Worked Examples

✓ ✓ ✓

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

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

   b. 12.5 mm $A = \pi r^2 = \pi \times (12.5\times10^{-3})^2 = 4.91\times10^{-4}\ m^2$ (3sf)

   c. 125 µm $A = \pi r^2 = \pi \times (125\times10^{-6})^2 = 4.91\times10^{-8}\ m^2$

   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.

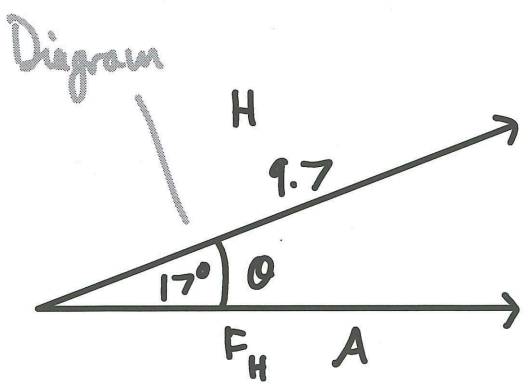
   $E_k = \frac{1}{2}mv^2$ — Equation + Rearrange

   $m = \frac{2E_k}{v^2} = \frac{2\times879\times10^{-3}}{8.9^2}$ — Working out (2sf)

   $m = 0.02219$

   $m = 2.2\times10^{-2}\ kg$ — Units (2sf)

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



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

$A = H\cos\theta$

$F_H = 9.7 \times \cos 17$

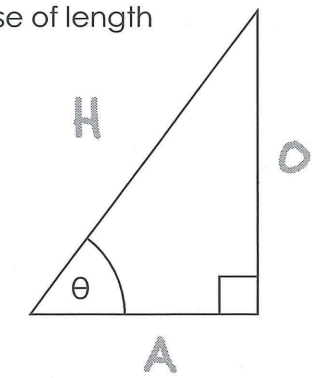
$F_H = 9.276$

$F_H = 9.3\ N$

1st July

1 2 3

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.

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

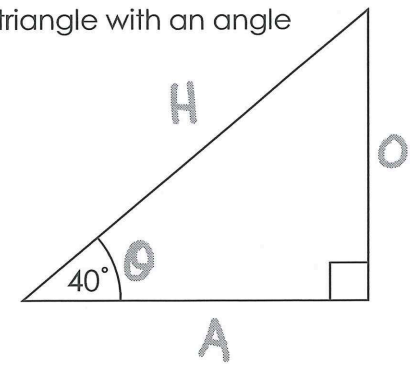
3. Calculate the **kinetic energy** and **momentum** of a car with a mass of 1200 kg and a velocity of 30 m s^{-1}.

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

2nd July

1 2 3

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.

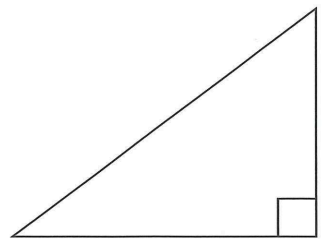
3. Explain what a **vector** quantity is and identify which of these quantities are vectors:

Speed, velocity, force, mass, energy and weight

3rd July

1 2 3

1. State **Pythagoras'** Theorem.



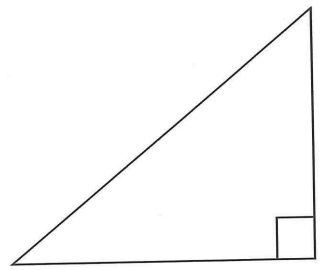
2. Write down the **proportionality relationship** between and frequency and time period for a wave.

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 2 3

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



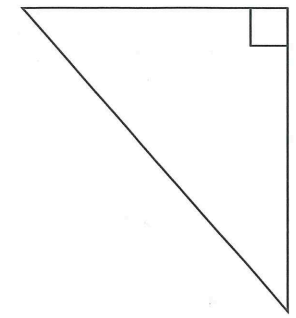
2. Write down the **proportionality relationship** between acceleration and mass, for a constant net force.

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.



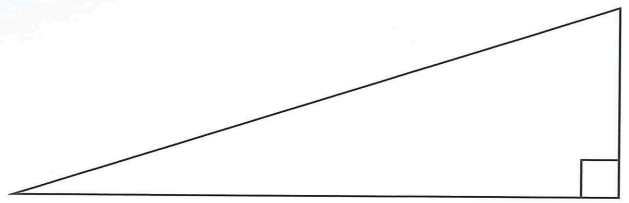
2. Write down the **proportionality relationship** between momentum and velocity.

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

6th July

1 2 3

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.

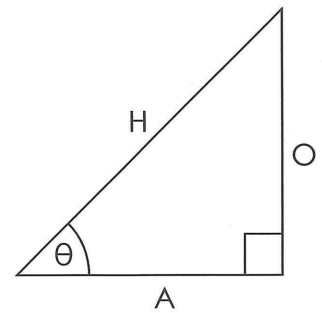
3. Describe, in a **DC circuit**, what electric current is and how **conventional current** is defined.

7th July

1 2 3

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



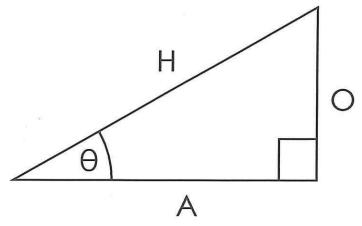
3. Calculate the **distance** travelled by an object that has a speed of 16 m s^{-1} in exactly one minute.

8th July

1 2 3

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 2 3

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 2 3

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 2 3

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 2 3

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.

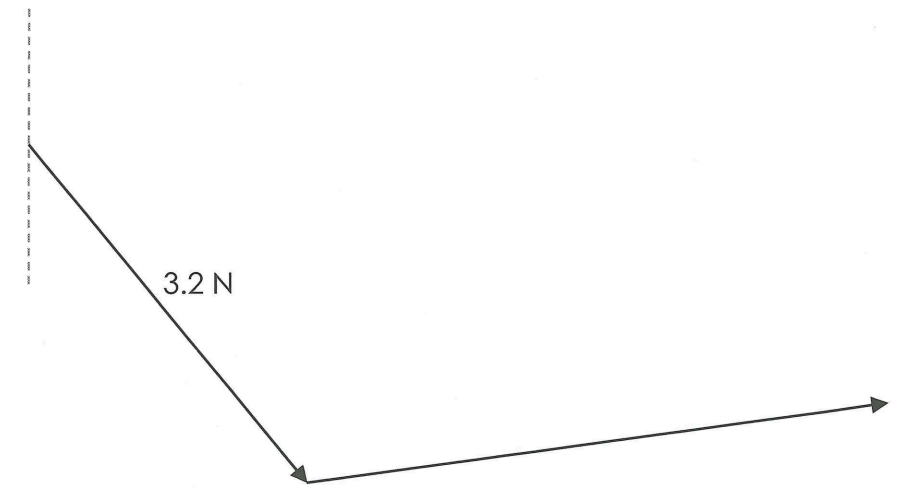
13th July

1 2 3

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

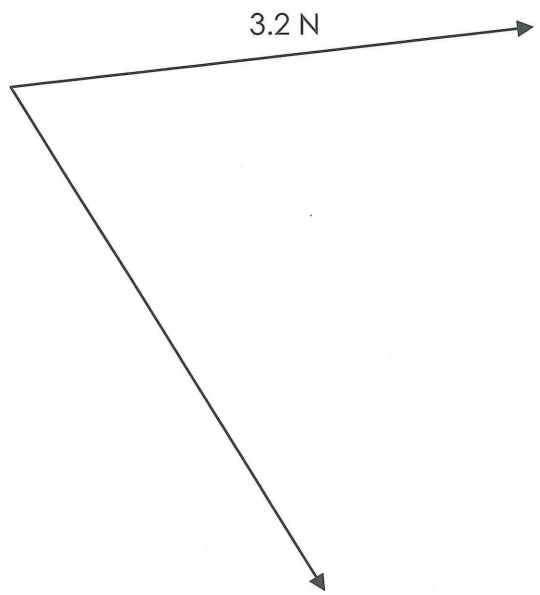
1 2 3

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

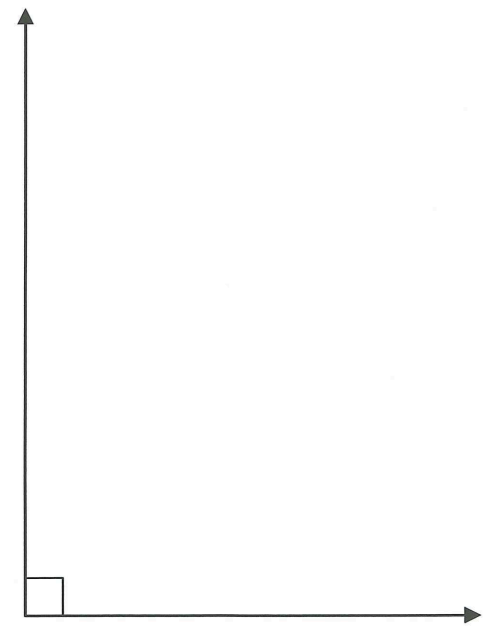
1 2 3

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).



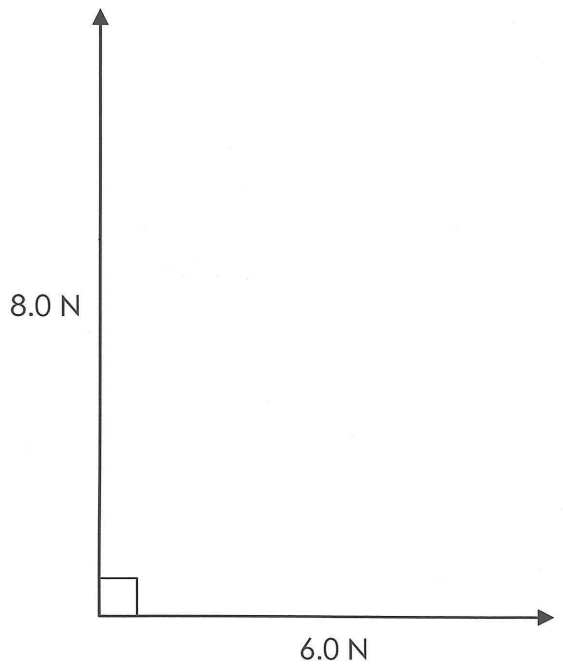
16th July

1 2 3

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 2 3

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. 0.000 000 000 000 000 000 000 013 806
   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 2 3

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.

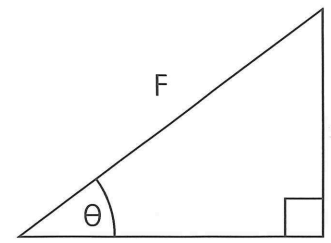
3. Calculate the size of the resultant force, using a **mathematical** method, produced by a vertical force of 950 N down and a horizontal force of 390 N to the left.

19th July

1 2 3

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

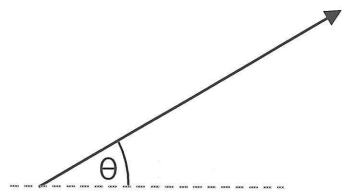
   c. Gamma radiation

20th July

1 2 3

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.



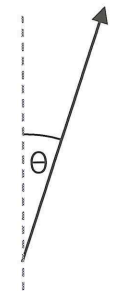
3. Calculate the **initial** velocity of a ball if its final velocity is 3.00 m s^{-1} after it accelerates at 24 m s^{-2} over 0.15 m.

21st July

1 2 3

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.

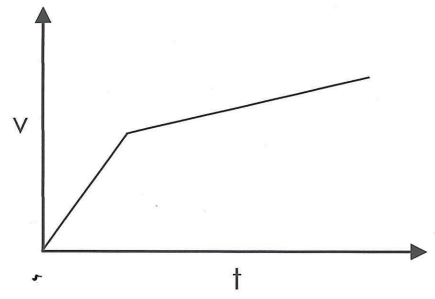
   Assume negligible air resistance and use g = 9.81 N kg^{-1}

22nd July

1 2 3

1. Define the **joule**.

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



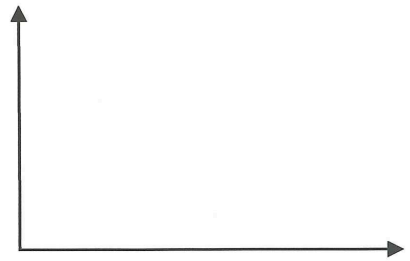
3. Calculate the **energy transferred per second** in a resistor with 2.0 V across it and 0.30 A through it.

23rd July

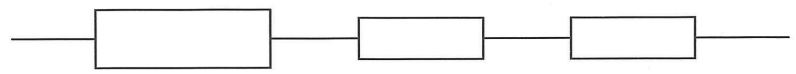
1 2 3

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.

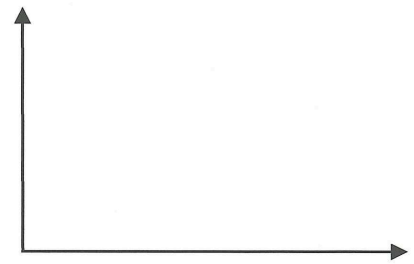


24th July

1 2 3

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 2 3

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 2 3

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 2 3

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 2 3

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

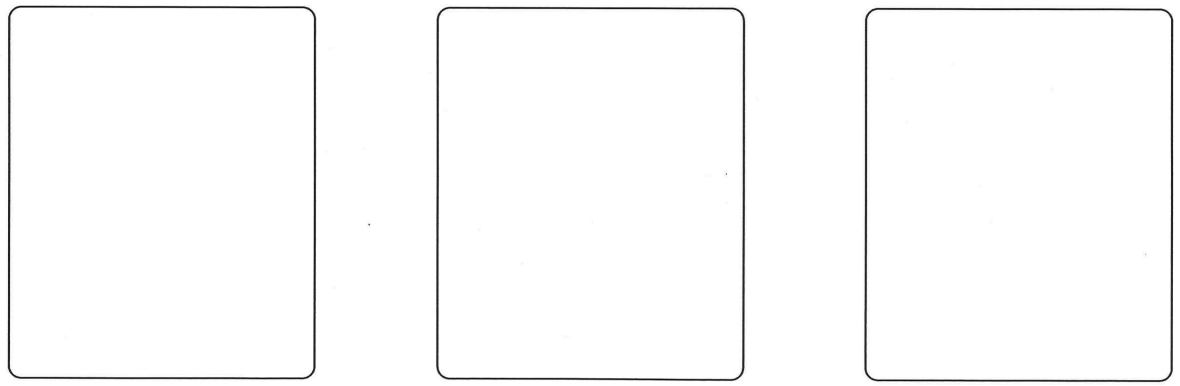
2. Rearrange the following to make **p** the subject:

   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 2 3

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.

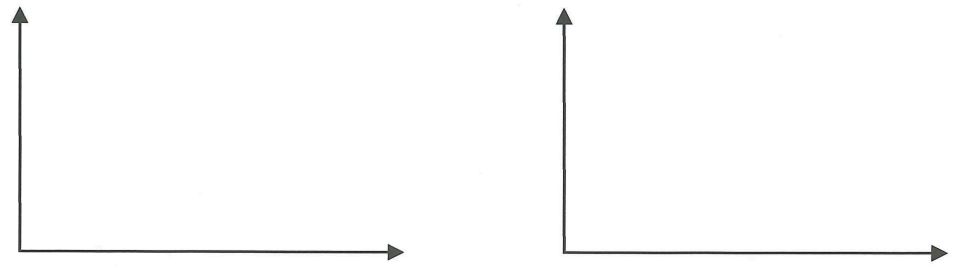
3. A 2.1 kg wheel rolls down a slope, losing 0.62 kJ of gravitational potential energy.

   Calculate the **height** it rolls down.

30th July

1 2 3

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



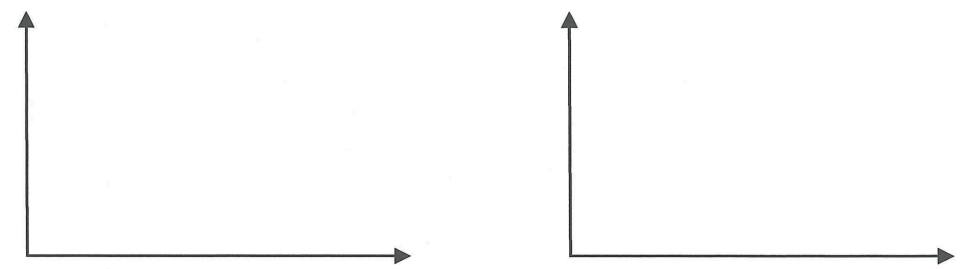
2. Write down **two** ways of defining radioactive **half-life**.

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 2 3

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



2. Define electrical **resistance**.

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

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

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

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