Course Start

Course Start is independent learning you need to complete as a fundamental part of your introduction to the course. It should take you approximately 5 hours to complete.

Course Name	**GCSE Combined Science**
How this **Course Start** fits into the first term of the course	Most students will have studied GCSE Combined Science previously. Although we will start at the beginning and cover all of the topics. These tasks will help to remind you about what you know already.
How will my **Course Start** learning be used in lessons?	Being familiar with the topics will help to remind you of basic Science principles and terminology and make your learning easier
Course Start learning objectives	• Understand the terminology used in GCSE Combined Science • Revise basic science principles • Use books and revision guides to find information
Study Skills	• Research skills to find information • Communication skills - putting your ideas and findings into words • Data analysis - understanding scientific table and graphs

Expectations for: GCSE Combined Science
Our specification is: AQA

What this course involves
Purchase a revision guide and workbook at the beginning of the course (we will order these for you)
Spend 10 hours each week outside of lesson times on independent study
Complete the pages in the work book after each lesson
Come to lessons prepared with all the materials you need
Use of maths skills, including calculations and analysing tables and graphs

The following pages give you a brief look at some of the work you will be covering in GCSE Combined Science.

Getting and staying organised

The key to level 2 success is good organisation; keeping your notes in good order and keeping track of progress through the course is essential.

Get yourself a large folder (just for Combined Science) with a set of dividers and file your notes at the end of each short section. You will also need to get a smaller folder for transporting notes to and from college, and for keeping your current notes in.

Bring paper, a pencil, calculator and pens to every lesson.

You will buy a textbook and a workbook which supports your GCSE Combined Science course which you should also bring into every lesson.

Preparation and reading ahead

You should do regular background reading (from the textbook and online resources) and keep up to date with the workbook, particularly important if you miss a lesson for some reason.

Homework

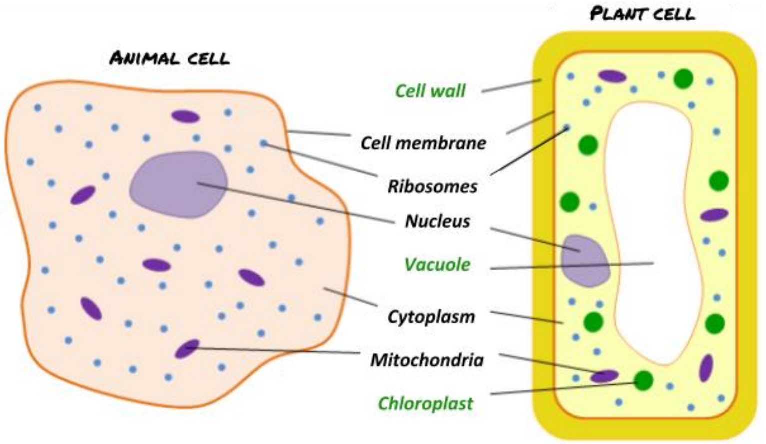
You will be set homework each week, from your workbook. It is important to purchase the revision guide and workbook promptly at the start of the course.

The following pages should refresh your general Combined Science skills and set you off on the right track.

Have a go. You may well find some of it difficult but persevere or see if you can work with someone.

Biology

You need to be able to label a plant and animal cell and describe the function of the organelle. Have a go at memorising and answering the questions that follow.

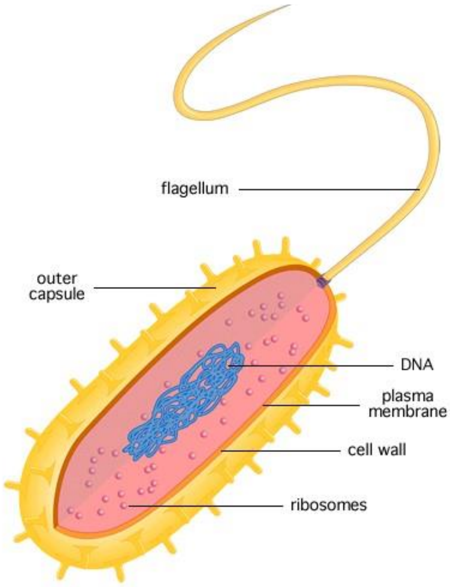


Part of Cell	Function
Cell Membrane	Controls what enters and leaves the cell
Nucleus	Contains the DNA that codes for proteins
Cytoplasm	Site of chemical reactions (contains enzymes)
Ribosomes	Assembles Proteins
Mitochondria	Site of AEROBIC respiration (releases energy)
Chloroplast	Site of photosynthesis
Cell Wall	Supports the cell, made of cellulose
Permanent Vacuole	Contains cell sap

There are 2 types of cells eukaryotic and prokaryotic. Plant and animal cells are eukaryotic, the genetic information is in a nucleus. A prokaryotic cell like bacteria does not have a nucleus.

Prokaryote : Key Features

- No Nucleus
- Smaller
- Cell Wall (not cellulose)
- Circular strand of DNA
- Cytoplasm
- Ribosomes
- Plasmid

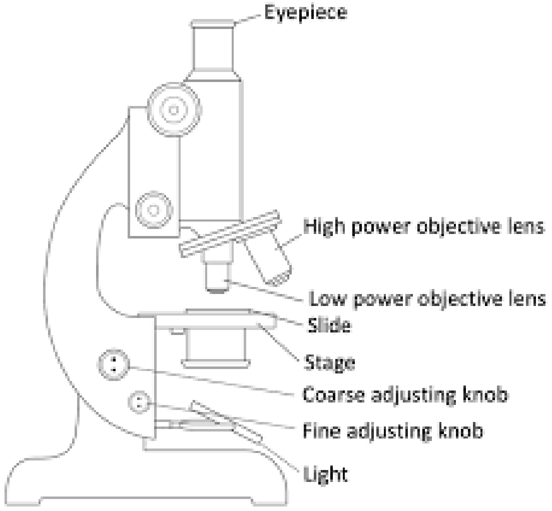


Prokaryote:

Part of Cell	Function
Flagellum	For locomotion (moving)
Circular DNA	Contains the genes that code for proteins
Cell Wall	Gives the cell structure
Cytoplasm	Site of chemical reactions
Plasmid	A small piece of DNA that can be swapped with other bacteria
Ribosomes	Assemble proteins

Microscopes

- **Microscopes are used to view small objects with more detail by creating a larger image of the real object.**
- **A light microscope uses light and lenses to magnify the object and make a larger image.**
- **This allows you to see individual cells and large organelle like the nucleus.**
- **However, to see smaller organelle like mitochondria, chloroplasts and ribosomes, you need to use an electron microscope which has higher resolution and magnification.**

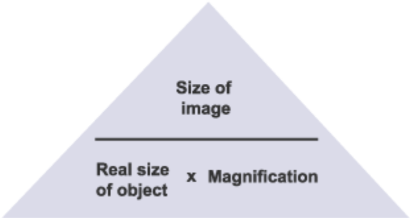


We will do a practical to look at onion cells under the microscope and draw the cells. There are rules for microscope drawing:

- **Use a sharp pencil and use at least 50% of the space provided**
- **Use clear unbroken lines**
- **No colouring or shading**
- **Organelle must be drawn in proportion**
- **Include a title and the magnification used**
- **Label important features**

Magnification is calculated using the following equation:

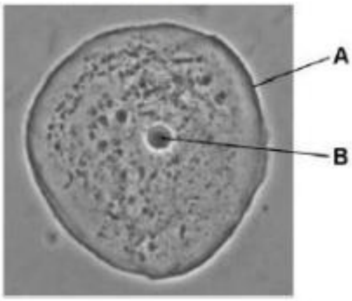
Magnification = Drawing size ÷ Actual size



Biology Questions - Use the information provided to answer these questions.

Q1.Figure 1 shows an animal cell.

Figure 1



© alex-mit/iStock/Thinkstock

(a) What is structure **A**?

Tick **one** box.

Cell membrane ☐

Cell wall ☐

Chromosome ☐

Cytoplasm ☐

(b) What is structure **B**?

Tick **one** box.

Chloroplast ☐

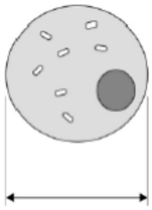
Mitochondria ☐

Nucleus ☐

Vacuole ☐

Q2.Figure 1 shows a cell viewed through a light microscope.

Figure 1



The size of the real cell is 0.03 mm.

(a) Calculate the magnification of the microscope.

Use **Figure 1** to help you answer.

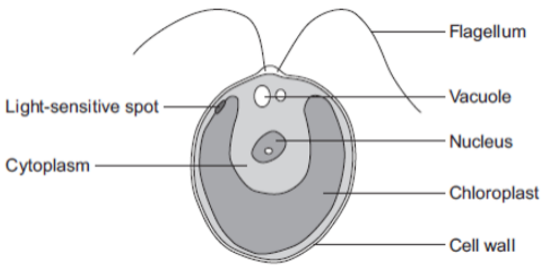
....

....

Magnification = ...

Q3

.The diagram below shows a single-celled alga which lives in fresh water.



(a) Which part of the cell labelled above:

(i) traps light for photosynthesis

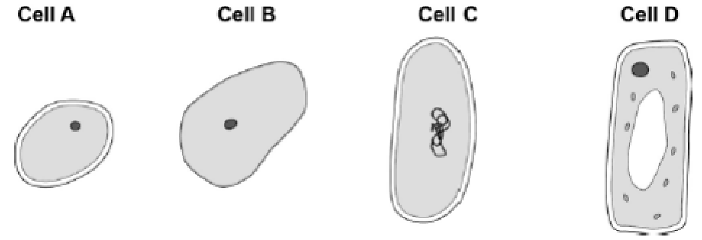
....
(1)

(ii) is made of cellulose?

....
(1)

Q4

.The figure below shows four different types of cell.



(a) Which cell is a plant cell?

Give **one** reason for your answer.

Cell ....

Reason ....

(2)

(b) Which cell is an animal cell?

Give **one** reason for your answer.

Cell ....

Reason ....

(2)

(c) Which cell is a prokaryotic cell?

Give **one** reason for your answer.

Cell ....

Reason ....

(2)

(d) A scientist observed a cell using an electron microscope. The size of the image was 25 mm. The magnification was × 100 000

Calculate the real size of the cell.

Use the equation:

$$\text{magnification} = \frac{\text{image size}}{\text{real size}}$$

Give your answer in micrometres.

....

....

....

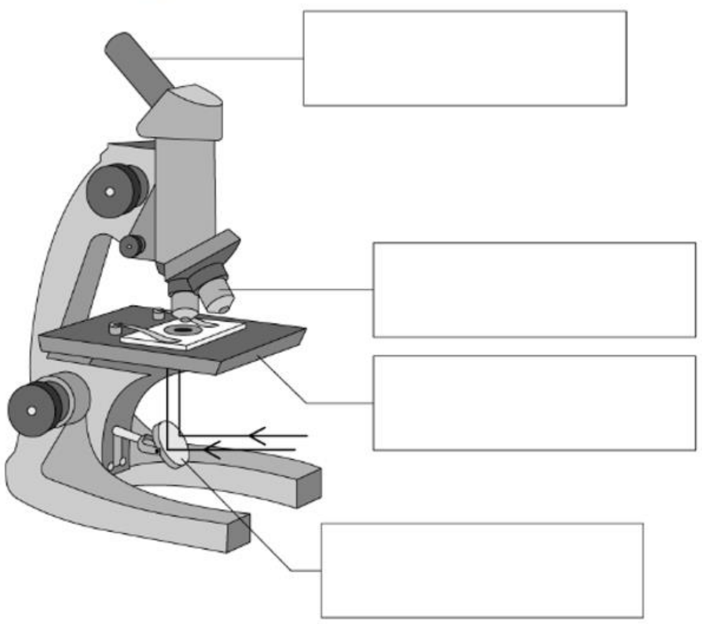
Real size = ... micrometres

Q5

Complete the table by adding a (✓) or a (X) to compare the components seen in plant cells and animals cells.

Component	Animal cell	Plant cell
Cell wall		
Nucleus		
Mitochondria		
Ribosomes		
Vacuole		
Cytoplasm		

Q6. Label the 3 parts of the microscope



A student is doing a drawing of onion cells observed using a microscope. What 2 rules must they follow?

1-

2-

Biology Extension Stem cells.

Q7 Read the information about stem cells.

Stem cells are used to treat some human diseases.

Embryonic stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now. Some people are against the use of embryonic stem cells for research as the human embryos could have been life. They think the embryos have rights and cannot consent to being used. The use of embryonic stem cells is a relatively new treatment and has a lower success rate. No pain is experienced by the patient being treated and the embryos would have been destroyed anyway.

Adult Stem cells can be collected from adult bone marrow. The operation is simple but may be painful. Stem cells cannot become any type of cell so they are less useful than embryonic stem cells. Stem cells in bone marrow differentiate to form different types of blood cells. These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases. You should give a conclusion to your evaluation.

....

....

....

....

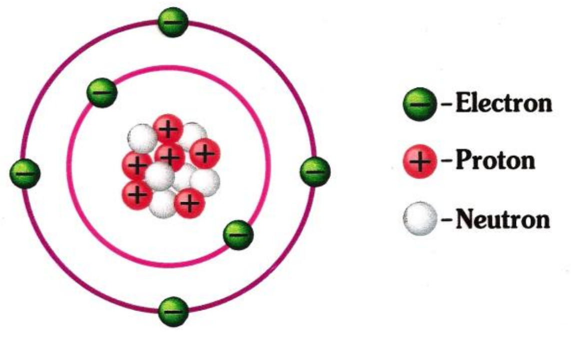
....

....

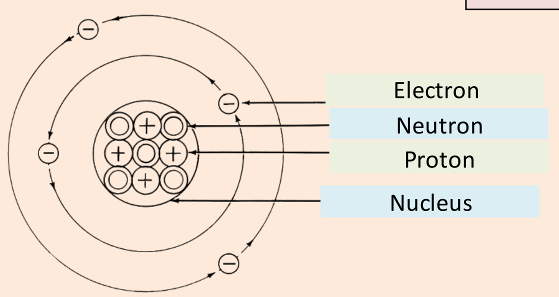
....

Chemistry

- Atoms are made up of sub-atomic particles called electrons, protons and neutrons.
- The centre of the atoms is called the nucleus and contains the protons and neutrons.
- The electrons are on shells around the nucleus.



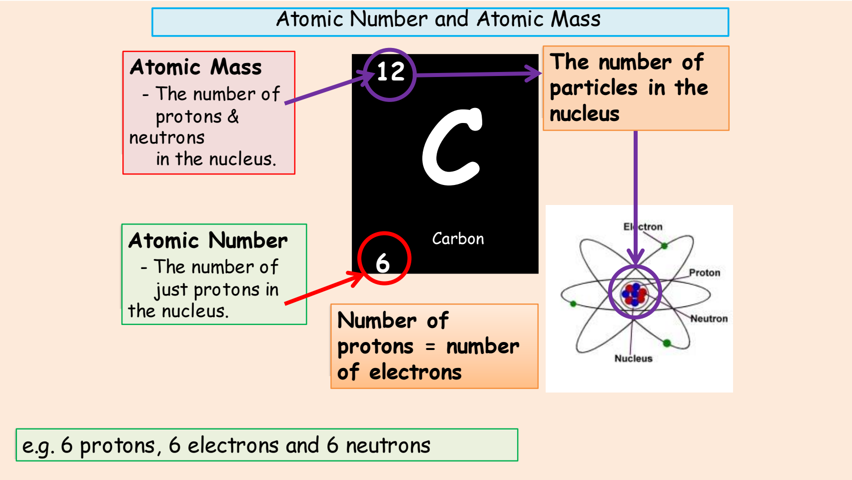
Sub atomic particle	Relative charge	Relative Mass
Proton	+1	1
Neutron	0	1
Electron	-1	Very small



All atoms have equal numbers of protons and electrons. A proton has a charge of +1 and an electron has a charge of -1, so the charges cancel each other out and the atom has no overall charge.

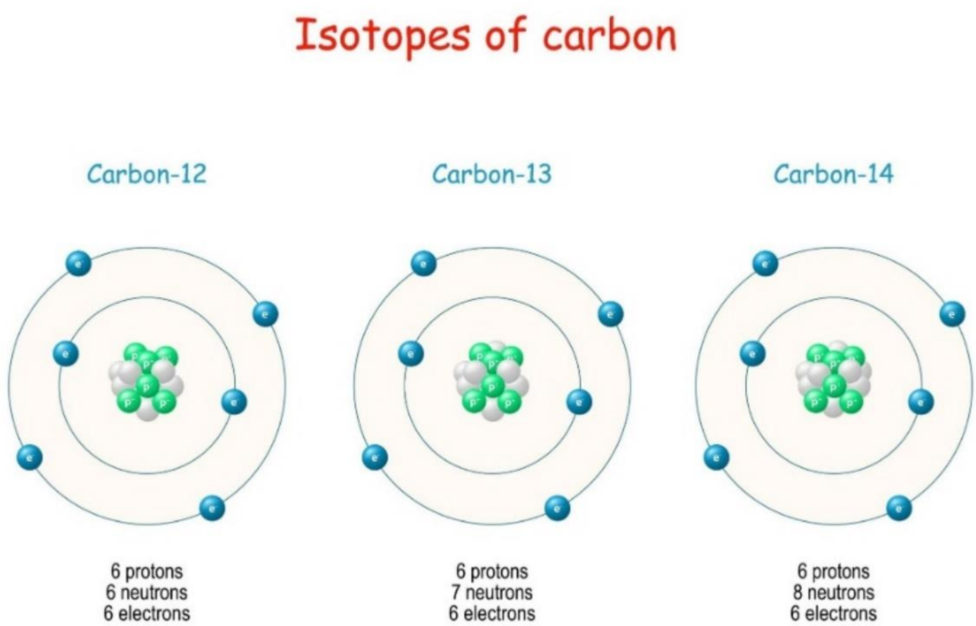
Only the protons and neutrons have mass, so we can say that all the mass of the atom is in the nucleus.

The periodic table uses symbols to identify the different elements.



The number of protons tells you which element it is. There are over 100 elements.

If atoms have different numbers of neutrons, but the same number of protons, they are called isotopes.



Chemistry Questions:

Q1. Isotopes are atoms of an element with the same number of ______________ but a different number of ________________.
Isotopes are atoms of an element with the same _____________ number but a different ____________ number

Use these words to fill the spaces: **Atomic** **mass** **neutrons** **protons**

Q2.

Define the mass number of an atom.

[1 mark]

____

____

Q3

The two types of particle with the same mass are the neutron

and the ______________________________.

Q4

If 2 atoms have the same number of protons and electrons but a different number of neutrons, they are ______________ of the same element.

Q5

.An atom of aluminium has the symbol $^{27}_{13}Al$

(a) Give the number of protons, neutrons and electrons in this atom of aluminium.

Number of protons ....

Number of neutrons ....

Number of electrons ....

(3)

Q6. This question is about atomic structure and elements.

(a) Complete the sentences.

(i) The atomic number of an atom is the number of ....

(1)

(ii) The mass number of an atom is the number of ....

....

(1)

(b) Explain why an atom has no overall charge.

Use the relative electrical charges of sub-atomic particles in your explanation.

....

....

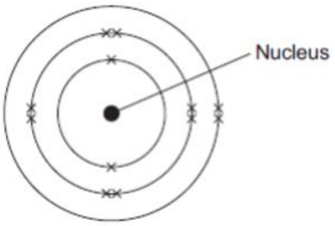
....

....

(2)

Q7

The electronic structure of a magnesium atom is shown below.



Use the correct answer from the box to complete each sentence.

electrons	**neutrons**	**protons**	**shells**

The nucleus contains protons and ....

The particles with the smallest relative mass that move around the nucleus are called ....

Atoms of magnesium are neutral because they contain the same number of electrons and ....

(3)

Chemistry Extension - Calculating Relative Atomic Mass

There are different amounts of each isotope of an element. To calculate the average mass of an atom of that element, we use this formula.

$$A_r = \frac{(\%\ \boldsymbol{of\ isotope\ a} \times \boldsymbol{mass\ of\ isotope\ a}) + (\%\ \boldsymbol{of\ isotope\ b} \times \boldsymbol{mass\ of\ isotope\ b})}{100}$$

Calculating relative atomic mass

Isotope	Relative isotopic mass	Relative abundance (%)
Cl	34.969	75.80
Cl	36.966	24.20

$$A_r = \frac{\text{(relative isotopic mass X1 \% abundance) + relative isotopic mass X2 \% abundance)}}{100}$$

$$A_r\,(Cl) = \frac{(34.969 \times 75.8) + (36.966 \times 24.2)}{100}$$

$$A_r\,(Cl) = \frac{2650.65 + 894.58}{100}$$

A_r (Cl) = 35.45 amu (atomic mass unit)

Q1

Element **X** has two isotopes. Their mass numbers are 69 and 71

The percentage abundance of each isotope is:

- 60% of ^{69}**X**
- 40% of ^{71}**X**

Estimate the relative atomic mass of element **X**.

[1 mark]

Tick **one** box.

< 69.5 ☐

Between 69.5 and 70.0 ☐

Between 70.0 and 70.5 ☐

> 70.5 ☐

Q2

There are two isotopes of element **A**. Information about the two isotopes is shown in the table below.

Mass number of the isotope	6	7
Percentage abundance	92.5	7.5

Use the information in the table above above to calculate the relative atomic mass of element **A**.
Give your answer to 2 decimal places.

....

....

....

....

....

Q3

Table 2 shows information about two isotopes of element **X**.

Table 2

	Mass number	**Percentage (%) abundance**
Isotope 1	63	70
Isotope 2	65	30

Calculate the relative atomic mass (A_r) of element **X** using the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope 1} + (\text{mass number} \times \text{percentage}) \text{ of isotope 2}}{100}$$

Give your answer to 1 decimal place.

[2 marks]

___

___

___

___

A_r = ___

Physics – Read through the information and answer the questions

We are going to learn about energy and the store and transfer of energy.

Examples of energy stores

Energy store	Description	Examples
Magnetic	The energy stored when repelling poles have been pushed closer together or when attracting poles have been pulled further apart.	Fridge magnets, compasses, maglev trains which use magnetic levitation.
Internal (thermal)	The total kinetic and potential energy of the particles in an object, in most cases this is the vibrations - also known as the kinetic energy - of particles. In hotter objects, the particles have more internal energy and vibrate faster.	Human bodies, hot coffees, stoves or hobs. Ice particles vibrate slower, but still have energy.
Chemical	The energy stored in chemical bonds, such as those between molecules.	Foods, muscles, electrical cells.
Kinetic	The energy of a moving object.	Runners, buses, comets.
Electrostatic	The energy stored when repelling charges have been moved closer together or when attracting charges have been pulled further apart.	Thunderclouds, Van De Graaff generators.
Elastic potential	The energy stored when an object is stretched or squashed.	Drawn catapults, compressed springs, inflated balloons.
Gravitational potential	The energy of an object at height.	Aeroplanes, kites, mugs on a table.
Nuclear	The energy stored in the nucleus of an atom.	Uranium nuclear power, nuclear reactors.

Conservation of Energy

The Law of Conservation of Energy states that:

"Energy cannot be created or destroyed, only transferred from one store to another"

Calculating Energy

Energy is measured in Joules (J). This is the same for all of the different energy stores. Whether it is kinetic or chemical, it is still measured in Joules.

Kinetic Energy Store

- The amount of energy an object has as a result of its mass and speed
- This means that any object in motion has energy in its kinetic store
- If an object speeds up, energy is transferred into its kinetic store
- If an object slows down, energy is transferred out of its kinetic store

Kinetic energy can be calculated using the equation:

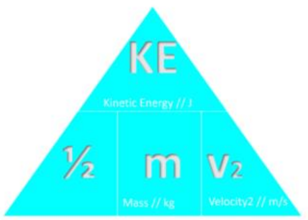
$$E_k = ½ \times m \times v^2$$

Where:

E_k = kinetic energy in **joules** (J)

m = mass of the object in **kilograms** (kg)

v = speed of the object in **metres per second** (m/s)



This equation is provided on the equation sheet and does not need to be memorised, but the appropriate units do need to be memorised.

Example:

Calculate the kinetic energy stored in a vehicle of mass 1200 kg moving at a speed of 27 m/s.

Write down the equation

$$E_K = ½ mv^2$$

Calculate the kinetic energy

$$E_K = ½ \times 1200 \times (27)^2$$

$$E_K = 437\ 400 \text{ J}$$

Gravitational Potential Energy

- Energy in the **gravitational store** of an object is defined as:
- **The energy an object has due to its height in a gravitational field**
- This means:
- If an object is **lifted** up, energy is **transferred to** its gravitational potential store
- If an object **falls**, energy will be **transferred away from** its gravitational potential store

- The gravitational potential energy, E_p, of an object can be calculated using the equation:

$$E_p = m \times g \times h$$

- Where:
  - E_p = gravitational potential energy, in **joules** (J)
  - m = mass, in **kilograms** (kg)
  - g = gravitational field strength in **newtons per kilogram** (N/kg)
  - h = height in **metres** (m)

This equation is provided on the equation sheet and does not need to be memorised, but the appropriate units do need to be memorised.

Example

A man of mass 70 kg climbs a flight of stairs that is 3 m higher than the floor. Gravitational field strength is approximately 9.8 N/kg. Calculate the energy transferred to the man's gravitational potential energy store.

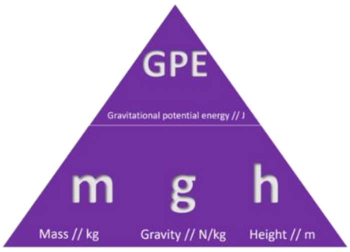
Write down the equation

$$E_P = mg\Delta h$$

Calculate the gravitational potential energy

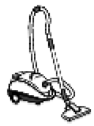
$$E_P = 70 \times 9.8 \times 3$$

$$E_P = 2058 \text{ J}$$

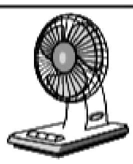


Physics Questions

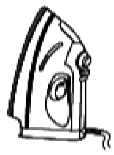
Q1. The appliances shown below transfer electrical energy to other types of energy.



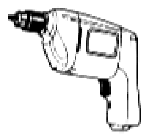
Vacuum cleaner



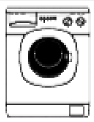
Fan



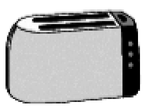
Iron



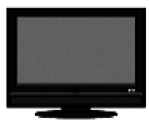
Drill



Washing machine



Toaster



Television

(a) The vacuum cleaner is designed to transfer electrical energy to kinetic energy.

Three more of the appliances are also designed to transfer electrical energy to kinetic energy. Which **three**?

Draw a ring around each correct appliance.

3

(b) Which **two** of the following statements are true?

Tick (✓) **two** boxes.

Appliances only transfer part of the energy usefully.

The energy transferred by appliances will be destroyed.

The energy transferred by appliances makes the surroundings warmer.

The energy output from an appliance is bigger than the energy input.

Q2

Figure 1 shows a battery operated remote control car.

Figure 1

© Brandon Bolin/iStock/Thinkstock

(a) The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

....

....

....

....

(2)

(b) The car has a top speed of 12 m / s and a mass of 800 g.

Write down the equation that links kinetic energy, mass and speed.

Equation ....

(1)

(c) Calculate the maximum kinetic energy of the car.

....

....

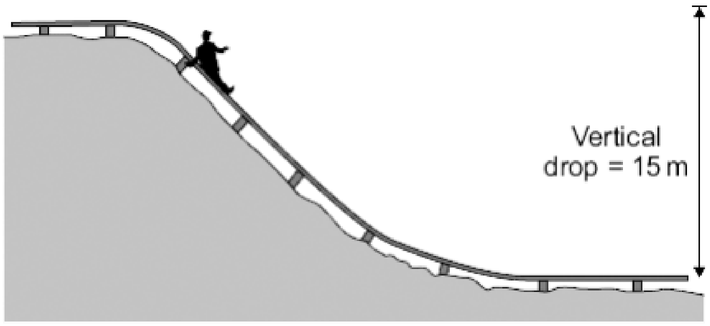
....

Maximum kinetic energy = ... J

(2)

Q3

The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.



(a) A miner of mass 90 kg travels down the slide.

Calculate the change in gravitational potential energy of the miner when he moves 15 m vertically downwards.

gravitational field strength = 10 N/kg

Show clearly how you work out your answer.

....

....

Change in gravitational potential energy = ... J

(2)

(b) Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.

Show clearly how you work out your answer.

Give your answer to an appropriate number of significant figures.

....

....

....

....

Maximum possible speed = ... m/s

Physics Extension

Specific Heat Capacity - Follow the link below to lean about specific heat capacity and the required practical.

https://www.bbc.co.uk/bitesize/guides/z2gjtv4/revision/5

1. Write the formula for specific heat capacity, showing the units for each part

2. The specific heat capacity of copper is 390 J/Kg °C. What does this mean?...

....

....

3. Calculate the energy transferred when 3kg of copper is heated from 20°C to 220°C

....

....

4. Calculate the energy needed to heat 2kg of water from 10°C to 90°C. The Specific heat capacity of water is 4200J/KgoC

....

....

5. Here are the specific heat capacity values of four different metals:

metal	**specific heat capacity**
aluminium	910 J/kg °C
brass	380 J/kg °C
copper	390 J/kg °C
iron	460 J/kg °C

6. How much energy must be transferred into 1 kg of copper to raise its temperature by 1 °C?

....

7. If you have 1 kg of each metal. Which one will need the most energy to raise its temperature by 1 °C?

……
……………………

8. The same amount of energy is transferred into 1 kg of each metal. Which one has the largest temperature rise?

……
……………………

9. How much energy must be transferred into 2 kg of iron to raise its temperature by 5°C?

……

……………………

10. Complete the table by calculating the missing values

material	**energy transfer**	**mass**	**temperature rise**	**specific heat capacity**
A		4 kg	6 °C	4000 J/kg°C
B	6 000 J	1 kg		2000 J/kg°C
C	8 000 J		4 °C	1000 J/kg°C
D		12 kg	24 °C	500 J/kg°C
E	2 500 J	2 kg	5 °C	