YEAR 12 – BRIDGING UNITS

BTEC LEVEL 3 EXTENDED CERTIFICATE IN APPLIED SCIENCE

ST HILDA'S COLLEGE

The 6th Form
@ St Hilda's

BRIDGING UNITS

Name:

Anything is POSSIBLE

Table of Contents

Welcome note

Getting a good head start into what BTEC Level 3 National Extended Certificate in Applied Science is about will be the key to your success. This bridging work is designed to help you bridge the gap between your GCSE Science studies and BTEC Level 3 National Extended Certificate course. It includes a list of topics from GCSE that will be helpful for you to review and practice.

It is important that you complete all your assigned work in preparation to your new course. The work will help you develop necessary skills for post 16 studies such as resilience and time management that will be essential during years 12 & 13. In September, your bridging work needs to be handed at the first lesson and it will be assessed. This way we can diagnose your strengths and weaknesses and begin to support you in a more targeted way.

This booklet has 4 sections.

1. Biology
2. Chemistry
3. Physics
4. Research task

All sections need to be completed.

Resources

1. There is a list of available resources plus valuable information as well as course specification in the Pearson's website.
https://qualifications.pearson.com/en/qualifications/btec-nationals/applied-science-2016.html

2. Royal Society of Biology
https://www.rsb.org.uk/

3. Royal Society of Chemistry
https://www.rsc.org/

4. Institute of Physics (IOP)
http://www.iop.org/tailored/students/

5. Free Science Lessons (You Tube)
https://www.youtube.com/channel/UCqbOeHaAUXw9ll7sBVG3_bw

6. BBC Bitesize
https://www.bbc.com/bitesize/levels/z98jmp3

Useful information

SI units

Physical quantity	Usual quantity symbol	Unit	Abbreviation
mass	*m*	kilogram	kg
length	*l* or *x*	metre	m
time	*t*	second	s
electric current	*I*	ampere	A
temperature	*T*	kelvin	K
amount of substance	*N*	mole	mol

Prefixes

Prefix	Symbol	Multiplication factor		
Tera	T	10^{12}	1 000 000 000 000	
Giga	G	10^{9}	1 000 000 000	
Mega	M	10^{6}	1 000 000	
kilo	k	10^{3}	1000	
deci	d	10^{-1}	0.1	1/10
centi	c	10^{-2}	0.01	1/100
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000
pico	p	10^{-12}	0.000 000 000 001	1/1 000 000 000 000
femto	f	10^{-15}	0.000 000 000 000 001	1/1 000 000 000 000 000

Greek letters

Greek letters are used often in science. They can be used as symbols for numbers (such as π = 3.14…), as prefixes for units to make them smaller (eg μm = 0.000 000 001 m) or as symbols for particular quantities (such as λ which is used for wavelength).

The Greek alphabet is shown below.

Α	α	alpha
Β	β	beta
Γ	γ	gamma
Δ	δ	delta
Ε	ε	epsilon
Ζ	ζ	zeta
Η	η	eta
Θ	θ	theta
Ι	ι	iota
Κ	κ	kappa
Λ	λ	lambda
Μ	μ	mu

Ν	ν	nu
Ξ	ξ	ksi
Ο	ο	omicron
Π	π	pi
Ρ	ρ	rho
Σ	ς or σ	sigma
Τ	τ	tau
Υ	υ	upsilon
Φ	φ	phi
Χ	χ	chi
Ψ	ψ	psi
Ω	ω	omega

Biology section

Activity 1

Join the boxes to link the word to its definition.

Accurate	A statement suggesting what may happen in the future.
Data	An experiment that gives the same results when a different person carries it out, or a different set of equipment or technique is used.
Precise	A measurement that is close to the true value.
Prediction	An experiment that gives the same results when the same experimenter uses the same method and equipment.
Range	Physical, chemical or biological quantities or characteristics.
Repeatable	A variable that is kept constant during an experiment.
Reproducible	A variable that is measured as the outcome of an experiment.
Resolution	This is the smallest change in the quantity being measured (input) of a measuring instrument that gives a perceptible change in the reading.
Uncertainty	The interval within the true value can be expected to lie.
Variable	The spread of data, showing the maximum and minimum values of the data.
Control variable	Measurements where repeated measurements show very little spread.
Dependent variable	Information, in any form, that has been collected.

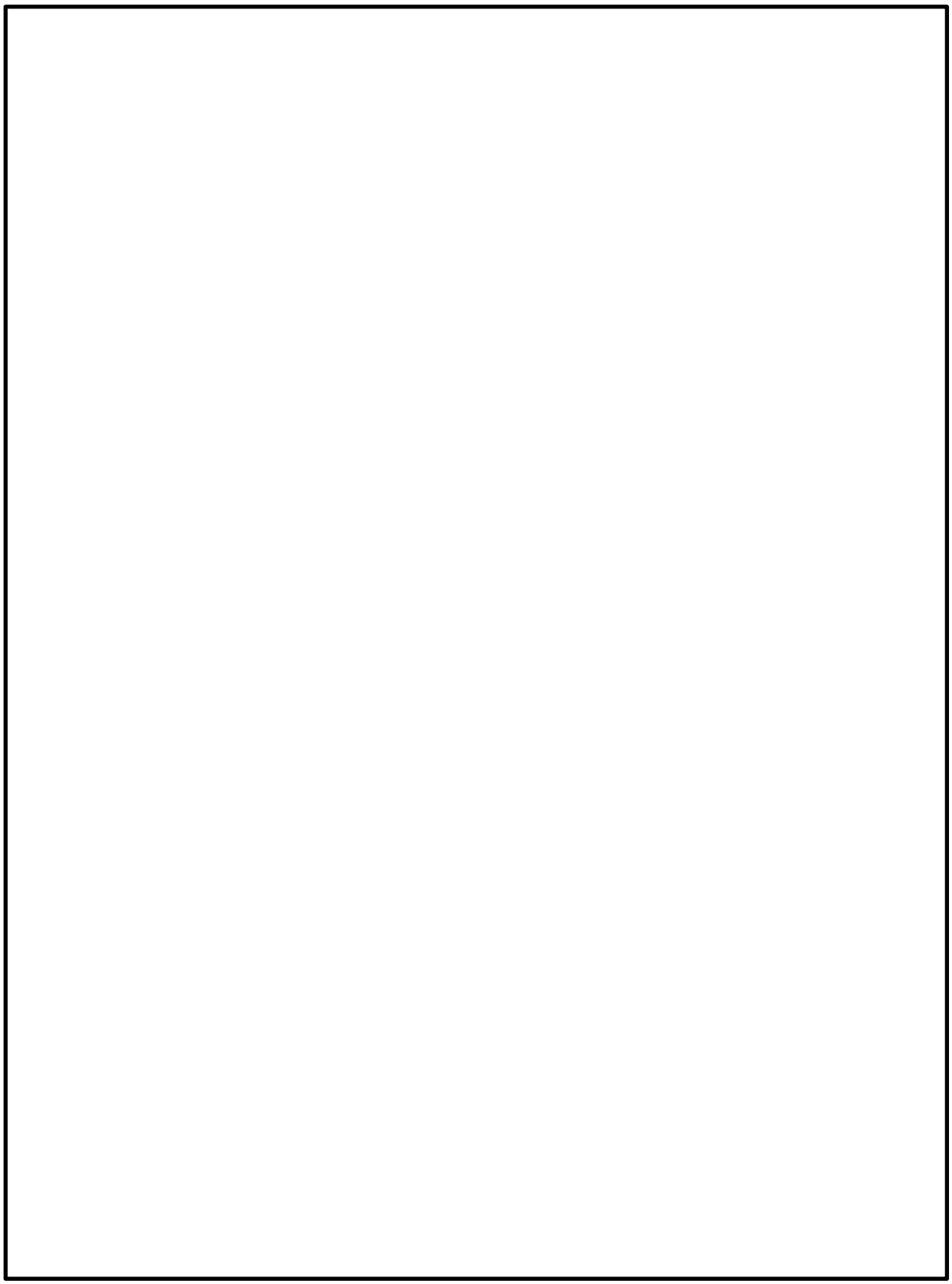
Activity 2

Complete the table.

Structure	Function
Cell-surface membrane	
Chloroplast	
Cell vacuole	
Mitochondria	
Nucleus	
Cell wall	
Chromosomes	
Ribosomes	

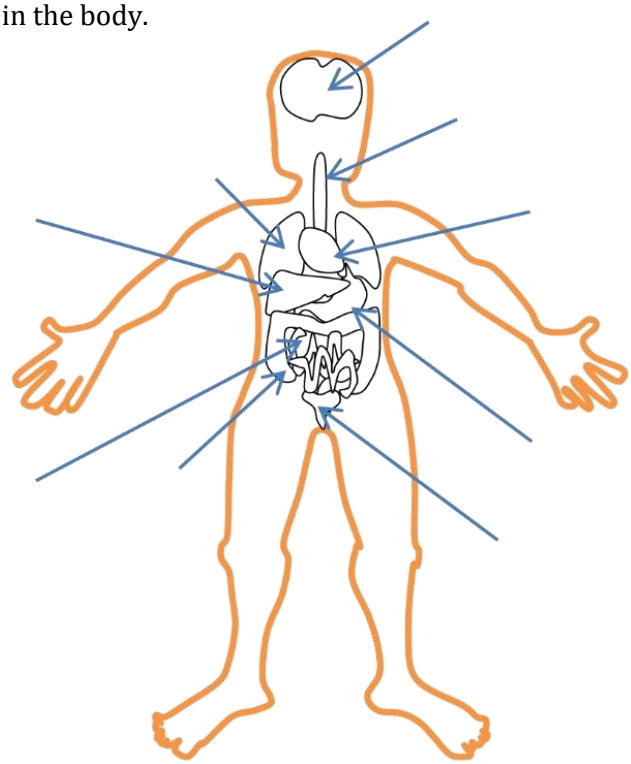
Activity 3

Draw the structure of a plant cell and an animal cell. On each cell, add labels showing each of the structures in the table, if they exist.



Activity 4

Label the organs in the body.



Activity 5

Complete the table to show which down the organ that carries out each function.

Organ	Function
	takes oxygen into the bloodstream
	breaks down (digests) food
	make sperm cells
	make egg cells
	controls the body's functions
	absorbs nutrients from food
	produce urine
	sense light

Activity 6

Draw a line to match each organ system with the organs it contains.

Reproductive	**ears, eyes, nerves**
Digestive	**stomach, intestines, pancreas**
Circulatory	**kidneys, liver, skin**
Excretory	**ovaries, uterus, oviduct**
Sensory	**heart, arteries, veins**
Nervous	**trachea, lungs, diaphragm**
Respiratory	**brain, spinal cord nerves**

Activity 7

Complete the table.

Structure	Description	Adaptation for function
Rib		
Alveoli		
Bronchus		
Trachea		
Larynx		
Diaphragm		
Bronchiole		

Activity 8

State the three types of blood vessels that make up the circulatory system.

-
-
-

State the name of the space which blood flows in a blood vessel.

.....

.....

Complete the table to compare the relative sizes and structures of the three types of blood vessels. Choose from the options in brackets.

Blood Vessel	Size of lumen (very narrow/narrow/wide)	Thickness of wall (thin/ thick/ very thin)	Do they contain valves? (yes / no)
Arteries			
Veins			
Capillaries			

Compare the function of arteries and veins.

.....

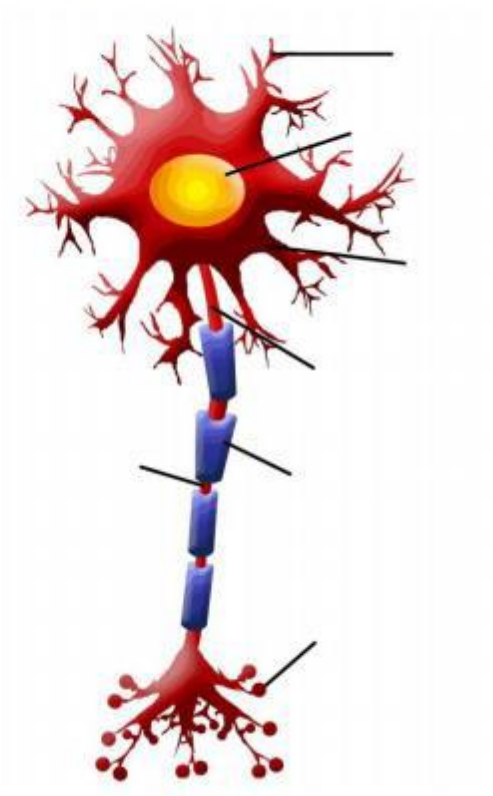
.....

Activity 9

There are three different kinds of neurons or nerve cells. Match each kind with its function.

A. Motor neuron **B. Sensory neuron** **C. Relay neuron**

Kind of neuron	Function
	The nerve cell that carries impulses from a sense receptor to the brain or spinal cord.
	The nerve cell that connects sensory and motor neurons.
	The nerve cell that transmits impulses from the brain or spinal cord to a muscle or gland.



Activity 10

Summarise the structure and function of the heart.

Chemistry section

Activity 1

1. Use the periodic table to find the following:
2. The atomic number of: osmium, sodium, lead, chlorine.
3. The relative atomic mass of: helium, barium, europium, oxygen.
4. The number of protons in: mercury, iodine, calcium.
5. The symbol for: gold, lead, copper, iron.
6. The name of: Sr, Na, Ag, Hg.

Activity 2

Relative atomic mass (Ar)

If there are several isotopes of an element, the relative atomic mass will take into account the proportion of atoms in a sample of each isotope. For example, chlorine gas is made up of 75% of chlorine-35 and 25% of chlorine-37. The relative atomic mass of chlorine is therefore the mean atomic mass of the atoms in a sample, and is calculated by:

$Ar = (75.0/100 \times 35) + (25.0/100 \times 37) = 26.25 + 9.25 = 35.5$

1. What is the relative atomic mass of Bromine, if the two isotopes, ^{79}Br and ^{81}Br, exist in equal amounts?

2. Neon has three isotopes. ^{20}Ne accounts for 90.9%, ^{21}Ne accounts for 0.3% and the last 8.8% of a sample is ^{22}Ne. What is the relative atomic mass of neon?

3. Magnesium has the following isotope abundances: ^{24}Mg: 79.0%; ^{25}Mg: 10.0% and ^{26}Mg: 11.0%. What is the relative atomic mass of magnesium?

Harder:

4. Boron has two isotopes, ^{10}B and ^{11}B. The relative atomic mass of boron is 10.8. What are the percentage abundances of the two isotopes?

5. Copper's isotopes are ^{63}Cu and ^{65}Cu. If the relative atomic mass of copper is 63.5, what are the relative abundances of these isotopes?

Activity 3

Relative formula mass (M_r)

Carbon dioxide, CO_2 has 1 carbon atom (A_r = 12.0) and two oxygen atoms (A_r = 16.0). The relative formula mass is therefore

$M_r = (12.0 \times 1) + (16.0 \times 2) = 44.0$

Magnesium hydroxide $Mg(OH)_2$ has one magnesium ion (A_r = 24.3) and two hydroxide ions, each with one oxygen (A_r = 16.0) and one hydrogen (A_r = 1.0).

The relative formula mass is therefore:

$(24.3 \times 1) + (2 \times (16.0 + 1.0)) = 58.3$

Calculate the relative formula mass of the following compounds:

1. Magnesium oxide MgO

2. Sodium hydroxide NaOH

3. Copper sulfate $CuSO_4$

4. Ammonium chloride NH_4Cl

5. Ammonium sulfate $(NH_4)_2SO_4$

Activity 4

Work out what the formulas for the following ionic compounds should be:

1. Magnesium bromide

2. Barium oxide

3. Zinc chloride

4. Ammonium chloride

5. Ammonium carbonate

6. Aluminium bromide

7. Iron(II) sulfate

8. Iron(III) sulfate

Activity 5

What are the formulas of the following compounds?

1. Methane

2. Ammonia

3. Hydrochloric acid

4. Sulfuric acid

5. Sodium hydroxide

6. Potassium manganate(VII)

7. Hydrogen peroxide

Activity 6

All metals form a positive ion, all non-metals form negative ions. The magnitude of the charge depends on the group number.

Draw the ionic bonding for each compound.

lithium fluoride	sodium fluoride	potassium fluoride	lithium chloride	sodium chloride

Activity 7

Draw a dot and cross diagram to show how the electrons are arranged in the following small molecules.

A. Hydrogen gas	B. Water
C. Carbon dioxide	D. Hydrogen chloride

Activity 8

Balance the equations below by adding numbers in front of the formulae – however, you must not change the formulae themselves!

Be careful as some may already be balanced. e.g. **2** H_2 + O_2 → **2** H_2O

1 $HCl + Mg \rightarrow MgCl_2 + H_2$

2 $Na + O_2 \rightarrow Na_2O$

3 $Si + HCl \rightarrow SiCl_4 + H_2$

4 $TiCl_4 + Mg \rightarrow Ti + MgCl_2$

5 $Al + O_2 \rightarrow Al_2O_3$

6 $HCl + Na_2S_2O_3 \rightarrow S + SO_2 + NaCl + H_2O$

7 $C_6H_{12}O_6 + O_2 \rightarrow H_2O + CO_2$

8 $HNO_3 + NaOH \rightarrow NaNO_3 + H_2O$

9 $K + H_2O \rightarrow KOH + H_2$

10 $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

11 $NaOH + H_3PO_4 \rightarrow Na_3PO_4 + H_2O$

12 $Pb(NO_3)_2 + AlCl_3 \rightarrow PbCl_2 + Al(NO_3)_3$

Physics section

Activity 1

Which SI unit and prefix would you use for the following quantities?

1. The length of a finger
2. The temperature of boiling water
3. The time between two heart beats
4. The width of an atom
5. The mass of iron in a bowl of cereal
6. The current in a simple circuit using a 1.5 V battery and bulb

Activity 2

Re-write the following quantities:

1. 1502 metres in kilometres

2. 0.000 45 grams in micrograms

3. 0.000 45 metres in millimetres

4. 1055 kilometres in metres

5. 180 megaseconds in seconds

6. 2500 centimetres in millimetres

Activity 3

1. Write in standard form
   (a) 379.4
   (b) 0.0712

2. Write as ordinary numbers (use the data sheet on the last page of this booklet):
   (a) The speed of light
   (b) The charge on an electron

3. Write one quarter of a million in standard form.

4. Write these constants in ascending order (ignoring units):
   permeability of free space; the Avogadro constant; proton rest mass;
   acceleration due to gravity; mass of the Sun.

5. Work out the value of the following.
   Give your answer in standard form.
   The mass of an electron/the mass of the Earth (use the data sheet).

6. Solve $(2.4 \times 10^7)x = 1.44 \times 10^9$
   Give your answer in standard form.

Activity 4

1. How many rockets would be needed to deliver 30 tonnes of material to a space station, if every rocket could hold 7 tonnes?

2. A power station has an output of 3.5 MW. The coal used had a potential output of 9.8 MW.

   Work out the efficiency of the power station.

   Give your answer as a percentage to one decimal place.

3. A radioactive source produces 17 804 beta particles in 1 hour.

   Calculate the mean number of beta particles produced in 1 minute.

   Give your answer to one significant figure.

Activity 5

1. The ratio of turns of wire on a transformer is 350 : 7000 (input : output)

   What fraction of the turns are on the input side?

2. A bag of electrical components contains resistors, capacitors and diodes.

   $\frac{2}{5}$ of the components are resistors.

   The ratio of capacitors to diodes in a bag is 1 : 5. There are 100 components in total.

   How many components are diodes?

3. The number of coins in two piles are in the ratio 5 : 3. The coins in the first pile are all 50p coins. The coins in the second pile are all £1 coins.

   Which pile has the most money?

4. A rectangle measures 3.2 cm by 6.8 cm. It is cut into four equal sized smaller rectangles.

   Work out the area of a small rectangle.

5. Small cubes of edge length 1 cm are put into a box. The box is a cuboid of length 5 cm, width 4 cm and height 2 cm.

   How many cubes are in the box if it is half full?

6. In a circuit there are 600 resistors and 50 capacitors. 1.5% of the resistors are faulty. 2% of the capacitors are faulty.

   How many faulty components are there altogether?

7. How far would you have to drill in order to drill down 2% of the radius of the Earth?

8. Power station A was online 94% of the 7500 days it worked for.

   Power station B was online $\frac{8}{9}$ of the 9720 days it worked for.

   Which power station was offline for longer?

Activity 6

1. Rearrange $y = 2x + 3$ to make x the subject.

2. Rearrange $C = 2\pi r$ to make r the subject.

3. Rearrange $E = \frac{1}{2}mv^2$ to make v the subject.

4. Rearrange $s = ut + \frac{1}{2}at^2$ to make u the subject.

5. Rearrange $s = ut + \frac{1}{2}at^2$ to make a the subject.

6. Rearrange $\omega = \frac{v}{r}$ to make r the subject.

7. Rearrange $T = 2\pi\sqrt{\frac{r}{v}}$ to make r the subject.

8. Rearrange $v = \omega\sqrt{A^2 - x^2}$ to make x the subject.

Note: in science, subscripts are often used to label quantities. So in the following two examples, there are two masses, m_1 and m_2. The 1 and 2 are part of the quantity and should be kept with the m.

9. Rearrange $F = \frac{Gm_1m_2}{r^2}$ to make m_2 the subject.

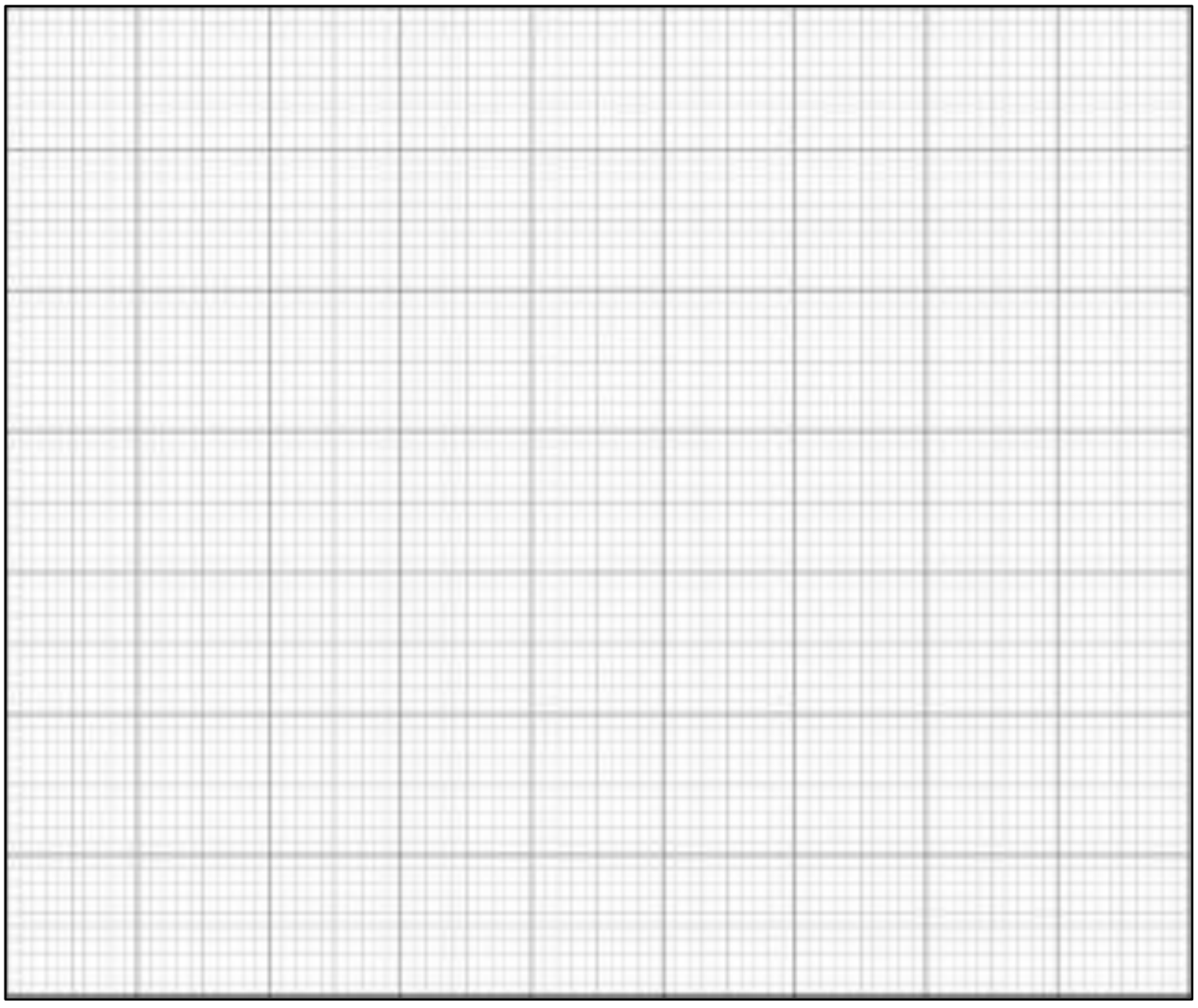
10. Rearrange $F = \frac{Gm_1m_2}{r^2}$ to make r the subject.

Activity 7

Light bulb technology has improved considerably over the last 20 years. Many objects like traffic lights now use LEDs.

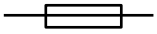
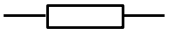
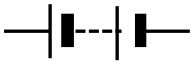
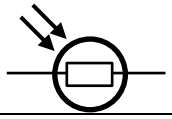
A. The table shows the input power of three types of lightbulb at different light intensities. Draw a suitable graph to display the data.

Light intensity in lumens	Power of incandescent light lamp in W	Power of CFL (energy saving) light lamp in W	Power of LED light in W
450	40	10	7.5
800	60	15	10.0
1400	75	20	14.0
1800	100	25	18.0
2800	150	45	16.0



Activity 8

Complete the table.

Component	Symbol	Function
		Lights up when the current flows through it
		
open switch		
diode		
		Measures potential difference across a component in volts
cell		
		
thermistor		
led		
closed switch		
		
		
ammeter		
		A component which can have its resistance changed to vary the amount of current flowing through a circuit.

Activity 9

To reinforce what you have learned about series circuit.

1 A cell, a resistor, a lamp and an ammeter are connected in series, as in Figure 1.

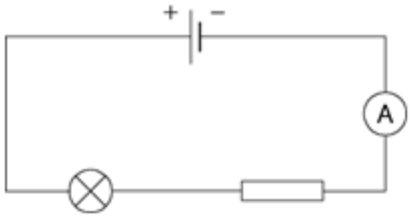


Figure 1

a) Complete the following sentences using words from the list below.

greater than **less than** **the same as**

i) The current through the battery is ..... the current through the ammeter.

ii) The potential difference across the battery is ..... the potential difference across the resistor.

iii) The current through the lamp is ..... the current through the resistor.

iv) The potential difference across the lamp is ..... the potential difference across the battery.

Optional Additional Research Task

All students need to create a scientific poster on one of the following topics.

1. Cardiovascular diseases

2. The Periodic Table

3. Electromagnetic waves and their uses

Poster Guidelines:

The dimensions of your poster should be min 90cm x 1m

Please visit the following websites to help you with your poster.

https://guides.nyu.edu/posters

https://www.youtube.com/watch?v=AwMFhyH7_5g

Have a lovely summer!

Data Sheet

Quantity	Symbol	Value	Units
speed of light in vacuo	c	3.00 × 108	m s–1
permeability of free space	μ0	4π × 10–7	H m–1
permittivity of free space	ε0	8.85 × 10–12	F m–1
magnitude of the charge of electron	e	1.60 × 10–19	C
the Planck constant	h	6.63 × 10–34	J s
gravitational constant	G	6.67 × 10–11	N m2 kg–2
the Avogadro constant	NA	6.02 × 1023	mol–1
electron rest mass	me	9.11 × 10–31	kg
proton rest mass	mp	1.67(3) × 10–27	kg
neutron rest mass	mn	1.67(5) × 10–27	kg
gravitational field strength	g	9.81	N kg–1
acceleration due to gravity	g	9.81	m s–2
atomic mass unit	u	1.661 × 10–27	kg

mass of the Sun	1.99 × 1030	kg
mean radius of the Sun	6.96 × 108	m
mass of the Earth	5.98 × 1024	kg
mean radius of the Earth	6.37 × 106	m