YEAR 12 – BRIDGING UNITS

AAQ BTEC National 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 the AAQ BTEC National 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 the AAQ BTEC National in Applied Science 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 in at the end of the second week of term** 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

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-aaq.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/UCqbOeHaAUXw9Il7sBVG3_bw

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

Anything is
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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

Periodic Table

The Periodic Table of Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
7 **Li** lithium 3	9 **Be** beryllium 4											11 **B** boron 5	12 **C** carbon 6	14 **N** nitrogen 7	16 **O** oxygen 8	19 **F** fluorine 9	20 **Ne** neon 10
23 **Na** sodium 11	24 **Mg** magnesium 12											27 **Al** aluminium 13	28 **Si** silicon 14	31 **P** phosphorus 15	32 **S** sulfur 16	35.5 **Cl** chlorine 17	40 **Ar** argon 18
39 **K** potassium 19	40 **Ca** calcium 20	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	70 **Ga** gallium 31	73 **Ge** germanium 32	75 **As** arsenic 33	79 **Se** selenium 34	80 **Br** bromine 35	84 **Kr** krypton 36
85 **Rb** rubidium 37	88 **Sr** strontium 38	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	115 **In** indium 49	119 **Sn** tin 50	122 **Sb** antimony 51	128 **Te** tellurium 52	127 **I** iodine 53	131 **Xe** xenon 54
133 **Cs** caesium 55	137 **Ba** barium 56	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	204 **Tl** thallium 81	207 **Pb** lead 82	209 **Bi** bismuth 83	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	[285] **Cn** copernicium 112	[286] **Nh** nihonium 113	[289] **Fl** flerovium 114	[289] **Mc** moscovium 115	[293] **Lv** livermorium 116	[294] **Ts** tennessine 117	[294] **Og** oganesson 118

58 – 71 Lanthanides	140 **Ce** cerium 58	141 **Pr** praseodymium 59	144 **Nd** neodymium 60	145 **Pm** promethium 61	150 **Sm** samarium 62	152 **Eu** europium 63	157 **Gd** gadolinium 64	159 **Tb** terbium 65	162.5 **Dy** dysprosium 66	165 **Ho** holmium 67	167 **Er** erbium 68	169 **Tm** thulium 69	173 **Yb** ytterbium 70	175 **Lu** lutetium 71
90 – 103 Actinides	232 **Th** thorium 90	231 **Pa** protactinium 91	238 **U** uranium 92	[237] **Np** neptunium 93	[244] **Pu** plutonium 94	[243] **Am** americium 95	[247] **Cm** curium 96	[247] **Bk** berkelium 97	[251] **Cf** californium 98	[252] **Es** einsteinium 99	[257] **Fm** fermium 100	[258] **Md** mendelevium 101	[259] **No** nobelium 102	[262] **Lr** lawrencium 103

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

Complete the table.

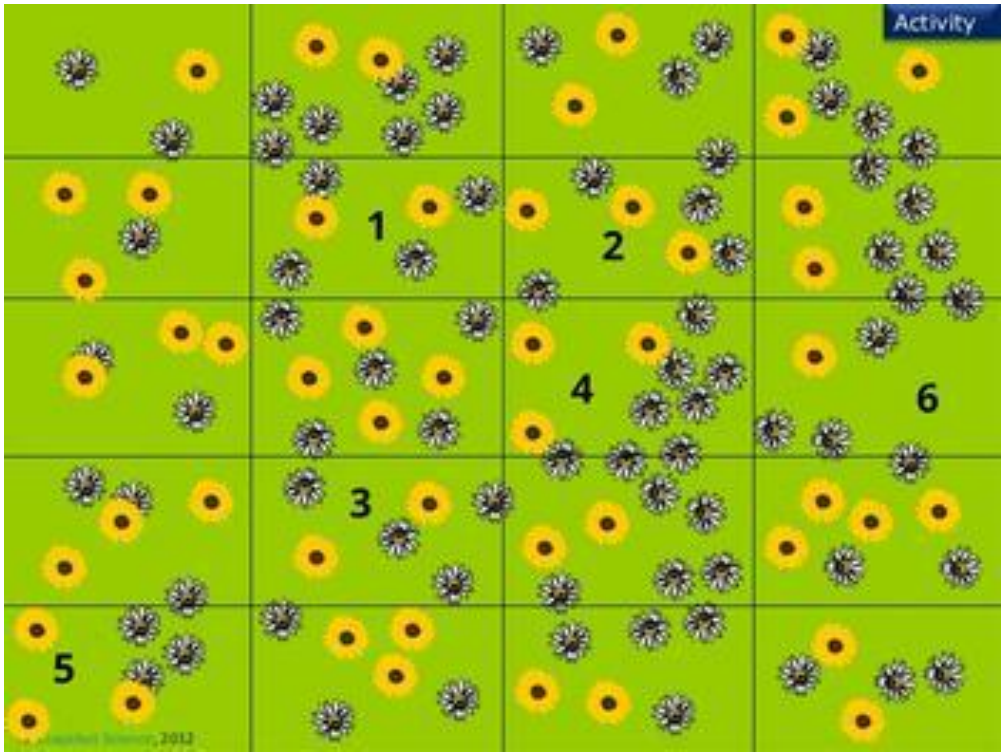
Structure	Function
Cell-surface membrane	
Chloroplast	
Cell vacuole	
Mitochondria	
Nucleus	
Cell wall	
Chromosomes	
Ribosomes	

Activity 2

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 3

The diagram shows a field filled with sunflowers (yellow) and daisies (white). Work out the number of sunflowers in each quadrat and fill these in on the table.



Quadrat	Number of sunflowers
1	
2	
3	
4	
5	
6	
Average	

Using the average number of sunflowers per quadrat, estimate how many sunflowers there are in the entire field.

Average number of sunflowers in one quadrat:

Number or quadrats in the field:

Estimated number of total sunflowers:

Now, count the actual number of sunflowers in the field, how do these numbers compare? Why might this be?

_____

_____

Activity 4

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**

Chemistry section

Activity 1

Use a periodic table on page 5 to find the following:

1. The atomic number of: osmium, sodium, lead, chlorine.

2. The relative atomic mass of: helium, barium, europium, oxygen.

3. The number of protons in: mercury, iodine, calcium.

4. The symbol for: gold, lead, copper, iron.

5. 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

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 5

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

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Physics section

Activity 1

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 2

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 3

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 4

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

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

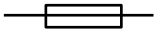
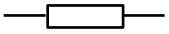
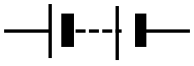
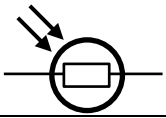
Note: in science, subscripts are often used to label quantities. So in the following two examples, there are two masses, m_1 and m_2. The 1 and 2 are part of the quantity and should be kept with the m.

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 5

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.

Optional Additional Research Task

All students can 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 a minimum of 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