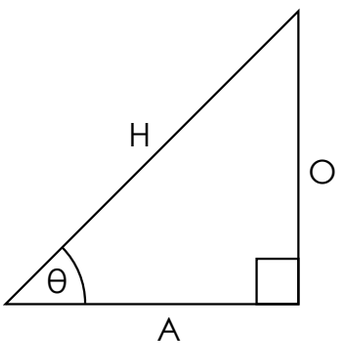
In a DC circuit the negative electrons move towards the positive terminal.

ANSWERS

7th July

1. Write the following numbers in **standard form**:
   a. 8 990 000 000 — 8.99×10^9 The size of the Coulomb constant
   b. 299 790 000 — 2.9979×10^8 Speed of light
   c. 96 485 — 9.6485×10^4 The Faraday constant

2. For the following **triangle** where O = 10.00, H = 14.14 and θ = 45.0° calculate to 3 sf:
   a. The ratio of side O to H — 0.707
   b. sinθ — 0.707
   c. The ratio of side A to H — 0.707
   d. cosθ — 0.707



Note: $\frac{O}{H} = \sin\theta$ $\frac{A}{H} = \cos\theta$

$\sin 45 = \cos 45$

3. Calculate the **distance** travelled by an object that has a speed of 16 m s^{-1} in exactly one minute.

$s = vt = 16 \times 60 = 960\text{m}$

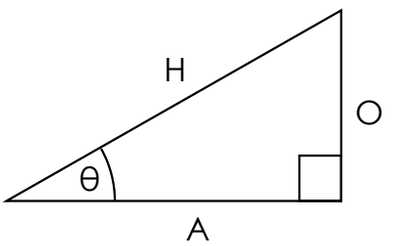
ANSWERS

8th July

1. Write the following numbers in **standard form**:
   a. 0.002 898
   b. 0.000 000 000 000 000 000 000 000 000 000 910 94
   c. 0.000 000 056 70

2.898×10^{-3} Wien's constant
9.1094×10^{-31} Mass of an electron
5.670×10^{-8} Stefan-Boltzmann constant

2. For the following **triangle** where O = 2.20, H = 4.40 and θ = 30.0° calculate to 3 sf:
   a. The ratio of side O to H
   b. sinθ
   c. The ratio of side A to H
   d. cosθ



0.500
0.500
0.866
0.866

$\frac{O}{H} = \sin\theta$ $\frac{A}{H} = \cos\theta$

3. Calculate the **speed of light** if red light has a frequency 4.3×10^{14} Hz and a wavelength of 7.0×10^{-7} m.

$v = f\lambda = 4.3 \times 10^{14} \times 7.0 \times 10^{-7}$

$v = 3.0 \times 10^{8}\ ms^{-1}$

The speed of light, c, is used all the time.

ANSWERS

9th July

1. Write down the charge, in **coulombs**, of:
   a. An electron -1.60×10^{-19} C
   b. A neutron 0
   c. A proton $+1.60 \times 10^{-19}$ C

2. Rearrange $v = u + at$ to make u the subject.

$$v = u + at$$
$$v - at = u$$
$$u = v - at$$

3. Calculate the **average acceleration** of a runner who starts at rest and reaches a velocity of 6.00 m s^{-1} in 9.00 s.

$$a = \frac{v-u}{t} = \frac{6.00 - 0}{9.00} = 0.667 \text{ m s}^{-2}$$

ANSWERS

10th July

1. Calculate, **without** using a calculator:
   a. 2.0 x 10^4 multiplied by 4.0 x 10^7 8.0×10^{11}
   b. 4.0 x 10^4 multiplied by 2.0 x 10^7 8.0×10^{11}
   c. 3.0 x 10^4 multiplied by 3.0 x 10^7 9.0×10^{11}
   d. 3.0 x 10^4 multiplied by 4.0 x 10^7 $12 \times 10^{11} = 1.2 \times 10^{12}$

2. Rearrange $v^2 = u^2 + 2as$ to make u the subject.

$$v^2 = u^2 + 2as$$
$$v^2 - 2as = u^2$$
$$u^2 = v^2 - 2as$$
$$u = \sqrt{v^2 - 2as}$$

3. Calculate the **final** velocity of a rocket if it starts at rest and uniformly accelerates at 0.80 m s^{-2} over 20 km.

$$v^2 = u^2 + 2as$$
$$v = \sqrt{u^2 + 2as}$$
$$v = \sqrt{0 + 2 \times 0.80 \times 20 \times 10^3}$$
$$v = 178.9 \approx 180 \text{ m s}^{-1}$$

2sf

ANSWERS

11th July

1. Calculate, **without** using a calculator:
   a. 4.0 x 10^4 divided by 2.0 x 10^7 2.0×10^{-3}
   b. 2.0 x 10^4 divided by 4.0 x 10^7 $0.50 \times 10^{-3} = 5.0 \times 10^{-4}$
   c. 2.0 x 10^7 divided by 4.0 x 10^7 0.50
   d. 2.0 x 10^7 divided by 4.0 x 10^4 $0.50 \times 10^{3} = 5.0 \times 10^{2}$

2. Rearrange the following to make **d** the subject:
   a. $E = V / d$ $d = \frac{V}{E}$
   b. $n\lambda = d\sin\theta$ $d = \frac{n\lambda}{\sin\theta}$
   c. $A = \pi d^2 / 4$ $d = \sqrt{\frac{4A}{\pi}}$

3. Calculate the **acceleration** of an object that slows down from 70 m s^{-1} to rest in 5.0 minutes.

$$a = \frac{v-u}{t} = \frac{0-70}{5.0 \times 60} = -0.23 \text{ ms}^{-2}$$

ANSWERS

12th July

1. Calculate, **without** a calculator:
   a. 2.0×10^4 plus 4.0×10^4 6.0×10^4
   b. 2.0×10^5 plus 4.0×10^4 2.4×10^5
   c. 2.0×10^4 plus 4.0×10^5 4.2×10^5
   d. 8.0×10^4 plus 4.0×10^5 4.8×10^5

2. Rearrange *the following* to make **Q** the subject.
   a. $r = p / BQ$ $Q = \frac{p}{Br}$
   b. $V = W / Q$ $Q = \frac{W}{V}$
   c. $F = BQv$ $Q = \frac{F}{Bv}$

3. A wave travels at 5.00×10^4 m s^{-1}. Calculate its **wavelength** if its frequency is 7.00×10^2 Hz.

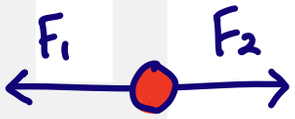
$v = f\lambda$ $\lambda = \frac{v}{f} = \frac{5.00 \times 10^4}{700} = 71.4$ m

ANSWERS

13th July

1. Calculate, **without** a calculator:
   a. 2.0 x 10^4 minus 4.0 x 10^4 -2.0×10^4
   b. 2.0 x 10^5 minus 4.0 x 10^4 1.6×10^5
   c. 2.0 x 10^4 minus 4.0 x 10^5 -3.8×10^5
   d. 8.0 x 10^4 minus 4.0 x 10^5 -3.2×10^5

2. State **Newton's 1st Law** and provide a real-life example.

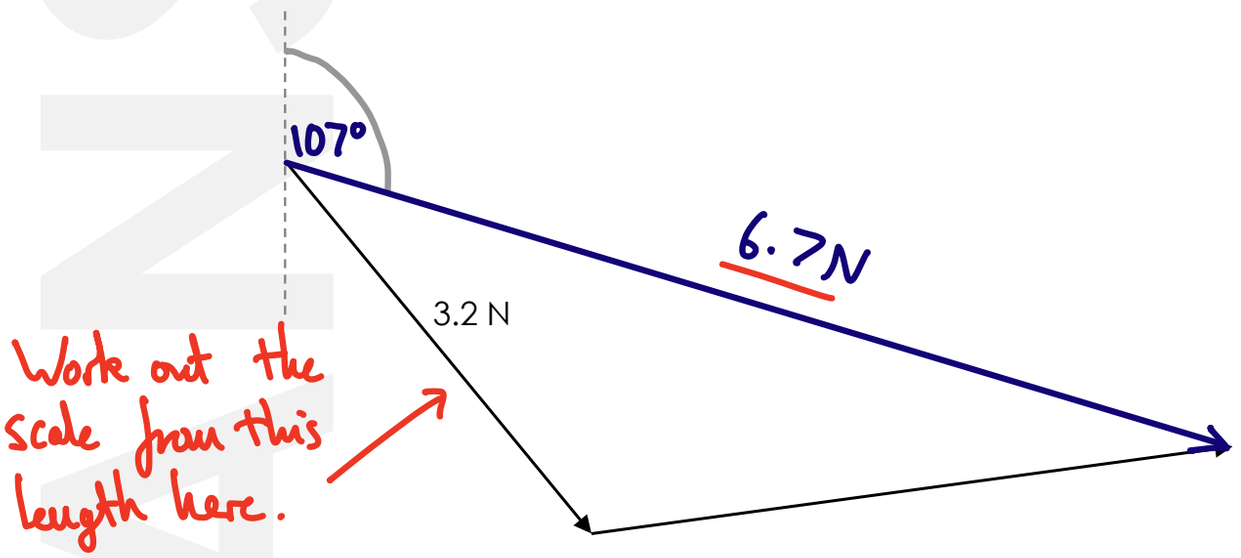


$F_1 = F_2$ ∴ No resultant force
$v = 0$ → Stays at rest
$v \neq 0$ → Continues at v

Plenty of real examples of stationary objects or things moving at a constant velocity.

3. Complete the tip-to-tail vector diagram by drawing in the resultant vector, working out its **magnitude** and measuring the **angle** from the vertical.

Answers close to 107° and 6.7 N



Work out the scale from this length here.

14th July

1. Calculate the **mean**, **mode** and **median** of the following set of numbers:

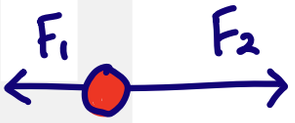
2, 3, 3, 3, 6, 8, 10

$$\text{Mean} = \frac{(2+3+3+3+6+8+10)}{7} = 5$$

Mode = 3

Median = 3

2. State **Newton's 2nd Law** and describe a real-life example to illustrate it in action.

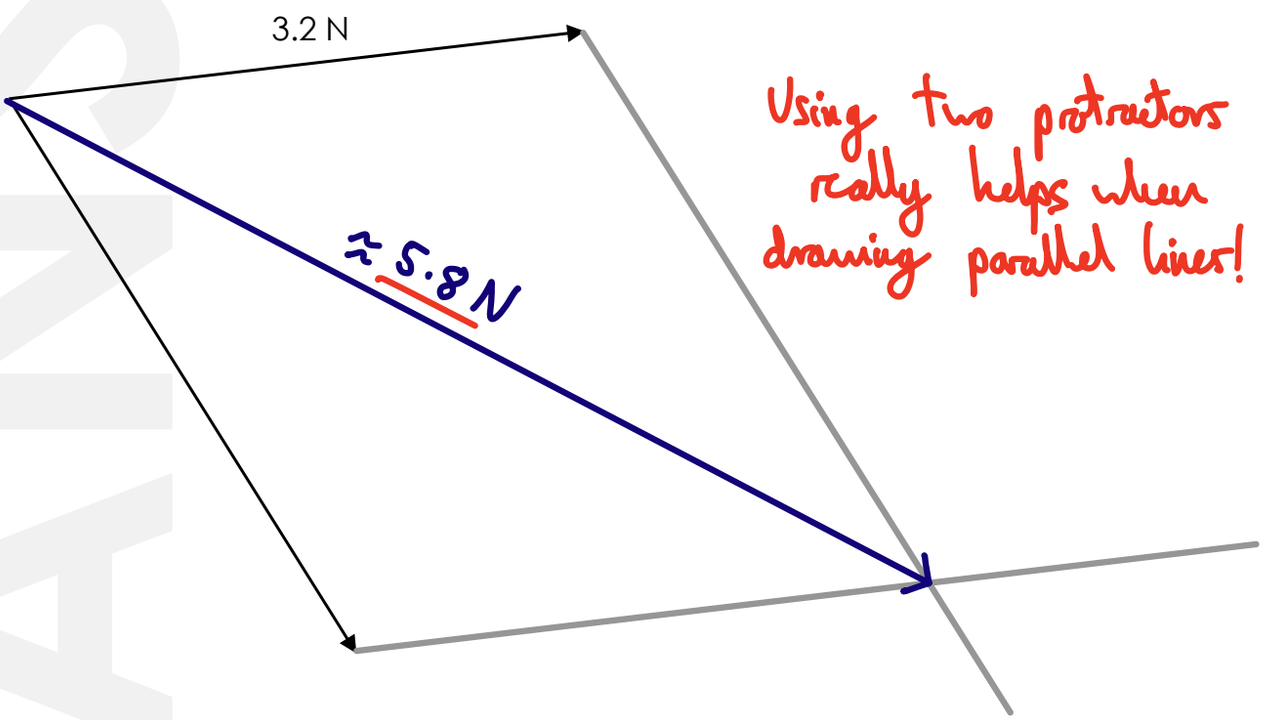


$F_1 \neq F_2$ ∴ Resultant force

$$F \propto \frac{\Delta p}{\Delta t}$$

F=ma is a special case where 'm' and 'a' are constant.

3. Complete the vector diagram using the **parallelogram** method. Draw in the resultant vector and work out its magnitude.



Using two protractors really helps when drawing parallel lines!

ANSWERS

15th July

1. Calculate the **mean**, **mode** and **median** of the following set of numbers:

39, 40, 45, 45, 46, 50, 51

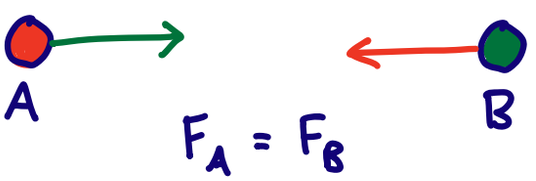
~~45, 46, 39, 40, 50, 45, 51~~

$$\text{Mean} = \frac{(39+40+45+45+46+50+51)}{7} = 45.1$$

Mode = 45

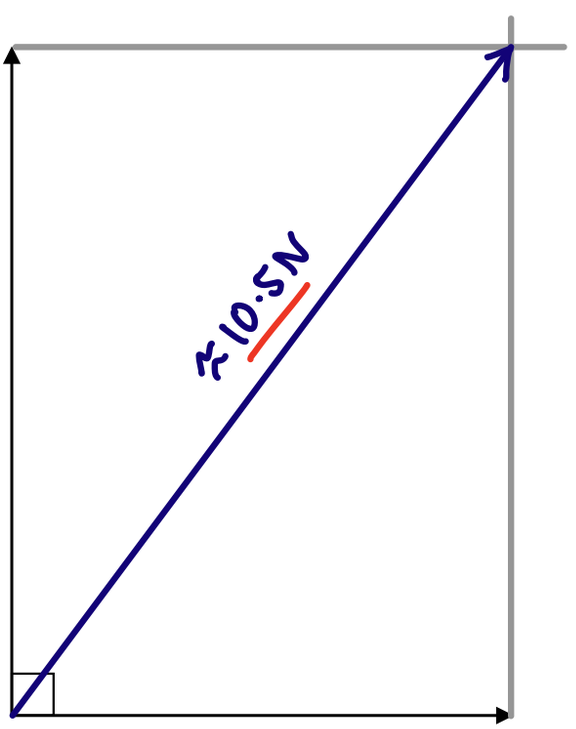
Median = 45

2. State **Newton's 3rd Law** (between two objects A and B) and give a relevant example.



This can be tricky to really deeply understand!

3. Calculate, using a **graphical** method, the size of the resultant force produced by these two perpendicular forces (where 1 cm = 1 N).



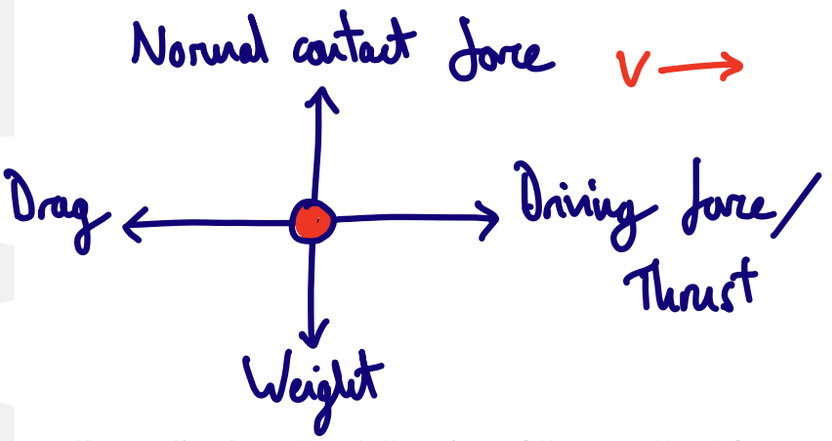
ANSWERS

16th July

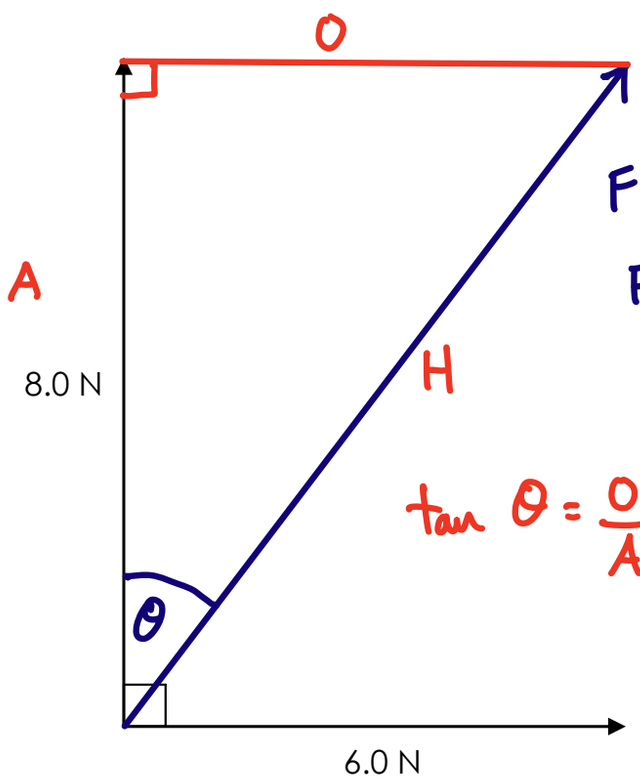
1. Write the following numbers in **standard form** to **3 significant** figures.
   a. 0.000 000 000 000 000 000 000 000 000 000 000 662 607
   b. 0.000 000 000 000 000 000 000 000 001 660 539
   c. 0.000 000 000 008 854 188

6.63×10^{-34} Planck's const
1.66×10^{-27} Atomic mass unit
8.85×10^{-12} Permittivity of free space

2. A car is travelling at a constant velocity of 30 m s^{-1}. Describe the **forces** acting on it and draw a diagram to illustrate your answer.



3. Calculate, using a **mathematical** method, the size of the resultant force produced by these two perpendicular forces and the angle through which it acts.



$F = \sqrt{6.0^2 + 8.0^2}$

$F = \underline{10\ N}$

$\tan\theta = \frac{O}{A}$

$\theta = \tan^{-1}\left(\frac{6.0}{8.0}\right)$

$\theta = \underline{37°}$

ANSWERS

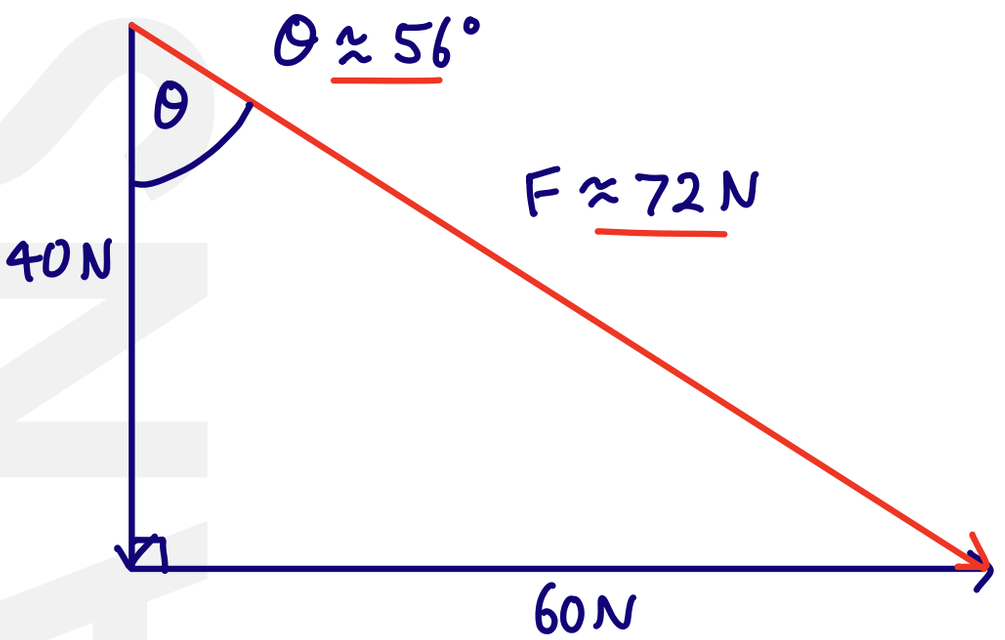
17th July

1. Write the following numbers in **standard form** to **3 significant** figures.
   a. 0.000 000 000 000 000 000 000 000 001 672 622 — 1.67×10^{-27} Mass of a proton
   b. 0.000 000 000 000 000 000 000 000 001 674 927 — 1.67×10^{-27} Mass of a neutron
   c. 0.000 000 000 000 000 000 000 013 806 — 1.38×10^{-23} Boltzmann's const
   d. 0.000 000 000 066 743 — 6.67×10^{-11} Big 'G'

2. State the relative **masses**, relative **charges** and **ionisation** power of alpha, beta minus and gamma radiation.

	m	Q	Ionisation
Alpha	4	+2	High
Beta⁻	$\frac{1}{1830}$	−1	Medium
Gamma	0	0	Low

3. Calculate the size and angle of the resultant force, using **scale drawing**, produced by a downwards vertical force of 40 N and a horizontal force to the right of 60 N.



Large diagram and a suitable scale.

ANSWERS

18th July

ANSWERS

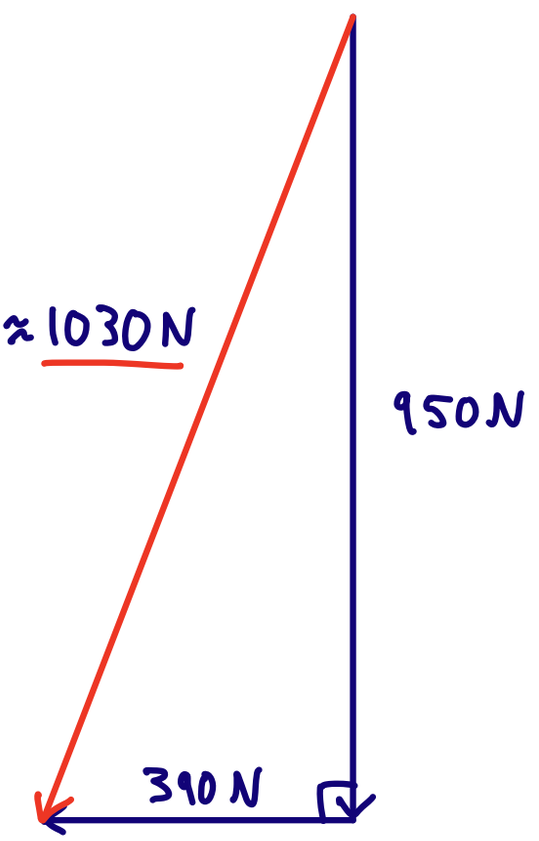
1. Calculate the following to an **appropriate** number of significant figures:
   a. 32.1 x 49 — 1.6×10^3 2sf
   b. 32 x 49 — 1.6×10^3 2sf
   c. 32.1 x 48.9 — 1.57×10^3 3sf
   d. 32 x 48.927 — 1.6×10^3 2sf

2. Calculate the **velocity** of a 600 g basketball ball when it has 67.5 J of kinetic energy.

$$E_K = \frac{1}{2}mv^2 \qquad v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2 \times 67.5}{0.600}}$$

$$v = 15\ ms^{-1}$$

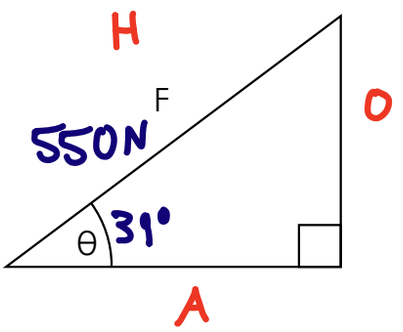
3. Calculate the size of the resultant force, using a **mathematical** method, produced by a vertical force of 950 N down and a horizontal force of 390 N to the left.



19th July

1. Calculate the following to an **appropriate** number of significant figures:
   a. 30 + 50 — 80 — 2sf
   b. 30.1 ÷ 49.97 — 0.602 — 3sf
   c. 30.0 + 50.0 — 80.0 — 3sf
   d. 30 x 49.97 — 1500 — 2sf

2. Calculate the **opposite** and **adjacent** sides of the triangle if F = 550 N and θ = 39°.



$\sin\theta = \frac{O}{H}$ $O = H\sin\theta$
$O = 550 \sin 39$
$O = 350\,N$

$\cos\theta = \frac{A}{H}$ $A = H\cos\theta$
$A = 550 \cos 39$
$A = 430\,N$

3. Describe the changes to a nucleus's **proton** and **mass** numbers if it decays by emitting:
   a. Alpha radiation

Proton no. −2
Mass no. −4

   b. Beta minus radiation

Proton no. +1
Mass no. 0

   c. Gamma radiation

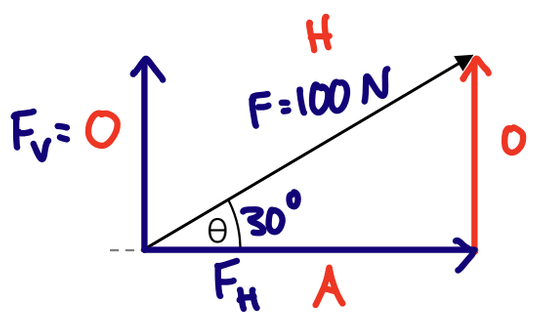
Proton no. 0
Mass no. 0

ANSWERS

20th July

1. Calculate the following to an **appropriate** number of significant figures:
   a. 9.2×10^{2} multiplied by 8.3×10^{-2} 76 2sf
   b. 9.21×10^{2} multiplied by 8.3×10^{-2} 76 2sf
   c. 9.2×10^{22} multiplied by 8.317×10^{-20} 7.7×10^{3} 2sf
   d. 9.210×10^{22} multiplied by 8.317×10^{-20} 7.660×10^{3} 4sf

2. Calculate the **horizontal** and **vertical** components of a resultant force of 100 N acting at 30˚ above the horizontal.



A: $F_H = 100 \cos 30$

$F_H = 87\,N$

O: $F_V = 100 \sin 30$

$F_V = 50\,N$

3. Calculate the **initial** velocity of a ball if its final velocity is 3.00 m s^{-1} after it accelerates at 24 m s^{-2} over 0.15 m.

$$v^2 = u^2 + 2as$$

$$u = \sqrt{v^2 - 2as} = \sqrt{3.00^2 - (2 \times 24 \times 0.15)}$$

$$u = 1.3\,m s^{-1}$$

ANSWERS

21st July

1. Solve:
   a. $4x + 20 = 0$
   b. $15x - 30 > 0$
   c. $8x - 16 < 0$
   d. $x^2 - 4 = 0$

$4x = -20 \quad x = -5$

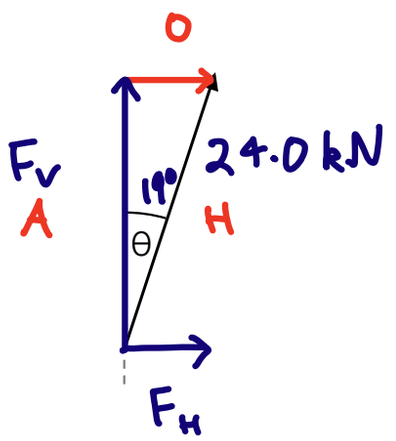
$15x > 30 \quad x > 2$

$8x < 16 \quad x < 2$

$x^2 = 4 \quad x = \pm 2^*$

* In A Level Physics we usually only consider the positive root, +2

2. Calculate the **horizontal** and **vertical** components of a force of 24.0 kN acting at 19° from the vertical plane.



$F_H = 24.0 \sin 19$

$F_H = 7.81\ kN$

$F_V = 24.0 \cos 19$

$F_V = 22.7\ kN$

3. Calculate the **maximum** theoretical height a 300 g ball would reach if fired vertically upwards with an initial kinetic energy of 400 J.

   Assume negligible air resistance and use g = 9.81 N kg^{-1}

$E_k \rightarrow E_p$

$E_k = mg\Delta h$

$\Delta h = \frac{E_k}{mg} = \frac{400}{0.300 \times 9.81}$

$\Delta h = 136\ m$

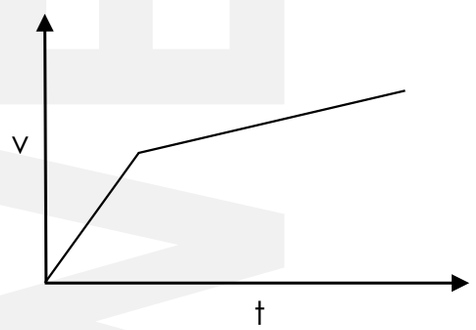
ANSWERS

22nd July

1. Define the **joule**.

One joule of work is done when a force of one newton causes a displacement of one metre.

2. Describe what the **area** underneath a velocity-time graph represents.



Total displacement

3. Calculate the **energy transferred per second** in a resistor with 2.0 V across it and 0.30 A through it.

power

$P = VI = 2.0 \times 0.30 = \underline{0.60}\ Js^{-1}$

$1\ Js^{-1} = 1\ W$

ANSWERS

23rd July

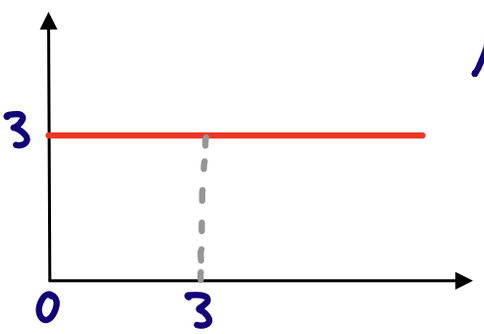
1. Define the **frequency** of a wave.

The frequency of a wave is the number of waves passing a point each second.

Definitions are really important to remember!

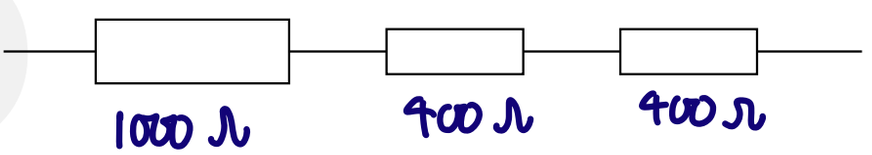
2. Calculate the **area** under the graph of y = 3 between x = 0 and x = 3.

   Sketching the graph may help.



Area = 3 × 3 = 9

3. Calculate the **total resistance** when a 1.0 kΩ resistor is connected in series to two 400 Ω resistors.



$R_T = R_1 + R_2 + R_3$

$R_T = 1000 + 400 + 400$

$R_T = 1800\ \Omega$

ANSWERS

24th July

1. Define **fission** and **fusion**.

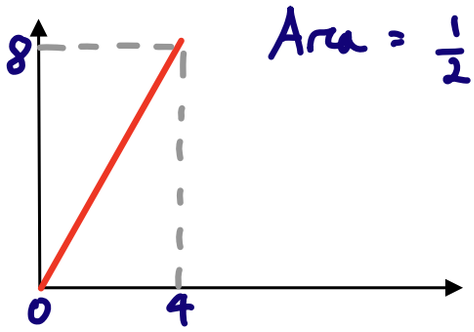
Fission - Splitting of a large and unstable nucleus.

Fusion - Joining of two light nuclei to form a heavier nucleus.

Both convert mass into energy!

2. Calculate the **area** under the graph of y = 2x between x = 0 and x = 4.

   Sketching the graph may help.



Area = $\frac{1}{2} \times 4 \times 8 = 16$

3. Calculate the **frequency** of a sound wave with a speed of 330 m s^{-1} and a wavelength of 30 cm.

≈ Speed of sound in air

$v = f\lambda$

$f = \frac{v}{\lambda} = \frac{330}{0.30} = 1100$ Hz

ANSWERS

25th July

1. $y = mx + c$ describes a graph with a straight line of gradient 'm' and y-intercept 'c'.

   Write down the **gradient** and **y-intercept** of the graphs with equation:

   a. $y = 2x + 3$ — $m = 2$ $c = 3$

   b. $y = 3x + 2$ — $m = 3$ $c = 2$

   c. $y = 6x + 3$ — $m = 6$ $c = 3$

   d. $y = 6 + 3x$ — $m = 3$ $c = 6$

2. Rearrange $F = BIL\sin\theta$ to make:

   a. **B** the subject — $B = F/IL\sin\theta$

   b. **I** the subject — $I = F/BL\sin\theta$

   c. **L** the subject — $L = F/BI\sin\theta$

   d. **θ** the subject — $\theta = \sin^{-1}(F/BIL)$

3. Write down the number of **protons**, **neutrons** and **electrons** in the following atoms:

	$^{56}_{26}Fe$	$^{54}_{26}Fe$	$^{59}_{27}Co$	$^{60}_{28}Ni$
p	26	26	27	28
n	30	28	32	32
e	26	26	27	28

ANSWERS

26th July

1. Write down the **gradient** and **y-intercept** of the graphs with equation:
   a. $y = 3x + 5$
   b. $2y = 4x + 2$
   c. $x + 3 = y$
   d. $y - 4 = x / 2$

$y = 2x + 1$ $\quad m = 3 \quad c = 5$

$y = x + 3$ $\quad m = 2 \quad c = 1$

$y = \frac{1}{2}x + 4$ $\quad m = 1 \quad c = 3$

$m = 0.5 \quad c = 4$

2. Rearrange $g = Gm / r^2$ to make **r** the subject.

G = Gravitational constant

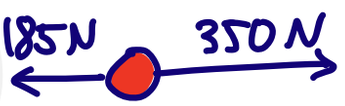
g = Gravitational field strength

$g = \frac{Gm}{r^2}$

$r^2 = \frac{Gm}{g}$

$r = \sqrt{\frac{Gm}{g}}$

3. Calculate the **acceleration** of a 1825 N boat when there is a thrust of 350 N from the engines and total drag forces of 185 N.



$F = 350 - 185 = 165\ N$

$m = \frac{W}{g} = \frac{1825}{9.81} = 186.03$

$F = ma \quad a = \frac{F}{m} = \frac{165}{186.03} = 0.887\ ms^{-2}$

ANSWERS

27th July

1. Calculate the **gradient** and **y-intercept** of the line with equation:

   a. $2y = 4x + 8$ $y = 2x + 4$ $m = 2$ $c = 4$

   b. $4y - 6 = x/2$ $y = \frac{1}{8}x + 1.5$ $m = 0.125$ $c = 1.5$

   c. $0 = x + y$ $y = -x$ $m = -1$ $c = 0$

   d. $x = 0.5y + 2$ $y = 2x - 4$ $m = 2$ $c = -4$

2. Rearrange $V_g = Gm / r$ to make **m** the subject.

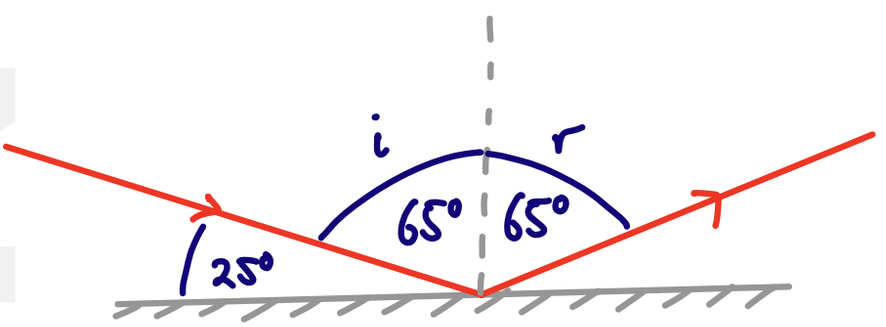
$$V_g = -\frac{Gm}{r}$$

$$V_g r = -Gm$$

$$\frac{V_g r}{G} = -m$$

$$m = -\frac{V_g r}{G}$$

3. A ray of light at 25° to the surface of a plane mirror is reflected (with a specular reflection). Calculate the angle of **reflection** (a diagram will help).



$i = r$

$r = 65°$

ANSWERS

28th July

1. Calculate the gradient and hence the **equation** of the straight-line graph that goes through the points (1, 2) and (5, 10).

$m = \frac{10-2}{5-1} = \frac{8}{4} = 2$

$y - y_1 = m(x - x_1)$

$y - 2 = 2(x-1)$

$y = 2x$

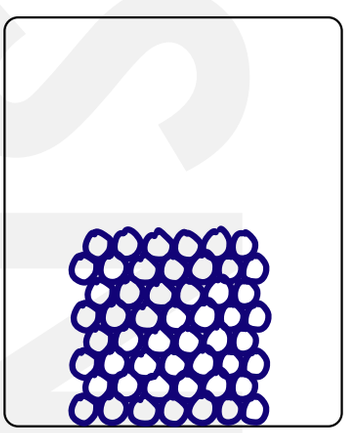
2. Rearrange the following to make **p** the subject:

a. $m = p / v$ $\quad p = mv$

b. $pV = NkT$ $\quad p = \frac{NkT}{V}$

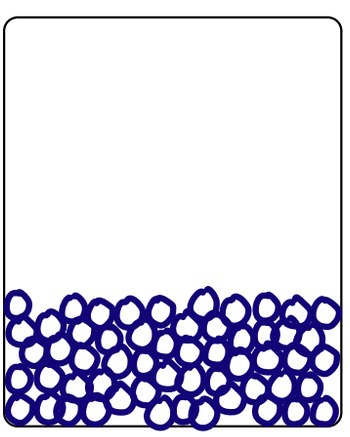
c. $E_k = p^2 / 2m$ $\quad p = \sqrt{2mE_k}$

3. Sketch the arrangement of particles in a **solid**, a **liquid** and a **gas**.



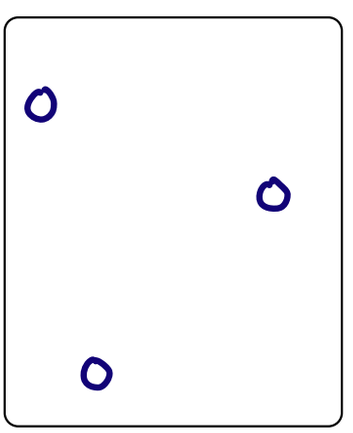
Close packed

Regular arrangement



Close packed

Random order



Far apart!

ANSWERS

29th July

1. Calculate the **equation** of the straight-line graph that goes through the point (1, 2) and has a gradient of 3.

$y - 2 = 3(x - 1)$

$y = 3x - 1$

2. Use the symbol '≈' to describe the **small-angle approximation** involving sin θ, cos θ and tan θ.

$\sin\theta \approx \theta$

$\cos\theta \approx 1$

$\tan\theta \approx \theta$

} when θ is very small

3. A 2.1 kg wheel rolls down a slope, losing 0.62 kJ of gravitational potential energy.

Calculate the **height** it rolls down.

$\Delta E_p = mg\Delta h$

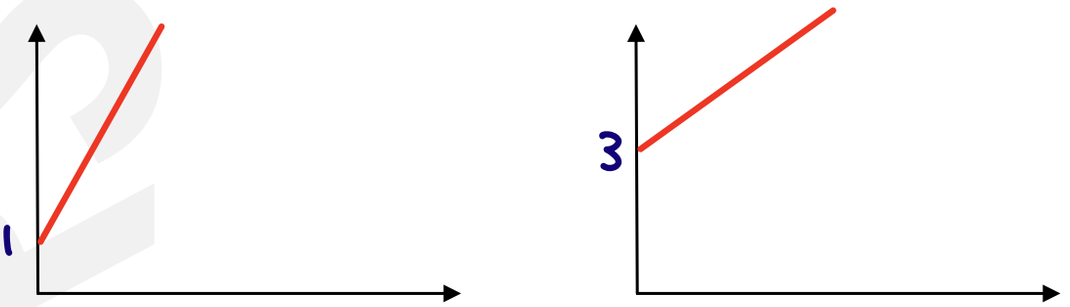
$\Delta h = \frac{\Delta E_p}{mg} = \frac{620}{2.1 \times 9.81}$

$\Delta h = 30\ m$

ANSWERS

30th July

1. **Sketch** the graphs of y = 3x + 1 and y = x + 3.



2. Write down **two** ways of defining radioactive **half-life**.

N
- The time it takes for the number of nuclei of the isotope in a sample to halve.

A
- The time it takes for the count rate, or activity, from a sample containing the radioactive isotope to fall to half its initial value.

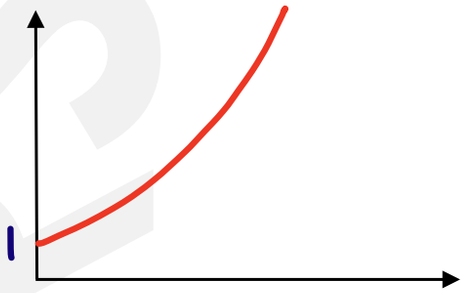
3. Calculate the **acceleration** of a car when it slows down from 10 m s^{-1} to 3.0 m s^{-1} in 2.5 s.

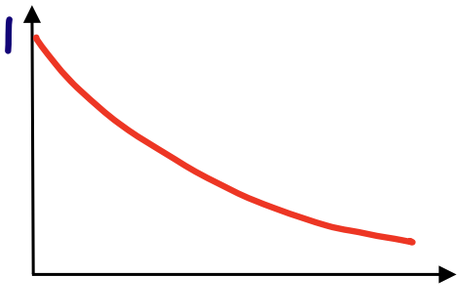
$$a = \frac{v-u}{t} = \frac{3.0-10}{2.5} = -2.8\ m\ s^{-2}$$

ANSWERS

31st July

1. **Sketch** the graphs of $y = e^x$ and $y = e^{-x}$.





2. Define electrical **resistance**.

$R = \frac{V}{I}$

Resistance is the ratio of the potential difference across a component to the current through the component.

3. Complete the following **nuclear** equations:

$$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$$

$$^{234}_{90}Th \rightarrow {}^{234}_{91}Pa + {}^{0}_{-1}\beta$$

$$^{234}_{91}Pa \rightarrow {}^{234}_{92}U + {}^{0}_{-1}\beta$$

ANSWERS